APPENDIX F

Appendix F

APPENDIX F: FACILITY ACCIDENTS

F.1 EVALUATION METHODOLOGIES AND ASSUMPTIONS

F.1.1 Introduction

The potential for facility accidents and the magnitudes of their consequences are important factors in the evaluation of No Action and tritium supply technologies and recycling facilities addressed in this Programmatic Environmental Impact Statement (PEIS). The health risk issues are twofold and consider:

- Whether potential accidents for any tritium supply technologies or recycling facility pose unacceptable health risks to workers or the general public; and
- Whether alternative locations for tritium supply technologies and recycling facilities can provide lesser public or worker health risks. These lesser risks may arise either from a greater isolation of the site from the public, or from a reduced frequency of such external accident initiators as seismic events, aircraft crashes, and other initiating events that are external to the facility.

Public comments received during the Draft PEIS reviews clearly indicated the public concern with facility safety and consequent health risks, and the need to address these concerns in the decisionmaking process.

F.1.2 Safety Design Process

The tritium supply and recycling facilities would be designed to comply with current Federal, state, and local laws, Department of Energy (DOE) orders, and industrial codes and standards. This would provide a plant that is highly resistant to the effects of natural phenomena, including earthquake, flood, tornado, and high wind, as well as credible events as appropriate to the site, such as fire and explosions and man-made threats to its continuing structural integrity for containing hazardous materials. The facilities would be designed to maintain their continuing structural integrity in the event of any credible accident or event, including an aircraft crash, at these sites.

The design process for the facilities would comply with the requirements for safety analysis and evaluation in DOE Orders 4700.1 *Project Management System* and 5480.23 *Nuclear Safety Analysis Reports*. These require that the safety assessment be an integral part of the design process to ensure compliance with all DOE safety criteria by the time the facilities are constructed and in operation.

The safety analysis process begins early in conceptual design with identification of hazards having the potential to produce unacceptable safety consequences to workers or the public. The Preliminary Hazards Assessment determines whether the operations that take place in the facility represent enough of a risk to warrant a Safety Analysis Report. As the design develops, failure mode and effects analyses are performed to identify events that have the potential to release hazardous and/or radioactive material. The kinds of events considered include equipment failure, spills, human error, fire and explosions, criticality, earthquake, electrical storms, tornado, flood, and aircraft crash. These postulated events become focal points for design changes or improvements to prevent unacceptable accidents. These analyses continue as the design progresses to assess the need for safety equipment and to assess the performance of this equipment in accident mitigation. Eventually, the safety analyses are formally documented in a Safety Analysis Report.

A detailed comprehensive preliminary Safety Analysis Report is issued upon completion of preliminary design and provides a broad assessment of the range of design-basis accident scenarios and the performance of equipment provided in the facility specifically for accident consequence mitigation. The Safety Analysis Report continues to be developed during detailed design. The review of the Safety Analysis Report is completed and safety issues resolved before initiation of construction of the facility. Final approval of the preliminary Safety Analysis Report is required before construction can commence on the new facility. A *Final Safety Analysis Report* is also produced that includes documentation of safety-related design changes during construction and the impact of those changes on the safety assessment. It also includes the results of any safety-related research and development that has been performed to support the safety assessment of the facility. Final approval of the *Final Safety Analysis Report* is required before the facility is allowed to commence operation.

F.1.3 Analysis Methodology

F.1.3.1 *Introduction*

The GENII computer code was used to estimate the consequences of all tritium supply and recycling facilities design-basis accidents. For beyond design-basis accidents at tritium production facilities, which include reactors, accelerators, and support facilities, the MACCS computer code was used.

A discussion of the GENII code is provided in appendix E. A discussion of the MACCS computer code is provided in section F.1.3.2. A detailed description of the model is available in a 3-volume report: *MELCOR Accident Consequence Code System* (*MACCS*) (NUREG/CR-4691 SAND 86-1562).

F.1.3.2 *MELCOR Accident Consequence Code System Overview*

The MACCS computer code models the offsite consequences of an accident that releases a plume of radioactive materials to the atmosphere. Should such an accidental release occur, the radioactive gases and aerosols in the plume would be transported by the prevailing wind while dispersing in the atmosphere. The environment would be contaminated by radioactive materials deposited from the plume and the population would be exposed to radiation. An estimation of the range and probability of the health effects induced by the radiation exposures not avoided by protective actions and the economic costs and losses that would result from the contamination of the environment are the objectives of a MACCS calculation.

There are two fundamental aspects of the organization of MACCS which are basic to its understanding: the time scale after the accident is divided into various "phases" and the region surrounding the reactor is divided into a polar-coordinate grid.

The time scale after the accident is divided into three phases: emergency phase, intermediate phase, and long-term phase. The emergency phase begins immediately after the accident and could last up to 7 days following the accident. In this period, the exposure of population to both radioactive clouds and contaminated ground is modeled. Various protective measures can be specified for this phase, including evacuation, sheltering, and dose-dependent relocation.

The intermediate phase can be used to represent a period in which evaluations are performed and decisions are made regarding the type of protective actions which need to be taken. In this period, the radioactive clouds are assumed to be gone and the only exposure pathways are those from the contaminated ground. The protective measure which can be taken during this period is temporary relocation.

The long-term phase represents all time subsequent to the intermediate phase. The only exposure pathways considered here are those resulting from the contaminated ground. A variety of protective measures can be taken in the long-term phase in order to reduce doses to acceptable levels: decontamination, interdiction, and condemnation of property.

The spatial grid used to represent the region is centered on the facility itself. The user specifies the number of radial divisions as well as their endpoint distances. Up to 35 of these divisions may be defined, extending out to a maximum distance of 6,200 miles (9,999 kilometers). The angular divisions used to define the spatial grid correspond to the 16 directions of the compass.

The emergency phase calculations utilizing dose-response models for early fatality and early injury are performed on a finer grid than the calculations of the intermediate and long-term phases. For this phase, the 16 compass sectors are divided into three, five, or seven user-specified subdivisions in the calculations.

The increased likelihood of latent cancer fatality to a member of the public is taken as $5.0x10^{-4}$ times the dose in rem for values of dose less than 20 rem. For larger doses, when the rate of exposure is greater than 10 rads per hour, the increased likelihood of latent cancer fatality is doubled. MACCS incorporates this by assuming that the rate of exposure during the accident emergency phase is greater than 10 rads per hour if the individual dose received during this phase is greater than 20 rem. Subsequent to the emergency phase (intermediate and long-term phases) the exposure rate is assumed to be less than 10 rads per hour (NUREG/CR-6059, SAND92-2146:3).

The MACCS code was applied in a probabilistic manner using a weather bin sampling technique. Centerline doses as a function of distance were calculated for each of 150 meteorological sequence samples; the mean value of these doses and increased likelihoods of cancer fatality for the distance corresponding to the location of the maximum offsite individual at each site were reported for that individual. Doses to uninvolved workers were calculated similarly, except that these workers will experience an increased likelihood of cancer fatality of 4.0×10^{-4} times the dose in rem for doses less than 20 rem or exposure rates less than 10 rads per hour. For larger doses, when the rate of exposure is greater than 10 rads per hour, the increased likelihood of latent cancer fatality is doubled. The workers were placed at 1,000 and 2,000 meters from the release.

It should be noted that since the doses and cancer fatalities for the maximum offsite individual and the workers reported in the high consequence/low probability accident tables are "mean" values based on 150 meteorological sequence samples, there is no direct correlation between the mean value of dose and the mean value of cancer fatalities. For example; high mean doses, in excess of 1,000 rad for the maximum offsite individual or 1,250 rad for workers during the emergency phase of an accident, will not result in an increased likelihood of cancer fatality mean value of 1.0 unless the individual doses resulting from all 150 meteorological sequence samples exceeds he emergency phase threshold values of 1,000 rad for the maximum exposed individual or 1,250 rad for the worker.

Offsite population doses and latent cancer fatalities are calculated by MACCS using a similar methodology to that described for the maximum offsite individual. In the case of the population, each of the sampled meteorological sequences was applied to each of the 16 sectors (accounting for the frequency of occurrence of the wind blowing in that direction). Population doses are the sum of the individual doses in each sector. Once again, the mean value of the calculated population doses and latent cancer fatalities for each of these trials are reported.

F.1.3.3 *Application to Tritium Production*

For the analysis of high consequence accidents at tritium supply facilities, the MACCS calculations used the source term data presented in section F.2.1 and modeled the dispersion and deposition of radionuclides released from the reactor or accelerator containments to the atmosphere with a straight-line Gaussian plume. Plume rise and dry and wet deposition were taken into consideration. One year of hourly onsite meteorological data and a weather bin sampling technique were used to represent the dispersion process according to each site's characteristic weather. Downwind concentrations of radionuclides up to a distance of 50 miles (80 kilometers) were calculated for each of 16 directional sectors around the reactor or accelerator.

Radiation doses to an offsite population were calculated in the dosimetry models using the concentrations of radionuclides obtained from the dispersion models. Dose conversion factors were used to convert the radionuclide concentrations to organ dose equivalents and whole-body effective dose equivalents. Exposure pathways considered in the MACCS for calculating doses received during the period following an accident were direct radiation from the passing plume and from radioactive material deposited on the ground, inhalation from the plume, deposition on skin, and inhalation of resuspended ground contamination. Long-term exposure pathways and liquid exposure pathways were not considered. No credit was taken for short-term actions such as evacuation, sheltering, and relocation.

F.2 TRITIUM SUPPLY AND RECYCLING ACCIDENTS

The tritium supply facility can be configured as a reactor or as an accelerator. The reactor configuration includes the reactor, reactor fuel/target fabrication facilities, and target extraction facilities. The Heavy Water Reactor (HWR), Modular High Temperature Gas-Cooled Reactor (MHTGR), and Advanced Light Water Reactor (ALWR) are candidate reactor technologies for tritium supply. Four ALWR configurations; the AP600, Simplified Boiling Water Reactor, Advanced Boiling Water Reactor, and CE System 80+; are under consideration for the ALWR tritium supply technology. The candidate ALWR configurations have been classified into two groups, Large ALWRs and Small ALWRs. The Advanced Boiling Water Reactor and CE System 80+ configurations are designated Large ALWRs and the AP600 and Simplified Boiling Water Reactor configurations are designated Small ALWRs. The Accelerator Production of Tritium (APT) facility configuration is associated with the linear accelerator and target areas of the facility. Two target designs are under consideration, the helium-3 target system and the spallation-induced lithium conversion target system. For the helium-3 target design, tritium would be continuously removed from the target and packaged without any additional target processing. For the spallation-induced lithium conversion target design, production targets will be processed at a tritium recycling facility collocated with the APT. The tritium recycling facility design and operation is similar for all reactor technologies and the spallation induced lithium conversion target system.

F.2.1 Tritium Supply Facility High Consequence Accidents

High consequence accidents for candidate tritium supply technologies and recycling facilities at five potential sites, (Idaho National Engineering Laboratory (INEL), Nevada Test Site (NTS), Oak Ridge Reservation (ORR), Pantex Plant (Pantex), and Savannah River Site (SRS)), have been evaluated using the MACCS computer code. The MACCS computer code is described in section F.1.3.3. The report, *MELCOR Accident Consequence Code System*, presents additional details on the computer code.

F.2.1.1 *Heavy Water Reactor*

Previous studies performed for the HWR developed a spectrum of severe accidents and their respective source terms (DOE 1995d). The release frequencies were in the range of $1.0\text{x}10^{-8}$ to $2.0\text{x}10^{-6}$ per reactor year. In order to provide a reasonably similar basis for comparisons, five accidents with an annual frequency of occurrence equal to or greater than $1.0\text{x}10^{-7}$ were selected for evaluation in this PEIS. The selected combination of release category and frequency is representative of accident conditions at the low frequency end of the credible range for beyond design-basis accidents.

Core Melt with Containment Spray System and Containment Functioning

Scenario. The HWR high consequence accident postulated an internally initiated core melt event. The containment spray system functioned and the containment did not fail (DOE 1995d). The source term is presented in table F.2.1.1–1. The annual frequency of occurrence for this accident is $5.0\text{x}10^{-6}$ per year (DOE 1995d).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.1–2 through F.2.1.1–6 for public consequences and in tables F.2.1.1–7 through F.2.1.1–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.1–1 using the MACCS computer code.

Seismically Induced Core Melt with Containment Spray System Failure and Containment Functioning

Scenario. The HWR high consequence accident postulated a seismically induced core melt event. The containment spray system failed but the containment did not fail (DOE 1995d). The source term is presented in table F.2.1.1–1. The annual frequency of occurrence for this accident is $2.0\text{x}10^{-6}$ per year (DOE 1995d).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.1–2 through F.2.1.1–6 for public consequences and in tables F.2.1.1–7 through F.2.1.1–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.1–1 using the MACCS computer code.

Core Melt with Containment Spray System Failure and Containment Functioning

Scenario. The HWR high consequence accident postulated an internally initiated core melt event. The containment spray system failed but the containment did not fail (DOE 1995d). The source term is presented in table F.2.1.1–1. The annual frequency of occurrence for this accident is $2.0\text{x}10^{-6}$ per year (DOE 1995d).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.1–2 through F.2.1.1–6 for public consequences and in tables F.2.1.1–7 through F.2.1.1–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.1–1 using the MACCS computer code.

Seismically Induced Core Melt with Containment Spray System Failure and Early Containment Failure

Scenario. The HWR high consequence accident postulated a seismically induced core melt event. The containment spray system failed and the containment failed early (DOE 1995d). The source term is presented in table F.2.1.1–1. The annual frequency of occurrence for this accident is $1.0\text{x}10^{-7}$ per year (DOE 1995d).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.1–2 through F.2.1.1–6 for public consequences and in tables F.2.1.1–7 through F.2.1.1–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.1–1 using the MACCS computer code.

Core Melt with Early Containment Spray System and Containment Failure

Scenario. The HWR high consequence accident postulated an internally initiated core melt event. The containment spray system and the containment failed early (DOE 1995d). The source term is presented in table F.2.1.1–1. The annual frequency of occurrence for this accident is 1.0×10^{-7} per year (DOE 1995d).

Consequences. The estimated consequences of the postulated accident with at each site are shown in tables F.2.1.1–2 through F.2.1.1–6 for public consequences and in tables F.2.1.1–7 through F.2.1.1–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.1–1 using the MACCS computer code.

Integrated Cancer Fatalities Complementary Cumulative Distribution Function for the Five Heavy Water Reactor High Consequence Accidents

Figure F.2.1.1–1 shows the annual probability that, in the event of any accident in the composite set of HWR high consequence accidents at one of the sites, the number of cancer fatalities exceeds the value N indicated on the horizontal axis. The curves, technically referred to as complementary cumulative distribution functions, reflect the probability of the accident's occurrence as well as the variability in the magnitude of its consequences. Generally, a curve that extends the farthest to the right has the highest accident consequences while a curve that is nearest to the left has the lowest accident consequences. A comparison of alternatives should include the information provided by these curves in conjunction with the point values shown in tables F.2.1.1–2 through F.2.1.1–11.

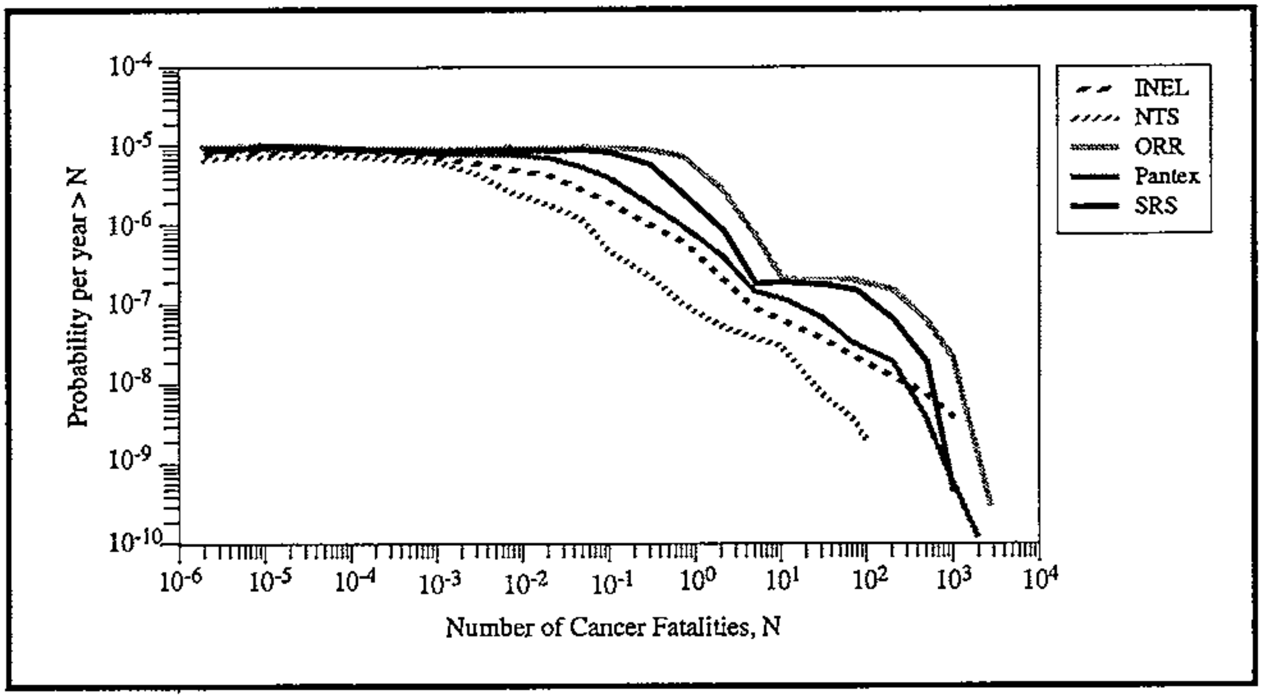

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FIGURE F.2.1.1–1.—*High Consequence Accident-Cancer Fatality Frequency Distribution Functions for the Heavy Water Reactor.*

TABLE F.2.1.1–1.—*Heavy Water Reactor High Consequence Accident Source Terms* [Page 1 of 5]

Isotope	Released Activity (curies) Core Melt with Containment Spray System and Containment Functioning	Seismically Induced Core Melt with Containment Spray System Failure and Containment Functioning	Core Melt with Containment Spray System Failure and Containment Functioning	Seismically Induced Core Melt with Containment Spray System Failure and Early Containment Failure	Core Melt with Early Containment Spray System and Containment Failure
H-3	3.8x10^{7}	3.8x10^{7}	3.8x10^{7}	3.8x10^{7}	3.8x10^{7}
Se-84	0.071	14	14	7.1x10^{4}	7.1x10^{4}
Se-85	0.045	9	9	4.5x10^{4}	4.5x10^{4}
Se-86	0.094	19	19	9.4x10^{4}	9.4x10^{4}
Se-87	0.07	14	14	7.0x10^{4}	7.0x10^{4}
Br-84	0.22	36	36	2.2x10^{4}	2.2x10^{4}
Br-85	0.27	45	45	2.7x10^{4}	2.7x10^{4}
Br-86	0.2	34	34	2.0x10^{4}	2.0x10^{4}
Br-86m	0.21	34	34	2.1x10^{4}	2.1x10^{4}
Br-87	0.47	78	78	4.7x10^{4}	4.7x10^{4}
Br-88	0.53	89	89	5.3x10^{4}	5.3x10^{4}
Br-89	0.4	67	67	4.0x10^{4}	4.0x10^{4}
Br-90	0.27	45	45	2.7x10^{4}	2.7x10^{4}
Kr-85	6.0x10^{2}	6.0x10^{2}	6.0x10^{2}	2.0x10^{4}	2.0x10^{4}
Kr-85m	2.7x10^{4}	2.7x10^{4}	2.7x10^{4}	9.1x10^{6}	9.1x10^{6}
Kr-87	5.5x10^{4}	5.5x10^{4}	5.5x10^{4}	1.8x10^{7}	1.8x10^{7}
Kr-88	7.8x10^{4}	7.8x10^{4}	7.8x10^{4}	2.6x10^{7}	2.6x10^{7}
Kr-89	9.9x10^{4}	9.9x10^{4}	9.9x10^{4}	3.3x10^{7}	3.3x10^{7}
Kr-90	9.8x10^{4}	9.8x10^{4}	9.8x10^{4}	3.3x10^{7}	3.3x10^{7}
Kr-91	7.3x10^{4}	7.3x10^{4}	7.3x10^{4}	2.4x10^{7}	2.4x10^{7}
Kr-92	3.2x10^{4}	3.2x10^{4}	3.2x10^{4}	1.1x10^{6}	1.1x10^{6}
Rb-88	0.79	130	130	7.9x10^{4}	7.9x10^{4}
Rb-89	1	170	170	1.0x10^{6}	1.0x10^{6}
Rb-90	1	170	170	1.0x10^{6}	1.0x10^{6}
Rb-90m	0.21	35	35	2.1x10^{4}	2.1x10^{4}
Rb-91	1.2	200	200	1.2x10^{6}	1.2x10^{6}
Rb-92	1	170	170	1.0x10^{6}	1.0x10^{6}
Rb-93	0.76	130	130	7.6x10^{4}	7.6x10^{4}
Rb-94	0.38	63	63	3.8x10^{4}	3.8x10^{4}
Rb-95	0.19	32	32	1.9x10^{4}	1.9x10^{4}
Sr-89	0.35	110	110	3.5x10^{4}	3.5x10^{4}
Sr-90	0.016	4.8	4.8	1.6x10^{4}	1.6x10^{4}
Sr-91	0.42	130	130	4.2x10^{4}	4.2x10^{4}
Sr-92	0.43	130	130	4.3x10^{4}	4.3x10^{4}

TABLE F.2.1.1–1.—*Heavy Water Reactor High Consequence Accident Source Terms* [Page 2 of 5]

Isotope	Released Activity (curies)				
	Core Melt with Containment Spray System and Containment Functioning	Seismically Induced Core Melt with Containment Spray System Failure and Containment Functioning	Core Melt with Containment Spray System Failure and Containment Functioning	Seismically Induced Core Melt with Containment Spray System Failure and Early Containment Failure	Core Melt with Early Containment Spray System and Containment Failure
Sr-93	0.46	140	140	4.6x10^{4}	4.6x10^{4}
Sr-94	0.42	130	130	4.2x10^{4}	4.2x10^{4}
Sr-95	0.39	120	120	3.9x10^{4}	3.9x10^{4}
Sr-96	0.27	81	81	2.7x10^{4}	2.7x10^{4}
Sr-97	0.14	41	41	1.4x10^{4}	1.4x10^{4}
Sr-98	0.05	15	15	5.0x10^{4}	5.0x10^{4}
Y-90	8.4x10^{-6}	1.7x10^{-3}	1.7x10^{-3}	8.4	8.4
Y-91	2.1x10^{-4}	0.043	0.043	210	210
Y-91m	1.2x10^{-4}	0.024	0.024	120	120
Y-92	2.1x10^{-4}	0.043	0.043	210	210
Y-93	2.3x10^{-4}	0.046	0.046	230	230
Y-94	2.2x10^{-4}	0.045	0.045	220	220
Y-95	2.3x10^{-4}	0.046	0.046	230	230
Y-96	2.2x10^{-4}	0.043	0.043	220	220
Y-97	1.8x10^{-4}	0.036	0.036	180	180
Y-98	1.3x10^{-4}	0.026	0.026	130	130
Y-99	7.2x10^{-4}	0.014	0.014	72	72
Y-100	3.2x10^{-4}	6.3x10^{-3}	6.3x10^{-3}	32	32
Zr-95	2.4x10^{-4}	0.047	0.047	240	240
Zr-97	2.1x10^{-4}	0.042	0.042	210	210
Zr-98	2.1x10^{-4}	0.042	0.042	210	210
Zr-99	2.1x10^{-4}	0.041	0.041	210	210
Zr-100	1.9x10^{-4}	0.038	0.038	190	190
Zr-101	1.2x10^{-4}	0.025	0.025	120	120
Zr-102	6.4x10^{-5}	0.013	0.013	64	64
Ru-103	1.2x10^{-4}	0.024	0.024	120	120
Ru-105	3.9x10^{-5}	7.8x10^{-3}	7.8x10^{-3}	39	39
Ru-106	1.0x10^{-5}	2.1x10^{-3}	2.1x10^{-3}	10	10
Rh-103m	1.1x10^{-4}	0.021	0.021	110	110
Rh-104	4.7x10^{-5}	9.4x10^{-3}	9.4x10^{-3}	47	47
Rh-105	3.7x10^{-5}	7.3x10^{-3}	7.3x10^{-3}	37	37
Rh-106	1.2x10^{-5}	2.4x10^{-3}	2.4x10^{-3}	12	12
Sb-129	2.5x10^{-5}	5.0x10^{-3}	5.0x10^{-3}	25	25
Sb-130m	4.5x10^{-5}	9.0x10^{-3}	9.0x10^{-3}	45	45
Sb-131	9.3x10^{-5}	0.019	0.019	93	93

TABLE F.2.1.1–1.—*Heavy Water Reactor High Consequence Accident Source Terms* [Page 3 of 5]

	Released Activity (curies)				
Isotope	Core Melt with Containment Spray System and Containment Functioning	Seismically Induced Core Melt with Containment Spray System Failure and Containment Functioning	Core Melt with Containment Spray System Failure and Containment Functioning	Seismically Induced Core Melt with Containment Spray System Failure and Early Containment Failure	Core Melt with Early Containment Spray System and Containment Failure
Sb-132	6.0x10^{-5}	0.012	0.012	60	60
Sb-132m	3.9x10^{-5}	7.8x10^{-3}	7.8x10^{-3}	39	39
Sb-133	8.1x10^{-5}	0.016	0.016	81	81
Te-129	0.05	9.9	9.9	5.0x10^{4}	5.0x10^{4}
Te-129m	7.6x10^{-3}	1.5	1.5	7.6x10^{2}	7.6x10^{2}
Te-131	0.19	37	37	1.9x10^{4}	1.9x10^{4}
Te-132	0.31	62	62	3.1x10^{4}	3.1x10^{4}
Te-133	0.28	56	56	2.8x10^{4}	2.8x10^{4}
Te-133m	0.21	42	42	2.1x10^{4}	2.1x10^{4}
Te-134	0.48	96	96	4.8x10^{4}	4.8x10^{4}
Te-135	0.24	47	47	2.4x10^{4}	2.4x10^{4}
Te-136	0.13	27	27	1.3x10^{4}	1.3x10^{4}
Sn-130	3.4x10^{-5}	6.8x10^{-3}	6.8x10^{-3}	34	34
Sn-131	3.5x10^{-5}	7.0x10^{-3}	7.0x10^{-3}	35	35
Sn-132	2.1x10^{-5}	4.2x10^{-3}	4.2x10^{-3}	21	21
I-131	0.63	110	110	6.3x10^{4}	6.3x10^{4}
I-132	0.93	160	160	9.3x10^{4}	9.3x10^{4}
I-133	1.5	240	240	1.5x10^{6}	1.5x10^{6}
I-134	1.6	270	270	1.6x10^{6}	1.6x10^{6}
I-135	1.4	230	230	1.4x10^{6}	1.4x10^{6}
I-136	0.66	110	110	6.6x10^{4}	6.6x10^{4}
I-136m	0.42	70	70	4.2x10^{4}	4.2x10^{4}
I-137	0.7	120	120	7.0x10^{4}	7.0x10^{4}
I-138	0.36	60	60	3.6x10^{4}	3.6x10^{4}
I-139	0.16	26	26	1.6x10^{4}	1.6x10^{4}
Xe-133	1.4x10^{6}	1.4x10^{6}	1.4x10^{6}	4.8x10^{7}	4.8x10^{7}
Xe-135	3.5x10^{4}	3.5x10^{4}	3.5x10^{4}	1.2x10^{7}	1.2x10^{7}
Xe-135m	2.5x10^{4}	2.5x10^{4}	2.5x10^{4}	8.2x10^{6}	8.2x10^{6}
Xe-137	1.3x10^{6}	1.3x10^{6}	1.3x10^{6}	4.3x10^{7}	4.3x10^{7}
Xe-138	1.3x10^{6}	1.3x10^{6}	1.3x10^{6}	4.5x10^{7}	4.5x10^{7}
Xe-139	1.1x10^{6}	1.1x10^{6}	1.1x10^{6}	3.6x10^{7}	3.6x10^{7}
Xe-140	7.6x10^{4}	7.6x10^{4}	7.6x10^{4}	2.5x10^{7}	2.5x10^{7}
Xe-141	2.5x10^{4}	2.5x10^{4}	2.5x10^{4}	8.4x10^{6}	8.4x10^{6}
Cs-134	0.043	7.1	7.1	4.3x10^{4}	4.3x10^{4}
Cs-137	0.05	8.4	8.4	5.0x10^{4}	5.0x10^{4}

TABLE F.2.1.1–1.—*Heavy Water Reactor High Consequence Accident Source Terms* [Page 4 of 5]

	Released Activity (curies)				
Isotope	Core Melt with Containment Spray System and Containment Functioning	Seismically Induced Core Melt with Containment Spray System Failure and Containment Functioning	Core Melt with Containment Spray System Failure and Containment Functioning	Seismically Induced Core Melt with Containment Spray System Failure and Early Containment Failure	Core Melt with Early Containment Spray System and Containment Failure
Cs-138	1.4	240	240	$1.4\text{x}10^{6}$	$1.4\text{x}10^{6}$
Cs-139	1.4	230	230	$1.4\text{x}10^{6}$	$1.4\text{x}10^{6}$
Cs-140	1.2	210	210	$1.2\text{x}10^{6}$	$1.2\text{x}10^{6}$
Cs-141	0.95	160	160	$9.5\text{x}10^{4}$	$9.5\text{x}10^{4}$
Cs-142	0.61	100	100	$6.1\text{x}10^{4}$	$6.1\text{x}10^{4}$
Cs-143	0.33	55	55	$3.3\text{x}10^{4}$	$3.3\text{x}10^{4}$
Ba-137m	0.016	4.7	4.7	$1.6\text{x}10^{4}$	$1.6\text{x}10^{4}$
Ba-139	0.46	140	140	$4.6\text{x}10^{4}$	$4.6\text{x}10^{4}$
Ba-140	0.46	140	140	$4.6\text{x}10^{4}$	$4.6\text{x}10^{4}$
Ba-141	0.42	130	130	$4.2\text{x}10^{4}$	$4.2\text{x}10^{4}$
Ba-142	0.42	120	120	$4.2\text{x}10^{4}$	$4.2\text{x}10^{4}$
Ba-143	0.38	110	110	$3.8\text{x}10^{4}$	$3.8\text{x}10^{4}$
Ba-144	0.3	91	91	$3.0\text{x}10^{4}$	$3.0\text{x}10^{4}$
Ba-145	0.14	43	43	$1.4\text{x}10^{4}$	$1.4\text{x}10^{4}$
Ba-146	0.048	15	15	$4.8\text{x}10^{4}$	$4.8\text{x}10^{4}$
La-140	$2.3\text{x}10^{-4}$	0.047	0.047	230	230
La-141	$2.1\text{x}10^{-4}$	0.042	0.042	210	210
La-142	$2.1\text{x}10^{-4}$	0.042	0.042	210	210
La-143	$2.1\text{x}10^{-4}$	0.042	0.042	210	210
La-144	$1.9\text{x}10^{-4}$	0.038	0.038	190	190
La-145	$1.3\text{x}10^{-4}$	0.026	0.026	130	130
La-146	$8.3\text{x}10^{-5}$	0.017	0.017	83	83
La-147	$3.8\text{x}10^{-5}$	$7.7\text{x}10^{-3}$	$7.7\text{x}10^{-3}$	38	38
Ce-141	$2.2\text{x}10^{-4}$	0.043	0.043	220	220
Ce-143	$2.1\text{x}10^{-4}$	0.043	0.043	210	210
Ce-144	$1.5\text{x}10^{-4}$	0.029	0.029	150	150
Ce-145	$1.4\text{x}10^{-4}$	0.028	0.028	140	140
Ce-146	$1.1\text{x}10^{-4}$	0.021	0.021	110	110
Ce-147	$8.0\text{x}10^{-5}$	0.016	0.016	80	80
Ce-148	$5.5\text{x}10^{-6}$	$1.1\text{x}10^{-3}$	$1.1\text{x}10^{-3}$	5.5	5.5
Ce-149	$2.8\text{x}10^{-5}$	$5.6\text{x}10^{-3}$	$5.6\text{x}10^{-3}$	28	28
Pr-143	$2.1\text{x}10^{-4}$	0.042	0.042	210	210
Pr-144	$1.5\text{x}10^{-4}$	0.029	0.029	150	150
Pr-144m	$1.7\text{x}10^{-6}$	$3.5\text{x}10^{-4}$	$3.5\text{x}10^{-4}$	1.7	1.7
Pr-145	$1.4\text{x}10^{-4}$	0.028	0.028	140	140

Table F.2.1.1–1.—*Heavy Water Reactor High Consequence Accident Source Terms* [Page 5 of 5]

	Released Activity (curies)				
Isotope	Core Melt with Containment Spray System and Containment Functioning	Seismically Induced Core Melt with Containment Spray System Failure and Containment Functioning	Core Melt with Containment Spray System Failure and Containment Functioning	Seismically Induced Core Melt with Containment Spray System Failure and Early Containment Failure	Core Melt with Early Containment Spray System and Containment Failure
Pr-146	$1.1x10^{-4}$	0.021	0.021	110	110
Pr-147	$8.2x10^{-5}$	0.016	0.016	82	82
Pr-148	$6.1x10^{-5}$	0.012	0.012	61	61
Pr-149	$3.9x10^{-5}$	$7.7x10^{-3}$	$7.7x10^{-3}$	39	39
Pr-150	$2.2x10^{-5}$	$4.3x10^{-3}$	$4.3x10^{-3}$	22	22
Nd-147	$8.4x10^{-5}$	0.017	0.017	84	84
Nd-149	$4.0x10^{-5}$	$8.0x10^{-3}$	$8.0x10^{-3}$	40	40
Pm-147	$1.8x10^{-6}$	$3.6x10^{-4}$	$3.6x10^{-4}$	1.8	1.8
Pm-148	$2.8x10^{-5}$	$5.7x10^{-3}$	$5.7x10^{-3}$	28	28
Pm-148m	$3.5x10^{-6}$	$7.1x10^{-4}$	$7.1x10^{-4}$	3.5	3.5
Pm-149	$4.6x10^{-5}$	$9.1x10^{-3}$	$9.1x10^{-3}$	46	46
Sm-153	$2.5x10^{-5}$	$5.1x10^{-3}$	$5.1x10^{-3}$	25	25
U-234	$3.0x10^{-10}$	$6.0x10^{-8}$	$6.0x10^{-8}$	$3.0x10^{-4}$	$3.0x10^{-4}$
U-237	$9.9x10^{-5}$	0.02	0.02	99	99
U-239	$5.5x10^{-5}$	0.011	0.011	55	55
Np-238	$1.9x10^{-5}$	$3.7x10^{-3}$	$3.7x10^{-3}$	19	19
Np-239	$5.5x10^{-5}$	0.011	0.011	55	55
Pu-238	$6.3x10^{-8}$	$1.3x10^{-5}$	$1.3x10^{-5}$	0.063	0.063
Pu-239	$8.0x10^{-8}$	$1.6x10^{-7}$	$1.6x10^{-7}$	$8.0x10^{-4}$	$8.0x10^{-4}$
Pu-240	$5.0x10^{-10}$	$9.9x10^{-8}$	$9.9x10^{-8}$	$5.0x10^{-4}$	$5.0x10^{-4}$
Pu-241	$2.3x10^{-7}$	$4.7x10^{-5}$	$4.7x10^{-5}$	0.23	0.23
Pu-243	$4.0x10^{-7}$	$8.0x10^{-5}$	$8.0x10^{-5}$	0.4	0.4
Cm-242	$3.7x10^{-8}$	$7.4x10^{-6}$	$7.4x10^{-6}$	0.037	0.037
Cm-244	$6.7x10^{-10}$	$1.3x10^{-7}$	$1.3x10^{-7}$	$6.7x10^{-4}$	$6.7x10^{-4}$

Note: Tritium source term based on an assumed production design goal of 32 million curies, tritium inventory in coolant of 6 million curies, and a release fraction of 1. Se is assumed to have the Te release fraction. Br is assumed to have the I release fraction. Sn, Pm, Sm, and U are assumed to have the "Other" release fraction.

Source: Source term derived from core inventory and accident release fractions (DOE 1995d: HNUS 1995c:3).

Table F.2.1.1–2.—*Heavy Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Core melt with containment spray system and containment functioning	0.35	1.8x10^{-4}	371	0.19	5.0x10^{-6}
Seismically induced core melt with containment spray system failure and containment functioning	0.36	1.8x10^{-4}	394	0.2	2.0x10^{-6}
Core melt with containment spray system failure and containment functioning	0.36	1.8.x10^{-4}	394	0.2	2.0x10^{-6}
Seismically induced core melt with containment spray system failure and containment failure	41	0.025	1.3x10^{4}	64	1.0x10^{-7}
Core melt with early containment spray system failure and containment failure	41	0.025	1.3x10^{4}	64	1.0x10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	7.1x10^{-4}	–	1.6	–
Expected risk for composite set of accidents (per year)	–	6.5x10^{-9}	–	1.4x10^{-5}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.2–1 and the MACCS computer code.

Table F.2.1.1–3.—*Heavy Water Reactor High Consequence Accidents at Nevada Test Site—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Core melt with containment spray system and containment functioning	0.9	4.5x10^{-4}	36	0.018	5.0x10^{-6}
Seismically induced core melt with containment spray system failure and containment functioning	0.91	4.6x10^{-4}	38	0.019	2.0x10^{-6}
Core melt with containment spray system failure and containment functioning	0.91	4.6x10^{-4}	38	0.019	2.0x10^{-6}
Seismically induced core melt with containment spray system failure and containment failure	117	0.071	1.2x10^{4}	6.1	1.0x10^{-7}
Core melt with early containment spray system failure and containment failure	117	0.071	1.2x10^{4}	6.1	1.0x10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	2.0x10^{-3}	–	0.15	–
Expected risk (per year)	–	1.8x10^{-8}	–	1.4x10^{-6}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.1–1 and the MACCS computer code.

Table F.2.1.1–4.—*Heavy Water Reactor High Consequence Accidents at Oak Ridge Reservation—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Core melt with containment spray system and containment functioning	6.2	3.1×10^{-3}	3.8×10^{3}	1.9	5.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment functioning	6.4	3.2×10^{-3}	4.0×10^{3}	2	2.0×10^{-6}
Core melt with containment spray system failure and containment functioning	6.4	3.2×10^{-3}	4.0×10^{3}	2	2.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment failure	1.0×10^{3}	0.54	9.9×10^{5}	496	1.0×10^{-7}
Core melt with early containment spray system failure and containment failure	1.0×10^{3}	0.54	9.9×10^{5}	496	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.015	–	13	–
Expected risk (per year)	–	1.4×10^{-7}	–	1.2×10^{-4}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.1–1 and the MACCS computer code.

Table F.2.1.1–5.—*Heavy Water Reactor High Consequence Accidents at Pantex Plant—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Core melt with containment spray system and containment functioning	4	2.0×10^{-3}	480	0.24	5.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment functioning	4.1	2.1×10^{-3}	504	0.25	2.0×10^{-6}
Core melt with containment spray system failure and containment functioning	4.1	2.1×10^{-3}	504	0.25	2.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment failure	685	0.38	1.3×10^{5}	65	1.0×10^{-7}
Core melt with early containment spray system failure and containment failure	685	0.38	1.3×10^{5}	65	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.01	–	1.7	–
Expected risk (per year)	–	9.5×10^{-8}	–	1.5×10^{-5}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.1–1 and the MACCS computer code.

Table F.2.1.1–6.—*Heavy Water Reactor High Consequence Accidents at Savannah River Site—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Core melt with containment spray system and containment functioning	0.29	1.5×10^{-4}	1.4×10^{3}	0.71	5.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment functioning	0.3	1.5×10^{-4}	1.5×10^{3}	0.75	2.0×10^{-6}
Core melt with containment spray system failure and containment functioning	0.3	1.5×10^{-4}	1.5×10^{3}	0.75	2.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment failure	44	0.024	4.4×10^{5}	222	1.0×10^{-7}
Core melt with early containment spray system failure and containment failure	44	0.024	4.4×10^{5}	222	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	6.6×10^{-4}	–	5.5	–
Expected risk (per year)	–	6.0×10^{-9}	–	5.1×10^{-5}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.1–1 and the MACCS computer code.

Table F.2.1.1–7.—*Heavy Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	Accident Frequency (per year)
Core melt with containment spray system and containment functioning	32	0.018	13	5.6×10^{-3}	5.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment functioning	33	0.018	13	5.7×10^{-3}	2.0×10^{-6}
Core melt with containment spray system failure and containment functioning	33	0.018	13	5.7×10^{-3}	2.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment failure	5.6×10^{3}	0.77	2.0×10^{3}	0.55	
Core melt with early containment spray system failure and containment failure	5.6×10^{3}	0.77	2.0×10^{3}	0.55	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.034	–	0.017	–
Expected risk (per year)	–	3.2×10^{-7}	–	1.6×10^{-7}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.1–1 and the MACCS computer code.

Table F.2.1.1–8.—*Heavy Water Reactor High Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Core melt with containment spray system and containment functioning	23	0.012	9.5	4.1×10^{-3}	5.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment functioning	24	0.013	9.8	4.3×10^{-3}	2.0×10^{-6}
Core melt with containment spray system failure and containment functioning	24	0.03	9.8	4.3×10^{-3}	2.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment failure	4.3×10^{3}	0.86	1.6×10^{3}	0.52	1.0×10^{-7}
Core melt with early containment spray system failure and containment failure	4.3×10^{3}	0.86	1.6×10^{3}	0.52	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.034	–	0.015	–
Expected risk (per year)	–	3.2×10^{-7}	–	1.4×10^{-7}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.1–1 and the MACCS computer code.

Table F.2.1.1–9.—*Heavy Water Reactor High Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Core melt with containment spray system and containment functioning	31	0.017	12	5.3×10^{-3}	5.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment functioning	32	0.018	12	5.4×10^{-3}	2.0×10^{-6}
Core melt with containment spray system failure and containment functioning	32	0.018	12	5.4×10^{-3}	2.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment failure	6.1×10^{3}	0.82	2.1×10^{3}	0.63	1.0×10^{-7}
Core melt with early containment spray system failure and containment failure	6.1×10^{3}	0.82	2.1×10^{3}	0.63	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.035	–	0.019	–
Expected risk (per year)	–	3.2×10^{-7}	–	1.4×10^{-7}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.1–1 and the MACCS computer code.

Table F.2.1.1–10.—*Heavy Water Reactor High Consequence Accidents at Pantex Plant—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Core melt with containment spray system and containment functioning	14	6.1×10^{-3}	5.5	2.3×10^{-3}	5.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment functioning	14	6.3×10^{-3}	5.7	2.3×10^{-3}	2.0×10^{-6}
Core melt with containment spray system failure and containment functioning	14	6.3×10^{-3}	5.7	2.3×10^{-3}	2.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment failure	2.6×10^{3}	0.81	974	0.39	1.0×10^{-7}
Core melt with early containment spray system failure and containment failure	2.6×10^{3}	0.81	974	0.39	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.024	–	0.011	–
Expected risk (per year)	–	2.2×10^{-7}	–	1.0×10^{-7}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.1–1 and the MACCS computer code.

Table F.2.1.1–11.—*Heavy Water Reactor High Consequence Accidents at Savannah River Site—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Core melt with containment spray system and containment functioning	14	6.4×10^{-3}	5.5	2.3×10^{-3}	5.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment functioning	14	6.6×10^{-3}	5.7	2.4×10^{-3}	2.0×10^{-6}
Core melt with containment spray system failure and containment functioning	14	6.6×10^{-3}	5.7	2.4×10^{-3}	2.0×10^{-6}
Seismically induced core melt with containment spray system failure and containment failure	2.7×10^{3}	0.74	983	0.37	1.0×10^{-7}
Core melt with early containment spray system failure and containment failure	2.7×10^{3}	0.74	983	0.37	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.023	–	0.01	–
Expected risk (per year)	–	2.1×10^{-7}	–	9.5×10^{-8}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.1–1 and the MACCS computer code.

F.2.1.2 *Modular High Temperature Gas-Cooled Reactor*

Previous studies performed for the MHTGR developed a spectrum of severe accidents and their respective source terms. The release frequencies were in the range of 1.0×10^{-9} to 6.0×10^{-6} per reactor year (DOE 1995e). In order to provide a reasonably similar basis for comparisons with other technologies, four accidents with an annual frequency of occurrence greater than 1.0×10^{-7} were selected for evaluation in this PEIS. The selected combination of release category and frequency is representative of accident conditions at the low frequency end of the credible range for beyond design-basis accidents.

Depressurized Conduction Cooldown with Reactor Cavity Cooling System Functioning

Scenario. The MHTGR high consequence accident postulated a depressurized reactor cooldown event. The reactor cavity cooling system was functioning and containment leak rate was 100 percent per day. The source term is presented in table F.2.1.2–1. The annual frequency of occurrence for this accident is 6.0×10^{-6} per year (DOE 1995e).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.2–2 through F.2.1.2–6 for public consequences and in tables F.2.1.2–7 through F.2.1.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.2–1 or F.2.1.1.–1 (like footnote) using the MACCS computer code.

Depressurized Conduction Cooldown Without Reactor Cavity Cooling System Functioning

Scenario. The MHTGR high consequence accident postulated a depressurized reactor cooldown event. The reactor cavity cooling system was not functioning and containment leak rate was 1 percent per day. The source term is presented in table F.2.1.2–1. The annual frequency of occurrence for this accident is 6.0×10^{-6} per year (DOE 1995e).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.2–2 through F.2.1.2–6. The dose estimates are based on analysis of the source terms in table F.2.1.2–1 using the MACCS computer code.

Air Ingress

Scenario. The MHTGR high consequence accident postulated an air ingress event with the containment leak rate at 100 percent per day. The source term is presented in table F.2.1.2–1. The annual frequency of occurrence for this accident is 2.0×10^{-6} per year (DOE 1995e).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.2–2 through F.2.1.2–6 for public consequences and in tables F.2.1.2–7 through F.2.1.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.2–1 using the MACCS computer code.

Moisture Ingress

Scenario. The MHTGR high consequence accident postulated a moisture ingress event with the containment leak rate at 1 percent per day. The source term is presented in table F.2.1.2–1. The annual frequency of occurrence for this accident is 2.0×10^{-6} per year (DOE 1995e).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.2–2 through F.2.1.2–6 for public consequences and in tables F.2.1.2–7 through F.2.1.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.2–1 using the MACCS computer code.

Integrated Cancer Fatalities Complementary Cumulative Distribution Function for the Four Modular High Temperature Gas-Cooled Reactor High Consequence Accidents

Figure F.2.1.2–1 shows the annual probability that, in the event of any accident in the composite set of MHTGR high consequence accidents at one of the sites, the number of cancer fatalities exceeds the value N indicated on the horizontal axis. The curves, technically referred to as complementary cumulative distribution functions, reflect the probability of the accident's occurrence, as well as the variability in the magnitude of its consequences. Generally, a curve that extends the farthest to the right has the highest accident consequences while a curve that is nearest to the left has the lowest accident consequences. A comparison of alternatives should include the information provided by these curves in conjunction with the point values shown in tables F.2.1.2–2 through F.2.1.2–11.

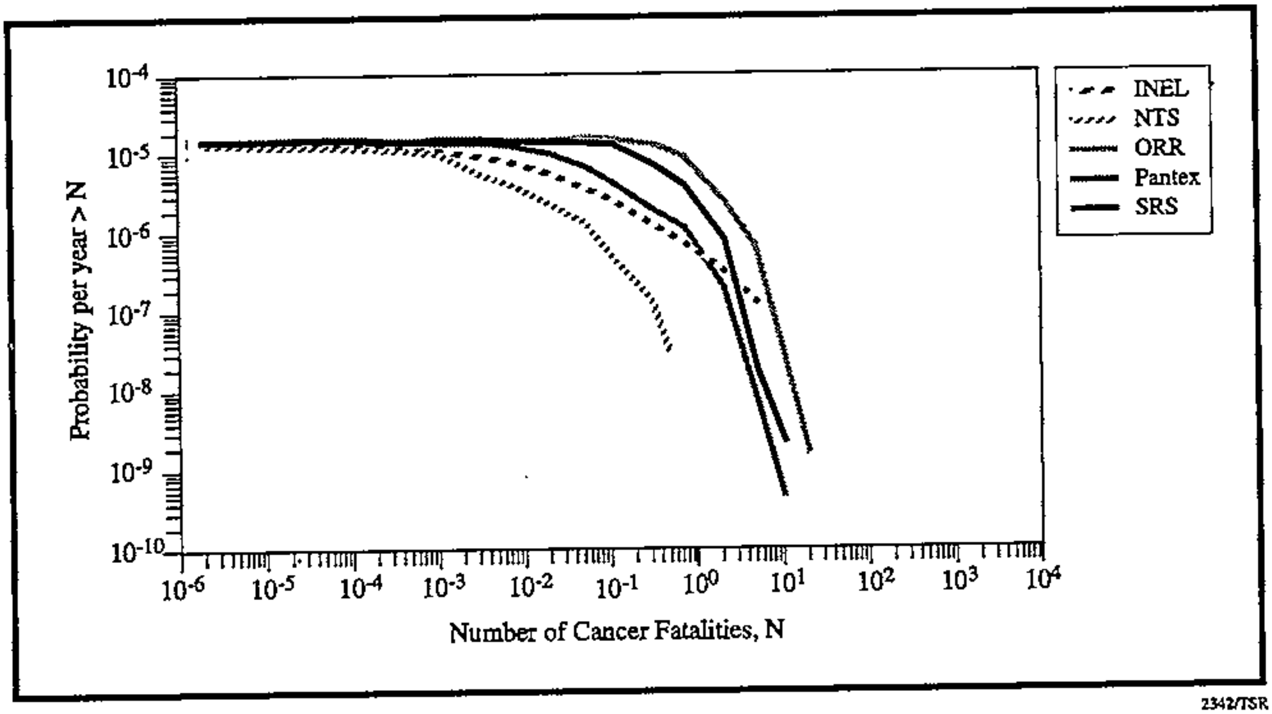

FIGURE F.2.1.2–1.—*High Consequence Accident-Cancer Fatality Frequency Distribution Functions for the Modular High Temperature Gas-Cooled Reactor*

TABLE F.2.1.2–1.—*Modular High Temperature Gas-Cooled Reactor High Consequence Accident Source Terms* [Page 1 of 2]

Isotope	Released Activity (curies)			
	Depressurized Conduction Cooldown with Reactor Cavity Cooling System Functioning (leakage 100 percent per day)	Depressurized Conduction Cooldown without Reactor Cavity Cooling System Functioning (leakage 1 percent per day)	Air Ingress (leakage 100 percent per day)	Moisture Ingress (leakage 1 percent per day)
H-3	7.3×10^5	2.8×10^6	7.3×10^5	2.8×10^6
Kr-85	0.014	0.014	0.014	0.014
Kr-85m	1.3	0.017	1.3	0.017
Kr-87	0.89	9.6×10^{-3}	0.89	9.6×10^{-3}
Kr-88	2.7	0.031	2.7	0.031
Rb-86	1.6	0.028	1.6	0.028
Sr-89	1.2×10^3	52	1.2×10^3	52
Sr-90	74	3.1	74	3.1
Sr-91	2.4	0.69	2.4	0.69
Y-90	34	1.9	34	1.9
Y-91	1.5×10^3	65	1.5×10^3	65
Zr-95	1.7×10^3	72	1.7×10^3	72
Zr-97	41	4.9	41	4.9
Nb-95	1.6×10^3	7.0×10^3	1.6×10^3	7.0×10^3
Mo-99	660	36	660	36
Tc-99m	0.067	0.59	0.067	0.59
Ru-103	960	41	960	41
Ru-105	6.2×10^{-4}	2.0×10^{-3}	6.2×10^{-4}	2.0×10^{-3}
Ru-106	69	3	69	3
Rh-105	70	4.8	70	4.8
Sb-127	28	1.4	28	1.4
Sb-129	5.3×10^{-8}	3.9×10^{-7}	5.3×10^{-8}	3.9×10^{-7}
Te-127	9.9	0.17	9.9	0.17
Te-127m	0.81	0.014	0.81	0.014
Te-129	0.076	8.1×10^{-4}	0.076	8.1×10^{-4}
Te-129m	2.1	0.037	2.1	0.037
Te-131m	1.2	0.019	1.2	0.019
Te-132	80	1.4	80	1.4

TABLE F.2.1.2–1.—*Modular High Temperature Gas-Cooled Reactor High Consequence Accident Source Terms* [Page 2 of 2]

	Released Activity (curies)			
Isotope	Depressurized Conduction Cooldown with Reactor Cavity Cooling System Functioning (leakage 100 percent per day)	Depressurized Conduction Cooldown without Reactor Cavity Cooling System Functioning (leakage 1 percent per day)	Air Ingress (leakage 100 percent per day)	Moisture Ingress (leakage 1 percent per day)
I-131	28	0.48	28	0.48
I-132	21	0.23	21	0.23
I-133	15	0.22	15	0.22
I-134	0.51	5.3×10^{-3}	0.51	5.3×10^{-3}
I-135	5	0.064	5	0.064
Xe-133	2.5	0.2	2.5	0.2
Xe-135	2.1	0.033	2.1	0.033
Cs-134	250	9.1	250	9.1
Cs-136	170	6.5	170	6.5
Cs-137	110	4	110	4
Ba-140	1.1×10^{3}	48	1.1×10^{3}	48
La-140	430	28	430	28
Ce-141	1.5×10^{3}	66	1.5×10^{3}	66
Ce-143	240	17	240	17
Ce-144	540	24	540	24
Pr-143	1.3×10^{3}	58	1.3×10^{3}	58
Nd-147	510	27	510	23

Source: DOE 1995e calculated using the source terms in table F.2.1.1–1 and the MACCS computer code.

Table F.2.1.2–2.—*Modular High Temperature Gas-Cooled Reactor High Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Depressurized conduction cooldown with reactor cavity cooling system functioning (leakage 100 percent per day)	0.17	$8.5\text{x}10^{-5}$	554	0.28	$6.0\text{x}10^{-6}$
Depressurized conduction cooldown without reactor cavity cooling system functioning (leakage 1 percent per day)	0.065	$3.2\text{x}10^{-5}$	170	0.085	$6.0\text{x}10^{-6}$
Air ingress (leakage 100 percent per day)	0.17	$8.5\text{x}10^{-5}$	554	0.28	$2.0\text{x}10^{-6}$
Moisture ingress (leakage 1 percent per day)	0.065	$3.2\text{x}10^{-5}$	170	0.085	$2.0\text{x}10^{-6}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$5.9\text{x}10^{-5}$	–	0.18	–
Expected risk (per year)	–	$9.4\text{x}10^{-10}$	–	$2.9\text{x}10^{-6}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.2–1 and the MACCS computer code.

Table F.2.1.2–3.—*Modular High Temperature Gas-Cooled Reactor High Consequence Accidents at Nevada Test Site—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Depressurized conduction cooldown with reactor cavity cooling system functioning (leakage 100 percent per day)	0.49	$2.5\text{x}10^{-4}$	53	0.026	$6.0\text{x}10^{-6}$
Depressurized conduction cooldown without reactor cavity cooling system functioning (leakage 1 percent per day)	0.18	$9.0\text{x}10^{-5}$	16	$8.1\text{x}10^{-3}$	$6.0\text{x}10^{-6}$
Air ingress (leakage 100 percent per day)	0.49	$2.5\text{x}10^{-4}$	53	0.026	$2.0\text{x}10^{-6}$
Moisture ingress (leakage 1 percent per day)	0.18	$9.0\text{x}10^{-5}$	16	$8.1\text{x}10^{-3}$	$2.0\text{x}10^{-6}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$1.7\text{x}10^{-4}$	–	0.017	–
Expected Risk (per year)	–	$2.7\text{x}10^{-9}$	–	$2.8\text{x}10^{-7}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.2–1 and the MACCS computer code.

Table F.2.1.2–4.—*Modular High Temperature Gas-Cooled Reactor High Consequence Accidents at Oak Ridge Reservation—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Depressurized conduction cooldown with reactor cavity cooling system functioning (leakage 100 percent per day)	4.4	2.2×10^{-3}	4.3×10^{3}	2.2	6.0×10^{-6}
Depressurized conduction cooldown without reactor cavity cooling system functioning (leakage 1 percent per day)	1.5	7.7×10^{-4}	1.4×10^{3}	0.68	6.0×10^{-6}
Air ingress (leakage 100 percent per day)	4.4	2.2×10^{-3}	4.3×10^{3}	2.2	2.0×10^{-6}
Moisture ingress (leakage 1 percent per day)	1.5	7.7×10^{-4}	1.4×10^{3}	0.68	2.0×10^{-6}
Evaluation of Composite Set of Accidents					
Expected consequences	–	1.5×10^{-3}	–	1.4	–
Expected risk (per year)	–	2.4×10^{-8}	–	2.3×10^{-5}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.2–1 and the MACCS computer code.

Table F.2.1.2–5.—*Modular High Temperature Gas-Cooled Reactor High Consequence Accidents at Pantex Plant—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Depressurized conduction cooldown with reactor cavity cooling system functioning (leakage 100 percent per day)	3	1.5×10^{-3}	570	0.29	6.0×10^{-6}
Depressurized conduction cooldown without reactor cavity cooling system functioning (leakage 1 percent per day)	1	5.2×10^{-4}	178	0.089	6.0×10^{-6}
Air ingress (leakage 100 percent per day)	3	1.5×10^{-3}	570	0.29	2.0×10^{-6}
Moisture ingress (leakage 1 percent per day)	1	5.2×10^{-4}	178	0.089	2.0×10^{-6}
Evaluation of Composite Set of Accidents					
Expected consequences	–	1.0×10^{-3}	–	0.19	–
Expected risk (per year)	–	1.6×10^{-8}	–	3.0×10^{-6}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.2–1 and the MACCS computer code.

Table F.2.1.2–6.—*Modular High Temperature Gas-Cooled Reactor High Consequence Accidents at Savannah River Site—Public Consequences*

Accident Description	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accident Frequency (per year)
Depressurized conduction cooldown with reactor cavity cooling system functioning (leakage 100 percent per day)	0.19	9.3×10^{-5}	1.9×10^{3}	0.96	6.0×10^{-6}
Depressurized conduction cooldown without reactor cavity cooling system functioning (leakage 1 percent per day)	0.066	3.3×10^{-5}	596	0.3	6.0×10^{-6}
Air ingress (leakage 100 percent per day)	0.19	9.3×10^{-5}	1.9×10^{3}	0.96	2.0×10^{-6}
Moisture ingress (leakage 1 percent per day)	0.066	3.3×10^{-5}	596	0.3	2.0×10^{-6}
Evaluation of Composite Set of Accidents					
Expected consequences	–	6.3×10^{-5}	–	0.63	–
Expected risk (per year)	–	1.0×10^{-9}	–	1.0×10^{-5}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.2–1 and the MACCS computer code.

Table F.2.1.2–7.—*Modular High Temperature Gas-Cooled Reactor High Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (person-rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Depressurized conduction cooldown with reactor cavity cooling system functioning (leakage 100 percent per day)	25	9.9×10^{-3}	8.5	3.4×10^{-3}	6.0×10^{-6}
Depressurized conduction cooldown without reactor cavity cooling system functioning (leakage 1 percent per day)	8.7	3.5×10^{-3}	3.1	1.2×10^{-3}	6.0×10^{-6}
Air ingress (leakage 100 percent per day)	25	9.9×10^{-3}	8.5	3.4×10^{-3}	2.0×10^{-6}
Moisture ingress (leakage 1 percent per day)	8.7	3.5×10^{-3}	3.1	1.2×10^{-3}	2.0×10^{-6}
Evaluation of Composite Set of Accidents					
Expected consequences	–	6.7×10^{-3}	–	2.3×10^{-3}	–
Expected risk (per year)	–	1.1×10^{-7}	–	3.7×10^{-8}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.2–1 and the MACCS computer code.

Table F.2.1.2–8.—*Modular High Temperature Gas-Cooled Reactor High Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Depressurized conduction cooldown with reactor cavity cooling system functioning (leakage 100 percent per day)	19	7.5×10^{-3}	6.8	2.7×10^{-3}	6.0×10^{-6}
Depressurized conduction cooldown without reactor cavity cooling system functioning (leakage 1 percent per day)	6.5	2.6×10^{-3}	2.4	9.6×10^{-4}	6.0×10^{-6}
Air ingress (leakage 100 percent per day)	19	7.5×10^{-3}	6.8	2.7×10^{-3}	2.0×10^{-6}
Moisture ingress (leakage 1 percent per day)	6.5	2.6×10^{-3}	2.4	9.6×10^{-4}	2.0×10^{-6}
Evaluation of Composite Set of Accidents					
Expected consequences	–	5.0×10^{-3}	–	1.8×10^{-3}	–
Expected risk (per year)	–	8.1×10^{-8}	–	3.0×10^{-8}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.2–1 and the MACCS computer code.

Table F.2.1.2–9.—*Modular High Temperature Gas-Cooled Reactor High Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Depressurized conduction cooldown with reactor cavity cooling system functioning (leakage 100 percent per day)	27	0.011	9.1	3.6×10^{-3}	6.0×10^{-6}
Depressurized conduction cooldown without reactor cavity cooling system functioning (leakage 1 percent per day)	9	3.6×10^{-3}	3.1	1.3×10^{-3}	6.0×10^{-6}
Air ingress (leakage 100 percent per day)	27	0.011	9.1	3.6×10^{-3}	2.0×10^{-6}
Moisture ingress (leakage 1 percent per day)	9	3.6×10^{-3}	3.1	1.3×10^{-3}	2.0×10^{-6}
Evaluation of Composite Set of Accidents					
Expected consequences	–	7.1×10^{-3}	–	2.4×10^{-3}	–
Expected risk (per year)	–	1.1×10^{-7}	–	3.9×10^{-8}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.2–1 and the MACCS computer code.

Table F.2.1.2–10.—*Modular High Temperature Gas-Cooled Reactor High Consequence Accidents at Pantex Plant—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Depressurized conduction cooldown with reactor cavity cooling system functioning (leakage 100 percent per day)	12	$4.6x10^{-3}$	4.2	$1.7x10^{-3}$	$6.0x10^{-6}$
Depressurized conduction cooldown without reactor cavity cooling system functioning (leakage 1 percent per day)	3.9	$1.6x10^{-3}$	1.5	$5.8x10^{-4}$	$6.0x10^{-6}$
Air ingress (leakage 100 percent per day)	12	$4.6x10^{-3}$	4.2	$1.7x10^{-3}$	$2.0x10^{-6}$
Moisture ingress (leakage 1 percent per day)	3.9	$1.6x10^{-3}$	1.5	$5.8x10^{-4}$	$2.0x10^{-6}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$3.1x10^{-3}$	–	$1.1x10^{-3}$	–
Expected risk (per year)	–	$5.0x10^{-8}$	–	$1.8x10^{-8}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.2–1 and the MACCS computer code.

Table F.2.1.2–11.—*Modular High Temperature Gas-Cooled Reactor High Consequence Accidents at Savannah River Site—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Depressurized conduction cooldown with reactor cavity cooling system functioning (leakage 100 percent per day)	12	$4.8x10^{-3}$	4.3	$1.7x10^{-3}$	$6.0x10^{-6}$
Depressurized conduction cooldown without reactor cavity cooling system functioning (leakage 1 percent per day)	4	$1.6x10^{-3}$	1.5	$5.9x10^{-4}$	$6.0x10^{-6}$
Air ingress (leakage 100 percent per day)	12	$4.8x10^{-3}$	4.3	$1.7x10^{-3}$	$2.0x10^{-6}$
Moisture ingress (leakage 1 percent per day)	4	$1.6x10^{-3}$	1.5	$5.9x10^{-4}$	$2.0x10^{-6}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$3.2x10^{-3}$	–	$1.1x10^{-3}$	–
Expected risk (per year)	–	$5.1x10^{-8}$	–	$1.8x10^{-8}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.2–1 and the MACCS computer code.

F.2.1.3 *Advanced Light Water Reactor*

Previous studies performed for the ALWR developed a spectrum of severe accidents and their respective source terms (ABB 1994a; DOE 1992t; GE 1993a; GE nda; TTI 1995b). The studies of the four ALWR technologies were for the Advanced Boiling Water Reactor , CE System 80+, AP600, and the Simplified Boiling Water Reactor; and were performed independently by their respective vendors for licensing purposes. Because they were performed independently, the modeling assumptions, techniques, and resulting source terms and consequences do not have uniform bases. Although the results are considered adequate for comparisons with other non-ALWR technologies, they should not be used for comparisons among the four ALWR technologies without further analyses using uniform bases. The release frequencies for the four ALWR release categories were in the range of $5.0\text{x}10^{-11}$ to $1.0\text{x}10^{-6}$ per reactor year. In order to provide a reasonably similar basis for comparisons with other technologies, a release category and corresponding frequency, out of several available, were chosen to represent the consequences and risks associated with each ALWR technology at each of the five candidate sites. The selected combination of release category and frequency for each technology is representative of accident conditions at the low frequency end of the credible range for beyond design-basis accidents.

F.2.1.3.1 *Advanced Boiling Water Reactor*

Chapter 19 of the *Advanced BWR Standard Safety Analysis Report*, evaluated beyond design-basis accidents that were initiated by either internal events (e.g., a sequence of equipment failures) or external events (e.g., severe natural phenomena such as beyond design-basis earthquakes). The evaluation of external event initiated accidents did not present accident frequency data, release fractions, or source term data that could be used to analyze the accident consequences and risks for this class of accident in this PEIS.

Numerous internal event initiated accidents were evaluated in Chapter 19. The accidents that had a common source term were binned or grouped together and evaluated as a single accident and a single total annual frequency of occurrence was defined for the group. Release fractions and the annual frequency of occurrence were defined for ten accidents. The annual frequency of occurrence for these ten accidents ranged from $7.0\text{x}10^{-8}$ per year to less than $1.0\text{x}10^{-10}$ per year (GE nda). Two of the accidents had an annual frequency of occurrence greater than $1.0\text{x}10^{-8}$ per year. These two accidents were selected for evaluation in this PEIS.

Accident No. 1

Scenario. The postulated accident is an anticipated transient without scram with the loss of core cooling. Due to the loss of core cooling, core damage results, the vessel fails in approximately 1 hour, and the containment fails in approximately 19 hours (GE nda). The source term is presented in table F.2.1.3.1–1. The annual frequency of occurrence for this accident is $1.3\text{x}10^{-7}$ per year (GE nda).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.3.1–2 through F.2.1.3.1–6 for public consequences and in tables F.2.1.3.1–7 through F.2.1.3.1–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.3.1–1 using the MACCS computer code.

Accident No. 2

Scenario. Accident No. 2 is represented by a source term that is common for a group of accidents. The group of accidents include the following:

- Loss of all core cooling, vessel failure at high pressure, firewater addition system switched to drywell spray mode, containment overpressure protection system rupture disk ruptures, and release negligible - less than 0.1 percent volatile fission products.
- Loss of all core cooling, vessel failure at high pressure, passive flooder and drywell spray available, containment overpressure protection system rupture disk ruptures, and release negligible - less than 0.1 percent volatile fission products.
- Large break loss of coolant accident, loss of all core cooling, firewater addition system switched to drywell spray mode,

containment overpressure protection system rupture disk ruptures, and release negligible - less than 0.1 percent volatile fission products.

- Station blackout with RCIC operating for 8 hours, offsite power restored at 8 hours, firewater addition system switched to drywell spray mode, containment overpressure protection system rupture disk ruptures, and release negligible - less than 0.1 percent volatile fission products.
- Loss of all core cooling, vessel failure at low pressure, passive flooder available, containment overpressure protection system rupture disk ruptures, and release negligible - less than 0.1 percent volatile fission products.
- Loss of all core cooling, vessel failure at low pressure, firewater addition system switched to drywell spray mode, containment overpressure protection system rupture disk ruptures, and release negligible - less than 0.1 percent volatile fission products (GE nda).

The source term is presented in table F.2.1.3.1–1. The annual frequency of occurrence for the group of accidents is 2.1×10^{-8} per year (GE nda).

Consequences. The estimated consequences of Accident No. 2 at each site are shown in tables F.2.1.3.1–2 through F.2.1.3.1–6 for public consequences and in tables F.2.1.3.1–7 through F.2.1.3.1–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.3.1–1 using the MACCS computer code.

Integrated Cancer Fatalities Complementary Cumulative Distribution Function for the Two High Consequence Accidents

Figure F.2.1.3.1–1 shows the annual probability that, in the event of any accident in the composite set of Advanced Boiling Water Reactor ALWR high consequence accidents at one of the sites, the number of cancer fatalities exceeds the value N indicated on the horizontal axis. The curves, technically referred to as complementary cumulative distribution functions, reflect the probability of the accident's occurrence, as well as the variability in the magnitude of its consequences. Generally, a curve that extends the farthest to the right has the highest accident consequences while a curve that is nearest to the left has the lowest accident consequences. A comparison of alternatives should include the information provided by these curves in conjunction with the point values shown in tables F.2.1.3.1–2 through F.2.1.3.1–11.

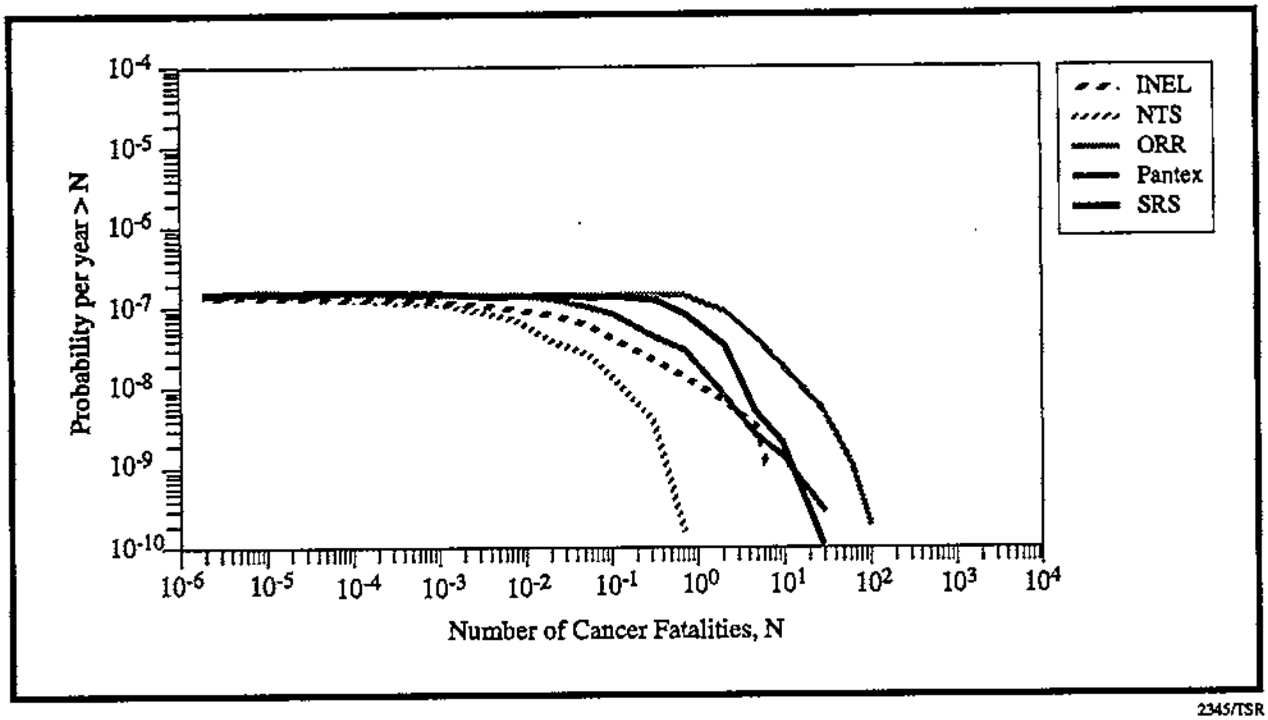

FIGURE F.2.1.3.1–1.—*High Consequence Accident-Cancer Fatality Frequency Distribution Functions for the Advanced Boiling Water Reactor.*

TABLE F.2.1.3.1–1.— *Advanced Boiling Water Reactor High Consequence Accident Source Terms*

Isotope	Released Activity (curies) Accident No. 1	Accident No. 2
H-3	1.4×10^6	3.2×10^7
Kr-85	4.4×10^4	1.0×10^6
Kr-85m	1.6×10^6	3.6×10^7
Kr-87	2.9×10^6	6.6×10^7
Kr-88	3.9×10^6	9.0×10^7
Rb-86	1.3	0.73
I-131	2.4×10^3	16
I-132	3.5×10^3	23
I-133	5.0×10^3	33
I-134	5.5×10^3	36
I-135	4.7×10^3	31
Xe-133	9.6×10^6	2.2×10^8
Xe-135	2.3×10^6	5.2×10^7
Cs-134	390	220
Cs-136	100	59
Cs-137	230	130

Source: Source term derived from accident release fractions (GE nda) and core inventory (TTI 1995b).

TABLE F.2.1.3.1–2.—*Advanced Boiling Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences*

Accident	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accident Frequency (per year)
No. 1	0.86	$4.3x10^{-4}$	640	0.32	$1.3x10^{-7}$
No. 2	16	0.14	$1.3x10^{3}$	0.64	$2.1x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$2.3x10^{-3}$	–	0.36	–
Expected risk (per year)	–	$3.5x10^{-10}$	–	$5.5x10^{-8}$	–

[a] Increased likelihood of a cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.1–1 and the MACCS computer code.

TABLE F.2.1.3.1–3.—*Advanced Boiling Water Reactor High Consequence Accidents at Nevada Test Site—Public Consequences*

Accident	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accidant Frequency (per year)
No. 1	2	$1.0x10^{-3}$	61	0.03	$1.3x10^{-7}$
No. 2	37	0.033	126	0.063	$2.1x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$5.5x10^{-3}$	–	0.035	–
Expected risk (per year)	–	$8.3x10^{-10}$	–	$5.3x10^{-9}$	–

[a] Increased likelihood of a cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.1–1 and the MACCS computer code.

TABLE F.2.1.3.1–4.—*Advanced Boiling Water Reactor High Consequence Accidents at Oak Ridge Reservation—Public Consequences*

Accident	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accident Frequency (per year)
No. 1	12	$7.4x10^{-3}$	$6.6x10^{3}$	3.3	$1.3x10^{-7}$
No. 2	186	0.099	$4.9x10^{4}$	24	$2.1x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.02	–	6.2	–
Expected risk (per year)	–	$3.1x10^{-9}$	–	$9.4x10^{-7}$	–

[a] Increased likelihood of a cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.1–1 and the MACCS computer code.

TABLE F.2.1.3.1–5.—*Advanced Boiling Water Reactor High Consequence Accidents at Pantex Plant—Public Consequence*

	Maximum Offsite Individual		Population to 50 Miles		
Accident	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
No. 1	7.3	3.8×10^{-3}	819	0.41	1.3×10^{-7}
No. 2	102	0.084	5.3×10^{3}	2.6	2.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.015	–	0.72	–
Expected risk (per year)	–	2.3×10^{-9}	–	1.1×10^{-7}	–

[a] Increased likelihood of a cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.1–1 and the MACCS computer code.

TABLE F.2.1.3.1–6.—*Advanced Boiling Water Reactor High Consequence Accidents at Savannah River Site—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
No. 1	0.66	3.3×10^{-4}	2.4×10^{3}	1.2	1.3×10^{-7}
No. 2	11	7.6×10^{-3}	9.5×10^{3}	4.7	2.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	1.3×10^{-3}	–	1.7	–
Expected risk (per year)	–	2.0×10^{-10}	–	2.6×10^{-7}	–

[a] Increased likelihood of a cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.1–1 and the MACCS computer code.

TABLE F.2.1.3.1–7.—*Advanced Boiling Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (rem)**	**Cancer Fatality**[a]	**Accident Frequency (per year)**
No. 1	49	0.028	22	0.013	1.3×10^{-7}
No. 2	562	0.066	311	0.059	2.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.033	–	0.019	–
Expected risk (per year)	–	5.0×10^{-9}	–	2.9×10^{-9}	–

[a] Increased likelihood of a cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.1–1 and the MACCS computer code.

TABLE F.2.1.3.1–8.—*Advanced Boiling Water Reactor High Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
No. 1	36	0.019	17	8.4×10^{-3}	1.3×10^{-7}
No. 2	409	0.093	230	0.075	2.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.03	–	0.018	–
Expected risk (per year)	–	4.5×10^{-9}	–	2.7×10^{-9}	–

[a] Increased likelihood of a cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.1–1 and the MACCS computer code.

TABLE F.2.1.3.1–9.—*Advanced Boiling Water Reactor High Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
No. 1	51	0.029	22	0.012	1.3×10^{-7}
No. 2	561	0.056	295	0.073	2.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.032	–	0.02	–
Expected risk (per year)	–	4.9×10^{-9}	–	3.0×10^{-9}	–

[a] Increased likelihood of a cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.1–1 and the MACCS computer code.

TABLE F.2.1.3.1–10.—*Advanced Boiling Water Reactor High Consequence Accidents at Pantex Plant—Worker Consequences*

Accident	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
No. 1	22	0.01	9.7	4.2×10^{-3}	1.3×10^{-7}
No. 2	239	0.14	127	0.075	2.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.023	–	0.014	–
Expected risk (per year)	–	3.5×10^{-9}	–	2.1×10^{-9}	–

[a] Increased likelihood of a cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.1–1 and the MACCS computer code.

TABLE F.2.1.3.1–11.—*Advanced Boiling Water Reactor High Consequence Accidents at Savannah River Site—Worker Consequences*

Accident	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
No. 1	22	0.011	9.9	$4.5x10^{-3}$	$1.3x10^{-7}$
No. 2	246	0.097	130	0.066	$2.1x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.023	–	0.013	–
Expected risk (per year)	–	$3.4x10^{-9}$	–	$2.0x10^{-9}$	–

[a] Increased likelihood of a cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.1–1 and the MACCS computer code.

F.2.1.3.2 *CE System 80+ Advanced Light Water Reactor*

Chapter 19 of the *CESSAR Design Certification - System 80+ Standard Design* evaluated beyond design-basis accidents that were initiated by internal events (e.g., a sequence of equipment failures). The accidents that had a common source term were binned or grouped together and evaluated as a single accident and a single total annual frequency of occurrence was defined for the group. Release fractions and the annual frequency of occurrence were defined for 23 accident groupings. The annual frequency of occurrence for these 23 accident groupings ranged from $1.4\text{x}10^{-6}$ to $5.1\text{x}10^{-10}$ (ABB 1994a). Two of the accidents had an annual frequency of occurrence greater than $1.0\text{x}10^{-8}$. These two accidents were selected for evaluation in this PEIS.

Tornado Strike Disables Switchyard and Both Emergency Diesel Generators Failed

Scenario. The analysis postulated that a tornado struck the switchyard. As a result of loss of load, the turbine tripped and the reactor tripped. The analysis postulated that both diesels failed to start and a station blackout condition existed at the site. When the emergency batteries were depleted, the core would overheat, the core would fail, and the vessel would fail. Ultimately the containment would fail (ABB 1994a:19.7-23,19.7-24,19.12-121). If all sites were assumed to be located in tornado region B, the region with the highest tornado frequency, the tornado strike frequency for the plant is $1.07\text{x}10^{-5}$ per year (ABB 1994a). Based on NRC licensing requirements, the minimum acceptable emergency diesel generator target reliability is 95 percent (NCR 1988a.155:1.155-3). The annual frequency of a tornado striking the plant switchyard and the failure of both emergency diesel generators is $2.7\text{x}10^{-8}$.

Consequences. The annual frequency of occurrence for the postulated accident is less than $1.0\text{x}10^{-7}$ and thus the accident consequence is considered beyond the scope of this PEIS and was not analyzed (DOE 1993z:28).

Loss of Coolant Accident, Failure of Safety Systems, and Containment Failure

Scenario. A spectrum of beyond design-basis loss of coolant accidents were postulated. The individual accident scenarios postulated the failure of safety systems that mitigate the accident consequences. Due to the failure of the safety systems, core damage resulted, the containment may overpressurize and fail or the containment may fail due to basemat melt-through. The annual frequency of occurrence for the spectrum of beyond design-basis loss of coolant accidents is in the range of $3.8\text{x}10^{-8}$ for release class RC2.4E to $1.8\text{x}10^{-9}$ for release class RC4.22E (ABB 1994a:19.12-116-19.12-129).

Consequences. The annual frequency of occurrence for the each of the of loss of coolant accidents sequences was less than $1.0\text{x}10^{-7}$ and thus the accident consequences are considered beyond the scope of this PEIS and were not analyzed (DOE 1993z).

Loss of Feedwater, Loss of Emergency Feedwater, and Failure to Bleed System

Scenario. The accident is initiated by loss of feedwater followed by the loss of emergency feedwater and the failure to bleed the system preventing feed and bleed cooling. Core damage is assumed to occur at 4 hours with vessel failure at 5 hours. Containment spray and containment heat removal are assumed operational and the cavity is flooded. The releases are assumed to start at the time of vessel breach at 4 hours and continue for 24 hours. The release occurs at an elevation 16.6 meters above grade. The source term is presented in table F.2.1.3.2–1. The annual frequency of occurrence for this accident is $1.4\text{x}10^{-6}$ per year (ABB 1994a:19.12-115).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.3.2–2 through F.2.1.3.2–6 for public consequences and in tables F.2.1.3.2–7 through F.2.1.3.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.3.2–1 using the MACCS computer code.

Loss of Feedwater and Failure of Long-Term Decay Heat Removal

Scenario. The accident is initiated by loss of feedwater. The emergency feedwater is initially successful but there is a failure of long-term decay heat removal in the 8- to 24-hour period. Core damage is assumed to occur at 16 hours with vessel failure at 17 hours.

The cavity is assumed flooded. The releases are assumed to start at the time of vessel breach at 17 hours and continue for 24 hours. The release occurs at an elevation 16.6 meters above grade. The source term is presented in table F.2.1.3.2–1. The annual frequency of occurrence for this accident is 3.8x10^{-7} per year (ABB 1994a:19.12-115;19.12-116).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.3.2–2 through F.2.1.3.2–6 for public consequences and in tables F.2.1.3.2–7 through F.2.1.3.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.3.2–1 using the MACCS computer code.

Integrated Cancer Fatalities Complementary Cumulative Distribution Function for the Two Loss of Feedwater High Consequence Accidents

Figure F.2.1.3.2–1 shows the annual probability that, in the event of any accident in the composite set of CE System 80+ ALWR high consequence accidents at one of the sites, the number of cancer fatalities exceeds the value N indicated on the horizontal axis. The curves, technically referred to as complementary cumulative distribution functions, reflect the probability of the accident's occurrence as well as the variability in the magnitude of its consequences. Generally, a curve that extends the farthest to the right has the highest accident consequences while a curve that is nearest to the left has the lowest accident consequences. A comparison of alternatives should include the information provided by these curves in conjunction with the point values shown in tables F.2.1.3.2–2 through F.2.1.3.2–11.

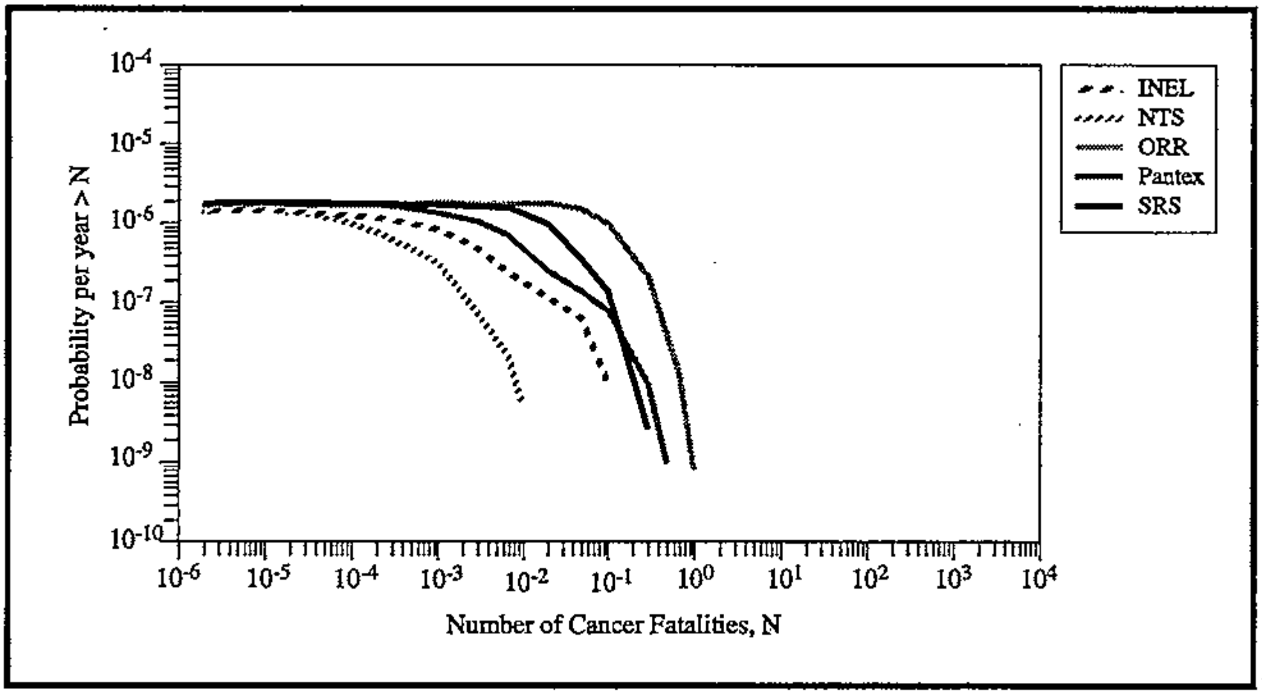

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FIGURE F.2.1.3.2–1.—*High Consequence Accident-Cancer Fatality Frequency Distribution Functions for the CE System 80+ Reactor.*

TABLE F.2.1.3.2–1.—*CE System 80+ Advanced Light Water Reactor High Consequence Accident Source Terms*

	Released Activity (curies)			Released Activity (curies)	
Isotope	**Loss of Feedwater, Loss of Emergency Feedwater, and Failure to Bleed System**	**Loss of Feedwater and Failure of Long-Term Decay Heat Removal**	**Isotope**	**Loss of Feedwater, Loss of Emergency Feedwater, and Failure to Bleed System**	**Loss of Feedwater and Failure of Long-Term Decay Heat Removal**
H-3[a]	$1.6\text{x}10^{5}$	$1.6\text{x}10^{5}$	Xe-133	$1.2\text{x}10^{6}$	$1.2\text{x}10^{6}$
Kr-85	$5.7\text{x}10^{3}$	$5.7\text{x}10^{3}$	Xe-135	$3.2\text{x}10^{5}$	$3.2\text{x}10^{5}$
Kr-85m	$1.8\text{x}10^{5}$	$1.8\text{x}10^{5}$	Cs-134	2.1	1
Kr-87	$3.6\text{x}10^{5}$	$3.6\text{x}10^{5}$	Cs-136	0.8	0.4
Kr-88	$5.1\text{x}10^{5}$	$5.1\text{x}10^{5}$	Cs-137	2.1	1
Rb-86[b]	0.03	0.015	Ba-139	5.2	2.5
Sr-89	0.59	0.26	Ba-140	5.1	2.5
Sr-90	0.038	0.017	La-140	1.4	0.69
Sr-91	0.72	0.32	La-141	1.3	0.63
Sr-92	0.76	0.34	La-142	1.2	0.61
Y-90	0.056	0.028	Ce-141	5.4	2.3
Y-91	1.1	0.53	Ce-143	5	2.2
Y-92	1.1	0.55	Ce-144	4	1.8
Y-93	1.2	0.61	Pr-143[c]	1.2	0.59
Zr-95	5.6	2.4	Nd-147[d]	0.5	0.25
Zr-97	5.3	2.3	Np-239[e]	46	20
Nb-95[f]	0.3	0.19	Pu-238	$2.8\text{x}10^{-3}$	$1.2\text{x}10^{-3}$
Mo-99[g]	0.3	0.2	Pu-239	$8.7\text{x}10^{-4}$	$3.8\text{x}10^{-4}$
Tc-99m[h]	0.27	0.17	Pu-240	$1.1\text{x}10^{-3}$	$4.7\text{x}10^{-4}$
Ru-103	0.22	0.14	Pu-241	0.2	0.088
Ru-105	0.13	0.085	Te-127	1	0.5
Ru-106	0.054	0.035	Te-127m	0.14	0.066
Rh-105[i]	0.12	0.08	Te-129	3.3	1.6
Sb-127	1	0.51	Te-129m	0.49	0.24
Sb-129	3.4	1.6	Te-131m	1.6	0.76
I-131	27	$2.4\text{x}10^{3}$	Te-132	16	7.8
I-132	39	$3.5\text{x}10^{3}$	Am-241[j]	$3.8\text{x}10^{-5}$	$1.9\text{x}10^{-5}$
I-133	57	$5.1\text{x}10^{3}$	Cm-242	$8.3\text{x}10^{-3}$	$4.1\text{x}10^{-3}$
I-134	63	$5.7\text{x}10^{3}$	Cm-244	$1.2\text{x}10^{-4}$	$5.8\text{x}10^{-5}$
I-135	53	$4.8\text{x}10^{3}$			

[a] H-3 is assumed to have the noble gas release fraction.

[b] Rb-86 is assumed to have the Cs release fraction.

[c] Pr-143 is assumed to have the La release fraction.

[d] Nd-147 is assumed to have the La release fraction.

[e] Np-239 is assumed to have the Ce release fraction.

[f] Nb-95 is assumed to have the Ru release fraction.

[g] Mo-99 is assumed to have the Ru release fraction.

[h] Tc-99m is assumed to have the Ru release fraction.

[i] Rh-105 is assumed to have the Ru release fraction.

[j] Am-241 is assumed to have the La release fraction.

Note: Cm and Y are assumed to have the La release fraction. Sb is assumed to have the Te release fraction. Pu and SB are assumed to have the Ce release fraction.

Source: Source term derived from accident release fractions (ABB 1994a) and core inventory (TTI 1995b).

TABLE F.2.1.3.2–2.—*CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences*

Accident Description	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accident Frequency (per year)
Loss of feedwater, loss of emergency feedwater, and failure to bleed system	0.094	$4.7x10^{-5}$	11	$5.6x10^{-3}$	$1.4x10^{-6}$
Loss of feedwater and failure of long-term decay heat removal	0.11	$5.3x10^{-5}$	18	$9.0x10^{-3}$	$3.8x10^{-7}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$4.8x10^{-5}$	–	$6.3x10^{-3}$	–
Expected risk (per year)	–	$8.6x10^{-11}$	–	$1.1x10^{-8}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.2–1 and the MACCS computer code.

TABLE F.2.1.3.2–3.—*CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Nevada Test Site—Public Consequences*

Accident Description	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accident Frequency (per year)
Loss of feedwater, loss of emergency feedwater, and failure to bleed system	0.21	$1.0x10^{-4}$	1.1	$5.4x10^{-4}$	$1.4x10^{-6}$
Loss of feedwater and failure of long-term decay heat removal	0.24	$1.2x10^{-4}$	1.8	$8.7x10^{-4}$	$3.8x10^{-7}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$1.1x10^{-4}$	–	$6.1x10^{-4}$	–
Expected risk (per year)	–	$1.9x10^{-10}$	–	$1.1x10^{-9}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.2–1 and the MACCS computer code.

TABLE F.2.1.3.2–4.—*CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Oak Ridge Reservation—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Loss of feedwater, loss of emergency feedwater, and failure to bleed system	1.1	5.4×10^{-4}	308	0.15	1.4×10^{-6}
Loss of feedwater and failure of long-term decay heat removal	1.3	6.5×10^{-4}	394	0.2	3.8×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	5.6×10^{-4}	–	0.16	–
Expected risk (per year)	–	1.0×10^{-9}	–	2.9×10^{-7}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.2–1 and the MACCS computer code.

TABLE F.2.1.3.2–5.—*CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Pantex Plant—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Loss of feedwater, loss of emergency feedwater, and failure to bleed system	0.6	3.0×10^{-4}	34	0.017	1.4×10^{-6}
Loss of feedwater and failure of long-term decay heat removal	0.75	3.8×10^{-4}	45	0.023	3.8×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	3.1×10^{-4}	–	0.018	–
Expected risk (per year)	–	5.6×10^{-10}	–	3.2×10^{-8}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.2–1 and the MACCS computer code.

TABLE F.2.1.3.2–6.—*CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Savannah River Site—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Loss of feedwater, loss of emergency feedwater, and failure to bleed system	0.063	$3.2\text{x}10^{-5}$	67	0.034	$1.4\text{x}10^{-6}$
Loss of feedwater and failure of long-term decay heat removal	0.073	$3.7\text{x}10^{-5}$	97	0.049	$3.8\text{x}10^{-7}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$3.3\text{x}10^{-5}$	–	0.037	–
Expected risk (per year)	–	$5.8\text{x}10^{-11}$	–	$6.5\text{x}10^{-8}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.2–1 and the MACCS computer code.

TABLE F.2.1.3.2–7.—*CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Loss of feedwater, loss of emergency feedwater, and failure to bleed system	3.4	$1.3\text{x}10^{-3}$	1.8	$7.3\text{x}10^{-4}$	$1.4\text{x}10^{-6}$
Loss of feedwater and failure of long-term decay heat removal	4.7	$1.9\text{x}10^{-3}$	2.4	$9.4\text{x}10^{-4}$	$3.8\text{x}10^{-7}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$1.5\text{x}10^{-3}$	–	$7.7\text{x}10^{-4}$	–
Expected risk (per year)	–	$2.6\text{x}10^{-9}$	–	$1.4\text{x}10^{-9}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.2–1 and the MACCS computer code.

TABLE F.2.1.3.2–8.—*CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Loss of feedwater, loss of emergency feedwater, and failure to bleed system	2.5	9.8×10^{-4}	1.4	5.4×10^{-4}	1.4×10^{-6}
Loss of feedwater and failure of long-term decay heat removal	3.4	1.3×10^{-3}	1.7	7.0×10^{-4}	3.8×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	1.1×10^{-3}	–	5.7×10^{-4}	–
Expected risk (per year)	–	1.9×10^{-9}	–	1.0×10^{-9}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.2–1 and the MACCS computer code.

TABLE F.2.1.3.2–9.—*CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Loss of feedwater, loss of emergency feedwater, and failure to bleed system	3.4	1.3×10^{-3}	1.7	6.9×10^{-4}	1.4×10^{-6}
Loss of feedwater and failure of long-term decay heat removal	4.5	1.8×10^{-3}	2.2	8.7×10^{-4}	3.8×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	1.4×10^{-3}	–	7.3×10^{-4}	–
Expected risk (per year)	–	2.6×10^{-9}	–	1.3×10^{-9}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.2–1 and the MACCS computer code.

TABLE F.2.1.3.2–10.—*CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Pantex Plant—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	Accident Frequency (per year)
Loss of feedwater, loss of emergency feedwater, and failure to bleed system	1.4	5.7×10^{-4}	0.75	3.0×10^{-4}	1.4×10^{-6}
Loss of feedwater and failure of long-term decay heat removal	1.9	7.8×10^{-4}	0.96	3.8×10^{-4}	3.8×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	6.2×10^{-4}	–	3.2×10^{-4}	–
Expected risk (per year)	–	1.1×10^{-9}	–	5.6×10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.2–1 and the MACCS computer code.

TABLE F.2.1.3.2–11.—*CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Savannah River Site—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	Accident Frequency (per year)
Loss of feedwater, loss of emergency feedwater, and failure to bleed system	1.5	5.9×10^{-4}	0.76	3.0×10^{-4}	1.4×10^{-6}
Loss of feedwater and failure of long-term decay heat removal	2	7.9×10^{-4}	0.97	3.9×10^{-4}	3.8×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	6.3×10^{-4}	–	3.2×10^{-4}	–
Expected risk (per year)	–	1.1×10^{-9}	–	5.6×10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.2–1 and the MACCS computer code.

F.2.1.3.3 *AP600 Advanced Light Water Reactor*

The *AP600 Standard Safety Analysis Report* (DOE 1992t), evaluated beyond design-basis accidents that were initiated by either internal events (e.g., a sequence of equipment failures) or external events (e.g., severe natural phenomena such as beyond design basis earthquakes). The evaluation of external event initiated accidents did not present accident frequency data, release fractions, or source term data that could be used to analyze the accident consequences and risks for this class of accident in this PEIS.

Numerous internal event initiated accidents were evaluated in the Safety Analysis Report. The accidents that had a common source term or release category were binned or grouped together and evaluated as a single accident and a single total annual frequency of occurrence was defined for the group. Release fractions and the annual frequency of occurrence were defined for four accidents. The annual frequency of occurrence for these four accidents ranged from 2.5×10^{-7} per year to 7.6×10^{-10} per year (DOE 1992t). Two of the accident groups with an annual frequency of occurrence greater than 5.0×10^{-8} per year were selected for evaluation in this PEIS. A representative accident within each group was used to define a typical accident sequence for the group.

Loss of Coolant Accident with Failure of Refueling Water Storage Tank and Residual Heat Removal

Scenario. The representative accident sequence for the OK release category has an initiating event which is a 4-inch diameter loss of coolant accident with a failure of the in-containment refueling water storage tank check valves and normal residual heat removal injection. Core damage begins 2 hours into the accident. The in-containment refueling water and storage tank is not drained into the containment cavity to provide external cooling to the reactor vessel. The vessel fails at 11.8 hours and the molten core drains into the containment at low pressure. The debris is quenched and cooled in the reactor cavity. The passive containment cooling system and hydrogen igniters are available and containment pressure remains below design pressure. The final source term at 24 hours after core damage is presented in table F.2.1.3.3–1. The annual frequency of occurrence for this accident is 2.5×10^{-7} per year (DOE 1992t).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.3.3–2 through F.2.1.3.3–6 for public consequences and in tables F.2.1.3.3–7 through F.2.1.3.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.3.3–1 using the MACCS computer code.

Loss of Coolant Accident with Failure of Refueling Water Storage Tank, Residual Heat Removal, and Passive Containment Cooling System Cooling Water

Scenario. The representative accident sequence for the OKP release category is initiated by a 4-inch diameter loss of cooling accident with a failure of the in-containment refueling water and storage tank check valves, normal residual heat removal injection, and passive containment cooling system cooling water. Four of the four core makeup tanks and accumulators are available. Core damage occurs at 2.5 hours and the vessel fails at 15.8 hours. The debris is quenched and cooled in the reactor cavity. The containment pressure is elevated over the long term, but it equilibrates at a pressure well below the ultimate capacity of the shell so containment integrity is maintained. The final source term, at 24 hours after core damage is presented in table F.2.1.3.3–1. The annual frequency of occurrence for this accident is 5.6×10^{-8} per year (DOE 1992t:1B-4, 1B-5).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.3.3–2 through F.2.1.3.3–6 for public consequences and in tables F.2.1.3.3–7 through F.2.1.3.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.3.3–1 using the MACCS computer code.

Integrated Cancer Fatalities Complementary Cumulative Distribution Function for the Two High Consequence Accidents

Figure F.2.1.3.3–1 shows the annual probability that, in the event of any accident in the composite set of AP600 ALWR high consequence accidents at one of the sites, the number of cancer fatalities exceeds the value N indicated on the horizontal axis. The curves, technically referred to as complementary cumulative distribution functions, reflect the probability of the accident's occurrence as well as the variability in the magnitude of its consequences. Generally, a curve that extends the farthest to the right has the highest accident consequences while a curve that is nearest to the left has the lowest accident consequences. A comparison of alternatives should include the information provided by these curves in conjunction with the point values shown in tables F.2.1.3.3–2 through F.2.1.3.3–11.

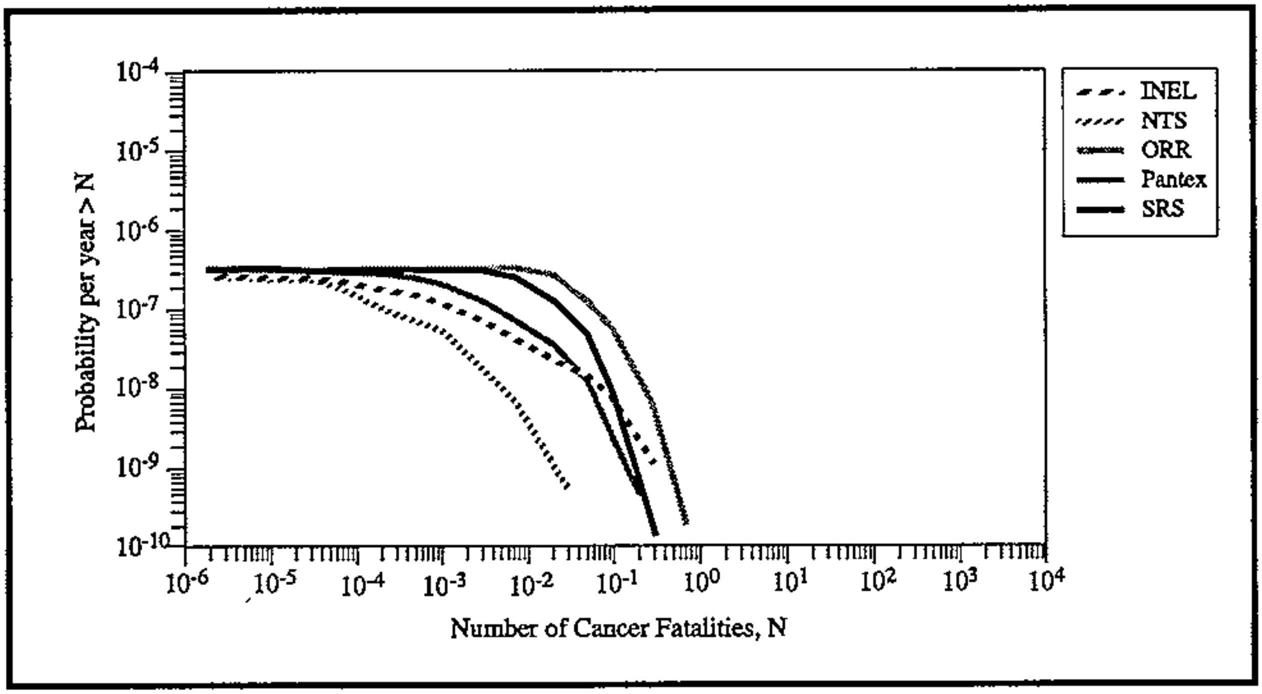

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FIGURE F.2.1.3.3–1.—***High Consequence Accident-Cancer Fatality Frequency Distribution Functions for the AP600 Reactor.***

TABLE F.2.1.3.3–1.—*AP600 Advanced Light Water Reactor High Consequence Accident Source Terms*

	Released Activity (curies)			Released Activity (curies)	
Isotope	Loss of Cooling Accident with Failure of Refueling Water Storage Tank and Residual Heat Removal (OK)	Loss of Cooling Accident with Failure of Refueling Water Storage Tank, Residual Heat Removal, and Possible Containment Cooling System Cooling Water(OKP)	Isotope	Loss of Cooling Accident with Failure of Refueling Water Storage Tank and Residual Heat Removal (OK)	Loss of Cooling Accident with Failure of Refueling Water Storage Tank, Residual Heat Removal, and Passive Containment Cooling System Cooling Water (OKP)
H-3	1.3×10^3	3.2×10^3	Te-132	79	380
Kr-85	23	54	I-131	31	110
Kr-85m	590	1.4×10^3	I-132	45	160
Kr-87	1.1×10^3	2.7×10^3	I-133	62	220
Kr-88	1.6×10^3	3.8×10^3	I-134	67	240
Sr-89	1.7	4.2	I-135	56	200
Sr-90	0.14	0.35	Xe-133	4.6×10^3	1.1×10^4
Ru-103	50	85	Xe-135	1.5×10^3	3.6×10^3
Ru-105	0	0	Cs-134	5.2	18
Ru-106	16	28	Cs-136	1.6	5.6
Te-129m	4.7	23	Cs-137	3.5	12
Te-131m	8.4	40			

Note: OK and OKP - release category codes for composite set of accident sequences.
Source: Derived from TTI 1995b.

TABLE F.2.1.3.3–2.—*AP600 Advanced Light Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Loss of cooling accident with failure of refueling water and storage tank and residual heat removal (OK)	4.0×10^{-3}	2.0×10^{-6}	12	5.8×10^{-3}	2.5×10^{-7}
Loss of cooling accident with failure of refueling water and storage tank, residual heat removal, and passive containment cooling system and cooling water (OKP)	0.012	6.1×10^{-6}	37	0.018	5.6×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	2.8×10^{-6}	–	8.1×10^{-3}	–
Expected risk (per year)	–	8.5×10^{-13}	–	2.5×10^{-9}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Note: OK and OKP - release category code for composite set of accident sequences.

Source: Calculated using the source terms in table F.2.1.3.3–1 and the MACCS computer code.

TABLE F.2.1.3.3–3.—*AP600 Advanced Light Water Reactor High Consequence Accidents at Nevada Test Site—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Loss of cooling accident with failure of refueling water storage tank and residual heat removal (OK)	0.011	5.7×10^{-6}	1.1	5.5×10^{-4}	2.5×10^{-7}
Loss of cooling accident with failure of refueling water storage tank, residual heat removal, and passive containment cooling system and cooling water (OKP)	0.035	1.7×10^{-5}	3.5	1.7×10^{-3}	5.6×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	7.8×10^{-6}	–	7.7×10^{-4}	–
Expected risk (per year)	–	2.4×10^{-12}	–	2.4×10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Note: OK and OKP - release category code for composite set of accident sequences.

Source: Calculated using the source terms in table F.2.1.3.3–1 and the MACCS computer code.

TABLE F.2.1.3.3–4.—*AP600 Advanced Light Water Reactor High Consequence Accidents at Oak Ridge Reservation—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Loss of cooling accident with failure of refueling water storage tank and residual heat removal (OK)	0.099	4.9×10^{-5}	92	0.046	2.5×10^{-7}
Loss of cooling accident with failure of refueling water storage tank, residual heat removal, and passive containment cooling system and cooling water (OKP)	0.3	1.5×10^{-4}	286	0.14	5.6×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	6.8×10^{-5}	–	0.064	–
Expected risk (per year)	–	2.1×10^{-11}	–	2.0×10^{-8}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Note: OK and OKP - release category code for composite set of accident sequences.

Source: Calculated using the source terms in table F.2.1.3.3–1 and the MACCS computer code

TABLE F.2.1.3.3–5.—*AP600 Advanced Light Water Reactor High Consequence Accidents at Pantex Plant—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
Loss of cooling accident with failure of refueling water storage tank and residual heat removal (OK)	0.066	$3.3x10^{-5}$	12	$6.1x10^{-3}$	$2.5x10^{-7}$
Loss of cooling accident with failure of refueling water storage tank, residual heat removal, and passive containment cooling system and cooling water (OKP)	0.2	$1.0x10^{-4}$	38	0.019	$5.6x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$4.5x10^{-5}$	–	$8.4x10^{-3}$	–
Expected risk (per year)	–	$1.4x10^{-11}$	–	$2.6x10^{-9}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Note: OK and OKP - release category code for composite set of accident sequences.

Source: Calculated using the source terms in table F.2.1.3.3–1 and the MACCS computer code.

TABLE F.2.1.3.3–6.—*AP600 Advanced Light Water Reactor High Consequence Accidents at Savannah River Site—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (person- rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
Loss of cooling accident with failure of refueling water storage tank and residual heat removal (OK)	$4.2x10^{-3}$	$2.1x10^{-6}$	41	0.02	$2.5x10^{-7}$
Loss of cooling accident with failure of refueling water storage tank, residual heat removal, and passive containment cooling system and cooling water (OKP)	0.013	$6.5x10^{-6}$	128	0.064	$5.6x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$2.9x10^{-6}$	–	0.028	–
Expected risk (per year)	–	$8.9x10^{-13}$	–	$8.7x10^{-9}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Note: OK and OKP - release category code for composite set of accident sequences

Source: Calculated using the source terms in table F.2.1.3.3–1 and the MACCS computer code.

TABLE F.2.1.3.3–7.—*AP600 Advanced Light Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Loss of cooling accident with failure of refueling water storage tank and residual heat removal (OK)	0.55	$2.2x10^{-4}$	0.19	$7.6x10^{-5}$	$2.5x10^{-7}$
Loss of cooling accident with failure of refueling water storage tank, residual heat removal, and passive containment cooling system and cooling water (OKP)	1.7	$6.7x10^{-4}$	0.59	$2.3x10^{-4}$	$5.6x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$3.0x10^{-4}$	–	$1.1x10^{-4}$	–
Expected risk (per year)	–	$9.2x10^{-11}$	–	$3.2x10^{-11}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Note: OK and OKP - release category code for composite set of accident sequences

Source: Calculated using the source terms in table F.2.1.3.3–1 and the MACCS computer code.

TABLE F.2.1.3.3–8.—*AP600 Advanced Light Water Reactor High Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Loss of cooling accident with failure of refueling water storage tank and residual heat removal (OK)	0.41	$1.6x10^{-4}$	0.15	$6.1x10^{-5}$	$2.5x10^{-7}$
Loss of cooling accident with failure of refueling water storage tank, residual heat removal, and passive containment cooling system and cooling water (OKP)	1.3	$5.1x10^{-4}$	0.47	$1.9x10^{-4}$	$5.6x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$2.3x10^{-4}$	–	$8.4x10^{-5}$	–
Expected risks (per year)	–	$7.0x10^{-11}$	–	$2.6x10^{-11}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Note: OK and OKP - release category code for composite set of accident sequences

Source: Calculated using the source terms in table F.2.1.3.3–1 and the MACCS computer code

TABLE F.2.1.3.3–9.—*AP600 Advanced Light Water Reactor High Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Loss of cooling accident with failure of refueling water storage tank and residual heat removal (OK)	0.58	$2.3\text{x}10^{-4}$	0.2	$8.1\text{x}10^{-5}$	$2.5\text{x}10^{-7}$
Loss of cooling accident with failure of refueling water storage tank, residual heat removal, and passive containment cooling system and cooling water (OKP)	1.8	$7.2\text{x}10^{-4}$	0.62	$2.5\text{x}10^{-4}$	$5.6\text{x}10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$3.2\text{x}10^{-4}$	–	$1.1\text{x}10^{-4}$	–
Expected risk (per year)	–	$9.8\text{x}10^{-11}$	–	$3.4\text{x}10^{-11}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Note: OK and OKP - release category code for composite set of accident sequences

Source: Calculated using the source terms in table F.2.1.3.3–1 and the MACCS computer code.

TABLE F.2.1.3.3–10.—*AP600 Advanced Light Water Reactor High Consequence Accidents at Pantex Plant—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Loss of cooling accident with failure of refueling water storage tank and residual heat removal (OK)	0.25	$1.0\text{x}10^{-4}$	0.094	$3.7\text{x}10^{-5}$	$2.5\text{x}10^{-7}$
Loss of cooling accident with failure of refueling water storage tank, residual heat removal, and passive containment cooling system and cooling water (OKP)	0.78	$3.1\text{x}10^{-4}$	0.29	$1.2\text{x}10^{-4}$	$5.6\text{x}10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$1.4\text{x}10^{-4}$	–	$5.2\text{x}10^{-5}$	–
Expected risk (per year)	–	$4.3\text{x}10^{-11}$	–	$1.6\text{x}10^{-11}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Note: OK and OKP - release category code for composite set of accident sequences.

Source: Calculated using the source terms in table F.2.1.3.3–1 and the MACCS computer code.

TABLE F.2.1.3.3–11.—*AP600 Advanced Light Water Reactor High Consequence Accidents at Savannah River Site—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (rem)**	**Cancer Fatality**[a]	**Accident Frequency (per year)**
Loss of cooling accident with failure of refueling water storage tank and residual heat removal (OK)	0.26	$1.0x10^{-4}$	0.094	$3.8x10^{-5}$	$2.5x10^{-7}$
Loss of cooling accident with failure of refueling water storage tank, residual heat removal, and passive containment cooling system and cooling water (OKP)	0.8	$3.2x10^{-4}$	0.29	$1.2x10^{-4}$	$5.6x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$1.4x10^{-4}$	–	$5.2x10^{-5}$	–
Expected risk (per year)	–	$4.4x10^{-11}$	–	$1.6x10^{-11}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Note: OK and OKP - release category code for composite set of accident sequences

Source: Calculated using the source terms in table F.2.1.3.3–1 and the MACCS computer code

F.2.1.3.4 *Simplified Boiling Water Reactor*

Chapter 19 of the *Simplified BWR Standard Safety Analysis Report,* evaluated beyond design-basis accidents that were initiated by either internal events (e.g., a sequence of equipment failures) or external events (e.g., severe natural phenomena such as beyond design-basis earthquakes). The evaluation of external event initiated accidents did not present accident frequency data, release fractions, or source term data that could be used to analyze the accident consequences and risks for this class of accident in this PEIS.

Fourteen internal event initiated accidents were evaluated in Chapter 19. The annual frequency of occurrence for these accidents ranged from $7.0x10^{-8}$ per year to $1.0x10^{-10}$ per year (GE 1993a). Four of the accidents had an annual frequency of occurrence greater than $1.0x10^{-8}$ per year. These four accidents were selected for evaluation in this PEIS.

Low Pressure Core Melt with Loss of Short-Term Coolant Makeup, Failure of the Drywell Sprays to Operate, and Normal Containment Leakage

Scenario. The postulated accident is initiated by the inadvertently open relief valve that depressurizes the reactor. The reactor scrams, the main steam isolation valves close, the feedwater pumps trip, and the automatic depressurizing system actuates. All high and low pressure injection systems are assumed to fail. Approximately 1 hour into the accident, the core is uncovered and fuel rods melt. The reactor lower vessel head penetrations fail at approximately 4.5 hours. Local temperatures cause the flooder to open and the gravity driven cooling system pool water drains into the lower drywell. The debris is quenched and the long-term containment pressure is less than the suppression chamber vent pressure setpoint. Normal containment leakage is the only mode of fission product release (GE 1993a:19B.6-819B.6-9). The source term is presented in table F.2.1.3.4–1. The annual frequency of occurrence for this accident is $7.0x10^{-8}$ per year (GE 1993a).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.3.4–2 through F.2.1.3.4–6 for public consequences and in tables F.2.1.3.4–7 through F.2.1.3.4–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.3.4–1 using the MACCS computer code.

Low Pressure Core Melt with Loss of Long-Term Coolant Makeup, Failure of the Drywell Sprays to Operate, and Normal Containment Leakage

Scenario. The postulated accident is initiated by the inadvertently open relief valve that depressurizes the reactor. The reactor scrams, the main steam isolation valves close, the feedwater pumps trip, and the automatic depressurizing system actuates. One gravity driven cooling system pool injects water into the reactor vessel. Approximately 7 hours into the accident, the core is uncovered and fuel rods melt. The reactor lower vessel head penetrations fail at approximately 12.5 hours. Local temperatures cause the flooder to open and the gravity driven cooling system pool water drains into the lower drywell. The debris is quenched and the long-term containment pressure is less than the suppression chamber vent pressure setpoint. Normal containment leakage is the only mode of fission product release (GE 1993a:19B.6-8,19B.6-9). The source term is presented in table F.2.1.3.4–1. The annual frequency of occurrence for this accident is 6.4×10^{-8} per year (GE 1993a).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.3.4–2 through F.2.1.3.4–6 for public consequences and in tables F.2.1.3.4–7 through F.2.1.3.4–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.3.4–1 using the MACCS computer code.

Low Pressure Core Melt with Loss of Short-Term Coolant Makeup, Failure of the Drywell Sprays to Operate, and Containment Vented

Scenario. The postulated accident is initiated by the inadvertently open relief valve that depressurizes the reactor. The reactor scrams, the main steam isolation valves close, the feedwater pumps trip, and the automatic depressurizing system actuates. All high and low pressure injection systems are assumed to fail. Approximately 1 hour into the accident, the core is uncovered and fuel rods melt. The reactor lower vessel head penetrations fail at approximately 4.5 hours. Local temperatures cause the flooder to open and the gravity driven cooling system pool water drains into the lower drywell. Relocation of the debris causes the long-term containment pressure to increase to the suppression chamber vent pressure setpoint and the containment is breached at approximately 29 hours. The fission product release is complete after the containment is vented (GE 1993a:19B.6-8-19B.6-10). The source term is presented in table F.2.1.3.4–1. The annual frequency of occurrence for this accident is 1.1×10^{-8} per year (GE 1993a).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.3.4–2 through F.2.1.3.4–6 for public consequences and in tables F.2.1.3.4–7 through F.2.1.3.4–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.3.4–1 using the MACCS computer code.

Low Pressure Core Melt with Loss of Long-Term Coolant Makeup, Failure of the Drywell Sprays to Operate, and Containment Vented

Scenario. The postulated accident is initiated by the inadvertently open relief valve that depressurizes the reactor. The reactor scrams, the main steam isolation valves close, the feedwater pumps trip, and the automatic depressurizing system actuates. One gravity driven cooling system pool injects water into the reactor vessel. Approximately 7 hours into the accident, the core is uncovered and fuel rods melt. The reactor lower vessel head penetrations fail at approximately 12.5 hours. Local temperatures cause the flooder to open and the gravity driven cooling system pool water drains into the lower drywell. Relocation of the debris causes the long-term containment pressure to increase to the suppression chamber vent pressure setpoint and the containment is breached at approximately 36.5 hours. The fission product release is complete after the containment is vented (GE 1993a:19B.6-8,19B.6-11). The source term is presented in table F.2.1.3.4–1. The annual frequency of occurrence for this accident is 1.1×10^{-8} per year (GE 1993a).

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.1.3.4–2 through F.2.1.3.4–6 for public consequences and in tables F.2.1.3.4–7 through F.2.1.3.4–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.3.4–1 using the MACCS computer code.

Integrated Cancer Fatalities Complementary Cumulative Distribution Function for the Four High Consequence Accidents

Figure F.2.1.3.4–1 shows the annual probability that, in the event of any accident in the composite set of Simplified Boiling Water Reactor ALWR high consequence accidents at one of the sites, the number of cancer fatalities exceeds the value N indicated on the horizontal axis. The curves, technically referred to as complementary cumulative distribution functions, reflect the probability of the accident's occurrence as well as the variability in the magnitude of its consequences. Generally, a curve that extends the farthest to the right has the highest accident consequences while a curve that is nearest to the left has the lowest accident consequences. A comparison of alternatives should include the information provided by these curves in conjunction with the point values shown in tables F.2.1.3.4–2 through F.2.1.3.4–11.

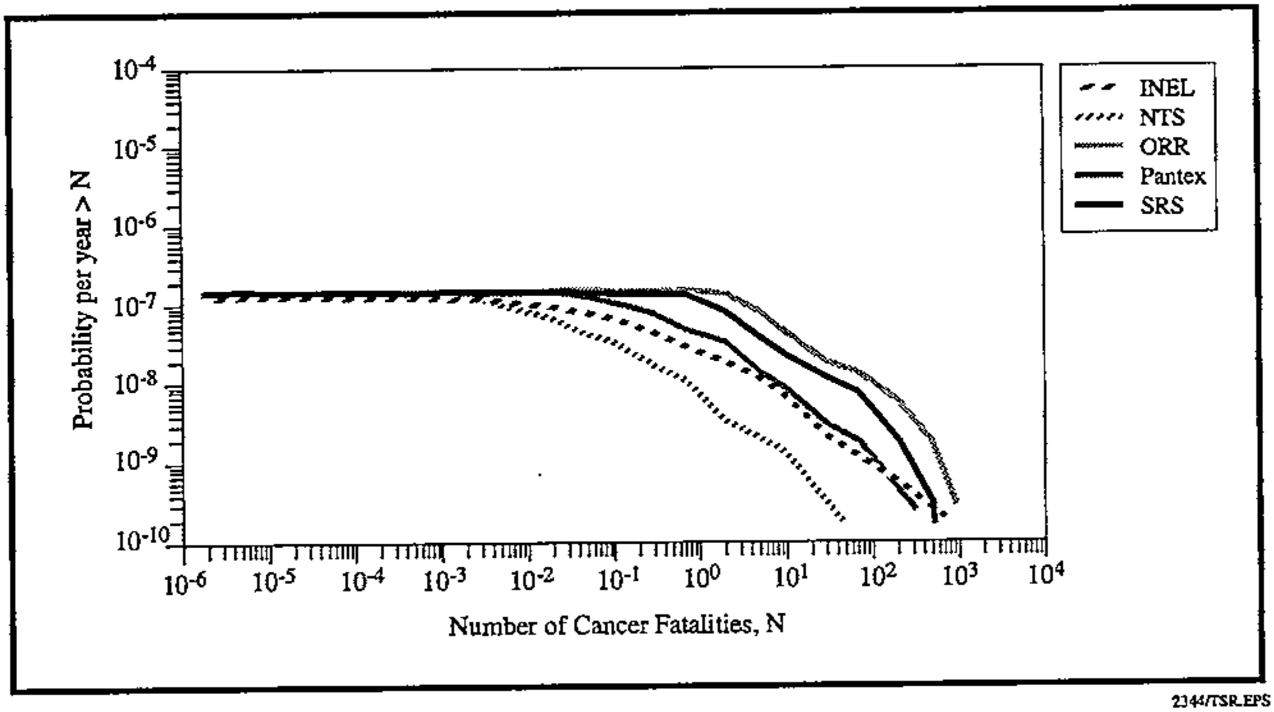

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FIGURE F.2.1.3.4–1.—*Simplified Boiling Water Reactor Cancer Fatalities Complementary Cumulative Distribution Functions for High Consequence Accidents.*

TABLE F.2.1.3.4–1.—*Simplified Boiling Water Reactor High Consequence Accident Source Terms* [Page 1 of 2]

	Released Activity (curies)			
Isotope	**Low Pressure Core Melt with Loss of Short-Term Coolant Makeup and Normal Containment Leakage**	**Low Pressure Core Melt with Loss of Long-Term Coolant Makeup and Normal Containment Leakage**	**Low Pressure Core Melt with Loss of Short-Term Coolant Makeup and Containment Vented**	**Low Pressure Core Melt with Loss of Long-Term Coolant Makeup and Containment Vented**
H-3[a]	$4.5x10^{4}$	$5.7x10^{4}$	$3.2x10^{7}$	$3.2x10^{7}$
Co-58	12	14	14	15
Co-60	14	17	17	18
Kr-85	720	920	$5.1x10^{5}$	$5.1x10^{5}$
Kr-85m	$2.6x10^{4}$	$3.3x10^{4}$	$1.9x10^{7}$	$1.9x10^{7}$
Kr-87	$4.7x10^{4}$	$6.1x10^{4}$	$3.4x10^{7}$	$3.4x10^{7}$
Kr-88	$6.4x10^{4}$	$8.2x10^{4}$	$4.6x10^{7}$	$4.6x10^{7}$
Rb-86[b]	2.7	3.7	26	160
Sr-89	62	90	90	110
Sr-90	4.4	6.4	6.4	7.6
Sr-91	81	120	120	140
Sr-92	84	120	120	150
Y-90	1.7	0.47	2.7	1.2
Y-91	27	7.6	43	19
Y-92	30	8.5	49	22
Y-93	34	9.6	55	25
Zr-95	150	64	260	140
Zr-97	150	66	270	140
Nb-95[c]	$3.3x10^{3}$	$3.9x10^{3}$	$3.9x10^{3}$	$4.2x10^{3}$
Mo-99	$3.8x10^{3}$	$4.5x10^{3}$	$4.5x10^{3}$	$4.9x10^{3}$
Tc-99m[d]	$3.3x10^{3}$	$3.9x10^{3}$	$3.9x10^{3}$	$4.2x10^{3}$
Ru-103	$2.9x10^{3}$	$3.4x10^{3}$	$3.4x10^{3}$	$3.7x10^{3}$
Ru-105	$1.9x10^{3}$	$2.3x10^{3}$	$2.3x10^{3}$	$2.5x10^{3}$
Ru-106	780	920	920	$1.0x10^{3}$
Rh-105[e]	$1.4x10^{3}$	$1.7x10^{3}$	$1.7x10^{3}$	$1.8x10^{3}$
Sb-127	$1.2x10^{3}$	$1.3x10^{3}$	$5.2x10^{4}$	$1.1x10^{5}$
Sb-129	$4.3x10^{3}$	$4.4x10^{3}$	$1.8x10^{5}$	$4.0x10^{5}$
I-131	$4.6x10^{3}$	$6.9x10^{3}$	$3.2x10^{4}$	$8.4x10^{4}$
I-132	$6.7x10^{3}$	$1.0x10^{4}$	$4.6x10^{4}$	$1.2x10^{5}$
I-133	$9.6x10^{3}$	$1.4x10^{4}$	$6.6x10^{4}$	$1.8x10^{5}$
I-134	$1.1x10^{4}$	$1.6x10^{4}$	$7.2x10^{4}$	$1.9x10^{5}$
I-135	$9.1x10^{3}$	$1.4x10^{4}$	$6.2x10^{4}$	$1.7x10^{5}$
Xe-133	$1.5x10^{5}$	$2.0x10^{5}$	$1.1x10^{8}$	$1.1x10^{8}$
Xe-135	$3.7x10^{4}$	$4.7x10^{4}$	$2.6x10^{7}$	$2.6x10^{7}$
Cs-134	800	$1.1x10^{3}$	$7.8x10^{3}$	$4.8x10^{4}$
Cs-136	220	300	$2.1x10^{3}$	$1.3x10^{4}$
Cs-137	480	670	$4.7x10^{3}$	$2.9x10^{4}$
Ba-139	570	710	670	800
Ba-140	560	700	660	790
La-140	40	11	65	29

TABLE F.2.1.3.4–1.—*Simplified Boiling Water Reactor High Consequence Accident Source Terms* [Page 2 of 2]

	Released Activity (curies)			
Isotope	**Low Pressure Core Melt with Loss of Short-Term Coolant Makeup and Normal Containment Leakage**	**Low Pressure Core Melt with Loss of Long-Term Coolant Makeup and Normal Containment Leakage**	**Low Pressure Core Melt with Loss of Short-Term Coolant Makeup and Containment Vented**	**Low Pressure Core Melt with Loss of Long-Term Coolant Makeup and Containment Vented**
La-141	37	10	60	26
La-142	36	10	57	26
Ce-141	150	65	260	140
Ce-143	140	63	260	130
Ce-144	95	42	170	89
Pr-143[f]	34	9.6	55	24
Nd-147[g]	15	4.3	25	11
Np-239[h]	$1.9x10^{3}$	820	$3.4x10^{3}$	$1.7x10^{3}$
Pu-238	0.13	0.057	0.23	0.12
Pu-239	0.033	0.014	0.059	0.031
Pu-240	0.041	0.018	0.074	0.038
Pu-241	7	3.1	13	6.6
Te-127	0.064	0.064	$2.1x10^{4}$	$4.6x10^{4}$
Te-127m	$8.7x10^{-3}$	$8.7x10^{-3}$	$2.8x10^{3}$	$6.2x10^{3}$
Te-129	0.22	0.22	$7.1x10^{4}$	$1.5x10^{5}$
Te-129m	0.057	0.057	$1.9x10^{4}$	$4.1x10^{4}$
Te-131m	0.11	0.11	$3.6x10^{4}$	$7.8x10^{4}$
Te-132	1.1	1.1	$3.5x10^{5}$	$7.6x10^{5}$
Am-241[i]	$1.7x10^{-3}$	$4.9x10^{-4}$	$2.8x10^{-3}$	$1.2x10^{-3}$
Cm-242	0.46	0.13	0.74	0.33
Cm-244	0.025	$7.0x10^{-3}$	0.04	0.018

[a] H-3 is assumed to have the noble gas release fraction.

[b] Rb-86 is assumed to have the Cs release fraction.

[c] Nb-95 is assumed to have the Mo release fraction.

[d] Tc-99m is assumed to have the Mo release fraction.

[e] Rh-105 is assumed to have the Mo release fraction.

[f] Pr-143 is assumed to have the La release fraction.

[g] Nd-147 is assumed to have the La release fraction.

[h] Np-239 is assumed to have the Ce release fraction.

[i] Am-241 is assumed to have the La release fraction.

Cm and Y are assumed to have the La release fraction. Co and Ru are assumed to have the Mo release fraction. Pu and Zr are assumed to have the Ce release fraction.

Source term derived from accident release fractions (GE 1993a) and core inventory (TTI 1995b).

TABLE F.2.1.3.4–2.—*Simplified Boiling Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences*

Accident	Maximum Offsite Individual		Population to 50 Miles		
	Dose (rem)	**Cancer Fatality**[a]	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
Low pressure core melt with loss of short-term coolant makeup and normal containment leakage	0.44	2.2×10^{-4}	1.5×10^{3}	0.75	7.0×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and normal containment leakage	0.58	2.9×10^{-4}	2.0×10^{3}	1	6.4×10^{-8}
Low pressure core melt with loss of short-term coolant makeup and containment vented	13	9.8×10^{-3}	1.5×10^{4}	7.6	1.1×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and containment vented	31	0.02	8.0×10^{4}	40	1.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	2.3×10^{-3}	–	4.1	–
Expected risk (per year)	–	3.6×10^{-10}	–	6.4×10^{-7}	–

[a] Increased likelihood of cancer fatality.

All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Calculated using the source terms in table F.2.1.3.4–1 and the MACCS computer code.

TABLE F.2.1.3.4–3.—*Simplified Boiling Water Reactor High Consequence Accidents at Nevada Test Site—Public Consequences*

Accident	Maximum Offsite Individual		Population to 50 Miles		
	Dose (rem)	**Cancer Fatality**[a]	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
Low pressure core melt with loss of short-term coolant makeup and normal containment leakage	1.3	6.4×10^{-4}	142	0.071	7.0×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and normal containment leakage	1.7	8.4×10^{-4}	190	0.095	6.4×10^{-8}
Low pressure core melt with loss of short-term coolant makeup and containment vented	33	0.026	1.5×10^{3}	0.72	1.1×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and containment vented	84	0.054	7.6×10^{3}	3.8	1.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	6.3×10^{-3}	–	0.39	–
Expected risk (per year)	–	9.8×10^{-10}	–	6.1×10^{-8}	–

[a] Increased likelihood of cancer fatality.

All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Calculated using the source terms in table F.2.1.3.4–1 and the MACCS computer code.

TABLE F.2.1.3.4–4.—*Simplified Boiling Water Reactor High Consequence Accidents at Oak Ridge Reservation—Public Consequences*

Accident	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Low pressure core melt with loss of short-term coolant makeup and normal containment leakage	12	5.8×10^{-3}	1.2×10^{4}	5.8	7.0×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and normal containment leakage	15	7.6×10^{-3}	1.6×10^{4}	7.7	6.4×10^{-8}
Low pressure core melt with loss of short-term coolant makeup and containment vented	219	0.14	1.4×10^{5}	69	1.1×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and containment vented	692	0.38	6.3×10^{5}	315	1.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.042	–	33	–
Expected risk (per year)	–	6.6×10^{-9}	–	5.1×10^{-6}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.4–1 and the MACCS computer code.

TABLE F.2.1.3.4–5.—*Simplified Boiling Water Reactor High Consequence Accidents at Pantex Plant—Public Consequences*

Accident	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Low pressure core melt with loss of short-term coolant makeup and normal containment leakage	7.8	3.9×10^{-3}	1.5×10^{3}	0.77	7.0×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and normal containment leakage	10	5.2×10^{-3}	2.0×10^{3}	1	6.4×10^{-8}
Low pressure core melt with loss of short-term coolant makeup and containment vented	135	0.099	1.8×10^{4}	8.8	1.1×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and containment vented	454	0.26	8.3×10^{4}	41	1.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.029	–	4.3	–
Expected risk (per year)	–	4.6×10^{-9}	–	6.7×10^{-7}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.4–1 and the MACCS computer code.

TABLE F.2.1.3.4–6.—*Simplified Boiling Water Reactor High Consequence Accidents at Savannah River Site—Public Consequences*

Accident	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Low pressure core melt with loss of short-term coolant makeup and normal containment leakage	0.49	2.4×10^{-4}	5.2×10^{3}	2.6	7.0×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and normal containment leakage	0.65	3.2×10^{-4}	7.0×10^{3}	3.5	6.4×10^{-8}
Low pressure core melt with loss of short-term coolant makeup and containment vented	11	6.4×10^{-3}	5.6×10^{4}	28	1.1×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and containment vented	31	0.017	2.8×10^{5}	139	1.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	1.9×10^{-3}	–	14	–
Expected risk (per year)	–	2.9×10^{-10}	–	2.3×10^{-6}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.4–1 and the MACCS computer code.

TABLE F.2.1.3.4–7.—*Simplified Boiling Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

Accident	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Low pressure core melt with loss of short-term coolant makeup and normal containment leakage	65	0.028	22	9.0×10^{-3}	7.0×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and normal containment leakage	86	0.037	29	0.012	6.4×10^{-8}
Low pressure core melt with loss of short-term coolant makeup and containment vented	992	0.28	409	0.15	1.1×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and containment vented	3.7×10^{3}	0.66	1.3×10^{3}	0.39	1.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequence	–	0.094	–	0.047	–
Expected risk (per year)	–	1.5×10^{-8}	–	7.3×10^{-9}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.4–1 and the MACCS computer code.

TABLE F.2.1.3.4–8.—*Simplified Boiling Water Reactor High Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Low pressure core melt with loss of short-term coolant makeup and normal containment leakage	49	0.02	18	$7.2x10^{-3}$	$7.0x10^{-8}$
Low pressure core melt with loss of long-term coolant makeup and normal containment leakage	65	0.027	23	$9.5x10^{-3}$	$6.4x10^{-8}$
Low pressure core melt with loss of short-term coolant makeup and containment vented	734	0.25	313	0.14	$1.1x10^{-8}$
Low pressure core melt with loss of long-term coolant makeup and containment vented	$2.8x10^{3}$	0.69	$1.0x10^{3}$	0.36	$1.1x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.087	–	0.042	–
Expected risk	–	$1.4x10^{-8}$	–	$6.6x10^{-9}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.4–1 and the MACCS computer code.

TABLE F.2.1.3.4–9.—*Simplified Boiling Water Reactor High Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Low pressure core melt with loss of short-term coolant makeup and normal containment leakage	70	0.029	24	$9.7x10^{-3}$	$7.0x10^{-8}$
Low pressure core melt with loss of long-term coolant makeup and normal containment leakage	93	0.039	32	0.013	$6.4x10^{-8}$
Low pressure core melt with loss of short-term coolant makeup and containment vented	$1.0x10^{3}$	0.3	408	0.17	$1.1x10^{-8}$
Low pressure core melt with loss of long-term coolant makeup and containment vented	$3.9x10^{3}$	0.72	$1.4x10^{3}$	0.45	$1.1x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.1	–	0.054	–
Expected risk (per year)	–	$1.6x10^{-8}$	–	$8.3x10^{-9}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.4–1 and the MACCS computer code.

TABLE F.2.1.3.4–10.—*Simplified Boiling Water Reactor High Consequence Accidents at Pantex Plant—Worker Consequences*

Accident	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Low pressure core melt with loss of short-term coolant makeup and normal containment leakage	31	0.012	11	4.5×10^{-3}	7.0×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and normal containment leakage	41	0.016	15	5.9×10^{-3}	6.4×10^{-8}
Low pressure core melt with loss of short-term coolant makeup and containment vented	442	0.2	184	0.1	1.1×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and containment vented	1.7×10^{3}	0.61	641	0.28	1.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.07	–	0.031	–
Expected risk (per year)	–	1.1×10^{-8}	–	4.9×10^{-9}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.4–1 and the MACCS computer code.

TABLE F.2.1.3.4–11.—*Simplified Boiling Water Reactor High Consequence Accidents at Savannah River Site—Worker Consequences*

Accident	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Low pressure core melt with loss of short-term coolant makeup and normal containment leakage	31	0.013	11	4.5×10^{-3}	7.0×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and normal containment leakage	42	0.017	15	6.0×10^{-3}	6.4×10^{-8}
Low pressure core melt with loss of short-term coolant makeup and containment vented	453	0.2	187	0.095	1.1×10^{-8}
Low pressure core melt with loss of long-term coolant makeup and containment vented	1.8×10^{3}	0.58	648	0.26	1.1×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	0.067	–	0.03	
Expected risk (per year)	–	1.1×10^{-8}	–	4.6×10^{-9}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.3.4–1 and the MACCS computer code.

F.2.1.4 *Accelerator Production of Tritium*

A study of the APT performed by Sandia National Laboratories, New Mexico, for DOE (SNL 1995a:8-1,8-2) has evaluated the hazards associated with the APT accelerator and beam transport system and has judged them to be a Category 3 hazard per DOE Order 5480.23. (A Category 3 hazard has the potential for only significant, but localized onsite consequences.) The spallation-induced lithium conversion and helium-3 target systems have been judged to be a Category 2 hazard. (A Category 2 hazard has the potential for significant onsite consequences, but does not have the potential for significant offsite consequences.) The helium-3 target tritium extraction has been judged a Category 3 hazard because only 15 grams of tritium are expected to be contained in the helium-3 blanket and in the target extraction facility. The spallation-induced lithium conversion target tritium extraction has been judged a Category 2 hazard.

F.2.1.4.1 *Accelerator and Beam Transport System*

Scenario. The only beyond design-basis event currently identified for the accelerator and beam transport system that has any significant probability involves misdirection or misfocusing of the beam. In this scenario, the beam is not terminated rapidly by the fast protection system, leading to vacuum seal failure, outright breaching of the vacuum system envelope, and/or partial melting of critical accelerator structures (SNL 1995a:8-9).

Consequences. The major consequence of this accident would be lost production time (SNL 1995a:8-9).

F.2.1.4.2 *Helium-3 Target System*

Loss of Coolant Accident with Loss of Emergency Cooling and Heat Sink but Confinement Operational

Scenario. The postulated high consequence accident for the Full and Phased APT is a large break loss of coolant accident with total failure of the active emergency cooling system and loss of heat sink. The postulated accident sequence assumed that the confinement system remained operational. A source term release to the environment was determined. Table F.2.1.4.2–1 presents the source term released by the Full APT during the accident and table F.2.1.4.2–2 presents the source term released by the Phased APT during the accident (SNL 1995a:8-18, 9-9). The accident annual frequency of occurrence is estimated at 7.0×10^{-7} per year (SNL1995b:1).

Consequences. The estimated consequences to the public for the postulated Full APT with the helium-3 target system accidents for each site are shown in tables F.2.1.4.2–3 through F.2.1.4.2–7. Consequences to the worker are shown in tables F.2.1.4.2–8 through F.2.1.4.2–12. The estimated consequences for the Phased APT with the helium-3 target system are shown for the public in table F.2.1.4.2–13 and for the worker in table F.2.1.4.2–14. Comparison of tables F.2.1.4.2–3 through F.2.1.4.2–14 indicates that the resultant doses and cancer risks are identical for the Full and the Phased APT beyond design-basis accidents. Review of the source terms for both accidents (tables 1 and 2) indicates that the tritium component of the source term is identical for both accidents. Review of the MACCS computer code output data for each accident analysis indicated that the tritium component of the source term dominated the dose calculation results. The impact of the other source term isotopes on the dose calculation results was negligible.

Loss of Coolant Accident with Loss of Emergency Cooling, Heat Sink, and Confinement

Scenario. The postulated bounding high consequence accident for the Full APT is a large break loss of coolant accident with total failure of the active emergency cooling system, loss of heat sink, and loss of confinement. The source term is presented in table F.2.1.4.2–1. The annual frequency of occurrence for this accident is 1.0×10^{-8} per year (SNL 1995b:1).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.4.2–3 through F.2.1.4.2–7 for public consequences and in tables F.2.1.4.2–8 through F.2.1.4.2–12 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.4.2–1 using the MACCS computer code.

Integrated Cancer Fatalities Complementary Cumulative Distribution Function for the Two Full Accelerator Production of Tritium High Consequence Accidents

Figure F.2.1.4.2–1 shows the annual probability that, in the event of any accident in the composite set of Full APT high consequence accidents at one of the sites, the number of cancer fatalities exceeds the value N indicated on the horizontal axis. The curves, technically referred to as complementary cumulative distribution functions, reflect the probability of the accident's occurrence as well as the variability in the magnitude of its consequences. Generally, a curve that extends the farthest to the right has the highest accident consequences while a curve that is nearest to the left has the lowest accident consequences. A comparison of alternatives should include the information provided by these curves in conjunction with the point values shown in tables F.2.1.4.2–3 through F.2.1.4.2–12.

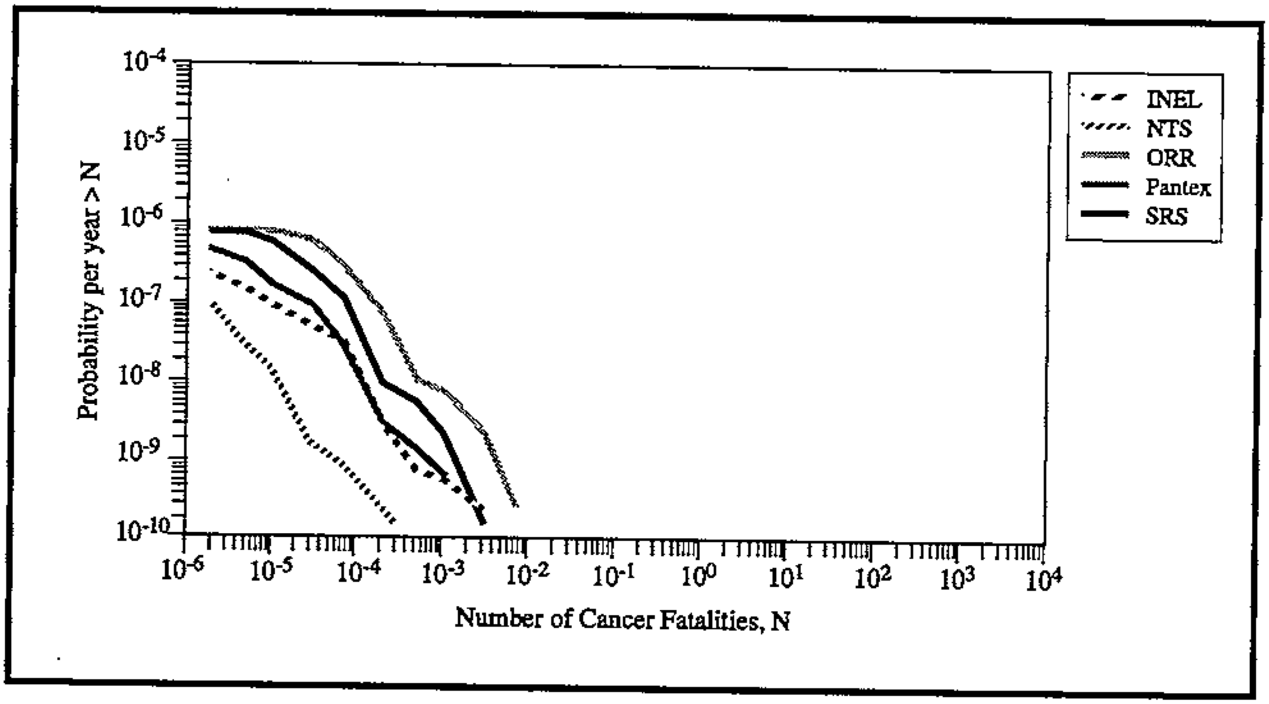

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FIGURE F.2.1.4.2–1.—*High Consequence Accident-Cancer Fatality Frequency Distribution Functions for the Full Size Accelerator Production of Tritium with Helium-3 Target.*

TABLE F.2.1.4.2–1.—*Source Term for Full Accelerator Production of Tritium with Helium-3 Target System High Consequence Accidents*

Isotope	Release Activity (curies) Loss of Coolant Accident with Loss of Emergency Cooling and Heat Sink, but Confinement Operational	Release Activity (curies) Loss of Coolant Accident with Loss of Emergency Cooling, Heat Sink, and Confinement
H-3	1,500	48,000
W-185	14,500	925,000
W-187	10,600	675,000
W-181	2,850	181,000
W-178	910	57,900
Xe-127	51	1,640
W-177	47	3,000
W-176	42	2,660
Cs-131	38	2,440
Xe-125	29	930
Cs-129	25	1,610
Cs-128	22	1,380
I-125	21	1,340
Ar-37	11	340
P-32	11	710
Cs-127	10	670
Te-121	9	290
I-123	8	510
Kr-79	7	220
Re-186	7	420
Xe-122	4	115

Source: SNL 1995a; SNL 1995b:1.

TABLE F.2.1.4.2–2.—*Source Term for Phased Accelerator Production of Tritium with Helium-3 Target System High Consequence Accidents*

Isotope	Released Activity (curies)	Isotope	Released Activity (curies)
H-3	1,500	Cs-128	13
W-185	8,700	I-125	13
W-187	6,400	Ar-37	6.6
W-181	1,700	P-32	6.6
W-178	550	Cs-127	6.0
Xe-127	31	Te-121	5.4
W-177	28	I-123	4.8
W-176	25	Kr-79	4.2
Cs-131	23	Re-186	4.2
Xe-125	17	Xe-122	<1
Cs-129	15		

Source: SNL 1995a.

TABLE F.2.1.4.2–3.—*Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	$8.7\text{x}10^{-6}$	$4.3\text{x}10^{-9}$	0.014	$7.2\text{x}10^{-6}$	$7.0\text{x}10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	$2.8\text{x}10^{-4}$	$1.4\text{x}10^{-7}$	0.46	$2.3\text{x}10^{-4}$	$1.0\text{x}10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$6.2\text{x}10^{-9}$	–	$1.0\text{x}10^{-5}$	–
Expected risk (per year)	–	$4.4\text{x}10^{-15}$	–	$7.4\text{x}10^{-12}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.2–1 and the MACCS computer code.

TABLE F.2.1.4.2–4.—*Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Nevada Test Site—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	$2.4\text{x}10^{-5}$	$1.2\text{x}10^{-8}$	$1.4\text{x}10^{-3}$	$6.9\text{x}10^{-7}$	$7.0\text{x}10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	$7.5\text{x}10^{-4}$	$3.8\text{x}10^{-7}$	0.044	$2.2\text{x}10^{-5}$	$1.0\text{x}10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$1.7\text{x}10^{-8}$	–	$9.9\text{x}10^{-7}$	–
Expected risk (per year)	–	$1.2\text{x}10^{-14}$	–	$7.0\text{x}10^{-13}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.2–1 and the MACCS computer code.

TABLE F.2.1.4.2–5.—*Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Oak Ridge Reservation—Public Consequences*

Accident Description	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accident Frequency (per year)
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	$1.9x10^{-4}$	$3.0x10^{-8}$	0.13	$6.7x10^{-5}$	$7.0x10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	$5.9x10^{-3}$	$3.0x10^{-6}$	4.3	$2.2x10^{-3}$	$1.0x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$1.3x10^{-7}$	–	$9.6x10^{-5}$	–
Expected risk (per year)	–	$9.5x10^{-14}$	–	$6.8x10^{-11}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.2–1 and the MACCS computer code.

TABLE F.2.1.4.2–6.—*Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Pantex Plant—Public Consequences*

Accident Description	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accident Frequency (per year)
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	$1.2x10^{-4}$	$6.2x10^{-8}$	0.017	$8.7x10^{-6}$	$7.0x10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	$4.0x10^{-3}$	$2.0x10^{-6}$	0.56	$2.8x10^{-4}$	$1.0x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$9.0x10^{-8}$	–	$1.3x10^{-5}$	–
Expected risk (per year)	–	$6.4x10^{-14}$	–	$8.9x10^{-12}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.2–1 and the MACCS computer code.

TABLE F.2.1.4.2–7.—*Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Savannah River Site—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	$8.0\text{x}10^{-6}$	$4.0\text{x}10^{-9}$	0.054	$2.7\text{x}10^{-5}$	$7.0\text{x}10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	$2.6\text{x}10^{-4}$	$1.3\text{x}10^{-7}$	1.7	$8.6\text{x}10^{-4}$	$1.0\text{x}10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$5.7\text{x}10^{-9}$	–	$3.9\text{x}10^{-5}$	–
Expected risk (per year)	–	$4.1\text{x}10^{-15}$	–	$2.8\text{x}10^{-11}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.2–1 and the MACCS computer code.

TABLE F.2.1.4.2–8.—*Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

Accident Description	Worker at 1,000 Meters		Worker at 2,000 Meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	$1.1\text{x}10^{-3}$	$4.3\text{x}10^{-7}$	$3.9\text{x}10^{-4}$	$1.6\text{x}10^{-7}$	$7.0\text{x}10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	0.034	$1.4\text{x}10^{-5}$	0.013	$5.0\text{x}10^{-6}$	$1.0\text{x}10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$6.1\text{x}10^{-7}$	–	$2.3\text{x}10^{-7}$	–
Expected risk (per year)	–	$4.4\text{x}10^{-13}$	–	$1.6\text{x}10^{-13}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.2–1 and the MACCS computer code.

TABLE F.2.1.4.2–9.—*Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident Description	Worker at 1,000 Meters		Worker at 2,000 Meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	$7.8x10^{-3}$	$3.1x10^{-7}$	$3.0x10^{-4}$	$1.2x10^{-7}$	$7.0x10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	0.025	$1.0x10^{-5}$	$9.6x10^{-3}$	$3.9x10^{-6}$	$1.0x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$4.5x10^{-7}$	–	$1.7x10^{-7}$	–
Expected risk (per year)	–	$3.2x10^{-13}$	–	$1.2x10^{-13}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.2–1 and the MACCS computer code.

TABLE F.2.1.4.2–10.—*Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident Description	Worker at 1,000 Meters		Worker at 2,000 Meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	$1.0x10^{-3}$	$4.2x10^{-7}$	$3.7x10^{-4}$	$1.5x10^{-7}$	$7.0x10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	0.034	$1.3x10^{-5}$	0.012	$4.8x10^{-6}$	$1.0x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$6.0x10^{-7}$	–	$2.2x10^{-7}$	–
Expected risk (per year)	–	$4.3x10^{-13}$	–	$1.5x10^{-13}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.2–1 and the MACCS computer code.

TABLE F.2.1.4.2–11.—*Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Pantex Plant—Worker Consequences*

Accident Description	Worker at 1,000 Meters		Worker at 2,000 Meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	4.6×10^{-4}	1.8×10^{-7}	1.7×10^{-4}	7.0×10^{-8}	7.0×10^{-7}
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	0.015	5.9×10^{-6}	5.6×10^{-3}	2.2×10^{-6}	1.0×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	2.6×10^{-7}	–	1.0×10^{-7}	–
Expected risk (per year)	–	1.9×10^{-13}	–	7.1×10^{-14}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.2–1 and the MACCS computer code.

TABLE F.2.1.4.2–12.—*Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Savannah River Site—Worker Consequences*

Accident Description	Worker at 1,000 Meters		Worker at 2,000 Meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	4.7×10^{-4}	1.9×10^{-7}	1.7×10^{-4}	7.0×10^{-8}	7.0×10^{-7}
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	0.015	5.9×10^{-6}	5.6×10^{-3}	2.2×10^{-6}	1.0×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	2.7×10^{-7}	–	1.0×10^{-7}	–
Expected risk (per year)	–	1.9×10^{-13}	–	7.1×10^{-14}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.2–1 and the MACCS computer code.

TABLE F.2.1.4.2–13.—*Phased Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accident—Public Consequences*

Site	Individual at Site Boundary		Population to 50 Miles		
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Idaho National Engineering Laboratory	8.7×10^{-6}	4.3×10^{-9}	0.014	7.2×10^{-6}	7.0×10^{-7}
Nevada Test Site	2.4×10^{-5}	1.2×10^{-8}	1.4×10^{-3}	6.9×10^{-7}	7.0×10^{-7}
Oak Ridge Reservation	1.9×10^{-4}	9.3×10^{-8}	0.13	6.7×10^{-5}	7.0×10^{-7}
Pantex Plant	1.2×10^{-4}	6.2×10^{-8}	0.017	8.7×10^{-6}	7.0×10^{-7}
Savannah River Site	8.0×10^{-6}	4.0×10^{-9}	0.054	2.7×10^{-5}	7.0×10^{-7}
Expected Risk of Cancer Fatality (per year)					
Idaho National Engineering Laboratory	–	3.0×10^{-15}	–	5.0×10^{-12}	–
Nevada Test Site	–	8.3×10^{-15}	–	4.8×10^{-13}	–
Oak Ridge Reservation	–	6.5×10^{-14}	–	4.7×10^{-11}	–
Pantex Plant	–	4.4×10^{-14}	–	6.1×10^{-12}	–
Savannah River Site	–	2.8×10^{-15}	–	1.9×10^{-11}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.2–2 and the MACCS computer code.

TABLE F.2.1.4.2–14.—*Phased Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accident—Worker Consequences*

Site	Worker at 1,000 meters		Worker at 2,000 meters		
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	Accident Frequency (per year)
Idaho National Engineering Laboratory	1.1×10^{-3}	4.3×10^{-7}	3.9×10^{-4}	1.6×10^{-7}	7.0×10^{-7}
Nevada Test Site	7.8×10^{-4}	3.1×10^{-7}	3.0×10^{-4}	1.2×10^{-7}	7.0×10^{-7}
Oak Ridge Reservation	1.0×10^{-3}	4.2×10^{-7}	3.7×10^{-4}	1.5×10^{-7}	7.0×10^{-7}
Pantex Plant	4.6×10^{-4}	1.8×10^{-7}	1.7×10^{-4}	7.0×10^{-8}	7.0×10^{-7}
Savannah River Site	4.7×10^{-4}	1.9×10^{-7}	1.7×10^{-4}	7.0×10^{-8}	7.0×10^{-7}
Expected Risk of Cancer Fatality (per year)					
Idaho National Engineering Laboratory	–	3.0×10^{-13}	–	1.1×10^{-13}	–
Nevada Test Site	–	2.2×10^{-13}	–	8.4×10^{-14}	–
Oak Ridge Reservation	–	2.9×10^{-13}	–	1.0×10^{-13}	–
Pantex Plant	–	1.3×10^{-13}	–	4.9×10^{-14}	–
Savannah River Site	–	1.3×10^{-13}	–	4.9×10^{-14}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.2–2 and the MACCS computer code.

F.2.1.4.3 *Spallation-Induced Lithium Conversion Target System*

Loss of Coolant Accident with Loss of Emergency Cooling and Natural Circulation, but Confinement Operational

Scenario. The postulated high consequence accident for the Full APT with the spallation-induced lithium conversion target system configuration is a large break loss of coolant accident, followed by a successful beam trip, but total failure of the active and passive cooling systems. This scenario would lead to partial melting of the target. Based on these analyses, a bounding source term release to the environment was determined. Table F.2.1.4.3–1 presents the source term released during the accident. The analysis did not estimate the accident annual frequency of occurrence (SNL 1995a:8-12–8-14).

The postulated accident sequence assumed that the only safety system to function is the passive water dump tank that floods the target room in the event of a loss of coolant accident. The postulated accident sequence assumed that the confinement system remained operational. The probability of the accident is in the residual risk category, but it is within the design basis of confinement (SNL 1995a:8-12). The accident annual frequency of occurrence is estimated at $7.0\mathrm{x}10^{-7}$ per year (SNL1995b:1).

Consequences. The estimated consequences of the postulated accident with at each site are shown in tables F.2.1.4.3–2 through F.2.1.4.3–6 for public consequences and in tables F.2.1.4.3–7 through F.2.1.4.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.4.3–1 using the MACCS computer code.

Loss of Coolant Accident with Loss of Emergency Cooling, Natural Circulation, and Confinement

Scenario. The postulated bounding high consequence accident for the Full APT with the spallation-induced lithium conversion target system is a large break loss of coolant accident with total failure of the active emergency cooling system, loss of natural circulation, and loss of confinement. The source term is presented in table F.2.1.4.3–1. The annual frequency of occurrence for this accident is $1.0\mathrm{x}10^{-8}$ per year (SNL 1995b:1).

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.4.3–2 through F.2.1.4.3–6 for public consequences and in tables F.2.1.4.3–7 through F.2.1.4.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.4.3–1 using the MACCS computer code.

Integrated Cancer Fatalities Complementary Cumulative Distribution Function for the Two Full Accelerator Production of Tritium with Spallation-Induced Lithium Conversion Target System High Consequence Accidents

Figure F.2.1.4.3–1 shows the annual probability that, in the event of any accident in the composite set of Full APT with spallation-induced lithium conversion target system high consequence accidents at one of the sites, the number of cancer fatalities exceeds the value N indicated on the horizontal axis. The curves, technically referred to as complementary cumulative distribution functions, reflect the probability of the accident's occurrence as well as the variability in the magnitude of its consequences. Generally, a curve that extends the farthest to the right has the highest accident consequences while a curve that is nearest to the left has the lowest accident consequences. A comparison of alternatives should include the information provided by these curves in conjunction with the point values shown in tables F.2.1.4.3–2 through F.2.1.4.3–11.

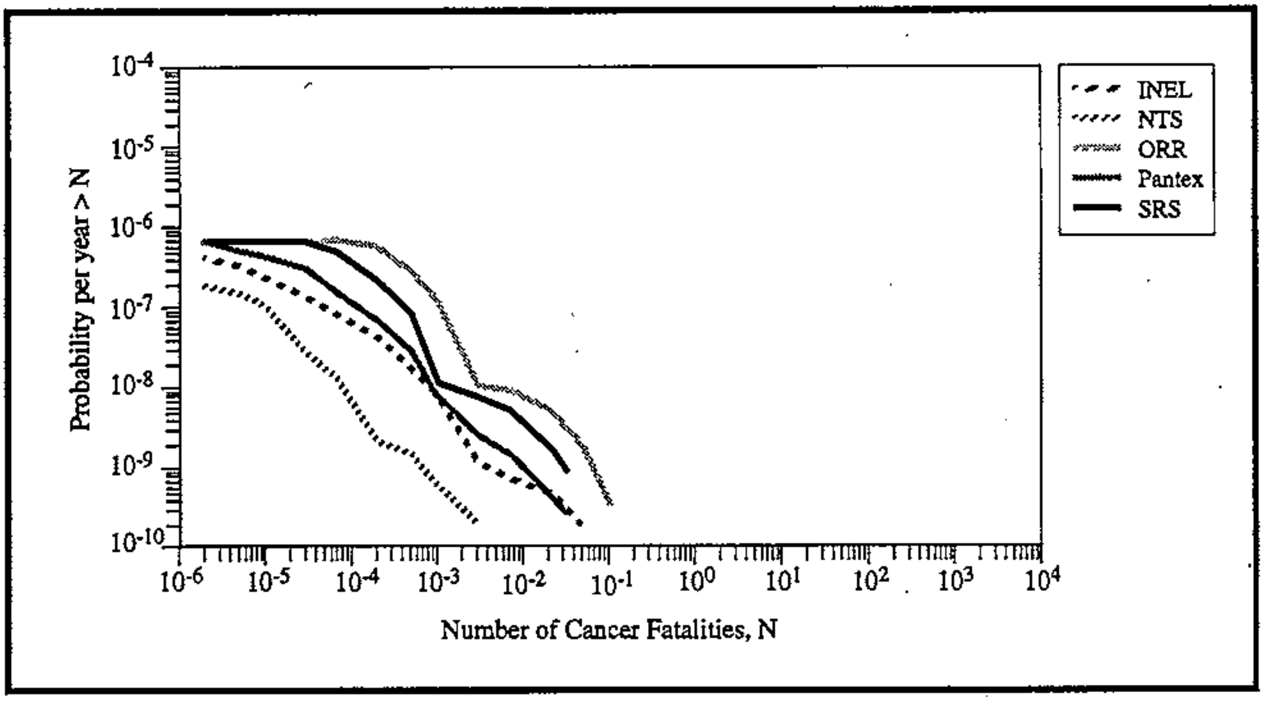

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FIGURE F.2.1.4.3–1.—*High Consequence Accident-Cancer Fatality Frequency Distribution Functions for the Full Accelerator Production of Tritium with Spallation-Induced Lithium Conversion Target System.*

TABLE F.2.1.4.3–1.—*Source Term for Full Accelerator Production of Tritium with Spallation-Induced Lithium Conversion Target System High Consequence Accident*

Isotope	Released Activity (curies) Loss of Coolant Accident with Loss of Emergency Cooling and Natural Circulation, but Confinement Operational	Released Activity (curies) Loss of Coolant Accident with Loss of Emergency Cooling, Natural Circulation, and Confinement
H-3	1,900	61,000
Hg-197	1,065	68,000
F-18	1,039	66,000
Kr-83m	1,039	33,000
Hg-195	518	33,000
Kr-79	477	15,000
Xe-125	465	15,000
Xe-127	320	10,000
Kr-88	259	8,200
Kr-85m	258	8,200
Br-83	243	16,000
Kr-87	221	7,000
Hg-193	211	13,000
Br-82	193	12,000
Br-76	177	11,000
Hg-203	136	8,600
Hg-192	115	7,300
I-125	113	7,200
I-123	101	6,400
I-126	84	5,400
Br-84	83	5,300
Br-77	79	5,000
Xe-122	77	2,400
I-121	76	4,900
I-124	64	4,100
I-120	55	3,500
I-130	54	3,500
I-128	45	2,900
Hg-197m	40	2,500
I-122	38	2,500
I-131	27	1,700
Hg-195m	20	1,300
Hg-190	14	910
I-133	13	820
I-135	12	760

Source: SNL 1995a; SNL 1995b:1.

TABLE F.2.1.4.3–2.—***Full Accelerator Production of Tritium with the Spallation-Induced Lithium Conversion Target System High Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences***

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Loss of coolant accident with loss of emergency cooling and beat sink, but confinement operational	$1.5x10^{-4}$	$7.6x10^{-8}$	0.11	$5.2x10^{-5}$	$7.0x10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	$7.8x10^{-3}$	$3.9x10^{-6}$	6.0	$3.0x10^{-3}$	$1.0x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$1.3x10^{-7}$	–	$9.4x10^{-5}$	–
Expected risk (per year)	–	$9.2x10^{-14}$	–	$6.7x10^{-11}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.3–1 and the MACCS computer code.

TABLE F.2.1.4.3–3.—***Full Accelerator Production of Tritium with the Spallation-Induced Lithium Conversion Target System High Consequence Accidents at Nevada Test Site—Public Consequences***

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	$3.8x10^{-4}$	$1.9x10^{-7}$	0.01	$5.0x10^{-6}$	$7.0x10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	0.02	$1.0x10^{-5}$	0.58	$2.9x10^{-4}$	$1.0x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$3.3x10^{-7}$	–	$9.0x10^{-6}$	–
Expected risk (per year)	–	$2.3x10^{-13}$	–	$6.4x10^{-12}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.3–1 and the MACCS computer code.

TABLE F.2.1.4.3–4.—*Full Accelerator Production of Tritium with the Spallation-Induced Lithium Conversion Target System High Consequence Accidents at Oak Ridge Reservation—Public Consequences*

Accident Description	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accident Frequency (per year)
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	2.5×10^{-3}	1.3×10^{-6}	1.2	5.9×10^{-4}	7.0×10^{-7}
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	0.14	6.9×10^{-5}	66	0.033	1.0×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	2.2×10^{-6}	–	1.0×10^{-3}	–
Expected risk for (per year)	–	1.6×10^{-12}	–	7.4×10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.3–1 and the MACCS computer code.

TABLE F.2.1.4.3–5.—*Full Accelerator Production of Tritium with the Spallation-Induced Lithium Conversion Target System High Consequence Accidents at Pantex Plant—Public Consequences*

Accident Description	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accident Frequency (per year)
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	1.6×10^{-3}	8.2×10^{-7}	0.15	7.6×10^{-5}	7.0×10^{-7}
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	0.09	4.5×10^{-5}	8.5	4.3×10^{-3}	1.0×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	1.4×10^{-6}	–	1.3×10^{-4}	–
Expected risk (per year)	–	1.0×10^{-12}	–	9.6×10^{-11}	–

[a] Increased likelihood of cancer fatality.

All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.3–1 and the MACCS computer code.

TABLE F.2.1.4.3–6.—*Full Accelerator Production of Tritium with the Spallation-Induced Lithium Conversion Target System High Consequence Accidents at Savannah River Site—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	1.2×10^{-4}	6.0×10^{-8}	0.43	2.1×10^{-4}	7.0×10^{-7}
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	6.3×10^{-3}	3.1×10^{-6}	24	0.012	1.0×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences for composite set of accidents	–	1.0×10^{-7}	–	3.8×10^{-4}	–
Expected risk (per year)	–	7.3×10^{-14}	–	2.7×10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.3–1 and the MACCS computer code.

TABLE F.2.1.4.3–7.—*Full Accelerator Production of Tritium with the Spallation-Induced Lithium Conversion Target System High Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	Accident Frequency (per year)
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	0.013	5.3×10^{-6}	5.4×10^{-3}	2.2×10^{-6}	7.0×10^{-7}
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	0.75	3.0×10^{-4}	0.3	1.2×10^{-4}	1.0×10^{-8}
Evaluation of Composite Set of Accidents					
Expected consequences	–	9.4×10^{-6}	–	3.8×10^{-6}	–
Expected risk (per year)	–	6.7×10^{-12}	–	2.7×10^{-12}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.3–1 and the MACCS computer code.

TABLE F.2.1.4.3–8.—*Full Accelerator Production of Tritium with the Spallation-Induced Lithium Conversion Target System High Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	$9.4x10^{-3}$	$3.8x10^{-6}$	$4.0x10^{-3}$	$1.6x10^{-6}$	$7.0x10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	0.53	$2.1x10^{-4}$	0.22	$8.9x10^{-5}$	$1.0x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected Consequences	–	$6.7x10^{-6}$	–	$2.8x10^{-6}$	–
Expected Risk (per year)	–	$4.8x10^{-12}$	–	$2.0x10^{-12}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.3–1 and the MACCS computer code.

TABLE F.2.1.4.3–9.—*Full Accelerator Production of Tritium with the Spallation-Induced Lithium Conversion Target System High Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	0.012	$4.9x10^{-6}$	$4.8x10^{-3}$	$1.9x10^{-6}$	$7.0x10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	0.69	$2.8x10^{-4}$	0.26	$1.1x10^{-4}$	$1.0x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$8.7x10^{-6}$	–	$3.4x10^{-6}$	–
Expected risk (per year)	–	$6.2x10^{-12}$	–	$2.4x10^{-12}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.3–1 and the MACCS computer code.

TABLE F.2.1.4.3–10.—*Full Accelerator Production of Tritium with the Spallation-Induced Lithium Conversion Target System High Consequence Accidents at Pantex Plant—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	$5.3x10^{-3}$	$2.1x10^{-6}$	$2.2x10^{-3}$	$8.9x10^{-7}$	$7.0x10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	0.3	$1.2x10^{-4}$	0.12	$4.9x10^{-5}$	$1.0x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$3.8x10^{-6}$	–	$1.6x10^{-6}$	–
Expected risk (per year)	–	$2.7x10^{-12}$	–	$1.1x10^{-12}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.3–1 and the MACCS computer code.

TABLE F.2.1.4.3–11.—*Full Accelerator Production of Tritium with the Spallation-Induced Lithium Conversion Target System High Consequence Accidents at Savannah River Site—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Loss of coolant accident with loss of emergency cooling and heat sink, but confinement operational	$5.4x10^{-3}$	$2.2x10^{-6}$	$2.2x10^{-3}$	$8.9x10^{-7}$	$7.0x10^{-7}$
Loss of coolant accident with loss of emergency cooling, heat sink, and confinement	0.3	$1.2x10^{-4}$	0.12	$4.9x10^{-5}$	$1.0x10^{-8}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$3.8x10^{-6}$	–	$1.6x10^{-6}$	–
Expected risk (per year)	–	$2.7x10^{-12}$	–	$1.1x10^{-12}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.4.3–1 and the MACCS computer code.

F.2.1.5 *Multipurpose Reactor Facility*

The multipurpose reactor facility consists of three elements. (1) The reactor element that burns the plutonium or mixed-oxide fuel can be either a Modular High Temperature Gas-Cooled Reactor or an Advanced Light Water Reactor. (2) The fuel fabrication element produces the fuel for use in the reactor. (3) The pit disassembly and conversion element disassembles plutonium pits and converts the plutonium in the pit to plutonium-oxide which is used in the production of plutonium or mixed-oxide fuel.

F.2.1.5.1 *Multipurpose Reactor*

Modular High Temperature Gas-Cooled Reactor

The use of plutonium in the plutonium-oxide fueled MHTGR will not have a significant effect on the source term for high consequence accidents generated for the uranium fueled MHTGR because no fuel failures are expected (HNUS 1995c:1). The accident consequences estimated for the uranium fueled MHTGR are applicable for the plutonium fueled MHTGR. Refer to section F.2.1.2 for the applicable accident consequences of the plutonium fueled MHTGR.

Advanced Light Water Reactor

The use of plutonium in the mixed-oxide fueled ALWR, as compared to the uranium-fueled ALWR, will not significantly affect the consequence of radioactivity releases for high consequence accidents. While there will he some small changes in the source term release spectrum and frequency, the changes will not have a significant effect on the accident consequences (HNUS 1995c:2). The accident consequences estimated for the uranium-fueled ALWR are applicable for the mixed-oxide fueled ALWR. Refer to section F.2.1.3 for the applicable accident consequences of the mixed-oxide fueled ALWR.

F.2.1.5.2 *Mixed-Oxide and Plutonium-Oxide Fuel Fabrication*

Criticality

Scenario. The postulated solid criticality accident is the result of accidental improper stacking of items. There will not be sufficient quantities of plutonium solutions in the fuel fabrication area to cause a liquid criticality accident if mishandled. It is assumed that the postulated solid criticality incident would not exceed 5.0×10^{17} fissions. Table F.2.1.5.2–2 presents the source term for important nuclides released to the environment during the postulated criticality accident. The annual frequency of occurrence for the criticality accident is estimated to be less than 1.0×10^{-7} per year (LANL 1995d). For calculational purposes, the annual frequency of occurrence is assumed to be 1.0×10^{-7} per year.

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.5.2–3 through F.2.1.5.2–7 for public consequences and in tables F.2.1.5.2–8 through F.2.1.5.2–12 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.5.2–2 using the MACCS computer code.

Beyond Design-Basis Fire

Scenario. The accident postulated is a fire in a process cell area with coincident failure of major safety systems. It is assumed that the process cell contains a glovebox used for milling plutonium powder. The gloves have become coated with a layer of plutonium dust. The analysis estimated the glove loading at 2 grams of plutonium per glove. Each of the 12 gloves is assumed to be stowed outside of the glovebox. A flammable cleaning liquid such as acetone or isopropyl alcohol is brought into the process cell in violation of operating procedures, spills, and ignites. All gloves are incinerated, but the sprinkler system does not activate to protect the glovebox from further damage. The ventilation system and HEPA filters are also assumed inoperative. Normally closed doors are assumed to remain closed except during personnel evacuation from the area. The analysis using the LANL computer code known as GASFLOW was used to model the dispersion of the fire products. The analysis estimated that 0.034 gram of plutonium is released to the environment. The annual frequency of occurrence is estimated to be less than 1.0×10^{-7} per year (LANL 1995d). For calculational purposes, the annual frequency of occurrence is assumed to be 1.0×10^{-7} per year. Table F.2.1.5.2–1 presents the isotopic distribution for a plutonium release at the fuel fahrication facility. Table F.2.1.5.2–2 presents the source term, by isotope, for the 0.034 gram of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.5.2–3 through F.2.1.5.2–7 for public consequences and in tables F.2.1.5.2–8 through F.2.1.5.2–12 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.5.2–2 using the MACCS computer code.

Beyond Design-Basis Explosion

Scenario. The explosion of an oxyacetylene bottle in a process cell has been postulated as a beyond design-basis explosion. The explosion has the potential to blow out the HEPA filters and cause significant damage to the ventilation system and nearby equipment. The explosion is postulated to occur in a process cell near a glovebox. The glovebox identified as having the most material-at-risk contains the milling operation where plutonium-oxide is milled to a fine powder prior to mixing with uranium dioxide. Based on a LANL TA-55 standard operating procedure, the criticality limit for plutonium-oxide in a dry atmosphere is assumed to be 10 kg. The analysis assumed the glovebox contains 10 kg of plutonium-oxide. The analysis estimated that 50 grams of plutonium are released up the stack. Sufficient control on the use of oxyacetylene welding equipment in process cells ensures that the probability of an accident occurring is less than 1.0×10^{-7} per year (LANL 1995d). For calculational purposes, the annual frequency of occurrence is assumed to be 1.0×10^{-7} per year. Table F.2.1.5.2–1 presents the isotopic distribution for a plutonium release at the fuel fabrication facility. Table F.2.1.5.2–2 presents the source term, by isotope, for the 50 grams of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.5.2–3 through F.2.1.5.2–7 for public consequences and in tables F.2.1.5.2–8 through F.2.1.5.2–12 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.5.2–2 using the MACCS computer code.

Beyond Design-Basis Earthquake

Scenario. The following assumptions are made for a beyond design-basis earthquake analysis: (1) the ventilation system is disabled, (2) there is significant structural damage but the building does not totally collapse, (3) a ceiling slab falls on a glovebox with the most material-at-risk (10 kg of plutonium-oxide powder) and the glovebox is significantly damaged, (4) the process cell with the glovebox has one wall on the outside of the building, (5) this outside wall cracks and the cracks have a total length of 10 meters and a 1-mm width, (6) the wind is blowing at 10 m/s, and (7) the cracks are located on the lee side of the building. The analysis estimated that 25 grams of plutonium were released at the building level. The annual frequency of occurrence is estimated to be less than 1.0×10^{-7} per year (LANL 1995d). For calculational purposes, the annual frequency of occurrence is assumed to be 1.0×10^{-7} per year. Table F.2.1.5.2–1 presents the isotopic distribution for a plutonium release at the fuel fabrication facility. Table F.2.1.5.2–2 presents the source term, by isotope, for the 25 grams of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.5.2–3 through F.2.1.5.2–7 for public consequences and in tables F.2.1.5.2–8 through F.2.1.5.2–12 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.5.2–2 using the MACCS computer code.

Integrated Cancer Fatalities Complementary Cumulative Distribution Function for the Four Multipurpose Fuel Fabrication High Consequence Accidents

Figure F.2.1.5.2–1 shows the annual probability that, in the event of any accident in the composite set of mixed-oxide fuel fabrication high consequence accidents at one of the sites, the number of cancer fatalities exceeds the value N indicated on the horizontal axis. The curves, technically referred to as complementary cumulative distribution functions, reflect the probability of the accident's occurrence as well as the variability in the magnitude of its consequences. Generally, a curve that extends the farthest to the right has the highest accident consequences while a curve that is nearest to the left has the lowest accident consequences. A comparison of alternatives should include the information provided by these curves in conjunction with the point values shown in tables F.2.1.5.2–3 through F.2.1.5.2–12.

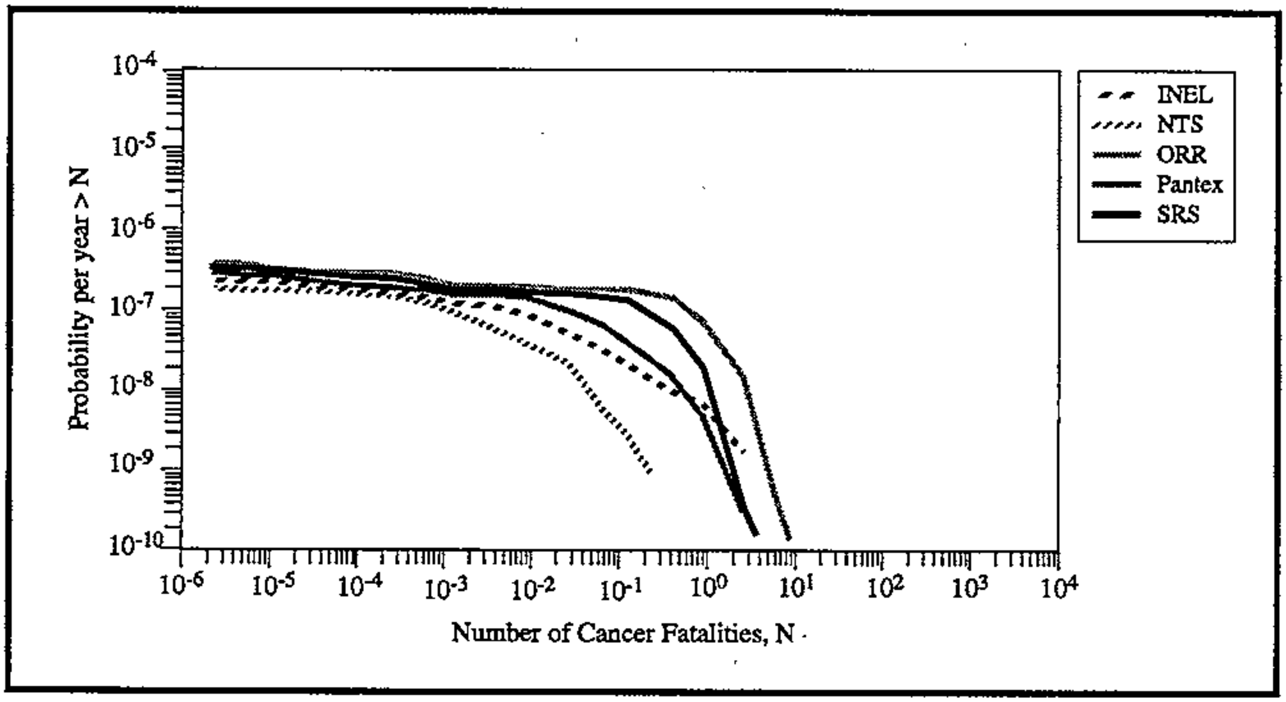

FIGURE F.2.1.5.2–1.—***High Consequence Accident-Cancer Fatality Frequency Distribution Functions for the Multipurpose Reactor Fuel Fabrication Facility.***

TABLE F.2.1.5.2–1.—*Multipurpose Reactor Fuel Fabrication High Consequence Accident Source Terms*

Isotope	Released Activity (curies)			
	Criticality	Beyond Design-Basis Fire	Beyond Design-Basis Explosion	Beyond Design-Basis Earthquake
Pu-238	0	2.9×10^{-4}	0.42	0.21
Pu-239	0	2.0×10^{-3}	2.9	1.4
Pu-240	0	4.6×10^{-4}	0.67	0.34
Pu-241	0	0.014	20	10
Am-241	0	4.4×10^{-4}	0.64	0.32
Kr-83m	2.8	0	0	0
Kr-85m	1.8	0	0	0
Kr-85	2.0×10^{-4}	0	0	0
Kr-87	11	0	0	0
Kr-88	5.8	0	0	0
Kr-89	325	0	0	0
Xe-131m	2.5×10^{-3}	0	0	0
Xe-133m	0.05	0	0	0
Xe-133	0.75	0	0	0
Xe-135m	83	0	0	0
Xe-135	10	0	0	0
Xe-137	1.2×10^{3}	0	0	0
Xe-138	275	0	0	0
I-131	0.025	0	0	0
I-132	3	0	0	0
I-133	0.4	0	0	0
I-134	11	0	0	0
I-135	1.1	0	0	0

Source: Derived from LANL1995 and table F.2.1.5.2–1.

TABLE F.2.1.5.2–2.—*Isotopic Distribution for a Plutonium Release*

Isotope	Isotope/ Plutonium (gram)	Specific Activity of Isotope (Ci/g)	Specific Activity (Ci Isotope/g Plutonium)
Pu-238	5.0×10^{-4}	16.8	8.4×10^{-3}
Pu-239	0.933	0.0616	0.0575
Pu-240	0.059	0.227	0.0134
Pu-241	3.5×10^{-3}	115	0.403
Am-241	4.0×10^{-3}	3.2	0.0128
Total Specific Activity (Ci/g plutonium)			0.495

Source: Derived from LANL1995i:1.

TABLE F.2.1.5.2–3.—*Multipurpose Reactor Fuel Fabrication High Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
Criticality	$3.1x10^{-6}$	$1.5x10^{-9}$	$6.7x10^{-4}$	$3.4x10^{-7}$	$1.0x10^{-7}$
Beyond design-basis fire	$1.0x10^{-4}$	$5.1x10^{-8}$	0.18	$8.9x10^{-5}$	$1.0x10^{-7}$
Beyond design-basis explosion	0.15	$7.4x10^{-5}$	258	0.13	$1.0x10^{-7}$
Beyond design-basis earthquake	0.073	$3.6x10^{-5}$	127	0.063	$1.0x10^{-7}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$2.8x10^{-5}$	–	0.048	–
Expected risk (per year)	–	$1.1x10^{-11}$	–	$1.9x10^{-8}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.2–2 and the MACCS computer code.

TABLE F.2.1.5.2–4.—*Multipurpose Reactor Fuel Fabrication High Consequence Accidents at Nevada Test Site—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
Criticality	$8.4x10^{-6}$	$4.2x10^{-9}$	$6.2x10^{-5}$	$3.1x10^{-8}$	$1.0x10^{-7}$
Beyond design-basis fire	$2.8x10^{-4}$	$1.4x10^{-7}$	0.017	$8.5x10^{-6}$	$1.0x10^{-7}$
Beyond design-basis explosion	0.4	$2.0x10^{-4}$	25	0.012	$1.0x10^{-7}$
Beyond design-basis earthquake	0.2	$9.9x10^{-5}$	12	$6.1x10^{-3}$	$1.0x10^{-7}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$7.5x10^{-5}$	–	$4.6x10^{-3}$	–
Expected risk (per year)	–	$3.0x10^{-11}$	–	$1.8x10^{-9}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.2–2 and the MACCS computer code.

TABLE F.2.1.5.2–5.—*Multipurpose Reactor Fuel Fabrication High Consequence Accidents at Oak Ridge Reservation—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Criticality	5.5×10^{-5}	2.7×10^{-8}	0.012	6.2×10^{-6}	1.0×10^{-7}
Beyond design-basis fire	2.2×10^{-3}	1.1×10^{-6}	1.6	8.2×10^{-4}	1.0×10^{-7}
Beyond design-basis explosion	3.2	1.6×10^{-3}	2.4×10^{3}	1.2	1.0×10^{-7}
Beyond design-basis earthquake	1.6	7.9×10^{-4}	1.2×10^{3}	0.58	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	6.0×10^{-4}	–	0.44	–
Expected risk (per year)	–	2.4×10^{-10}	–	1.8×10^{-7}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.2–2 and the MACCS computer code.

TABLE F.2.1.5.2–6.—*Multipurpose Reactor Fuel Fabrication High Consequence Accidents at Pantex Plant—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Criticality	3.9×10^{-5}	1.9×10^{-8}	1.7×10^{-3}	8.5×10^{-7}	1.0×10^{-7}
Beyond design-basis fire	1.5×10^{-3}	7.4×10^{-7}	0.21	1.1×10^{-4}	1.0×10^{-7}
Beyond design-basis explosion	2.2	1.1×10^{-3}	308	0.15	1.0×10^{-7}
Beyond design-basis earthquake	1.1	5.3×10^{-4}	152	0.076	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	4.0×10^{-4}	–	0.057	–
Expected risk (per year)	–	1.6×10^{-10}	–	2.3×10^{-8}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.2–2 and the MACCS computer code.

TABLE F.2.1.5.2–7.—*Multipurpose Reactor Fuel Fabrication High Consequence Accidents at Savannah River Site—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Criticality	2.6×10^{-6}	1.3×10^{-9}	3.4×10^{-3}	1.7×10^{-6}	1.0×10^{-7}
Beyond Design Basis Fire	9.5×10^{-5}	4.8×10^{-8}	0.66	3.3×10^{-4}	1.0×10^{-7}
Beyond Design Basis Explosion	0.14	6.9×10^{-5}	959	0.48	1.0×10^{-7}
Beyond Design Basis Earthquake	0.068	3.4×10^{-5}	471	0.24	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	2.6×10^{-5}	–	0.18	–
Expected risk (per year)	–	1.0×10^{-11}	–	7.2×10^{-8}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.2–2 and the MACCS computer code.

TABLE F.2.1.5.2–8.—*Multipurpose Reactor Fuel Fabrication High Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	Accident Frequency (per year)
Criticality	2.7×10^{-4}	1.1×10^{-7}	1.2×10^{-4}	4.7×10^{-8}	1.0×10^{-7}
Beyond design-basis fire	0.013	5.1×10^{-6}	4.7×10^{-3}	1.9×10^{-6}	1.0×10^{-7}
Beyond design-basis explosion	18	9.1×10^{-3}	6.8	2.9×10^{-3}	1.0×10^{-7}
Beyond design-basis earthquake	9	3.6×10^{-3}	3.3	1.3×10^{-3}	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	3.2×10^{-3}	–	1.1×10^{-3}	–
Expected risk (per year)	–	1.3×10^{-9}	–	4.2×10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.2–2 and the MACCS computer code.

TABLE F.2.1.5.2–9.—*Multipurpose Reactor Fuel Fabrication High Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Criticality	2.0×10^{-4}	7.9×10^{-8}	8.9×10^{-5}	3.5×10^{-8}	1.0×10^{-7}
Beyond design-basis fire	9.3×10^{-3}	3.7×10^{-6}	3.6×10^{-3}	1.4×10^{-6}	1.0×10^{-7}
Beyond design-basis explosion	14	6.2×10^{-3}	5.2	2.2×10^{-3}	1.0×10^{-7}
Beyond design-basis earthquake	6.6	2.7×10^{-3}	2.6	1.0×10^{-3}	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	2.2×10^{-3}	–	8.0×10^{-4}	–
Expected risk (per year)	–	8.9×10^{-10}	–	3.2×10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.2–2 and the MACCS computer code.

TABLE F.2.1.5.2–10.—*Multipurpose Reactor Fuel Fabrication High Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Criticality	2.5×10^{-4}	1.0×10^{-7}	1.0×10^{-4}	4.1×10^{-8}	1.0×10^{-7}
Beyond design-basis fire	0.013	5.0×10^{-6}	4.5×10^{-3}	1.8×10^{-6}	1.0×10^{-7}
Beyond design-basis explosion	18	8.5×10^{-3}	6.5	2.7×10^{-3}	1.0×10^{-7}
Beyond design-basis earthquake	9	3.6×10^{-3}	3.2	1.3×10^{-3}	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	3.0×10^{-3}	–	1.0×10^{-3}	–
Expected risk (per year)	–	1.2×10^{-9}	–	4.0×10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.2–2 and the MACCS computer code.

TABLE F.2.1.5.2–11.—*Multipurpose Reactor Fuel Fabrication High Consequence Accidents at Pantex Plant—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Criticality	1.2×10^{-4}	4.6×10^{-8}	5.1×10^{-5}	2.1×10^{-8}	1.0×10^{-7}
Beyond design-basis fire	5.5×10^{-3}	2.2×10^{-6}	2.1×10^{-3}	8.4×10^{-7}	1.0×10^{-7}
Beyond design-basis explosion	8	3.3×10^{-3}	3	1.2×10^{-3}	1.0×10^{-7}
Beyond design-basis earthquake	3.9	1.6×10^{-3}	1.5	6.0×10^{-4}	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	1.2×10^{-3}	–	4.6×10^{-4}	–
Expected risk (per year)	–	4.9×10^{-10}	–	1.8×10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.2–2 and the MACCS computer code.

TABLE F.2.1.5.2–12.—*Multipurpose Reactor Fuel Fabrication High Consequence Accidents at Savannah River Site—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Criticality	1.2×10^{-4}	4.6×10^{-8}	5.0×10^{-5}	2.0×10^{-8}	1.0×10^{-7}
Beyond design-basis fire	5.6×10^{-3}	2.2×10^{-6}	2.1×10^{-3}	8.3×10^{-7}	1.0×10^{-7}
Beyond design-basis explosion	8.1	3.5×10^{-3}	3	1.2×10^{-3}	1.0×10^{-7}
Beyond design-basis earthquake	4	1.6×10^{-3}	1.5	5.9×10^{-4}	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	1.3×10^{-3}	–	4.6×10^{-4}	–
Expected risk (per year)	–	5.0×10^{-10}	–	1.8×10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.2–2 and the MACCS computer code.

F.2.1.5.3 *Pit Disassembly and Conversion*

Criticality

Scenario. The postulated solid criticality accident is the result of accidental improper stacking of items. There will not be sufficient quantities of plutonium solutions in the mixed-oxide fuel fabrication area to cause a liquid criticality accident if mishandled. It is assumed that the postulated solid criticality incident would not exceed 5.0×10^{17} fissions. Table F.2.1.5.3–1 presents the source term for important nuclides released to the environment during the postulated criticality accident. The annual frequency of occurrence for the criticality accident is estimated to be less than 1.0×10^{-7} per year (LANL 1995b:1). For calculational purposes, the annual frequency of occurrence is assumed to be 1.0×10^{-7} per year.

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.5.3–2 through F.2.1.5.3–6 for public consequences and in tables F.2.1.5.3–7 through F.2.1.5.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.5.3–1 using the MACCS computer code.

Beyond Design-Basis Fire

Scenario. The accident postulated is a fire in a process cell area with coincident failure of major safety systems. It is assumed that the process cell contains a glovebox used for milling plutonium powder. The gloves have become coated with a layer of plutonium dust. The analysis estimated the glove loading at 2 grams of plutonium per glove. Each of the 12 gloves is assumed to be stowed outside of the glovebox. A flammable cleaning liquid such as acetone or isopropyl alcohol is brought into the process cell in violation of operating procedures, spills and ignites. All gloves are incinerated, but the sprinkler system does not activate to protect the glovebox from further damage. The ventilation system and HEPA filters are also assumed inoperative. Normally, closed doors are assumed to remain closed except during personnel evacuation from the area. The analysis using the LANL computer code known as GASFLOW was used to model the dispersion of the fire products. The analysis estimated that 0.034 gram of plutonium is released to the environment. The annual frequency of occurrence is estimated to be less than 1.0×10^{-7} per year. (LANL 1995b:1) For calculational purposes, the annual frequency of occurrence is assumed to be 1.0×10^{-7} per year. Table F.2.1.5.2–2 presents the isotopic distribution for a plutonium release at the mixed-oxide fuel reactor facility. Table F.2.1.5.3–1 presents the source term, by isotope, for the 0.034 gram of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.5.3–2 through F.2.1.5.3–6 for public consequences and in tables F.2.1.5.3–7 through F.2.1.5.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.5.3–1 using the MACCS computer code.

Beyond Design-Basis Explosion

Scenario. The explosion of an oxyacetylene bottle in a process cell has been postulated as a beyond design-basis explosion. The explosion has the potential to blow out the HEPA filters and cause significant damage to the ventilation system and nearby equipment. The explosion is postulated to occur in a process cell near a glovebox. The glovebox identified as having the most material at risk contains the milling operation where plutonium-oxide is milled to a fine powder prior to mixing with uranium dioxide. Based on a LANL TA-55 standard operating procedure, the criticality limit for plutonium-oxide in a dry atmosphere is assumed to be 4.5 kg. The analysis assumed the glovebox contains 4.5 kg of plutonium-oxide. The analysis estimated that 22.5 grams of plutonium is released up the stack. Sufficient control on the use of oxyacetylene welding equipment in process cells ensures that the probability of an accident occurring is less than 1.0×10^{-7} per year. (LANL 1995b:1) For calculational purposes, the annual frequency of occurrence is assumed to be 1.0×10^{-7} per year. Table F.2.1.5.2–2 presents the isotopic distribution for a plutonium release at the mixed-oxide fuel reactor facility. Table F.2.1.5.3–1 presents the source term, by isotope, for the 22.5 grams of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.5.3–2 through F.2.1.5.3–6 for public consequences and in tables F.2.1.5.3–7 through F.2.1.5.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.5.3–1 using the MACCS computer code.

Beyond Design-Basis Earthquake

Scenario. The following assumptions are made for a beyond design-basis earthquake analysis: (1) the ventilation system is disabled, (2) there is significant structural damage but the building does not totally collapse, (3) a ceiling slab falls on a glovebox with the most material at risk (4.5 kg of plutonium-oxide powder) and the glovebox is significantly damaged, (4) the process cell with the glovebox has one wall on the outside of the building, (5) this outside wall cracks and the cracks have a total length of 10 meters and a 1-mm width, (6) the wind is blowing at 10 m/s, and (7) the cracks are located on the lee side of the building. The analysis estimated that 11.3 g of plutonium was released at the building level. The annual frequency of occurrence is estimated to be less than 1.0×10^{-7} per year. (LANL1995b:1) For calculational purposes, the annual frequency of occurrence is assumed to be 1.0×10^{-7} per year. Table F.2.1.5.2–2 presents the isotopic distribution for a plutonium release at the mixed-oxide fuel reactor facility. Table F.2.1.5.3–1 presents the source term, by isotope, for the 11.3 grams of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident at each site are shown in tables F.2.1.5.3–2 through F.2.1.5.3–6 for public consequences and in tables F.2.1.5.3–7 through F.2.1.5.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.1.5.3–1 using the MACCS computer code.

Integrated Cancer Fatalities Complementary Cumulative Distribution Function for the Four Pit Disassembly and Conversion High Consequence Accidents

Figure F.2.1.5.3–1 shows the annual probability that, in the event of any accident in the composite set of mixed-oxide fuel fabrication high consequence accidents at one of the sites, the number of cancer fatalities exceeds the value N indicated on the horizontal axis. The curves, technically referred to as complementary cumulative distribution functions, reflect the probability of the accident's occurrence as well as the variability in the magnitude of its consequences. Generally, a curve that extends the farthest to the right has the highest accident consequences while a curve that is nearest to the left has the lowest accident consequences. A comparison of alternatives should include the information provided by these curves in conjunction with the point values shown in tables F.2.1.5.3–2 through F.2.1.5.3–11.

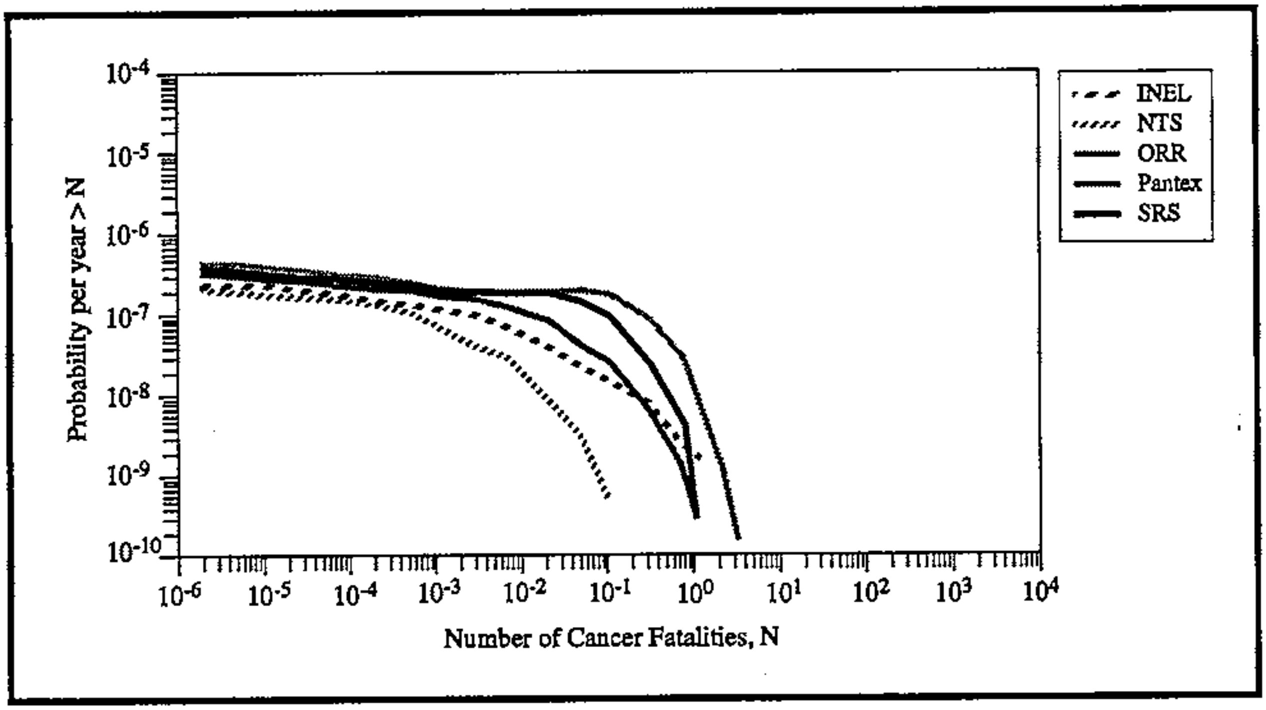

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FIGURE F.2.1.5.3–1.—*High Consequence Accident–Cancer Fatality Frequency Distributions Functions for the Disassembly and Conversion Facility.*

TABLE F.2.1.5.3–1.—*Pit Disassembly and Conversion High Consequence Accident Source Terms*

Isotope	Released Activity (curies)			
	Criticality	Beyond Design-Basis Fire	Beyond Design-Basis Explosion	Beyond Design-Basis Earthquake
Pu-238	0	2.9×10^{-4}	0.19	0.095
Pu-239	0	2.0×10^{-3}	1.3	0.65
Pu-240	0	4.6×10^{-4}	0.3	0.15
Pu-241	0	.014	9.1	4.6
Am-241	0	4.4×10^{-4}	0.29	0.14
Kr-83m	5.5	0	0	0
Kr-85m	3.6	0	0	0
Kr-85	4.1×10^{-5}	0	0	0
Kr-87	22	0	0	0
Kr-88	12	0	0	0
Kr-89	650	0	0	0
Xe-131m	5.0×10^{-3}	0	0	0
Xe-133m	0.11	0	0	0
Xe-133	1.4	0	0	0
Xe-135m	165	0	0	0
Xe-135	21	0	0	0
Xe-137	2.5×10^{3}	0	0	0
Xe-138	550	0	0	0
I-131	0.14	0	0	0
I-132	15	0	0	0
I-133	2	0	0	0
I-134	54	0	0	0
I-135	5.4	0	0	0

Source: Derived from LANL 1995def and table F.2.1.5.3–1.

TABLE F.2.1.5.3–2.—*Pit Disassembly and Conversion High Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Criticality	$1.1\text{x}10^{-5}$	$5.7\text{x}10^{-9}$	$3.2\text{x}10^{-3}$	$1.6\text{x}10^{-6}$	$1.0\text{x}10^{-7}$
Beyond design-basis fire	$1.0\text{x}10^{-4}$	$5.1\text{x}10^{-8}$	0.18	$8.9\text{x}10^{-5}$	$1.0\text{x}10^{-7}$
Beyond design-basis explosion	0.067	$3.3\text{x}10^{-5}$	116	0.058	$1.0\text{x}10^{-7}$
Beyond design-basis earthquake	0.033	$1.7\text{x}10^{-5}$	58	0.029	$1.0\text{x}10^{-7}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$1.2\text{x}10^{-5}$	–	0.022	–
Expected risk (per year)	–	$5.0\text{x}10^{-12}$	–	$8.7\text{x}10^{-9}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.3–1 and the MACCS computer code.

TABLE F.2.1.5.3–3.—*Pit Disassembly and Conversion High Consequence Accidents at Nevada Test Site—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Criticality	$3.3\text{x}10^{-5}$	$1.6\text{x}10^{-8}$	$3.0\text{x}10^{-4}$	$1.5\text{x}10^{-7}$	$1.0\text{x}10^{-7}$
Beyond design-basis fire	$2.8\text{x}10^{-4}$	$1.4\text{x}10^{-7}$	0.017	$8.5\text{x}10^{-6}$	$1.0\text{x}10^{-7}$
Beyond design-basis explosion	0.18	$9.1\text{x}10^{-5}$	11	$5.5\text{x}10^{-3}$	$1.0\text{x}10^{-7}$
Beyond design-basis earthquake	0.091	$4.5\text{x}10^{-5}$	5.5	$2.8\text{x}10^{-3}$	$1.0\text{x}10^{-7}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$3.4\text{x}10^{-5}$	–	$2.1\text{x}10^{-3}$	–
Expected risk (per year)	–	$1.4\text{x}10^{-11}$	–	$8.3\text{x}10^{-10}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.3–1 and the MACCS computer code.

TABLE F.2.1.5.3–4.—*Pit Disassembly and Conversion High Consequence Accidents at Oak Ridge Reservation—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Criticality	$2.3x10^{-4}$	$1.1x10^{-7}$	0.052	$2.6x10^{-5}$	$1.0x10^{-7}$
Beyond design basis fire	$2.2x10^{-3}$	$1.1x10^{-6}$	1.6	$8.2x10^{-4}$	$1.0x10^{-7}$
Beyond design basis explosion	1.4	$7.2x10^{-4}$	$1.1x10^{3}$	0.53	$1.0x10^{-7}$
Beyond design basis earthquake	0.72	$3.6x10^{-4}$	530	0.27	$1.0x10^{-7}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$2.7x10^{-4}$	–	0.20	–
Expected risk (per year)	–	$1.1x10^{-10}$	–	$8.0x10^{-8}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.3–1 and the MACCS computer code.

TABLE F.2.1.5.3–5.—*Pit Disassembly and Conversion High Consequence Accidents at Pantex Plant—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Criticality	$1.7x10^{-4}$	$8.4x10^{-8}$	$7.4x10^{-3}$	$3.7x10^{-6}$	$1.0x10^{-7}$
Beyond design-basis fire	$1.5x10^{-3}$	$7.4x10^{-7}$	0.21	$1.1x10^{-4}$	$1.0x10^{-7}$
Beyond design-basis explosion	0.97	$4.9x10^{-4}$	139	0.069	$1.0x10^{-7}$
Beyond design-basis earthquake	0.48	$2.4x10^{-4}$	69	0.035	$1.0x10^{-7}$
Evaluation of Composite Set of Accidents					
Expected consequences	–	$1.8x10^{-4}$	–	0.026	–
Expected risk (per year)	–	$7.3x10^{-11}$	–	$1.0x10^{-8}$	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.3–1 and the MACCS computer code.

TABLE F.2.1.5.3–6.—*Pit Disassembly and Conversion High Consequence Accidents at Savannah River Site—Public Consequences*

Accident Description	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accident Frequency (per year)
Criticality	1.0×10^{-5}	5.1×10^{-9}	0.016	7.7×10^{-6}	1.0×10^{-7}
Beyond design-basis fire	9.5×10^{-5}	4.8×10^{-8}	0.66	3.3×10^{-4}	1.0×10^{-7}
Beyond design-basis explosion	0.062	3.1×10^{-5}	432	0.22	1.0×10^{-7}
Beyond design-basis earthquake	0.032	1.5×10^{-5}	215	0.11	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	1.2×10^{-5}	–	0.081	–
Expected risk (per year)	–	4.6×10^{-12}	–	3.2×10^{-8}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.3–1 and the MACCS computer code.

TABLE F.2.1.5.3–7.—*Pit Disassembly and Conversion High Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Criticality	1.2×10^{-3}	4.9×10^{-7}	5.0×10^{-4}	2.0×10^{-7}	1.0×10^{-7}
Beyond design-basis fire	0.013	5.1×10^{-6}	4.7×10^{-3}	1.9×10^{-6}	1.0×10^{-7}
Beyond design-basis explosion	8.3	3.3×10^{-3}	3.0	1.2×10^{-3}	1.0×10^{-7}
Beyond design-basis earthquake	4.1	1.7×10^{-3}	1.5	6.1×10^{-4}	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	1.2×10^{-3}	–	4.6×10^{-4}	–
Expected risk (per year)	–	5.0×10^{-10}	–	1.8×10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.3–1 and the MACCS computer code.

TABLE F.2.1.5.3–8.—*Pit Disassembly and Conversion High Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Criticality	8.8×10^{-4}	3.5×10^{-7}	3.8×10^{-4}	1.5×10^{-7}	1.0×10^{-7}
Beyond design-basis fire	9.3×10^{-3}	3.7×10^{-6}	3.6×10^{-3}	1.4×10^{-6}	1.0×10^{-7}
Beyond design-basis explosion	6.1	2.4×10^{-3}	2.3	9.3×10^{-4}	1.0×10^{-7}
Beyond design-basis earthquake	3.	1.2×10^{-3}	1.2	4.6×10^{-4}	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	-	9.1×10^{-4}	-	3.5×10^{-4}	-
Expected risk (per year)	-	3.6×10^{-10}	-	1.4×10^{-10}	-

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.3–1 and the MACCS computer code.

TABLE F.2.1.5.3–9.—*Pit Disassembly and Conversion High Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Criticality	1.1×10^{-3}	4.5×10^{-7}	4.4×10^{-4}	1.8×10^{-7}	1.0×10^{-7}
Beyond design-basis fire	0.013	5.0×10^{-6}	4.5×10^{-3}	1.8×10^{-6}	1.0×10^{-7}
Beyond design-basis explosion	8.2	3.3×10^{-3}	2.9	1.2×10^{-3}	1.0×10^{-7}
Beyond design-basis earthquake	4.1	1.6×10^{-3}	1.5	5.8×10^{-4}	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	1.2×10^{-3}	–	4.4×10^{-4}	–
Expected risk (per year)	–	4.9×10^{-10}	–	1.8×10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.3–1 and the MACCS computer code.

TABLE F.2.1.5.3–10.—*Pit Disassembly and Conversion High Consequence Accidents at Pantex Plant —Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Criticality	5.2×10^{-4}	2.1×10^{-7}	2.2×10^{-4}	9.0×10^{-8}	1.0×10^{-7}
Beyond design-basis fire	5.5×10^{-3}	2.2×10^{-6}	2.1×10^{-3}	8.4×10^{-7}	1.0×10^{-7}
Beyond design-basis explosion	3.6	1.4×10^{-3}	1.4	5.5×10^{-4}	1.0×10^{-7}
Beyond design-basis earthquake	1.8	7.1×10^{-4}	0.68	2.7×10^{-4}	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	5.4×10^{-4}	–	2.0×10^{-4}	–
Expected risk (per year)	–	2.1×10^{-10}	–	8.2×10^{-11}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.3–1 and the MACCS computer code.

TABLE F.2.1.5.3–11.—*Pit Disassembly and Conversion High Consequence Accidents at Savannah River Site—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Criticality	5.2×10^{-4}	2.1×10^{-7}	2.2×10^{-4}	8.7×10^{-8}	1.0×10^{-7}
Beyond design-basis fire	5.6×10^{-3}	2.2×10^{-6}	2.1×10^{-3}	8.3×10^{-7}	1.0×10^{-7}
Beyond design-basis explosion	3.6	1.5×10^{-3}	1.4	5.4×10^{-4}	1.0×10^{-7}
Beyond design-basis earthquake	1.8	7.2×10^{-4}	0.68	2.7×10^{-4}	1.0×10^{-7}
Evaluation of Composite Set of Accidents					
Expected consequences	–	5.4×10^{-4}	–	2.0×10^{-4}	–
Expected risk (per year)	–	2.2×10^{-10}	–	8.2×10^{-11}	–

[a] Increased likelihood of cancer fatality.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source terms in table F.2.1.5.3–1 and the MACCS computer code.

F.2.1.6 *Tritium Target Extraction Facility*

Scenario. A tritium extraction facility removes tritium from targets. The accidents for the tritium extraction facility are based on the analysis of tritium operation at SRS. The high consequence accident for the facility postulated a beyond design-basis earthquake that caused the release of major portions of the process vessel tritium inventory. Approximately 2.4×10^6 Ci of tritium in oxide form could be released to the environment. The accident annual frequency of occurrence is estimated at 1.4×10^{-4} per year at SRS (DOE 1995d).

The accident annual frequency of occurrence for new facilities at the other candidate sites will be less than the frequency for existing facilities at SRS. It is assumed that the process systems, tanks, and confinement systems will be designed to maintain functional integrity following a design-basis earthquake or a safe shutdown earthquake with a return frequency of 1.0×10^{-4} per year. The evaluation also assumed that the process system pressure boundary and/or some of the active or passive safety systems may survive an earthquake with a return frequency of 1.0×10^{-5} per year but catastrophic failure of the facility could be expected after an earthquake with a return frequency of 1.0×10^{-6} per year. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence for all new facilities is assumed to be 1.0×10^{-6} per year.

Consequences. The estimated consequences of the postulated tritium target extraction facility accident for each site are shown for the public in table F.2.1.6–1, and for the worker in table F.2.1.6–2. NTS can be seen to have the lowest number of cancer fatalities in the event of this accident. The dose and cancer fatality estimates are based on analysis to the release of 2.4×10^6 Ci of tritium in the oxide form using the MACCS computer code.

Cancer Fatalities Complementary Cumulative Distribution Function for the Tritium Target Extraction Facility High Consequence Accident

Figure F.2.1.6–1 shows the annual probability that, in the event of the tritium target extraction facility high consequence accident at one of the sites, the number of cancer fatalities exceeds the value N indicated on the horizontal axis. The curves, technically referred to as complementary cumulative distribution functions, reflect the probability of the accident's occurrence as well as the variability in the magnitude of its consequences. Generally, a curve that extends the farthest to the right has the highest accident consequences while a curve that is nearest to the left has the lowest accident consequences. A comparison of alternatives should include the information provided by these curves in conjunction with the point values shown in tables F.2.1.6–1 and F.2.1.6–2.

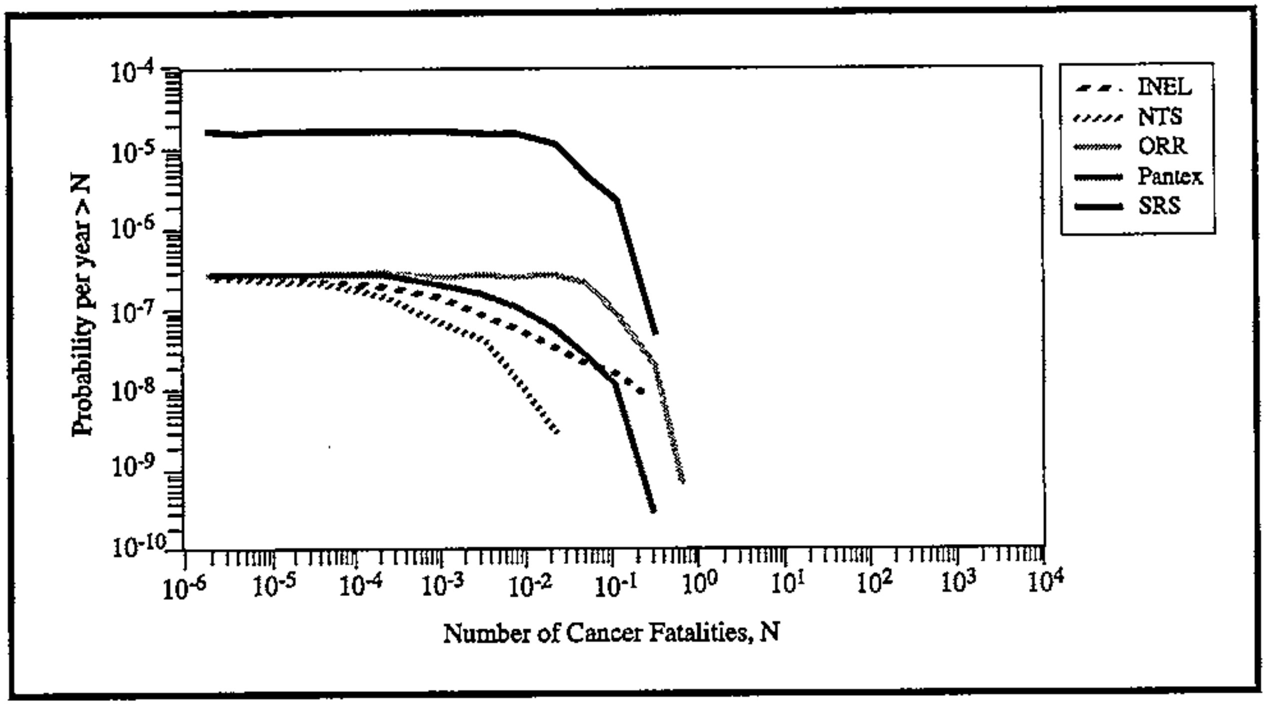

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FIGURE F.2.1.6–1.—*High Consequence Accident-Cancer Fatality Frequency Distribution Functions for Tritium Extraction.*

TABLE F.2.1.6–1.—*Tritium Target Extraction Facility High Consequence Accident —Public Consequences*

Site	Individual at Site Boundary: Dose (rem)	Individual at Site Boundary: Cancer Fatality[a]	Population to 50 Miles: Dose (person-rem)	Population to 50 Miles: Cancer Fatality	Accident Frequency (per year)
Idaho National Engineering Laboratory	0.014	6.9×10^{-6}	23	0.012	1.0×10^{-6}
Nevada Test Site	0.038	1.9×10^{-5}	2.2	1.1×10^{-3}	1.0×10^{-6}
Oak Ridge Reservation	0.3	1.5×10^{-4}	215	0.11	1.0×10^{-6}
Pantex Plant	0.2	1.0×10^{-4}	28	0.014	1.0×10^{-6}
Savannah River Site[b]	0.013	6.4×10^{-6}	86	0.043	1.4×10^{-4}
Expected Risk of Cancer Fatality (per year)					
Idaho National Engineering Laboratory	–	6.9×10^{-12}	–	1.2×10^{-8}	–
Nevada Test Site	–	1.9×10^{-11}	–	1.1×10^{-9}	–
Oak Ridge Reservation	–	1.5×10^{-10}	–	1.1×10^{-7}	–
Pantex Plant	–	1.0×10^{-10}	–	1.4×10^{-8}	–
Savannah River Site[c]	–	9.0×10^{-10}	–	6.0×10^{-6}	–

[a] Increased likelihood of cancer fatality.

[b] Values are shown for the SRS tritium extraction facility upgrade option.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source term of 2.4×10^6 Ci of tritium in oxide form and the MACCS computer code.

TABLE F.2.1.6–2.—*Tritium Target Extraction Facility High Consequence Accident —Worker Consequences*

Site	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Idaho National Engineering Laboratory	1.7	$6.8x10^{-4}$	0.63	$2.5x10^{-4}$	$1.0x10^{-6}$
Nevada Test Site	1.2	$5.0x10^{-4}$	0.48	$1.9x10^{-4}$	$1.0x10^{-6}$
Oak Ridge Reservation	1.7	$6.7x10^{-4}$	0.6	$2.4x10^{-4}$	$1.0x10^{-6}$
Pantex Plant	0.73	$2.9x10^{-4}$	0.28	$1.1x10^{-4}$	$1.0x10^{-6}$
Savannah River Site[b]	0.74	$3.0x10^{-4}$	0.28	$1.1x10^{-4}$	$1.4x10^{-4}$
Expected Risk of Cancer Fatality (per year)					
Idaho National Engineering Laboratery	–	$6.8x10^{-10}$	–	$2.5x10^{-10}$	–
Nevada Test Site	–	$5.0x10^{-10}$	–	$1.9x10^{-10}$	–
Oak Ridge Reservation	–	$6.7x10^{-10}$	–	$2.4x10^{-10}$	–
Pantex Plant	–	$2.9x10^{-10}$	–	$1.1x10^{-10}$	–
Savannah River Site[c]	–	$4.2x10^{-8}$	–	$1.5x10^{-8}$	–

[a] Increased likelihood of cancer fatality.

[b] Values are shown for the SRS tritium extraction facility upgrade option.

Note: All values are mean values. See section F.1.3.2 for details on the dose and cancer fatality estimates generated by the MACCS computer code.

Source: Calculated using the source term of $2.4x10^6$ Ci of tritium in oxide form and the MACCS computer code.

F.2.2 Tritium Supply and Recycling Facility Low-to-Moderate Consequence Accidents

Low-to-moderate consequence accidents for candidate tritium supply technologies and recycling facilities at potential sites (INEL, NTS, ORR, Pantex, and SRS) have been evaluated using the GENII computer code. The consequences are based on inhalation and external dose pathways. Ingestion pathways are modeled but not included because it is assumed the food and water supply will be interdicted. The details of the evaluation are presented in sections F.2.2.1 through F.2.2.6.

F.2.2.1 *Heavy Water Reactor*

Scenario. The HWR low-to-moderate consequence accident occurs due to a charge-and-discharge mishap. During refueling operations, an irradiated fuel assembly containing tritium targets is assumed to melt in air in the hot cell refueling canyon, due to an assumed failure of the crane motive systems and the water-delivery systems that are used to cool the fuel assembly. Initially, the hot cell vents to the environment through filters. After 1 minute, the hot cell is isolated and leaks into the containment, which in turn leaks to the environment at the rate of 0.1 percent of its volume per day. Table F.2.2.1–1 presents the source term released during the accident. The analysis did not estimate the accident annual frequency (DOE 1995d:B-3).

Consequences. The estimated consequences of the postulated accident for 50 percent meteorology conditions, to the public and worker at each site, are shown in tables F.2.2.1–2 and F.2.2.1–3, respectively. The dose estimates are based on analysis of the source term in table F.2.2.1–1 using the GENII computer code.

TABLE F.2.2.1–1.—*Source Term for Heavy Water Reactor Charge/Discharge Accident*

Isotope	Released Activity (curies)	Isotope	Released Activity (curies)
H-3	2.61×10^{3}	Xe-135	24.7
Br-83	0.0615	I-129	2.69×10^{-6}
Br-83	4.21×10^{-8}	I-131	70.5
Kr-83m	1.90	I-132	0.145
Kr-85	11.9	I-133	10.4
Kr-85m	54.0	I-134	2.47×10^{-4}
Kr-87	0.45	I-135	3.11
Kr-88	41.3	Cs-134	26.5
Rb-86	0.124	Cs-136	0.94
Xe-131m	15.4	Cs-137	9.69
Xe-133	2.90×10^{3}	Cs-138	1.00×10^{-7}
Xe-133m	558	Cs-139	1.62×10^{-26}

Source: DOE 1995d.

TABLE F.2.2.1–2.—*Heavy Water Reactor Charge/Discharge Accident—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Site	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Idaho National Engineering Laboratory	0.016	8.1×10^{-6}	150	0.074	[b]
Nevada Test Site	8.4×10^{-3}	4.2×10^{-6}	2.4	1.2×10^{-3}	[c]
Oak Ridge Reservation	0.14	6.8×10^{-5}	1.5×10^{3}	0.75	[c]
Pantex Plant	0.012	6.2×10^{-6}	52	0.026	[c]
Savannah River Site	0.046	2.3×10^{-5}	1.5×10^{3}	0.73	[c]
Expected Risk of Cancer Fatality (per year)					
Idaho National Engineering Laboratory	–	8.1×10^{-9}	–	7.4×10^{-5}	–
Nevada Test Site	–	4.2×10^{-9}	–	1.2×10^{-6}	–
Oak Ridge Reservation	–	6.8×10^{-8}	–	7.5×10^{-4}	–
Pantex Plant	–	6.2×10^{-9}	–	2.6×10^{-5}	–
Savannah River Site	–	2.3×10^{-8}	–	7.3×10^{-4}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 1.0×10^{-2} to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

Note: All values are mean values.

Source: Calculated using the source term in table F.2.2.1–1 and the GENII computer code.

TABLE F.2.2.1–3.—*Heavy Water Reactor Charge/Discharge Accident—Worker Consequences*

	Worker at 1,000 meters		Worker to 2,000 meters		
Site	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality[a]	Accident Frequency (per year)
Idaho National Engineering Laboratory	0.27	1.1×10^{-4}	0.088	3.5×10^{-5}	[b]
Nevada Test Site	0.07	2.8×10^{-5}	0.025	9.8×10^{-6}	[c]
Oak Ridge Reservation	0.41	1.6×10^{-4}	0.13	5.3×10^{-5}	[c]
Pantex Plant	0.031	1.2×10^{-5}	8.7×10^{-3}	3.5×10^{-6}	[c]
Savannah River Site	0.72	2.9×10^{-4}	0.25	9.8×10^{-5}	[c]
Expected Risk of Cancer Fatality per year)					
Idaho National Engineering Laboratory	–	1.1×10^{-7}	–	3.5×10^{-8}	–
Nevada Test Site	–	2.8×10^{-8}	–	9.8×10^{-9}	–
Oak Ridge Reservation	–	1.6×10^{-7}	–	5.3×10^{-8}	–
Pantex Plant	–	1.2×10^{-8}	–	3.5×10^{-9}	–
Savannah River Site	–	2.9×10^{-7}	–	9.8×10^{-8}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the $<1.0 \times 10^{-2}$ to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

Note: All values are mean values.

Source: Calculated using the source term in table F.2.2.1–1 and the GENII computer code.

F.2.2.2 *Modular High Temperature Gas-Cooled Reactor*

The draft of the PEIS, issued for review and comment in February 1995, considered a large break in the primary coolant system as the hounding MHTGR low-to-moderate consequence accident. The actual source term used in the analysis assumed the failure of redundant trains of safety class systems. The calculated accident consequences were significantly higher than the consequences for equivalent design-basis or evaluation-basis accidents where appropriate credit was taken for safety class systems to mitigate the accident consequences. The postulated bounding MHTGR low-to-moderate consequence accident was actually a beyond design-basis accident with high consequences and has been dropped from consideration as an MHTGR low-to-moderate consequence accident. A spectrum of low-to-moderate consequence accidents for MHTGRs was reviewed and two accidents were selected for evaluation in this document.

Small Primary System Break

Scenario. The accident postulated is a small break in the primary system piping that results in the release of the circulating radioactive material in the primary coolant into the containment. The containment leak rate to the environment is assumed at the rate of 1 percent per day (DOE1992i:I-13). Table F.2.2.2–1 presents the source term released to the environment. The accident annual frequency is in the moderate class (DOE1992i). Moderate frequency events are events that would reasonably be expected to occur once during any year of reactor operations (DOE1992i:I-8). For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be 1.0 per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.2–2 through F.2.2.2–6 for public consequences and in tables F.2.2.2–7 through F.2.2.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.2–1 using the GENII computer code.

Moderate Primary System Break

Scenario. The accident postulated is a moderate break in the primary system piping that results in the release of the circulating radioactive material in the primary coolant into the containment. The shear force of the coolant as it escapes the primary system is assumed to lift off any radioactive material deposited on the inside surfaces of the primary system and cause it to be released to the containment along with the circulating radioactive material. The containment leak rate to the environment is assumed at the rate of 1 percent per day (DOE1992i:I-13). Table F.2.2.2–1 presents the source term released to the environment. The accident annual frequency is in the infrequent class (DOE1992i). Infrequent frequency events are events that would reasonably be expected to occur once during the plant's lifetime (DOE1992i:I-8). For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be $2.5\text{x}10^{-2}$ per year (1 time in 40 years).

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.2–2 through F.2.2.2–6 for public consequences and in tables F.2.2.2–7 through F.2.2.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.2–1 using the GENII computer code.

TABLE F.2.2.2–1.— *Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accident Source Terms*

	Released Activity (curies)			Released Activity (curies)	
Isotope	Small Primary System Break	Moderate Primary System Break	Isotope	Small Primary System Break	Moderate Primary System Break
H-3	2.3	2.3	Sb-129	4.5×10^{-10}	4.5×10^{-8}
Kr-85m	0.017	1.3	Te-127m	1.4×10^{-6}	8.0×10^{-5}
Kr-85	0.014	0.014	Te-127	4.7×10^{-6}	2.7×10^{-4}
Kr-87	9.6×10^{-3}	0.89	Te-129m	1.2×10^{-5}	6.8×10^{-4}
Kr-88	0.031	2.7	Te-129	1.5×10^{-4}	0.014
Kr-89	2.2×10^{-4}	0.022	Te-131m	1.5×10^{-4}	9.5×10^{-3}
Kr-90	1.6×10^{-5}	1.6×10^{-3}	Te-132	4.6×10^{-4}	0.026
Rb-86	1.6×10^{-5}	9.3×10^{-4}	I-131	6.1×10^{-4}	0.036
Sr-89	1.1×10^{-5}	6.5×10^{-4}	I-132	1.2×10^{-3}	0.11
Sr-90	2.3×10^{-8}	1.3×10^{-6}	I-133	2.7×10^{-3}	0.18
Sr-91	1.3×10^{-8}	9.6×10^{-7}	I-134	1.2×10^{-3}	0.12
Y-90	2.3×10^{-10}	1.4×10^{-8}	I-135	2.4×10^{-3}	0.19
Y-91	2.2×10^{-10}	1.3×10^{-8}	Xe-133	0.2	2.5
Zr-95	2.2×10^{-10}	1.3×10^{-8}	Xe-135	0.033	2.1
Zr-97	1.1×10^{-8}	7.5×10^{-7}	Cs-134	3.2×10^{-10}	1.8×10^{-8}
Nb-95	4.0×10^{-10}	2.3×10^{-8}	Cs-136	8.9×10^{-11}	5.1×10^{-9}
Mo-99	4.2×10^{-9}	2.6×10^{-7}	Cs-137	1.0×10^{-10}	5.9×10^{-9}
Tc-99m	1.5×10^{-8}	1.2×10^{-6}	Ba-140	8.0×10^{-10}	4.6×10^{-8}
Ru-103	2.1×10^{-10}	1.2×10^{-8}	La-140	7.3×10^{-9}	4.6×10^{-7}
Ru-105	5.3×10^{-9}	4.4×10^{-7}	Ce-141	4.2×10^{-10}	2.4×10^{-8}
Ru-106	2.0×10^{-12}	1.2×10^{-10}	Ce-143	6.7×10^{-9}	4.3×10^{-7}
Rh-105	1.8×10^{-9}	1.1×10^{-7}	Ce-144	1.9×10^{-11}	1.1×10^{-9}
Ag-110m	2.2×10^{-14}	1.3×10^{-12}	Pr-143	9.2×10^{-10}	5.3×10^{-8}
Sb-127	1.0×10^{-10}	6.3×10^{-9}	Nd-147	4.6×10^{-10}	2.6×10^{-8}

Source: DOE 1992i.

TABLE F.2.2.2–2.— ***Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory–Public Consequences***

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	**Dose (rem)**	**Cancer Fatality[a]**	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
Primary System Break					
Small	$3.1x10^{-7}$	$1.5x10^{-10}$	$2.2x10^{-3}$	$1.1x10^{-6}$	1
Moderate	$1.0x10^{-5}$	$5.1x10^{-9}$	0.04	$2.0x10^{-5}$	$2.5x10^{-2}$
Expected Risk of Cancer Fatality (per year)					
Primary System Break					
Small	–	$1.5x10^{-10}$	–	$1.1x10^{-6}$	–
Moderate	–	$1.3x10^{-10}$	–	$5.0x10^{-7}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.2–1 and the GENII computer code.

TABLE F.2.2.2–3.—***Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Nevada Test Site—Public Consequences***

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	**Dose (rem)**	**Cancer Fatality[a]**	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
Primary System Break					
Small	$1.3x10^{-7}$	$6.6x10^{-11}$	$4.3x10^{-5}$	$2.1x10^{-8}$	1
Moderate	$4.4x10^{-6}$	$2.2x10^{-9}$	$1.4x10^{-3}$	$6.8x10^{-7}$	$2.5x10^{-2}$
Expected Risk of Cancer Fatality (per year)					
Primary System Break					
Small	–	$6.6x10^{-11}$	–	$2.1x10^{-8}$	–
Moderate	–	$5.5x10^{-11}$	–	$1.7x10^{-8}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.2–1 and the GENII computer code.

TABLE F.2.2.2–4.—*Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Oak Ridge Reservation—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Primary System Break					
Small	$2.5x10^{-6}$	$1.2x10^{-9}$	0.028	$1.4x10^{-5}$	1
Moderate	$8.7x10^{-5}$	$4.4x10^{-8}$	0.86	$4.3x10^{-4}$	$2.5x10^{-2}$
Expected Risk of Cancer Fatality (per year)					
Primary System Break					
Small	–	$1.2x10^{-9}$	–	$1.4x10^{-5}$	–
Moderate	–	$1.1x10^{-9}$	–	$1.1x10^{-5}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.2–1 and the GENII computer code.

TABLE F.2.2.2–5.—*Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Pantex Plant—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Primary System Break					
Small	$2.3x10^{-7}$	$1.2x10^{-10}$	$8.8x10^{-4}$	$4.4x10^{-7}$	1
Moderate	$7.9x10^{-6}$	$4.0x10^{-9}$	0.025	$1.2x10^{-5}$	$2.5x10^{-2}$
Expected Risk of Cancer Fatality (per year)					
Primary System Break					
Small	–	$1.2x10^{-10}$	–	$4.4x10^{-7}$	–
Moderate	–	$1.0x10^{-10}$	–	$3.0x10^{-7}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in tableF.2.2.2–1 and the GENII computer code.

TABLE F.2.2.2–6.— *Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Savannah River Site—Public Consequences*

Accident Description	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accident Frequency (per year)
Primary System Break					
Small	7.9×10^{-7}	4.0×10^{-10}	0.022	1.1×10^{-5}	1
Moderate	2.4×10^{-5}	1.2×10^{-8}	0.5	2.5×10^{-4}	2.5×10^{-2}
Expected Risk of Cancer Fatality (per year)					
Primary System Break					
Small	–	4.0×10^{-10}	–	1.1×10^{-5}	–
Moderate	–	3.0×10^{-10}	–	6.3×10^{-6}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.2–1 and the GENII computer code.

TABLE F.2.2.2–7.— *Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory–Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (person-rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Primary System Break					
Small	1.1×10^{-5}	4.5×10^{-9}	3.7×10^{-6}	1.5×10^{-9}	1
Moderate	3.2×10^{-4}	1.3×10^{-7}	1.1×10^{-4}	4.2×10^{-8}	2.5×10^{-2}
Expected Risk of Cancer Fatality (per year)					
Primary System Break					
Small	–	4.5×10^{-9}	–	1.5×10^{-9}	–
Moderate	–	3.3×10^{-9}	–	1.1×10^{-9}	–

[a] Increased likelihood of cancer fatality.

Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.2–1 and the GENII computer code.

TABLE F.2.2.2–8.— ***Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Nevada Test Site—Worker Consequences***

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Primary System Break					
Small	$3.0x10^{-6}$	$1.2x10^{-9}$	$1.1x10^{-6}$	$4.2x10^{-10}$	1
Moderate	$8.2x10^{-5}$	$3.3x10^{-8}$	$3.0x10^{-5}$	$1.2x10^{-8}$	$2.5x10^{-2}$
Expected Risk of Cancer Fatality (per year)					
Primary System Break					
Small	–	$1.2x10^{-9}$	–	$4.2x10^{-10}$	–
Moderate	–	$8.3x10^{-10}$	–	$3.0x10^{-10}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.2–1 and the GENII computer code.

TABLE F.2.2.2–9.— ***Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Oak Ridge Reservation—Worker Consequences***

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Primary System Break					
Small	$1.7x10^{-5}$	$6.9x10^{-9}$	$5.8x10^{-6}$	$2.3x10^{-9}$	1
Moderate	$4.8x10^{-4}$	$1.9x10^{-7}$	$1.6x10^{-4}$	$6.5x10^{-8}$	$2.5x10^{-2}$
Expected Risk of Cancer Fatality (per year)					
Primary System Break					
Small	–	$6.9x10^{-9}$	–	$2.3x10^{-9}$	–
Moderate	–	$4.8x10^{-9}$	–	$1.6x10^{-9}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.2–1 and the GENII computer code.

TABLE F.2.2.2–10.— ***Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Pantex Plant—Worker Consequences***

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Primary System Break					
Small	1.3×10^{-6}	5.3×10^{-10}	3.7×10^{-7}	1.5×10^{-10}	1
Moderate	3.8×10^{-5}	1.5×10^{-8}	1.0×10^{-5}	4.2×10^{-9}	2.5×10^{-2}
Expected Risk of Cancer Fatality (per year)					
Primary System Break					
Small	–	5.3×10^{-10}	–	1.5×10^{-10}	–
Moderate	–	3.8×10^{-10}	–	1.1×10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.2–1 and the GENII computer code.

TABLE F.2.2.2–11.— ***Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Savannah River Site—Worker Consequences***

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Primary System Break					
Small	3.0×10^{-5}	1.2×10^{-8}	1.0×10^{-5}	4.2×10^{-9}	1
Moderate	8.5×10^{-4}	3.4×10^{-7}	2.9×10^{-4}	1.2×10^{-7}	2.5×10^{-2}
Expected Risk of Cancer Fatality (per year)					
Primary System Break					
Small	–	1.2×10^{-8}	–	4.2×10^{-9}	–
Moderate	–	8.5×10^{-9}	–	3.0×10^{-9}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.2–1 and the GENII computer code.

F.2.2.3 *Advanced Light Water Reactor*

The draft of this PEIS, issued for review and comment in February 1995, considered a large break in the primary coolant system as the bounding ALWR low-to-moderate consequence accident. The actual source term used in the analysis assumed the failure of redundant trains of safety class systems. The calculated accident consequences were significantly higher than the consequences for equivalent design-basis or evaluation basis accidents where appropriate credit was taken for safety class systems to mitigate the accident consequences. The postulated bounding ALWR low-to-moderate consequence accident was actually a beyond design-basis accident with high consequences and has been dropped from consideration as an ALWR low-to-moderate consequence accident.

A spectrum of low-to-moderate consequence accidents for Large and Small ALWRs are evaluated in this document. The evaluation considered the AP600 Reactor, the Simplified Boiling Water Reactor, and the Advanced Boiling Water Reactor options. Data was not available for the CE System 80+ ALWR option. Sections F.2.2.3.1 through F.2.2.3.3 present the evaluations for the AP600 Reactor, the Simplified Boiling Water Reactor, and the Advanced Boiling Water Reactor options.

F.2.2.3.1 *AP600 Reactor*

Reactor Coolant Pump Shaft Seizure (Locked Rotor)

Scenario. The accident postulated is an instantaneous seizure of a reactor coolant pump rotor. The reactor will trip on a low-flow signal and the turbine will trip. Following the reactor trip, heat stored in the fuel rods and the target assemblies continues to be transferred to the coolant, causing the coolant to expand and the reactor coolant system to pressurize. The pressurizer safety valves open to control the overpressure transient. There are two components to the radioactive releases to the environment; the activity initially in the secondary coolant at the time of the accident and the activity from the reactor coolant leaking into the steam generator is assumed to mix with the secondary coolant. Radioactive releases to the environment will continue as long as the secondary coolant steam releases continue. Table F.2.2.3.1–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence (TTI 1995b). It is expected that the postulated annual frequency of occurrence would range from $1.0x10^{-4}$ to $1.0x10^{-6}$ per year. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be $1.0x10^{-5}$ per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.3.1–2 through F.2.2.3.1–6 for public consequences and in tables F.2.2.3.1–7 through F.2.2.3.1–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.3.1–1 using the GENII computer code.

Rod Cluster Control Assembly Ejection

Scenario. The accident postulated the continuous withdrawal of a single rod control cluster assembly. This results in an increase in core power and coolant temperature. The reactor ultimately trips. Following reactor trip, normal reactor shutdown procedures are followed. Table F.2.2.3.1–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence (TTI 1995b). It is expected that the postulated annual frequency of occurrence would range from 0.01 to $1.0x10^{-4}$ per year. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be $1.0x10^{-3}$ per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.3.1–2 through F.2.2.3.1–6 for public consequences and in tables F.2.2.3.1–7 through F.2.2.3.1–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.3.1–1 using the GENII computer code.

Failure of Small Primary Coolant Line Outside of Containment

Scenario. The accident postulated the failure of a sample line between the isolation valve outside of containment and the sample panel. The sample line includes a flow restrictor at the sample point to limit the break flow to less than 130 gpm. The analysis assumed that the flow from the break was isolated after 30 minutes. Table F.2.2.3.1–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence. It is expected that the postulated annual frequency of occurrence would range from 0.01 to $1.0\text{x}10^{-4}$ per year. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be $1.0\text{x}10^{-3}$ per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.3.1–2 through F.2.2.3.1–6 for public consequences and in tables F.2.2.3.1–7 through F.2.2.3.1–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.3.1–1 using the GENII computer code.

Steam Generator Tube Rupture

Scenario. The accident postulated the complete severance of a single steam generator tube which leads to an increase in contamination of the secondary system due to leakage of radioactive coolant from the reactor coolant system. Continued loss of reactor coolant inventory leads to a reactor trip. The analysis assumed that the accident occurred coincident with the loss of offsite power and the high steam generator pressure causes a steam discharge to the atmosphere. The analysis also assumed that the initial iodine concentrations are those associated with the design fuel defect level. The iodine spike is assumed to be initiated by the accident. Table F.2.2.3.1–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence. It is expected that the postulated annual frequency of occurrence would range from $1.0\text{x}10^{-3}$ to $1.0\text{x}10^{-5}$ per year. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be $1.0\text{x}10^{-4}$ per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.3.1–2 through F.2.2.3.1–6 for public consequences and in tables F.2.2.3.1–7 through F.2.2.3.1–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.3.1–1 using the GENII computer code.

Fuel Handling Accident

Scenario. The accident postulated that a spent fuel/target assembly dropped outside of containment in the auxiliary building fuel handling area. The analysis assumed that the assembly was dropped in such a way that every rod/target in the assembly has its cladding breached. The analysis also assumed that subsequent to the fuel handling accident, there was a loss of spent fuel cooling capability for up to 72 hours resulting in boiling water in the spent fuel pool. Table F.2.2.3.1–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence. It is expected that the postulated annual frequency of occurrence would range from $1.0\text{x}10^{-4}$ to $1.0\text{x}10^{-6}$ per year. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be $1.0\text{x}10^{-5}$ per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.3.1–2 through F.2.2.3.1–6 for public consequences and in tables F.2.2.3.1–7 through F.2.2.3.1–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.3.1–1 using the GENII computer code.

TABLE F.2.2.3.1–1.—*AP600 Low-to-Moderate Consequence Accident Source Terms*

Isotope	Released Activity (curies)				
	Reactor Coolant Pump Shaft Seizure	Rod Cluster Control Assembly Ejection	Failure of Small Primary Coolant Line Outside Containment	Steam Generator Tube Rupture	Fuel Handling
H-3	$3.8x10^4$	$9.2x10^4$	$1.4x10^3$	$1.2x10^4$	0
I-131	63	60	22	15	230
I-132	24	45	120	75	3.7
I-133	110	100	47	33	9.6
I-134	47	41	54	30	0
I-135	150	77	45	31	0
Xe-131m	12	29	5.8	32	130
Xe-133m	470	330	53	290	$2.3x10^3$
Xe-133	$3.3x10^3$	$4.6x10^3$	820	4.7x10	$2.7x10^4$
Xe-135m	11	6.2	0.49	1.7	0
Xe-135	820	180	24	130	51
Xe-138	41	25	0.83	2.8	0
Kr-85m	240	39	5.9	31	0
Kr-85	58	150	21	120	610
Kr-87	140	24	2.9	14	0
Kr-88	450	67	9.7	51	0

Source: TTI 1995b.

TABLE F.2.2.3.1–2.—*AP600 Reactor Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Reactor coolant pump shaft seizure	$9.3x10^{-3}$	$4.7x10^{-6}$	67	0.034	[b]
Rod cluster control assembly ejection	0.012	$6.0x10^{-6}$	100	0.051	[c]
Failure of small primary coolant line outside containment	$2.6x10^{-3}$	$1.3x10^{-6}$	16	$8.1x10^{-3}$	[d]
Steam Generator Tube Rupture	$2.6x10^{-3}$	$1.3x10^{-6}$	19	$9.3x10^{-3}$	[d]
Fuel handling	0.014	$6.8x10^{-6}$	120	0.062	[c]
Expected Risk of Cancer Fatality (per year)					
Reactor coolant pump shaft seizure	–	$4.7x10^{-11}$	–	$3.4x10^{-7}$	–
Rod cluster control assembly ejection	–	$6.0x10^{-9}$	–	$5.1x10^{-5}$	–
Failure of small primary coolant line outside containment	–	$1.3x10^{-9}$	–	$8.1x10^{-6}$	–
Steam generator tube rupture	–	$1.3x10^{-10}$	–	$9.3x10^{-7}$	–
Fuel handling	–	$6.8x10^{-11}$	–	$6.2x10^{-7}$	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the $1.0x10^{-4}$ to $1.0x10^{-6}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-5}$ per year.

[c] Data not available. The value is expected to be in the 0.01 to $1.0x10^{-4}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-3}$ per year.

[d] Data not available. The value is expected to be in the $1.0x10^{-3}$ to $1.0x10^{-5}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-4}$ per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.1–1 and the GENII computer code.

TABLE F.2.2.3.1–3.—*AP600 Reactor Low-to-Moderate Consequence Accidents at Nevada Test Site—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Reactor coolant pump shaft seizure	$4.1x10^{-3}$	$2.1x10^{-6}$	1.3	$6.7x10^{-4}$	[b]
Rod cluster control assembly ejection	$5.4x10^{-3}$	$2.7x10^{-6}$	1.8	$9.0x10^{-4}$	[c]
Failure of small primary coolant line outside containment	$1.2x10^{-3}$	$5.9x10^{-7}$	0.35	$1.8x10^{-4}$	[d]
Steam generator tube rupture	$1.2x10^{-3}$	$5.9x10^{-7}$	0.38	$1.9x10^{-4}$	[d]
Fuel handling	$6.0x10^{-3}$	$3.0x10^{-6}$	2.1	$1.0x10^{-3}$	[c]
Expected Risk of Cancer Fatality (per year)					
Reactor coolant pump shaft seizure	–	$2.1x10^{-11}$	–	$6.7x10^{-9}$	–
Rod cluster control assembly ejection	–	$2.7x10^{-9}$	–	$9.0x10^{-7}$	–
Failure of small primary coolant line outside containment	–	$5.9x10^{-10}$	–	$1.8x10^{-7}$	–
Steam generator tube rupture	–	$5.9x10^{-11}$	–	$1.9x10^{-8}$	–
Fuel handling	–	$3.0x10^{-11}$	–	$1.0x10^{-8}$	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the $1.0x10^{-4}$ to $1.0x10^{-6}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-5}$ per year.

[c] Data not available. The value is expected to be in the 0.01 to $1.0x10^{-4}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-3}$ per year.

[d] Data not available. The value is expected to be in the $1.0x10^{-3}$ to $1.0x10^{-5}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-4}$ per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.1–1 and the GENII computer code.

TABLE F.2.2.3.1–4.—*AP600 Reactor Low-to-Moderate Consequence Accidents at Oak Ridge Reservation—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Reactor coolant pump shaft seizure	0.079	4.0×10^{-5}	840	0.42	[b]
Rod cluster control assembly ejection	0.1	5.1×10^{-5}	1.1×10^{3}	0.55	[c]
Failure of small primary coolant line outside containment	0.023	1.2×10^{-5}	230	0.11	[d]
Steam generator tube rupture	0.023	1.2×10^{-5}	240	0.12	[d]
Fuel handling	0.12	5.8×10^{-5}	1.3×10^{3}	0.64	[c]
Expected Risk of Cancer Fatality (per year)					
Reactor coolant pump shaft seizure	–	4.0×10^{-10}	–	4.2×10^{-6}	–
Rod cluster control assembly ejection	–	5.1×10^{-8}	–	5.5×10^{-4}	–
Failure of small primary coolant line outside containment	–	1.2×10^{-8}	–	1.1×10^{-4}	–
Steam generator tube rupture	–	1.2×10^{-9}	–	1.2×10^{-5}	–
Fuel handling	–	5.8×10^{-10}	–	6.4×10^{-6}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

[c] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[d] Data not available. The value is expected to be in the 1.0×10^{-3} to 1.0×10^{-5} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-4} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.1–1 and the GENII computer code.

TABLE F.2.2.3.1–5.—*AP600 Reactor Low-to-Moderate Consequence Accidents at Pantex Plant—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Reactor coolant pump shaft seizure	7.2×10^{-3}	3.6×10^{-6}	27	0.013	[b]
Rod cluster control assembly ejection	9.3×10^{-3}	4.6×10^{-6}	37	0.018	[c]
Failure of small primary coolant line outside containment	2.1×10^{-3}	1.1×10^{-6}	7.1	3.6×10^{-3}	[d]
Steam generator tube rupture	2.1×10^{-3}	1.1×10^{-6}	7.8	3.9×10^{-3}	[d]
Fuel handling	0.01	5.2×10^{-6}	42	0.021	[c]
Expected Risk of Cancer Fatality (per year)					
Reactor coolant pump shaft seizure	–	3.6×10^{-11}	–	1.3×10^{-7}	–
Rod cluster control assembly ejection	–	4.6×10^{-9}	–	1.8×10^{-5}	–
Failure of small primary coolant line outside containment	–	1.1×10^{-9}	–	3.6×10^{-6}	–
Steam generator tube rupture	–	1.1×10^{-10}	–	3.9×10^{-7}	–
Fuel handling	–	5.2×10^{-11}	–	2.1×10^{-7}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

[c] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[d] Data not available. The value is expected to be in the 1.0×10^{-3} to 1.0×10^{-5} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-4} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.1–1 and the GENII computer code.

TABLE F.2.2.3.1–6.—*AP600 Reactor Low-to-Moderate Consequence Accidents at Savannah River Site—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Reactor coolant pump shaft seizure	0.025	$1.3\text{x}10^{-5}$	690	0.34	[b]
Rod cluster control assembly ejection	0.032	$1.6\text{x}10^{-5}$	980	0.49	[c]
Failure of small primary coolant line outside containment	$6.6\text{x}10^{-3}$	$3.3\text{x}10^{-6}$	170	0.084	[d]
Steam generator tube rupture	$7.0\text{x}10^{-3}$	$3.5\text{x}10^{-6}$	190	0.097	[d]
Fuel handling	0.039	$2.0\text{x}10^{-5}$	$1.2\text{x}10^{3}$	0.6	[c]
Expected Risk of Cancer Fatality (per year)					
Reactor coolant pump shaft seizure	–	$1.3\text{x}10^{-10}$	–	$3.4\text{x}10^{-6}$	–
Rod cluster control assembly ejection	–	$1.6\text{x}10^{-8}$	–	$4.9\text{x}10^{-4}$	–
Failure of small primary coolant line outside containment	–	$3.3\text{x}10^{-9}$	–	$8.4\text{x}10^{-5}$	–
Steam generator tube rupture	–	$3.5\text{x}10^{-10}$	–	$9.7\text{x}10^{-6}$	–
Fuel handling	–	$2.0\text{x}10^{-10}$	–	$6.0\text{x}10^{-6}$	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the $1.0\text{x}10^{-4}$ to $1.0\text{x}10^{-6}$ per year range. For calculational purposes, the value is assumed to be $1.0\text{x}10^{-5}$ per year.

[c] Data not available. The value is expected to be in the 0.01 to $1.0\text{x}10^{-4}$ per year range. For calculational purposes, the value is assumed to be $1.0\text{x}10^{-3}$ per year.

[d] Data not available. The value is expected to be in the $1.0\text{x}10^{-3}$ to $1.0\text{x}10^{-5}$ per year range. For calculational purposes, the value is assumed to be $1.0\text{x}10^{-4}$ per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.1–1 and the GENII computer code.

TABLE F.2.2.3.1–7.—*AP600 Reactor Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	Accident Frequency (per year)
Reactor coolant pump shaft seizure	0.29	$1.2\text{x}10^{-4}$	0.096	$3.8\text{x}10^{-5}$	[b]
Rod cluster control assembly ejection	0.41	$1.6\text{x}10^{-4}$	0.14	$5.4\text{x}10^{-5}$	[c]
Failure of small primary coolant line outside containment	0.067	$2.7\text{x}10^{-5}$	0.022	$8.9\text{x}10^{-6}$	[d]
Steam generator tube rupture	0.084	$3.4\text{x}10^{-5}$	0.029	$1.1\text{x}10^{-5}$	[d]
Fuel handling	0.33	$1.3\text{x}10^{-4}$	0.11	$4.5\text{x}10^{-5}$	[c]
Expected Risk of Cancer Fatality (per year)					
Reactor coolant pump shaft seizure	–	$1.2\text{x}10^{-9}$	–	$3.8\text{x}10^{-10}$	–
Rod cluster control assembly ejection	–	$1.6\text{x}10^{-7}$	–	$5.4\text{x}10^{-8}$	–
Failure of small primary coolant line outside containment	–	$2.7\text{x}10^{-8}$	–	$8.9\text{x}10^{-9}$	–
Steam generator tube rupture	–	$3.4\text{x}10^{-9}$	–	$1.1\text{x}10^{-9}$	–
Fuel handling	–	$1.3\text{x}10^{-9}$	–	$4.5\text{x}10^{-10}$	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the $1.0\text{x}10^{-4}$ to $1.0\text{x}10^{-6}$ per year range. For calculational purposes, the value is assumed to be $1.0\text{x}10^{-5}$ per year.

[c] Data not available. The value is expected to be in the 0.01 to $1.0\text{x}10^{-4}$ per year range. For calculational purposes, the value is assumed to be $1.0\text{x}10^{-3}$ per year.

[d] Data not available. The value is expected to be in the $1.0\text{x}10^{-3}$ to $1.0\text{x}10^{-5}$ per year range. For calculational purposes, the value is assumed to be $1.0\text{x}10^{-4}$ per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.1–1 and the GENII computer code.

TABLE F.2.2.3.1–8.—*AP600 Reactor Low-to-Moderate Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Reactor coolant pump shaft seizure	0.085	3.4×10^{-5}	0.029	1.1×10^{-5}	b
Rod cluster control assembly ejection	0.12	5.0×10^{-5}	0.041	1.6×10^{-5}	c
Failure of small primary coolant line outside containment	0.02	8.0×10^{-6}	6.6×10^{-3}	2.6×10^{-6}	d
Steam generator tube rupture	0.025	9.9×10^{-6}	8.3×10^{-3}	3.3×10^{-6}	d
Fuel handling	0.097	3.9×10^{-5}	0.033	1.3×10^{-5}	c
Expected Risk of Cancer Fatality (per year)					
Reactor coolant pump shaft seizure	–	3.4×10^{-10}	–	1.1×10^{-10}	–
Rod cluster control assembly ejection	–	5.0×10^{-8}	–	1.6×10^{-8}	–
Failure of small primary coolant line outside containment	–	8.0×10^{-9}	–	2.6×10^{-9}	–
Steam generator tube rupture	–	9.9×10^{-10}	–	3.3×10^{-10}	–
Fuel handling	–	3.9×10^{-10}	–	1.3×10^{-10}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

[c] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[d] Data not available. The value is expected to be in the 1.0×10^{-3} to 1.0×10^{-5} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-4} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.1–1 and the GENII computer code.

TABLE F.2.2.3.1–9.—*AP600 Reactor Low-to-Moderate Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Reactor coolant pump shaft seizure	0.44	1.8×10^{-4}	0.15	6.0×10^{-5}	b
Rod cluster control assembly ejection	0.63	2.5×10^{-4}	0.21	8.6×10^{-5}	c
Failure of small primary coolant line outside containment	0.1	4.0×10^{-5}	0.034	1.4×10^{-5}	d
Steam generator tube rupture	0.13	5.2×10^{-5}	0.043	1.7×10^{-5}	d
Fuel handling	0.52	2.1×10^{-4}	0.17	6.7×10^{-5}	c
Expected Risk of Cancer Fatality (per year)					
Reactor coolant pump shaft seizure	–	1.8×10^{-9}	–	6.0×10^{-10}	–
Rod cluster control assembly ejection	–	2.5×10^{-7}	–	8.6×10^{-8}	–
Failure of small primary coolant line outside containment	–	4.0×10^{-8}	–	1.4×10^{-8}	–
Steam generator tube rupture	–	5.2×10^{-9}	–	1.7×10^{-9}	–
Fuel handling	–	2.1×10^{-9}	–	6.7×10^{-10}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

[c] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[d] Data not available. The value is expected to be in the 1.0×10^{-3} to 1.0×10^{-5} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-4} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.1–1 and the GENII computer code.

TABLE F.2.2.3.1–10.—*AP600 Reactor Low-to-Moderate Consequence Accidents at Pantex Plant—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	Accident Frequency (per year)
Reactor coolant pump shaft seizure	0.033	$1.3x10^{-5}$	$9.4x10^{-3}$	$3.8x10^{-6}$	[b]
Rod cluster control assembly ejection	0.049	$1.9x10^{-5}$	0.014	$5.4x10^{-6}$	[c]
Failure of small primary coolant line outside containment	$7.9x10^{-3}$	$3.2x10^{-6}$	$2.2x10^{-3}$	$8.8x10^{-7}$	[d]
Steam generator tube rupture	$9.9x10^{-3}$	$4.0x10^{-6}$	$2.8x10^{-3}$	$1.1x10^{-6}$	[d]
Fuel handling	0.039	$1.6x10^{-5}$	0.011	$4.4x10^{-6}$	[c]
Expected Risk of Cancer Fatality (per year)					
Reactor coolant pump shaft seizure	–	$1.3x10^{-10}$	–	$3.8x10^{-11}$	–
Rod cluster control assembly ejection	–	$1.9x10^{-8}$	–	$5.4x10^{-9}$	–
Failure of small primary coolant line outside containment	–	$3.2x10^{-9}$	–	$8.8x10^{-10}$	–
Steam generator tube rupture	–	$4.0x10^{-10}$	–	$1.1x10^{-10}$	–
Fuel handling	–	$1.6x10^{-10}$	–	$4.4x10^{-11}$	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the $1.0x10^{-4}$ to $1.0x10^{-6}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-5}$ per year.

[c] Data not available. The value is expected to be in the 0.01 to $1.0x10^{-4}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-3}$ per year.

[d] Data not available. The value is expected to be in the $1.0x10^{-3}$ to $1.0x10^{-5}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-4}$ per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.1–1 and the GENII computer code.

TABLE F.2.2.3.1–11.—*AP600 Reactor Low-to-Moderate Consequence Accidents at Savannah River Site—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	Accident Frequency (per year)
Reactor coolant pump shaft seizure	0.76	$3.0x10^{-4}$	0.27	$1.1x10^{-4}$	[b]
Rod cluster control assembly ejection	1.1	$4.4x10^{-4}$	0.38	$1.5x10^{-4}$	[c]
Failure of small primary coolant line outside containment	0.18	$7.3x10^{-5}$	0.059	$2.4x10^{-5}$	[d]
Steam generator tube rupture	0.23	$9.2x10^{-5}$	0.076	$3.0x10^{-5}$	[d]
Fuel handling	0.9	$3.6x10^{-4}$	0.31	$1.2x10^{-4}$	[c]
Expected Risk of Cancer Fatality (per year)					
Reactor coolant pump shaft seizure	–	$3.0x10^{-9}$	–	$1.1x10^{-9}$	–
Rod cluster control assembly ejection	–	$4.4x10^{-7}$	–	$1.5x10^{-7}$	–
Failure of small primary coolant line outside containment	–	$7.3x10^{-8}$	–	$2.4x10^{-8}$	–
Steam generator tube rupture	–	$9.2x10^{-9}$	–	$3.0x10^{-9}$	–
Fuel handling	–	$3.6x10^{-9}$	–	$1.2x10^{-9}$	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the $1.0x10^{-4}$ to $1.0x10^{-6}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-5}$ per year.

[c] Data not available. The value is expected to be in the 0.01 to $1.0x10^{-4}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-3}$ per year.

[d] Data not available. The value is expected to be in the $1.0x10^{-3}$ to $1.0x10^{-5}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-4}$ per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.1–1 and the GENII computer code.

F.2.2.3.2 *Simplified Boiling Water Reactor*

Failure of Small Primary Coolant Line Outside of Containment

Scenario. The accident postulated the rupture of an instrument line outside the drywell but inside the reactor building. The leak is not isolatable. The flow from the instrument line is limited by a one-quarter inch diameter flow restricting orifice inside the drywell. The total integrated mass of fluid released into the reactor building is 13,000 kg with approximately 5,000 kg being flashed into steam. The accident sequence is terminated by the orderly shutdown and depressurization of the reactor. Table F.2.2.3.2–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence. It is expected that the postulated annual frequency of occurrence would range from 0.01 to $1.0x10^{-4}$ per year. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be $1.0x10^{-3}$ per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.3.2–2 through F.2.2.3.2–6 for public consequences and in tables F.2.2.3.2–7 through F.2.2.3.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.3.2–1 using the GENII computer code.

Steam System Piping Break Outside Containment

Scenario. The accident postulated a large steam line break outside of containment downstream of the outermost isolation valve. The plant is designed to immediately detect the break and initiate isolation of the broken line. Table F.2.2.3.2–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence (TTI 1995b). It is expected that the postulated annual frequency of occurrence would range from $1.0x10^{-4}$ to $1.0x10^{-6}$ per year. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be $1.0x10^{-5}$ per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.3.2–2 through F.2.2.3.2–6 for public consequences and in tables F.2.2.3.2–7 through F.2.2.3.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.3.2–1 using the GENII computer code.

Feedwater Line Break Outside of Containment

Scenario. The accident postulated a feedwater line break outside of containment. Feedwater line check valves isolate the leak from the reactor. The total mass of fluid released is 320,000 kg with approximately 10,000 kg being flashed into steam. The reactor core remains covered during the accident and no core heatup occurs. Table F.2.2.3.2–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence. It is expected that the postulated annual frequency of occurrence range from the $1.0x10^{-4}$ to $1.0x10^{-6}$ per year. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be $1.0x10^{-5}$ per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.3.2–2 through F.2.2.3.2–6 for public consequences and in tables F.2.2.3.2–7 through F.2.2.3.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.3.2–1 using the GENII computer code.

Fuel Handling Accident

Scenario. The accident postulated that a spent fuel/target assembly dropped into the reactor core. The analysis assumed that some rods/targets in the dropped assembly and in the struck assembly fail. Table F.2.2.3.2–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence (TTI 1995b). It is expected that the postulated annual frequency of occurrence would range from $1.0x10^{-4}$ to $1.0x10^{-6}$ per year. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be $1.0x10^{-5}$ per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.3.2–2 through F.2.2.3.2–6 for public consequences and in tables F.2.2.3.2–7 through F.2.2.3.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.3.2–1 using the GENII computer code.

TABLE F.2.2.3.2–1.—*Simplified Boiling Water Reactor Low-to-Moderate Consequence Accident Source Terms*

	Released Activity (curies)			
Isotope	Failure of Small Primary Coolant Line Outside Containment	Steam System Piping Break Outside Containment	Feedwater Line Break Outside Containment	Fuel Handling
H-3	1.0×10^{3}	1.1×10^{3}	2.0×10^{4}	0.044
I-131	30	20	2.7×10^{-3}	150
I-132	46	0.84	0.020	1.6×10^{-6}
I-133	71	22	0.019	25
I-134	77	0.027	0.032	2.3×10^{-28}
I-135	68	5.1	0.024	0.046
Xe-131m	0	1.5×10^{-4}	0	110
Xe-133m	0	0.084	0	730
Xe-133	0	3.0×10^{-3}	0	3.0×10^{4}
Xe-135m	0	0.22	0	0
Xe-135	0	0.26	0	86
Xe-137	0	1.4	0	1.4
Xe-138	0	0.89	0	0
Xe-139	0	2.3	0	0
Kr-83m	0	0.035	0	8.6×10^{-10}
Kr-85m	0	0.062	0	7.0×10^{-3}
Kr-85	0	2.0×10^{-4}	0	300
Kr-87	0	0.2	0	3.5×10^{-17}
Kr-88	0	0.2	0	7.6×10^{-6}
Kr-89	0	1.2	0	0
Kr-90	0	2.2	0	0

Source: TTI 1995b.

TABLE F.2.2.3.2–2.—*Simplified Boiling Water Reactor Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Failure of small primary coolant line outside containment	3.3×10^{-3}	1.6×10^{-6}	21	0.011	b
Steam system piping break outside containment	1.4×10^{-3}	7.1×10^{-7}	12	5.9×10^{-3}	c
Feedwater line break outside containment	1.4×10^{-3}	7.0×10^{-7}	14	7.0×10^{-3}	d
Fuel handling	9.8×10^{-3}	4.9×10^{-6}	89	0.044	d
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	1.6×10^{-9}	–	1.1×10^{-5}	–
Steam system piping break outside containment	–	7.1×10^{-12}	–	5.9×10^{-8}	–
Feedwater line break outside containment	–	7.0×10^{-12}	–	7.0×10^{-8}	–
Fuel handling	–	4.9×10^{-11}	–	4.4×10^{-7}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.2–1 and the GENII computer code.

TABLE F.2.2.3.2–3.—*Simplified Boiling Water Reactor Low-to-Moderate Consequence Accidents at Nevada Test Site—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Failure of small primary coolant line outside containment	1.4×10^{-3}	7.2×10^{-7}	0.45	2.2×10^{-4}	b
Steam system piping break outside containment	6.3×10^{-4}	3.1×10^{-7}	0.21	1.0×10^{-4}	c
Feedwater line break outside containment	6.2×10^{-4}	3.1×10^{-7}	0.22	1.1×10^{-4}	d
Fuel handling	4.0×10^{-3}	2.0×10^{-6}	1.5	7.5×10^{-4}	d
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	7.2×10^{-10}	–	2.2×10^{-7}	–
Steam system piping break outside containment	–	3.1×10^{-12}	–	1.0×10^{-9}	–
Feedwater line break outside containment	–	3.1×10^{-12}	–	1.1×10^{-9}	–
Fuel handling	–	2.0×10^{-11}	–	7.5×10^{-9}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.2–1 and the GENII computer code.

TABLE F.2.2.3.2–4.—*Simplified Boiling Water Reactor Low-to-Moderate Consequence Accidents at Oak Ridge Reservation—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Failure of small primary coolant line outside containment	0.028	$1.4\text{x}10^{-5}$	290	0.15	b
Steam system piping break outside containment	0.012	$6.1\text{x}10^{-6}$	130	0.066	c
Feedwater line break outside containment	0.012	$6.0\text{x}10^{-6}$	140	0.07	d
Fuel handling	0.083	$4.2\text{x}10^{-5}$	940	0.47	d
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	$1.4\text{x}10^{-8}$	–	$1.5\text{x}10^{-4}$	–
Steam system piping break outside containment	–	$6.1\text{x}10^{-11}$	–	$6.6\text{x}10^{-7}$	–
Feedwater line break outside containment	–	$6.0\text{x}10^{-11}$	–	$7.0\text{x}10^{-7}$	–
Fuel handling	–	$4.2\text{x}10^{-10}$	–	$4.7\text{x}10^{-6}$	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to $1.0\text{x}10^{-4}$ per year range. For calculational purposes, the value is assumed to be $1.0\text{x}10^{-3}$ per year.

[c] Data not available. The value is expected to be in the $1.0\text{x}10^{-4}$ to $1.0\text{x}10^{-6}$ per year range. For calculational purposes, the value is assumed to be $1.0\text{x}10^{-5}$ per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.2–1 and the GENII computer code.

TABLE F.2.2.3.2–5.—*Simplified Boiling Water Reactor Low-to-Moderate Consequence Accidents at Pantex Plant—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Failure of small primary coolant line outside containment	$2.5\text{x}10^{-3}$	$1.2\text{x}10^{-6}$	9.2	$4.6\text{x}10^{-3}$	b
Steam system piping break outside containment	$1.1\text{x}10^{-3}$	$5.5\text{x}10^{-7}$	4.3	$2.2\text{x}10^{-3}$	c
Feedwater line break outside containment	$1.1\text{x}10^{-3}$	$5.5\text{x}10^{-7}$	4.5	$2.3\text{x}10^{-3}$	d
Fuel handling	$7.6\text{x}10^{-3}$	$3.8\text{x}10^{-6}$	31	0.016	d
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	$1.2\text{x}10^{-9}$	–	$4.6\text{x}10^{-6}$	–
Steam system piping break outside containment	–	$5.5\text{x}10^{-12}$	–	$2.2\text{x}10^{-8}$	–
Feedwater line break outside containment	–	$5.5\text{x}10^{-12}$	–	$2.3\text{x}10^{-8}$	–
Fuel handling	–	$3.8\text{x}10^{-11}$	–	$1.6\text{x}10^{-7}$	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to $1.0\text{x}10^{-4}$ per year range. For calculational purposes, the value is assumed to be $1.0\text{x}10^{-3}$ per year.

[c] Data not available. The value is expected to be in the $1.0\text{x}10^{-4}$ to $1.0\text{x}10^{-6}$ per year range. For calculational purposes, the value is assumed to be $1.0\text{x}10^{-5}$ per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.2–1 and the GENII computer code.

TABLE F.2.2.3.2–6.—*Simplified Boiling Water Reactor Low-to-Moderate Consequence Accidents at Savannah River Site—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
Failure of small primary coolant line outside containment	8.4×10^{-3}	4.2×10^{-6}	230	0.11	b
Steam system piping break outside containment	7.9×10^{-3}	4.0×10^{-6}	250	0.12	c
Feedwater line break outside containment	4.0×10^{-3}	2.0×10^{-6}	130	0.065	d
Fuel handling	0.028	1.4×10^{-5}	850	0.43	d
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	4.2×10^{-9}	–	1.1×10^{-4}	–
Steam system piping break outside containment	–	4.0×10^{-11}	–	1.2×10^{-6}	–
Feedwater line break outside containment	–	2.0×10^{-11}	–	6.5×10^{-7}	–
Fuel handling	–	1.4×10^{-10}	–	4.3×10^{-6}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.2–1 and the GENII computer code.

TABLE F.2.2.3.2–7.—*Simplified Boiling Water Reactor Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (rem)**	**Cancer Fatality**[a]	**Accident Frequency (per year)**
Failure of small primary coolant line outside containment	0.08	3.2×10^{-5}	0.027	1.1×10^{-5}	b
Steam system piping break outside containment	0.034	1.4×10^{-5}	0.011	4.6×10^{-6}	c
Feedwater line break outside containment	0.061	2.4×10^{-5}	0.021	8.4×10^{-6}	d
Fuel handling	0.26	1.0×10^{-4}	0.085	3.4×10^{-5}	d
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	3.2×10^{-8}	–	1.1×10^{-8}	–
Steam system piping break outside containment	–	1.4×10^{-10}	–	4.6×10^{-11}	–
Feedwater line break outside containment	–	2.4×10^{-10}	–	8.4×10^{-11}	–
Fuel handling	–	1.0×10^{-9}	–	3.4×10^{-10}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.2–1 and the GENII computer code.

TABLE F.2.2.3.2–8.—*Simplified Boiling Water Reactor Low-to-Moderate Consequence Accidents at Nevada Test Site—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	**Dose (rem)**	**Cancer Fatality[a]**	**Dose (rem)**	**Cancer Fatality[a]**	**Accident Frequency (per year)**
Failure of small primary coolant line outside containment	0.023	9.4x10^{-6}	8.0x10^{-3}	3.2x10^{-6}	b
Steam system piping break outside containment	0.01	4.0x10^{-6}	3.4x10^{-3}	1.4x10^{-6}	c
Feedwater line break outside containment	0.018	7.2x10^{-6}	6.0x10^{-3}	2.4x10^{-6}	d
Fuel handling	0.075	3.0x10^{-5}	0.025	9.9x10^{-6}	d
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	9.4x10^{-9}	–	3.2x10^{-9}	–
Steam system piping break outside containment	–	4.0x10^{-11}	–	1.4x10^{-11}	–
Feedwater line break outside containment	–	7.2x10^{-11}	–	2.4x10^{-11}	–
Fuel handling	–	3.0x10^{-10}	–	9.9x10^{-11}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0x10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0x10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0x10^{-4} to 1.0x10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0x10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.2–1 and the GENII computer code.

TABLE F.2.2.3.2–9.—*Simplified Boiling Water Reactor Low-to-Moderate Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	**Dose (rem)**	**Cancer Fatality[a]**	**Dose (rem)**	**Cancer Fatality[a]**	**Accident Frequency (per year)**
Failure of small primary coolant line outside containment	0.12	5.0x10^{-5}	0.04	1.6x10^{-5}	b
Steam system piping break outside containment	0.051	2.0x10^{-5}	0.018	7.0x10^{-6}	c
Feedwater line break outside containment	0.09	3.6x10^{-5}	0.032	1.3x10^{-5}	d
Fuel handling	0.39	1.6x10^{-4}	0.13	5.2x10^{-5}	d
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	5.0x10^{-8}	–	1.6x10^{-8}	–
Steam system piping break outside containment	–	2.0x10^{-10}	–	7.0x10^{-11}	–
Feedwater line break outside containment	–	3.6x10^{-10}	–	1.3x10^{-10}	–
Fuel handling	–	1.6x10^{-9}	–	5.2x10^{-10}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0x10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0x10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0x10^{-4} to 1.0x10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0x10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.2–1 and the GENII computer code.

TABLE F.2.2.3.2–10.—*Simplified Boiling Water Reactor Low-to-Moderate Consequence Accidents at Pantex Plant—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (rem)**	**Cancer Fatality**[a]	**Accident Frequency (per year)**
Failure of small primary coolant line outside containment	9.4×10^{-3}	3.8×10^{-6}	2.7×10^{-3}	1.1×10^{-6}	b
Steam system piping break outside containment	4.1×10^{-3}	1.6×10^{-6}	1.1×10^{-3}	4.4×10^{-7}	c
Feedwater line break outside containment	7.2×10^{-3}	2.9×10^{-6}	2.0×10^{-3}	8.0×10^{-7}	d
Fuel handling	0.03	1.2×10^{-5}	8.5×10^{-3}	3.4×10^{-6}	d
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	3.8×10^{-9}	–	1.1×10^{-9}	–
Steam system piping break outside containment	–	1.6×10^{-11}	–	4.4×10^{-12}	–
Feedwater line break outside containment	–	2.9×10^{-11}	–	8.0×10^{-12}	–
Fuel handling	–	1.2×10^{-10}	–	3.4×10^{-11}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.2–1 and the GENII computer code.

TABLE F.2.2.3.2–11.—*Simplified Boiling Water Reactor Low-to-Moderate Consequence Accidents at Savannah River Site—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (rem)**	**Cancer Fatality**[a]	**Accident Frequency (per year)**
Failure of small primary coolant line outside containment	0.22	8.6×10^{-5}	0.072	2.9×10^{-5}	b
Steam system piping break outside containment	0.25	1.0×10^{-4}	0.088	3.5×10^{-5}	c
Feedwater line break outside containment	0.16	6.4×10^{-5}	0.057	2.3×10^{-5}	d
Fuel handling	0.7	2.8×10^{-4}	0.23	9.3×10^{-5}	d
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	8.6×10^{-8}	–	2.9×10^{-8}	–
Steam system piping break outside containment	–	1.0×10^{-9}	–	3.5×10^{-10}	–
Feedwater line break outside containment	–	6.4×10^{-10}	–	2.3×10^{-10}	–
Fuel handling	–	2.8×10^{-9}	–	9.3×10^{-10}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.2–1 and the GENII computer code.

F.2.2.3.3 *Advanced Boiling Water Reactor*

Failure of Small Primary Coolant Line Outside of Containment

Scenario. The accident postulated the rupture of an instrument line outside the drywell hut inside the reactor building. The leak is not isolatable. The flow from the instrument line is limited by a 0.64 cm diameter flow restricting orifice inside the drywell. The total integrated mass of fluid released into the reactor building is 5,442 kg with approximately 2,270 kg being flashed into steam. The accident sequence is terminated by the orderly shutdown and depressurization of the reactor. Table F.2.2.3.3–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence (TTI 1995b). It is expected that the postulated annual frequency of occurrence would be in the 0.01 to 1.0×10^{-4} per year range. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be 1.0×10^{-3} per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.3.3–2 through F.2.2.3.3–6 for public consequences and in tables F.2.2.3.3–7 through F.2.2.3.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.3.3–1 using the GENII computer code.

Steam System Piping Break Outside Containment

Scenario. The accident postulated a large steam line break outside of containment downstream of the outermost isolation valve. The plant is designed to immediately detect the break and initiate isolation of the broken line. Table F.2.2.3.3–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence (TTI 1995b). It is expected that the postulated annual frequency of occurrence would be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be 1.0×10^{-5} per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.3.3–2 through F.2.2.3.3–6 for public consequences and in tables F.2.2.3.3–7 through F.2.2.3.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.3.3–1 using the GENII computer code.

Cleanup Water Line Break Outside Containment

Scenario. The accident postulated a large cleanup water line break outside of containment. The analysis assumed that the non-filtered inventory in both the regenerative and non-regenerative heat exchangers is released through the break. The leak is automatically isolated approximately 75 seconds after the break. Table F.2.2.3.3–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence (TTI 1995b). It is expected that the postulated annual frequency of occurrence would be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be 1.0×10^{-5} per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.3.3–2 through F.2.2.3.3–6 for public consequences and in tables F.2.2.3.3–7 through F.2.2.3.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.3.3–1 using the GENII computer code.

Fuel Handling Accident

Scenario. The accident postulated that a spent fuel/target assembly dropped into the reactor core. The analysis assumed that some rods/targets in the dropped assembly and in the struck assembly fail. Table F.2.2.3.3–1 presents the source term released to the environment. The analysis did not estimate the accident annual frequency of occurrence (TTI 1995b). It is expected that the postulated annual frequency of occurrence would be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence is assumed to be 1.0×10^{-5} per year.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.3.3–2 through F.2.2.3.3–6 for public consequences and in tables F.2.2.3.3–7 through F.2.2.3.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.3.3–1 using the GENII computer code.

TABLE F.2.2.3.3–1.—*Advanced Boiling Water Reactor Low-to-Moderate Consequence Accident Source Terms*

Isotope	Released Activity (curies) Failure of Small Primary Coolant Line Outside Containment	Steam System Piping Break Outside Containment	Cleanup Water Line Break Outside Containment	Fuel Handling
H-3	890	1.5×10^{3}	1.3×10^{3}	0.037
I-131	3.8	39	2.2	120
I-132	32	380	5.1	150
I-133	26	270	6.2	130
I-134	51	750	8.6	6.2×10^{-6}
I-135	36	390	6.8	21
Xe-131m	0	2.9×10^{-4}	0	84
Xe-133m	0	5.5×10^{-3}	0	1.1×10^{3}
Xe-133	0	0.15	0	2.8×10^{4}
Xe-135m	0	0.47	0	220
Xe-135	0	0.44	0	6.4×10^{3}
Xe-137	0	2	0	2.1×10^{-10}
Xe-138	0	1.5	0	4.3×10^{-10}
Xe-139	0	0.7	0	0
Kr-83m	0	0.066	0	6.4
Kr-85m	0	0.12	0	85
Kr-85	0	3.7×10^{-4}	0	480
Kr-87	0	0.4	0	0.012
Kr-88	0	0.4	0	24
Kr-89	0	1.6	0	8.1×10^{-11}
Kr-90	0	0.42	0	0

Source: TTI 1995b.

TABLE F.2.2.3.3–2.—*Advanced Boiling Water Reactor Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person rem)	Cancer Fatality	Accident Frequency (per year)
Failure of small primary coolant line outside containment	9.6x10^{-4}	4.8x10^{-7}	4.7	2.4x10^{-3}	[b]
Steam system piping break outside containment	9.9x10^{-3}	5.0x10^{-6}	42	0.021	[c]
Cleanup water line break outside containment	3.9x10^{-4}	1.9x10^{-7}	2.8	1.4x10^{-3}	[d]
Fuel handling	9.9x10^{-3}	5.0x10^{-6}	76	0.038	[c]
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	4.8x10^{-10}	–	2.4x10^{-6}	–
Steam system piping break outside containment	–	5.0x10^{-11}	–	2.1x10^{-7}	–
Cleanup water line break outside containment	–	1.9x10^{-12}	–	1.4x10^{-8}	–
Fuel handling	–	5.0x10^{-11}	–	3.8x10^{-7}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0x10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0x10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0x10^{-4} to 1.0x10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0x10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.3–1 and the GENII computer code.

TABLE F.2.2.3.3–3.—*Advanced Boiling Water Reactor Low-to-Moderate Consequence Accidents at Nevada Test Site—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Failure of small primary coolant line outside containment	4.3x10^{-4}	2.2x10^{-7}	0.13	6.4x10^{-5}	[b]
Steam system piping break outside containment	6.5x10^{-5}	3.3x10^{-8}	1.3	6.4x10^{-4}	[c]
Cleanup water line break outside containment	1.7x10^{-4}	8.7x10^{-8}	0.056	2.8x10^{-5}	[d]
Fuel handling	4.4x10^{-3}	2.2x10^{-6}	1.5	7.3x10^{-4}	[c]
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	2.2x10^{-10}	–	6.4x10^{-8}	–
Steam system piping break outside containment	–	3.3x10^{-13}	–	6.4x10^{-9}	–
Cleanup water line break outside containment	–	8.7x10^{-13}	–	2.8x10^{-10}	–
Fuel handling	–	2.2x10^{-11}	–	7.3x10^{-9}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0x10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0x10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0x10^{-4} to 1.0x10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0x10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.3–1 and the GENII computer code.

TABLE F.2.2.3.3–4.—*Advanced Boiling Water Reactor Low-to-Moderate Consequence Accidents at Oak Ridge Reservation—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
Failure of small primary coolant line outside containment	$8.6x10^{-3}$	$4.3x10^{-6}$	81	0.041	b
Steam system piping break outside containment	0.091	$4.6x10^{-5}$	820	0.41	c
Cleanup water line break outside containment	$3.4x10^{-3}$	$1.7x10^{-6}$	35	0.018	d
Fuel handling	0.086	$4.3x10^{-5}$	910	0.46	c
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	$4.3x10^{-9}$	–	$4.1x10^{-5}$	–
Steam system piping break outside containment	–	$4.6x10^{-10}$	–	$4.1x10^{-6}$	–
Cleanup water line break outside containment	–	$1.7x10^{-11}$	–	$1.8x10^{-7}$	–
Fuel handling	–	$4.3x10^{-10}$	–	$4.6x10^{-6}$	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to $1.0x10^{-4}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-3}$ per year.

[c] Data not available. The value is expected to be in the $1.0x10^{-4}$ to $1.0x10^{-6}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-5}$ per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.3–1 and the GENII computer code.

TABLE F.2.2.3.3–5.—*Advanced Boiling Water Reactor Low-to-Moderate Consequence Accidents at Pantex Plant—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
Failure of small primary coolant line outside containment	$7.8x10^{-4}$	$3.9x10^{-7}$	2.5	$1.2x10^{-3}$	b
Steam system piping break outside containment	$8.2x10^{-3}$	$4.1x10^{-6}$	24	0.012	c
Cleanup water line break outside containment	$3.1x10^{-4}$	$1.5x10^{-7}$	1.1	$5.7x10^{-4}$	d
Fuel handling	$7.7x10^{-3}$	$3.9x10^{-6}$	29	0.015	c
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	$3.9x10^{-10}$	–	$1.2x10^{-6}$	–
Steam system piping break outside containment	–	$4.1x10^{-11}$	–	$1.2x10^{-7}$	–
Cleanup water line break outside containment	–	$1.5x10^{-12}$	–	$5.7x10^{-9}$	–
Fuel handling	–	$3.9x10^{-11}$	–	$1.5x10^{-7}$	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to $1.0x10^{-4}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-3}$ per year.

[c] Data not available. The value is expected to be in the $1.0x10^{-4}$ to $1.0x10^{-6}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-5}$ per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.3–1 and the GENII computer code.

TABLE F.2.2.3.3–6.—*Advanced Boiling Water Reactor Low-to-Moderate Consequence Accidents at Savannah River Site—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 Miles		
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Failure of small primary coolant line outside containment	2.3×10^{-3}	1.2×10^{-6}	53	0.027	b
Steam system piping break outside containment	0.023	1.2×10^{-5}	500	0.25	c
Cleanup water line break outside containment	1.0×10^{-3}	5.2×10^{-7}	28	0.014	d
Fuel handling	0.027	1.3×10^{-5}	760	0.038	c
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	1.2×10^{-9}	–	2.7×10^{-5}	–
Steam system piping break outside containment	–	1.2×10^{-10}	–	2.5×10^{-6}	–
Cleanup water line break outside containment	–	5.2×10^{-12}	–	1.4×10^{-7}	–
Fuel handling	–	1.3×10^{-10}	–	3.8×10^{-6}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.3–1 and the GENII computer code.

TABLE F.2.2.3.3–7.—*Advanced Boiling Water Reactor Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	Accident Frequency (per year)
Failure of small primary coolant line outside containment	0.026	1.0×10^{-5}	8.5×10^{-3}	3.4×10^{-6}	b
Steam system piping break outside containment	0.26	1.0×10^{-4}	0.087	3.5×10^{-5}	c
Cleanup water line break outside containment	0.012	4.8×10^{-6}	4.0×10^{-3}	1.6×10^{-6}	d
Fuel handling	0.26	1.0×10^{-4}	0.089	3.6×10^{-5}	c
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	1.0×10^{-8}	–	3.4×10^{-9}	–
Steam system piping break outside containment	–	1.0×10^{-9}	–	3.5×10^{-10}	–
Cleanup water line break outside containment	–	4.8×10^{-11}	–	1.6×10^{-11}	–
Fuel handling	–	1.0×10^{-9}	–	3.6×10^{-10}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.3–1 and the GENII computer code.

TABLE F.2.2.3.3–8.—*Advanced Boiling Water Reactor Low-to-Moderate Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Failure of small primary coolant line outside containment	$7.5x10^{-3}$	$3.0x10^{-6}$	$2.5x10^{-3}$	$1.0x10^{-6}$	b
Steam system piping break outside containment	0.077	$3.1x10^{-5}$	0.026	$1.0x10^{-5}$	c
Cleanup water line break outside containment	$3.6x10^{-3}$	$1.4x10^{-6}$	$1.2x10^{-3}$	$4.7x10^{-7}$	d
Fuel handling	0.078	$3.1x10^{-5}$	0.026	$1.0x10^{-5}$	c
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	$3.0x10^{-9}$	–	$1.0x10^{-9}$	–
Steam system piping break outside containment	–	$3.0x10^{-10}$	–	$1.0x10^{-10}$	–
Cleanup water line break outside containment	–	$1.4x10^{-11}$	–	$4.7x10^{-12}$	–
Fuel handling	–	$3.1x10^{-10}$	–	$1.0x10^{-10}$	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to $1.0x10^{-4}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-3}$ per year.

[c] Data not available. The value is expected to be in the $1.0x10^{-4}$ to $1.0x10^{-6}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-5}$ per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.3–1 and the GENII computer code.

TABLE F.2.2.3.3–9.—*Advanced Boiling Water Reactor Low-to-Moderate Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Failure of small primary coolant line outside containment	0.039	$1.6x10^{-5}$	0.013	$5.1x10^{-6}$	b
Steam system piping break outside containment	0.4	$1.6x10^{-4}$	0.13	$5.2x10^{-5}$	c
Cleanup water line break outside containment	0.018	$7.2x10^{-6}$	$6.1x10^{-3}$	$2.5x10^{-6}$	d
Fuel handling	0.4	$1.6x10^{-4}$	0.14	$5.4x10^{-5}$	c
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	$1.6x10^{-8}$	–	$5.1x10^{-9}$	–
Steam system piping break outside containment	–	$1.6x10^{-9}$	–	$5.2x10^{-10}$	–
Cleanup water line break outside containment	–	$7.2x10^{-11}$	–	$2.5x10^{-11}$	–
Fuel handling	–	$1.6x10^{-9}$	–	$5.4x10^{-10}$	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to $1.0x10^{-4}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-3}$ per year.

[c] Data not available. The value is expected to be in the $1.0x10^{-4}$ to $1.0x10^{-6}$ per year range. For calculational purposes, the value is assumed to be $1.0x10^{-5}$ per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.3–1 and the GENII computer code.

TABLE F.2.2.3.3–10.—*Simplified Boiling Water Reactor Low-to-Moderate Consequence Accidents at Pantex Plant—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Failure of small primary coolant line outside containment	3.0×10^{-3}	1.2×10^{-6}	8.3×10^{-4}	3.3×10^{-7}	b
Steam system piping break outside containment	0.03	1.2×10^{-5}	8.4×10^{-3}	3.4×10^{-6}	c
Cleanup water line break outside containment	1.4×10^{-3}	5.6×10^{-7}	4.0×10^{-4}	1.6×10^{-7}	d
Fuel handling	0.031	1.2×10^{-5}	8.4×10^{-3}	3.4×10^{-6}	c
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	1.2×10^{-9}	–	3.3×10^{-10}	–
Steam system piping break outside containment	–	1.2×10^{-10}	–	3.4×10^{-11}	–
Cleanup water line break outside containment	–	5.6×10^{-12}	–	1.6×10^{-12}	–
Fuel handling	–	1.2×10^{-10}	–	3.4×10^{-11}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.3–1 and the GENII computer code.

TABLE F.2.2.3.3–11.—*Simplified Boiling Water Reactor Low-to-Moderate Consequence Accidents at Savannah River Site—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality[a]	
Failure of small primary coolant line outside containment	0.066	2.6×10^{-5}	0.022	8.9×10^{-6}	b
Steam system piping break outside containment	0.67	2.7×10^{-4}	0.22	8.8×10^{-5}	c
Cleanup water line break outside containment	0.032	1.3×10^{-5}	0.011	4.4×10^{-6}	d
Fuel handling	0.71	2.8×10^{-4}	0.24	9.6×10^{-5}	c
Expected Risk of Cancer Fatality (per year)					
Failure of small primary coolant line outside containment	–	2.6×10^{-8}	–	8.9×10^{-9}	–
Steam system piping break outside containment	–	2.7×10^{-9}	–	8.8×10^{-10}	–
Cleanup water line break outside containment	–	1.3×10^{-10}	–	4.4×10^{-11}	–
Fuel handling	–	2.8×10^{-9}	–	9.6×10^{-10}	–

[a] Increased likelihood of cancer fatality.

[b] Data not available. The value is expected to be in the 0.01 to 1.0×10^{-4} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-3} per year.

[c] Data not available. The value is expected to be in the 1.0×10^{-4} to 1.0×10^{-6} per year range. For calculational purposes, the value is assumed to be 1.0×10^{-5} per year.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.3.3–1 and the GENII computer code.

F.2.2.4 *Accelerator Production of Tritium*

F.2.2.4.1 *Accelerator and Beam Transport System*

One design-basis accident for the accelerator was considered. Incorrect administrative procedures and control for maintenance access to activated accelerator components could result in higher than permitted dose levels to service personnel. The consequences of the accident are limited to the dose received by service personnel. No lost production time or equipment replacement expense would be incurred. Based on operating APT experience, the annual frequency of occurrence is estimated at 1 time per year (SNL 1995a:8-5).

F.2.2.4.2 *Helium-3 Target System*

Scenario. The low-to-moderate consequence accident for this APT technology is a double-ended guillotine cold leg break near the pump discharge. The plant protection and safety systems performed as designed. The analysis assumed the most limiting single failure was the loss of power to one of the residual heat removal pumps. During this accident, the rod temperatures flatten out at approximately 340 Kelvin (152 °F) and would be expected to decrease in time as the power decays. The source term to the confinement for this design basis accident is judged to be similar to and bounded by the source term for the beyond design-basis accident (large break low-to-moderate consequence) presented in section F.2.1.4.2. The analysis did not estimate the accident annual frequency of occurrence (SNL 1995a:8-8).

Consequences. The estimated consequences of the postulated APT with helium-3 target system low-to-moderate consequence accident are bounded by the beyond design-basis accident presented in section F.2.1.4.2.

F.2.2.4.3 *Spallation-Induced Lithium Conversion Target System*

The low-to-moderate consequence accident for the APT technology is a large break in the primary coolant system. The analysis assumed that all plant protection systems functioned as designed. The worst single failure responding to the initiating event was assumed. The source term for this accident will consist of a small fraction of the radioactivity inventory released from the heavy-water coolant that is expelled into the confinement. The radionuclides released to the confinement are minimal. The analysis did not estimate the accident annual frequency of occurrence (SNL 1995a:8-6).

F.2.2.5 *Multipurpose Reactor Facility*

The multipurpose fuel reactor facility consists of three elements. 1) The reactor element that burns the plutonium mixed oxide fuel can be either a modular high temperature gas cooled reactor or an advanced light water reactor. 2) The fuel fabrication element produces the fuel for use in the reactor. 3) The pit disassembly and conversion element disassembles plutonium pits and converts the plutonium in the pit to plutonium-oxide which is used in the production of the plutonium or mixed-oxide fuel.

F.2.2.5.1 *Multipurpose Reactor*

Modular High Temperature Gas-Cooled Reactor

The use of plutonium oxide as the fuel in the MHTGR will not have a significant effect on the source term for low-to-moderate consequence accidents generated for the uranium fueled MHTGR because no fuel failures are expected (HNUS 1995c:1). The accident consequences estimated for the uranium fueled MHTGR are applicable for the plutonium-oxide fueled MHTGR. Refer to section F.2.2.2 for the applicable accident consequences of the plutonium-oxide fueled MHTGR.

Advanced Light Water Reactor

The use of plutonium-oxide in the fuel in Large and Small ALWRs will have a significant effect on the source term for low-to-moderate consequence accidents generated for the uranium fueled ALWRs because of increased gap inventories in the mixed-oxide fuels. Tables F.2.2.3.1–1, F.2.2.3.2–1, and F.2.2.3.3–1 present the low-to-moderate consequence accident source terms for the AP600, Simplified Boiling Water Reactor and Advanced Boiling Water Reactor ALWRs. When the accident source terms are adjusted for the increased gap inventory of gasses (ORNL 1995b:B-13) and the typical core inventory isotope ratios for the mixed-oxide core (ORNL 1995c) are considered (HNUS 1995c:2), it is estimated that the consequences for uranium fueled

ALWR low-to-moderate accident consequences should be increased by an approximate factor of 1.5 to 2 to obtain the consequences for equivalent mixed-oxide fueled ALWR accidents. Refer to section F.2.2.3 and apply an approximate correction factor of 1.5 to 2 to assess the increased consequences of mixed-oxide fueled ALWR low-to-moderate consequence accidents.

F.2.2.5.2 *Multipurpose Reactor Fuel Fabrication*

Loading Dock Fire

Scenario. The accident postulated is a fire on an open loading dock caused by welding, cleaning solvents, electrical shorts, or other miscellaneous causes. A single drum of combustible waste, containing 18 grams of plutonium, is involved in the fire. The analysis estimated that 0.077 gram of plutonium was released directly to the environment by the fire. The annual frequency of occurrence is estimated to be in the range of $1.0x10^{-3}$ to $1.0x10^{-4}$ per year (LANL 1995d). For calculational purposes, the annual frequency of occurrence is assumed to be $5.0x10^{-4}$ per year, the mid point of the estimated range. Table F.2.1.5.2–2 presents the isotopic distribution for a plutonium release at the mixed-oxide fuel reactor facility. Table F.2.2.5.2–1 presents the source term, by isotope, for the 0.077 gram of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.5.2–2 through F.2.2.5.2–6 for public consequences and in tables F.2.2.5.2–7 through F.2.2.5.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.5.2–1 using the GENII computer code.

Process Cell Fire

Scenario. The accident postulated is a fire in a process cell area. It is assumed that the process cell contains a glovebox used for milling plutonium powder. The gloves have become coated with a layer of plutonium dust. The analysis estimated the glove loading at 2 grams of plutonium per glove. Each of the 12 gloves is assumed to be stowed outside of the glovebox. A flammable cleaning liquid such as acetone or isopropyl alcohol is brought into the process cell in violation of operating procedures, spills and ignites. All gloves are incinerated, the sprinkler system activates and protects the glovebox from further damage. The ventilation system and HEPA filters continue to function through the accident. It is estimated that $4.8x10^{-6}$ grams of plutonium are released to the environment. The annual frequency of occurrence is estimated to be in the range of $1.0x10^{-3}$ to $1.0x10^{-5}$ per year (LANL 1995d). For calculational purposes, the annual frequency of occurrence is assumed to be $1.0x10^{-4}$ per year, the mid point of the estimated range. Table F.2.1.5.2–2 presents the isotopic distribution for a plutonium release at the mixed-oxide fuel reactor facility. Table F.2.2.5.2–1 presents the source term, by isotope, for the $4.8x10^{-6}$ grams of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.5.2–2 through F.2.2.5.2–6 for public consequences and in tables F.2.2.5.2–7 through F.2.2.5.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.5.2–1 using the GENII computer code.

Spill

Scenario. The most catastrophic case of leak or spill of plutonium would result from a fork lift or other large vehicle running over a package of plutonium-oxide and breaching the package. The analysis postulated that the package contained 4 kg of plutonium-oxide and that 0.4 gram would become airborne after the accident. During cleanup operations, the analysis assumed that an additional 0.04 gram would be resuspended for a total airborne release to the room of 0.44 gram of plutonium-oxide. After three stage HEPA filtration of the facility exhaust, the total release to the environment is estimated to be $1.7x10^{-9}$ gram of plutonium. The probability calculated from the event tree for this scenario is $4.5x10^{-5}$ per year (LANL 1995d). Table F.2.1.5.2–2 presents the isotopic distribution for a plutonium release at the mixed-oxide fuel reactor facility. Table F.2.2.5.2–1 presents the source term, by isotope, for the $1.7x10^{-9}$ gram of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.5.2–2 through F.2.2.5.2–6 for public consequences and in tables F.2.2.5.2–7 through F.2.2.5.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.5.2–1 using the GENII computer code.

Glovebox Explosion

Scenario. The bounding design-basis accident explosion is a conflagration for a flammable gas mixture inside a glovebox. The glovebox identified as having the most material at risk contains the milling operation where plutonium-oxide is milled to a fine powder prior to mixing with uranium dioxide. Based on a LANL TA-55 standard operating procedure, the criticality limit for plutonium-oxide in a dry atmosphere is assumed to be 10 kg. The analysis assumed the glovebox contains 10 kg of plutonium-oxide and through some unforeseen set of failures, a combustible gas mixture accumulates inside a glovebox and is ignited, possibly by an electrical spark from an operating electrical device. The conflagration blows out the HEPA filter from the glovebox ventilation system exit. In addition, gloves may also be blown out. The building HEPA filters and ventilation system continue to operate during the accident. The analysis estimated that $1.0\text{x}10^{-3}$ gram of plutonium is released up the stack. The annual frequency of occurrence is estimated to be in the range of $1.0\text{x}10^{-3}$ to $1.0\text{x}10^{-5}$ per year (LANL 1995d). For calculational purposes, the annual frequency of occupance is assumed to be $1.0\text{x}10^{-4}$ per year, the mid point of the estimated range. Table F.2.1.5.2–2 presents the isotopic distribution for a plutonium release at the mixed-oxide fuel reactor facility. Table F.2.2.5.2–1 presents the source term, by isotope, for the $1.0\text{x}10^{-3}$ gram of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.5.2–2 through F.2.2.5.2–6 for public consequences and in tables F.2.2.5.2–7 through F.2.2.5.2–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.5.2–1 using the GENII computer code.

TABLE F.2.2.5.2–1.—*Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accident Source Terms*

	Released Activity (curies)			
Isotope	**Loading Dock Fire**	**Process Cell Fire**	**Spill**	**Glovebox Explosion**
Pu-238	$6.5\text{x}10^{-4}$	$4.0\text{x}10^{-8}$	$1.4\text{x}10^{-11}$	$8.4\text{x}10^{-6}$
Pu-239	$4.5\text{x}10^{-3}$	$2.8\text{x}10^{-7}$	$9.8\text{x}10^{-11}$	$5.8\text{x}10^{-5}$
Pu-240	$1.0\text{x}10^{-3}$	$6.4\text{x}10^{-8}$	$2.3\text{x}10^{-11}$	$1.3\text{x}10^{-5}$
Pu-241	0.031	$1.9\text{x}10^{-6}$	$6.9\text{x}10^{-10}$	$4.0\text{x}10^{-4}$
Am-241	$9.9\text{x}10^{-4}$	$6.1\text{x}10^{-8}$	$2.2\text{x}10^{-11}$	$1.3\text{x}10^{-5}$

Source: Derived from LANL 1995d and table F.2.1.5.2–2.

TABLE F.2.2.5.2–2.—*Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory—Public Consequences*

Accident Description	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accident Frequency (per year)
Loading dock fire	1.9x10^{-3}	9.5x10^{-7}	18	9.0x10^{-3}	5.0x10^{-4}
Process cell fire	1.2x10^{-7}	6.0x10^{-11}	1.1x10^{-3}	5.5x10^{-7}	1.0x10^{-4}
Spill	4.2x10^{-11}	2.1x10^{-14}	4.0x10^{-7}	2.0x10^{-10}	4.5x10^{-5}
Glovebox explosion	2.5x10^{-5}	1.3x10^{-8}	0.24	1.2x10^{-4}	1.0x10^{-4}
Expected Risk of Cancer Fatality (per year)					
Loading dock fire	–	4.8x10^{-10}	–	4.5x10^{-6}	–
Process cell fire	–	6.0x10^{-15}	–	5.5x10^{-11}	–
Spill	–	9.5x10^{-19}	–	9.0x10^{-15}	–
Glovebox explosion	–	1.3x10^{-12}	–	1.2x10^{-8}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.2–1 and the GENII computer code.

TABLE F.2.2.5.2–3.—*Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Nevada Test Site—Public Consequences*

Accident Description	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality	Accident Frequency (per year)
Loading dock fire	8.3x10^{-4}	4.2x10^{-7}	0.29	1.5x10^{-4}	5.0x10^{-4}
Process cell fire	5.2x10^{-8}	2.6x10^{-11}	1.8x10^{-5}	9.0x10^{-9}	1.0x10^{-4}
Spill	1.9x10^{-11}	9.5x10^{-15}	6.5x10^{-9}	3.3x10^{-12}	4.5x10^{-5}
Glovebox explosion	1.1x10^{-5}	5.5x10^{-9}	3.7x10^{-3}	1.9x10^{-6}	1.0x10^{-4}
Expected Risk of Cancer Fatality (per year)					
Loading dock fire	–	2.1x10^{-10}	–	7.5x10^{-8}	–
Process cell fire	–	2.6x10^{-15}	–	9.0x10^{-13}	–
Spill	–	4.3x10^{-19}	–	1.5x10^{-16}	–
Glovebox explosion	–	5.5x10^{-13}	–	1.9x10^{-10}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.2–1 and the GENII computer code.

TABLE F.2.2.5.2–4.—*Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Oak Ridge Reservation—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Loading dock fire	0.016	8.0x10^{-6}	180	0.09	5.0x10^{-4}
Process cell fire	1.0x10^{-6}	5.0x10^{-10}	0.011	5.5x10^{-6}	1.0x10^{-4}
Spill	3.6x10^{-10}	1.8x10^{-13}	4.0x10^{-6}	2.0x10^{-9}	4.5x10^{-5}
Glovebox explosion	2.1x10^{-4}	1.1x10^{-7}	2.4	1.2x10^{-3}	1.0x10^{-4}
Expected Risk of Cancer Fatality (per year)					
Loading dock fire	–	4.0x10^{-9}	–	4.5x10^{-5}	–
Process cell fire	–	5.0x10^{-14}	–	5.5x10^{-10}	–
Spill	–	8.1x10^{-18}	–	9.0x10^{-14}	–
Glovebox explosion	–	1.1x10^{-11}	–	1.2x10^{-7}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.2–1 and the GENII computer code.

TABLE F.2.2.5.2–5.—*Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Pantex Plant—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Loading dock fire	1.5x10^{-3}	7.5x10^{-7}	6	3.0x10^{-3}	5.0x10^{-4}
Process cell fire	9.2x10^{-8}	4.6x10^{-11}	3.8x10^{-4}	1.9x10^{-7}	1.0x10^{-4}
Spill	3.2x10^{-11}	1.6x10^{-14}	1.3x10^{-7}	6.5x10^{-11}	4.5x10^{-5}
Glovebox explosion	1.9x10^{-5}	9.5x10^{-9}	0.077	3.9x10^{-5}	1.0x10^{-4}
Expected Risk of Cancer Fatality (per year)					
Loading dock fire	–	3.8x10^{-10}	–	1.5x10^{-6}	–
Process cell fire	–	4.6x10^{-15}	–	1.9x10^{-11}	–
Spill	–	7.2x10^{-19}	–	2.9x10^{-15}	–
Glovebox explosion	–	9.5x10^{-13}	–	3.9x10^{-9}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.2–1 and the GENII computer code.

TABLE F.2.2.5.2–6.—*Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Savannah River Site—Public Consequences*

	Maximum Offsite Individual		Population to 50 Miles		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Loading dock fire	$5.4x10^{-3}$	$2.7x10^{-6}$	170	0.085	$5.0x10^{-4}$
Process cell fire	$3.4x10^{-7}$	$1.7x10^{-10}$	0.011	$5.5x10^{-6}$	$1.0x10^{-4}$
Spill	$1.2x10^{-10}$	$6.0x10^{-14}$	$3.7x10^{-6}$	$1.9x10^{-9}$	$4.5x10^{-5}$
Glovebox explosion	$7.1x10^{-5}$	$3.6x10^{-8}$	2.2	$1.1x10^{-3}$	$1.0x10^{-4}$
Expected Risk of Cancer Fatality (per year)					
Loading dock fire	–	$1.4x10^{-9}$	–	$4.3x10^{-5}$	–
Process cell fire	–	$1.7x10^{-14}$	–	$5.5x10^{-10}$	–
Spill	–	$2.7x10^{-18}$	–	$8.6x10^{-14}$	–
Glovebox explosion	–	$3.6x10^{-12}$	–	$1.1x10^{-7}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.2–1 and the GENII computer code.

TABLE F.2.2.5.2–7.—*Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Accident Description	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	Accident Frequency (per year)
Loading dock fire	0.083	$3.3x10^{-5}$	0.028	$1.1x10^{-5}$	$5.0x10^{-4}$
Process cell fire	$5.2x10^{-6}$	$2.1x10^{-9}$	$1.7x10^{-6}$	$6.8x10^{-10}$	$1.0x10^{-4}$
Spill	$1.8x10^{-9}$	$7.2x10^{-13}$	$6.1x10^{-10}$	$2.4x10^{-13}$	$4.5x10^{-5}$
Glovebox explosion	$1.1x10^{-3}$	$4.4x10^{-7}$	$3.6x10^{-4}$	$1.4x10^{-7}$	$1.0x10^{-4}$
Expected Risk of Cancer Fatality (per year)					
Loading dock fire	–	$1.7x10^{-8}$	–	$5.5x10^{-9}$	–
Process cell fire	–	$2.1x10^{-13}$	–	$6.8x10^{-14}$	–
Spill	–	$3.2x10^{-17}$	–	$1.1x10^{-17}$	–
Glovebox explosion	–	$4.4x10^{-11}$	–	$1.4x10^{-11}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.2–1 and the GENII computer code.

TABLE F.2.2.5.2–8.—*Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Loading dock fire	0.024	$9.6x10^{-6}$	$8.1x10^{-3}$	$3.2x10^{-6}$	$5.0x10^{-4}$
Process cell fire	$1.5x10^{-6}$	$6.0x10^{-10}$	$5.0x10^{-7}$	$2.0x10^{-10}$	$1.0x10^{-4}$
Spill	$5.4x10^{-10}$	$2.2x10^{-13}$	$1.8x10^{-10}$	$7.2x10^{-14}$	$4.5x10^{-5}$
Glovebox explosion	$3.2x10^{-4}$	$1.3x10^{-7}$	$1.0x10^{-4}$	$4.0x10^{-8}$	$1.0x10^{-4}$
Expected Risk of Cancer Fatality (per year)					
Loading dock fire	–	$4.8x10^{-9}$	–	$1.6x10^{-9}$	–
Process cell fire	–	$6.0x10^{-14}$	–	$2.0x10^{-14}$	–
Spill	–	$9.9x10^{-18}$	–	$3.2x10^{-18}$	–
Glovebox explosion	–	$1.3x10^{-11}$	–	$4.0x10^{-12}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.2–1 and the GENII computer code.

TABLE F.2.2.5.2–9.—*Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Loading dock fire	0.13	$5.2x10^{-5}$	0.042	$1.7x10^{-5}$	$5.0x10^{-4}$
Process cell fire	$8.1x10^{-6}$	$3.2x10^{-9}$	$2.6x10^{-6}$	$1.0x10^{-9}$	$1.0x10^{-4}$
Spill	$2.8x10^{-9}$	$1.1x10^{-12}$	$9.3x10^{-10}$	$3.7x10^{-13}$	$4.5x10^{-5}$
Glovebox explosion	$1.6x10^{-3}$	$6.4x10^{-7}$	$5.4x10^{-4}$	$2.2x10^{-7}$	$1.0x10^{-4}$
Expected Risk of Cancer Fatality (per year)					
Loading dock fire	–	$2.6x10^{-8}$	–	$5.0x10^{-9}$	–
Process cell fire	–	$3.2x10^{-13}$	–	$1.0x10^{-13}$	–
Spill	–	$5.0x10^{-17}$	–	$1.7x10^{-17}$	–
Glovebox explosion	–	$6.4x10^{-11}$	–	$2.2x10^{-11}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.2–1 and the GENII computer code.

TABLE F.2.2.5.2–10.—***Mixed Oxide Fuel Fabrication Low-to-Moderate Consequence Accidents at Pantex Plant—Worker Consequences***

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality[a]	
Loading dock fire	9.8x10^{-3}	3.9x10^{-6}	2.7x10^{-3}	1.1x10^{-6}	5.0x10^{-3}
Process cell fire	6.0x10^{-7}	2.4x10^{-10}	1.7x10^{-7}	6.8x10^{-11}	1.0x10^{-4}
Spill	2.2x10^{-10}	8.8x10^{-14}	6.1x10^{-11}	2.4x10^{-14}	4.5x10^{-5}
Glovebox explosion	1.3x10^{-4}	5.2x10^{-8}	3.6x10^{-5}	1.4x10^{-8}	1.0x10^{-4}
Expected Risk of Cancer Fatality (per year)					
Loading dock fire	–	2.0x10^{-8}	–	5.5x10^{-9}	–
Process cell fire	–	2.4x10^{-14}	–	6.8x10^{-15}	–
Spill	–	4.0x10^{-18}	–	1.1x10^{-18}	–
Glovebox explosion	–	5.2x10^{-12}	–	1.4x10^{-12}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.2–1 and the GENII computer code.

TABLE F.2.2.5.2–11.—***Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Savannah River Site–Worker Consequences***

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	
Loading dock fire	0.22	8.8x10^{-5}	0.076	3.0x10^{-5}	5.0x10^{-4}
Process cell fire	1.4x10^{-5}	5.6x10^{-9}	4.8x10^{-6}	1.9x10^{-9}	1.0x10^{-4}
Spill	4.9x10^{-9}	2.0x10^{-12}	1.7x10^{-9}	6.8x10^{-13}	4.5x10^{-5}
Glovebox explosion	2.9x10^{-3}	1.2x10^{-6}	9.9x10^{-4}	4.0x10^{-7}	1.0x10^{-4}
Expected Risk of Cancer Fatality (per year)					
Loading dock fire	–	4.4x10^{-8}	–	1.5x10^{-7}	–
Process cell fire	–	5.6x10^{-13}	–	1.9x10^{-13}	–
Spill	–	9.0x10^{-17}	–	3.1x10^{-17}	–
Glovebox explosion	–	1.2x10^{-10}	–	4.0x10^{-11}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.2–1 and the GENII computer code.

F.2.2.5.3 *Pit Disassembly and Conversion*

Loading Dock Fire

Scenario. The accident postulated is a fire on an open loading dock caused by welding, cleaning solvents, electrical shorts, or other miscellaneous causes. A single drum of combustible waste, containing 18 grams of plutonium, is involved in the fire. The analysis estimated that 0.077 gram of plutonium was released directly to the environment by the fire. The annual frequency of occurrence is estimated to be in the range of $1.0\text{x}10^{-4}$ to $1.0\text{x}10^{-5}$ per year. (LANL 1995b:1) For calculational purposes, the annual frequency of occurrence is assumed to be $5.0\text{x}10^{-4}$ per year, the mid point of the estimated range. Table F.2.1.5.2–2 presents the isotopic distribution for a plutonium release at the mixed-oxide fuel reactor facility. Table F.2.2.5.3–1 presents the source term, by isotope, for the 0.077 gram of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.5.3–2 through F.2.2.5.3–6 for public consequences and in tables F.2.2.5.3–7 through F.2.2.5.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.5.3–1 using the GENII computer code.

Process Cell Fire

Scenario. The accident postulated is a fire in a process cell area. It is assumed that the process cell contains a glovebox used for milling plutonium powder. The gloves have become coated with a layer of plutonium dust. The analysis estimated the glove loading at 2 grams of plutonium per glove. Each of the 12 gloves is assumed to be stowed outside of the glovebox. A flammable cleaning liquid such as acetone or isopropyl alcohol is brought into the process cell in violation of operating procedures, spills and ignites. All gloves are incinerated, the sprinkler system activates and protects the glovebox from further damage. The ventilation system and HEPA filters continue to function through the accident. It is estimated that $4.8\text{x}10^{-6}$ gram of plutonium is released to the environment. The annual frequency of occurrence is estimated to be in the range of $1.0\text{x}10^{-3}$ to $1.0\text{x}10^{-5}$ per year. (LANLb:1) For calculational purposes, the annual frequency of occurrence is assumed to be $1.0\text{x}10^{-4}$ per year, the mid point of the estimated range. Table F.2.1.5.2–2 presents the isotopic distribution for a plutonium release at the mixed-oxide fuel reactor facility. Table F.2.2.5.3–1 presents the source term, by isotope, for the $4.8\text{x}10^{-6}$ gram of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.5.3–2 through F.2.2.5.3–6 for public consequences and in tables F.2.2.5.3–7 through F.2.2.5.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.5.3–1 using the GENII computer code.

Spill

Scenario. The most catastrophic case of leak or spill of plutonium would result from a fork lift or other large vehicle running over a package of plutonium-oxide and breaching the package. The analysis postulated that the package contained 4 kg of plutonium-oxide and that 0.4 gram would become airborne after the accident. During cleanup operations, the analysis assumed that an additional 0.04 gram would be resuspended for a total airborne release to the room of 0.44 gram of plutonium-oxide. After three stage HEPA filtration of the facility exhaust, the total release to the environment is estimated to be $1.7\text{x}10^{-9}$ gram of plutonium. The probability calculated from the event tree for this scenario is $4.5\text{x}10^{-5}$ per year (LANL 1995b:1). Table F.2.1.5.2–2 presents the isotopic distribution for a plutonium release at the mixed-oxide fuel reactor facility. Table F.2.2.5.3–1 presents the source term, by isotope, for the $1.7\text{x}10^{-9}$ gram of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.5.3–2 through F.2.2.5.3–6 for public consequences and in tables F.2.2.5.3–7 through F.2.2.5.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.5.3–1 using the GENII computer code.

Glovebox Explosion

Scenario. The bounding design-basis accident explosion is a conflagration for a flammable gas mixture inside a glovebox. The glovebox identified as having the most material at risk contains the milling operation where plutonium-oxide is milled to a fine powder prior to mixing with uranium dioxide. Based on a LANL TA-55 standard operating procedure, the criticality limit for plutonium-oxide in a dry atmosphere is assumed to be 4.5 kg. The analysis assumed the glovebox contains 4.5 kg of plutonium-oxide and through some unforeseen set of failures, a combustible gas mixture accumulates inside a glovebox and is ignited, possibly by an electrical spark from an operating electrical device. The conflagration blows out the HEPA filter from the glovebox ventilation system exit. In addition, gloves may also be blown out. The building HEPA filters and ventilation system continue to operate during the accident. The analysis estimated that $4.5\text{x}10^{-4}$ gram of plutonium is released up the stack. The annual frequency of occurrence is estimated to be in the range of $1.0\text{x}10^{-3}$ to $1.0\text{x}10^{-5}$ per year. (LANL 1995 b:1) For calculational purposes, the annual frequency of occupance is assumed to be $1.0\text{x}10^{-4}$ per year, the mid point of the estimated range. Table F.2.1.5.2–2 presents the isotopic distribution for a plutonium release at the mixed-oxide fuel reactor facility. Table F.2.2.5.3–1 presents the source term, by isotope, for the $4.5\text{x}10^{-4}$ gram of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.5.3–2 through F.2.2.5.3–6 for public consequences and in tables F.2.2.5.3–7 through F.2.2.5.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.5.3–1 using the GENII computer code.

Ion Exchange Column Explosion

Scenario. The postulated accident assumed the processing of the maximum possible plutonium load and 223 grams of material would be released to the room due to the explosion. 45 grams of the material would be aerosol consisting of 20 grams per liter of plutonium nitrate solution. The quantity of soluble plutonium released would be 0.75 gram. A total of 3 grams of plutonium would be released to the room. The ventilation system continues to operate and the aerosol would be carried through the ventilation system to the HEPA filters. The final environmental release was estimated to be $3.0\text{x}10^{-9}$ gram of plutonium. The accident frequency is estimated to be $7.0\text{x}10^{-4}$ per year. (LANL 1995b:1) Table F.2.1.5.2–2 presents the isotopic distribution for a plutonium release at the mixed-oxide fuel reactor facility. Table F.2.2.5.3–1 presents the source term, by isotope, for the $3.0\text{x}10^{-9}$ gram of plutonium released to the environment during the postulated accident.

Consequences. The estimated consequences of the postulated accident with 50 percent meteorology at each site are shown in tables F.2.2.5.3–2 through F.2.2.5.3–6 for public consequences and in tables F.2.2.5.3–7 through F.2.2.5.3–11 for worker consequences. The dose estimates are based on analysis of the source terms in table F.2.2.5.3–1 using the GENII computer code.

TABLE F.2.2.5.3–1.—*Pit Disassembly and Conversion Low-to-Moderate Consequence Accident Source Terms*

	Released Activity (curies)				
Isotope	**Loading dock fire**	**Process Cell Fire**	**Spill**	**Glovebox explosions**	**Ion Exchange Column Explosion**
Pu-238	$6.5x10^{-4}$	$4.0x10^{-8}$	$1.4x10^{-11}$	$3.8x10^{-6}$	$2.5x10^{-11}$
Pu-239	$4.5x10^{-3}$	$2.8x10^{-7}$	$9.8x10^{-11}$	$2.6x10^{-5}$	$1.7x10^{-10}$
Pu-240	$1.0x10^{-3}$	$6.4x10^{-8}$	$2.3x10^{-11}$	$6.0x10^{-6}$	$4.0x10^{-11}$
Pu-241	0.031	$1.9x10^{-6}$	$6.9x10^{-10}$	$1.8x10^{-4}$	$1.2x10^{-9}$
Pu-241	$9.9x10^{-4}$	$6.1x10^{-8}$	$2.2x10^{-11}$	$5.8x10^{-6}$	$3.8x10^{-11}$

TABLE F.2.2.5.3–2.—*Pit Disassembly and Conversion Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory —Public Consequences*

	Maximum Offsite Individual		Population to 50 miles		
Accident Description	**Dose (rem)**	**Cancer Fatality**[a]	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
Loading dock fire	$1.9x10^{-3}$	$9.5x10^{-7}$	0.18	$9.0x10^{-3}$	$5.0x10^{-4}$
Process cell fire	$1.2x10^{-7}$	$6.0x10^{-11}$	$1.1x10^{-3}$	$5.5x10^{-7}$	$1.0x10^{-4}$
Spill	$4.21x10^{-11}$	$2.1x10^{-14}$	$4.0x10^{-7}$	$2.0x10^{-10}$	$4.5x10^{-5}$
Glovebox explosion	$1.1x10^{-5}$	$5.5x10^{-8}$	0.10	$5.0x10^{-5}$	$1.0x10^{-4}$
Ion exchange column explosion	$7.3x10^{-11}$	$3.7x10^{-14}$	$7.1x10^{-7}$	$3.6x10^{-10}$	$7.0x10^{-4}$
Expected Risk of Cancer Fatality (cancer fatalities per year)					
Loading dock fire	–	$4.8x10^{-10}$	–	$4.5x10^{-6}$	–
Process cell fire	–	$6.0x10^{-15}$	–	$5.5x10^{-11}$	–
Spill	–	$9.5x10^{-19}$	–	$9.0x10^{-15}$	–
Glovebox explosion	–	$5.5x10^{-12}$	–	$5.0x10^{-9}$	–
Ion exchange column explosion	–	$2.6x10^{-17}$	–	$2.5x10^{-13}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.3-1 and the GENII computer code.

TABLE F.2.2.5.3–3.—*Pit Disassembly and Conversion Low-to-Moderate Consequence Accidents at Nevada Test Site—Public Consequences*

Accident Description	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 miles Dose (person-rem)	Population to 50 miles Cancer Fatality	Accident Frequency (per year)
Loading dock fire	$8.3\text{x}10^{-4}$	$4.2\text{x}10^{-7}$	0.29	$1.5\text{x}10^{-4}$	$5.0\text{x}10^{-4}$
Process cell fire	$5.2\text{x}10^{-8}$	$2.6\text{x}10^{-11}$	$1.8\text{x}10^{-5}$	$9.0\text{x}10^{-9}$	$1.0\text{x}10^{-4}$
Spill	$1.9\text{x}10^{-11}$	$9.5\text{x}10^{-15}$	$6.5\text{x}10^{-9}$	$3.3\text{x}10^{-12}$	$4.5\text{x}10^{-5}$
Glovebox explosion	$4.9\text{x}10^{-6}$	$2.5\text{x}10^{-9}$	$1.7\text{x}10^{-3}$	$8.5\text{x}10^{-7}$	$1.0\text{x}10^{-4}$
Ion exchange column explosion	$3.2\text{x}10^{-11}$	$1.6\text{x}10^{-14}$	$1.1\text{x}10^{-8}$	$5.5\text{x}10^{-12}$	$7.0\text{x}10^{-4}$
Expected Risk of Cancer Fatality (cancer fatalities per year)					
Loading dock fire	–	$2.1\text{x}10^{-10}$	–	$7.5\text{x}10^{-8}$	–
Process cell fire	–	$2.6\text{x}10^{-15}$	–	$9.0\text{x}10^{-13}$	–
Spill	–	$4.3\text{x}10^{-19}$	–	$1.5\text{x}10^{-16}$	–
Glovebox explosion	–	$2.5\text{x}10^{-13}$	–	$8.5\text{x}10^{-11}$	–
Ion exchange column explosion	–	$1.1\text{x}10^{-17}$	–	$3.9\text{x}10^{-15}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.3-1 and the GENII computer code.

TABLE F.2.2.5.3–4.—*Pit Disassembly and Conversion Low-to-Moderate Consequence Accidents at Oak Ridge Reservation—Public Consequences*

Accident Description	Maximum Offsite Individual Dose (rem)	Maximum Offsite Individual Cancer Fatality[a]	Population to 50 miles Dose (person-rem)	Population to 50 miles Cancer Fatality	Accident Frequency (per year)
Loading dock fire	0.016	$8.0\text{x}10^{-6}$	180	0.090	$5.0\text{x}10^{-4}$
Process cell fire	$1.0\text{x}10^{-6}$	$5.0\text{x}10^{-10}$	0.011	$5.5\text{x}10^{-6}$	$1.0\text{x}10^{-4}$
Spill	$3.6\text{x}10^{-10}$	$1.8\text{x}10^{-13}$	$4.0\text{x}10^{-6}$	$2.0\text{x}10^{-9}$	$4.5\text{x}10^{-5}$
Glovebox explosion	$9.4\text{x}10^{-5}$	$4.7\text{x}10^{-8}$	1.0	$5.0\text{x}10^{-4}$	$1.0\text{x}10^{-4}$
Ion exchange column explosion	$6.1\text{x}10^{-10}$	$3.1\text{x}10^{-13}$	$7.1\text{x}10^{-6}$	$3.6\text{x}10^{-9}$	$7.0\text{x}10^{-4}$
Expected Risk of Cancer Fatality (cancer fatalities per year)					
Loading dock fire	–	$4.0\text{x}10^{-9}$	–	$4.5\text{x}10^{-5}$	–
Process cell fire	–	$5.0\text{x}10^{-14}$	–	$5.5\text{x}10^{-10}$	–
Spill	–	$8.1\text{x}10^{-18}$	–	$9.0\text{x}10^{-14}$	–
Glovebox explosion	–	$4.7\text{x}10^{-12}$	–	$5.0\text{x}10^{-8}$	–
Ion exchange column explosion	–	$2.2\text{x}10^{-16}$	–	$2.5\text{x}10^{-12}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.3-1 and the GENII computer code.

TABLE F.2.2.5.3–5.—*Pit Disassembly and Conversion Low-to-Moderate Consequence Accidents at Pantex Plant—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Loading dock fire	1.5x10^{-3}	7.5x10^{-7}	6.0	3.0x103^{-}	5.0x10^{-4}
Process cell fire	9.2x10^{-8}	4.6x10^{-11}	3.8x10^{-4}	1.9x10^{-7}	1.0x10^{-4}
Spill	3.2x10^{-11}	1.6x10^{-14}	1.3x10^{-7}	6.5x10^{-11}	4.5x10^{-5}
Glovebox explosion	8.7x10^{-6}	4.4x10^{-9}	0.035	1.8x10^{-5}	1.0x10^{-4}
Ion exchange column explosion	5.6x10^{-11}	2.8x10^{-14}	2.3x10^{-7}	1.2x10^{-10}	7.0x10^{-4}
Expected Risk of Cancer Fatality (cancer fatalities per year)					
Loading dock fire	–	3.8x10^{-10}	–	1.5x10^{-6}	–
Process cell fire	–	4.6x10^{-15}	–	1.9x10^{-11}	–
Spill	–	7.2x10^{-19}	–	2.9x10^{-15}	–
Glovebox explosion	–	4.4x10^{-13}	–	1.8x10^{-9}	–
Ion exchange column explosion	–	2.0x10^{-17}	–	8.4x10^{-14}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.3-1 and the GENII computer code.

TABLE F.2.2.5.3–6.—*Pit Disassembly and Conversion Low-to-Moderate Consequence Accidents at Savannah River Site—Public Consequences*

Accident Description	Maximum Offsite Individual		Population to 50 miles		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	
Loading dock fire	5.4x10^{-3}	2.7x10^{-6}	170	0.085	5.0x10^{-4}
Process cell fire	3.4x10^{-7}	1.7x10^{-10}	0.011	5.5x10^{-6}	1.0x10^{-4}
Spill	1.2x10^{-10}	6.0x10^{-14}	3.7x10^{-6}	1.9x10^{-9}	4.5x10^{-5}
Glovebox explosion	3.2x10^{-5}	1.6x10^{-8}	1.0	5.0x10^{-4}	1.0x10^{-4}
Ion exchange column explosion	2.1x10^{-5}	1.1x10^{-13}	6.6x10^{-6}	3.3x10^{-9}	7.0x10^{-4}
Expected Risk of Cancer Fatality (cancer fatalities per year)					
Loading dock fire	–	1.4x10^{-9}	–	4.3x10^{-5}	–
Process cell fire	–	1.7x10^{-14}	–	5.5x10^{-10}	–
Spill	–	2.7x10^{-18}	–	8.6x10^{-14}	–
Glovebox explosion	–	1.6x10^{-12}	–	5.0x10^{-8}	–
Ion exchange column explosion	–	7.7x10^{-17}	–	2.3x10^{-12}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.3-1 and the GENII computer code.

TABLE F.2.2.5.3–7.—*Pit Disassembly and Conversion Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory —Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2.000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality[a]	
Loading dock fire	0.083	$3.3x10^{-5}$	0.028	$1.1x10^{-5}$	$5.0x10^{-4}$
Process cell fire	$5.2x10^{-6}$	$2.1x10^{-9}$	$1.7x10^{-6}$	$6.8x10^{-10}$	$1.0x10^{-4}$
Spill	$1.8x10^{-9}$	$7.2x10^{-13}$	$6.1x10^{-10}$	$2.4x10^{-13}$	$4.5x10^{-5}$
Glovebox explosion	$4.8x10^{-4}$	$1.9x10^{-7}$	$1.6x10^{-4}$	$6.4x10^{-8}$	$1.0x10^{-4}$
Ion exchange column explosion	$3.2x10^{-9}$	$1.3x10^{-12}$	$1.1x10^{-9}$	$4.4x10^{-13}$	$7.0x10^{-4}$
Expected Risk of Cancer Fatality (cancer fatalities per year)					
Loading dock fire	–	$1.7x10^{-8}$	–	$5.5x10^{-9}$	–
Process cell fire	–	$2.1x10^{-13}$	–	$6.8x10^{-14}$	–
Spill	–	$3.2x10^{-17}$	–	$1.1x10^{-17}$	–
Glovebox explosion	–	$1.9x10^{-11}$	–	$6.4x10^{-12}$	–
Ion exchange column explosion	–	$9.1x10^{-16}$	–	$3.1x10^{-16}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.3-1 and the GENII computer code.

TABLE F.2.2.5.3–8.—*Pit Disassembly and Conversion Low-to-Moderate Consequence Accidents at Nevada Test Site—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality[a]	
Loading dock fire	0.024	$9.6x10^{-6}$	$8.1x10^{-3}$	$3.2x10^{-6}$	$5.0x10^{-4}$
Process cell fire	$1.5x10^{-6}$	$6.0x10^{-10}$	$5.0x10^{-7}$	$2.0x10^{-10}$	$1.0x10^{-4}$
Spill	$5.4x10^{-10}$	$2.2x10^{-13}$	$1.8x10^{-10}$	$7.2x10^{-14}$	$4.5x10^{-5}$
Glovebox explosion	$1.4x10^{-4}$	$5.6x10^{-8}$	$4.8x10^{-5}$	$1.9x10^{-8}$	$1.0x10^{-4}$
Ion exchange column explosion	$9.4x10^{-10}$	$3.8x10^{-13}$	$3.1x10^{-10}$	$1.2x10^{-13}$	$7.0x10^{-4}$
Expected Risk of Cancer Fatality (cancer fatalities per year)					
Loading dock fire	–	$4.8x10^{-9}$	–	$1.6x10^{-9}$	–
Process cell fire	–	$6.0x10^{-14}$	–	$2.0x10^{-14}$	–
Spill	–	$9.9x10^{-18}$	–	$3.2x10^{-18}$	–
Glovebox explosion	–	$5.6x10^{-12}$	–	$1.9x10^{-12}$	–
Ion exchange column explosion	–	$2.7x10^{-16}$	–	$8.4x10^{-17}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.3-2 and the GENII computer code.

TABLE F.2.2.5.3–9.—*Pit Disassembly and Conversion Low-to-Moderate Consequence Accidents at Oak Ridge Reservation—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (person-rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Loading dock fire	0.13	$5.2\text{x}10^{-5}$	0.042	$1.7\text{x}10^{-5}$	$5.0\text{x}10^{-4}$
Process cell fire	$8.1\text{x}10^{-6}$	$3.2\text{x}10^{-9}$	$2.6\text{x}10^{-6}$	$1.0\text{x}10^{-9}$	$1.0\text{x}10^{-4}$
Spill	$2.8\text{x}10^{-9}$	$1.1\text{x}10^{-12}$	$9.3\text{x}10^{-10}$	$3.7\text{x}10^{-13}$	$4.5\text{x}10^{-5}$
Glovebox explosion	$7.2\text{x}10^{-4}$	$2.9\text{x}10^{-7}$	$2.5\text{x}10^{-4}$	$1.0\text{x}10^{-7}$	$1.0\text{x}10^{-4}$
Ion exchange column explosion	$4.9\text{x}10^{-9}$	$2.0\text{x}10^{-12}$	$1.6\text{x}10^{-9}$	$6.4\text{x}10^{-13}$	$7.0\text{x}10^{-4}$
Expected Risk of Cancer Fatality (cancer fatalities per year)					
Loading dock fire	–	$2.6\text{x}10^{-8}$	–	$8.5\text{x}10^{-9}$	–
Process cell fire	–	$3.2\text{x}10^{-13}$	–	$1.0\text{x}10^{-13}$	–
Spill	–	$5.0\text{x}10^{-17}$	–	$1.7\text{x}10^{-17}$	–
Glovebox explosion	–	$2.9\text{x}10^{-11}$	–	$1.0\text{x}10^{-11}$	–
Ion exchange column explosion	–	$1.4\text{x}10^{-15}$	–	$4.5\text{x}10^{-16}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.3-1 and the GENII computer code.

TABLE F.2.2.5.3–10.—*Pit Disassembly and Conversion Low-to-Moderate Consequence Accidents at Pantex Plant—Worker Consequences*

Accident Description	Worker at 1,000 meters Dose (rem)	Worker at 1,000 meters Cancer Fatality[a]	Worker at 2,000 meters Dose (person-rem)	Worker at 2,000 meters Cancer Fatality[a]	Accident Frequency (per year)
Loading dock fire	$9.8\text{x}10^{-3}$	$3.9\text{x}10^{-6}$	$2.7\text{x}10^{-3}$	$1.1\text{x}10^{-6}$	$5.0\text{x}10^{-4}$
Process cell fire	$6.0\text{x}10^{-7}$	$2.4\text{x}10^{-10}$	$1.7\text{x}10^{-7}$	$6.8\text{x}10^{-11}$	$1.0\text{x}10^{-4}$
Spill	$2.2\text{x}10^{-10}$	$8.8\text{x}10^{-14}$	$6.1\text{x}10^{-11}$	$2.4\text{x}10^{-14}$	$4.5\text{x}10^{-5}$
Glovebox explosion	$5.6\text{x}10^{-5}$	$2.2\text{x}10^{-8}$	$1.6\text{x}10^{-5}$	$6.4\text{x}10^{-9}$	$1.0\text{x}10^{-4}$
Ion exchange column explosion	$3.7\text{x}10^{-10}$	$1.5\text{x}10^{-13}$	$1.0\text{x}10^{-10}$	$4.0\text{x}10^{-14}$	$7.0\text{x}10^{-4}$
Expected Risk of Cancer Fatality (cancer fatalities per year)					
Loading dock fire	–	$2.0\text{x}10^{-9}$	–	$5.5\text{x}10^{-10}$	–
Process cell fire	–	$2.4\text{x}10^{-14}$	–	$6.8\text{x}10^{-15}$	–
Spill	–	$4.0\text{x}10^{-18}$	–	$1.1\text{x}10^{-18}$	–
Glovebox explosion	–	$2.2\text{x}10^{-12}$	–	$6.4\text{x}10^{-13}$	–
Ion exchange column explosion	–	$1.1\text{x}10^{-16}$	–	$2.8\text{x}10^{-17}$	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.3-1 and the GENII computer code.

Table F.2.2.5.3–11.—*Pit Disassembly and Conversion Low-to-Moderate Consequence Accidents at Savannah River Site—Worker Consequences*

Accident Description	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality[a]	
Loading dock fire	0.22	8.8×10^{-5}	7.6×10^{-2}	3.0×10^{-5}	5.0×10^{-4}
Process cell fire	1.4×10^{-5}	5.6×10^{-9}	4.8×10^{-6}	1.9×10^{-9}	1.0×10^{-4}
Spill	4.9×10^{-9}	2.0×10^{-12}	1.7×10^{-9}	6.8×10^{-13}	4.5×10^{-5}
Glovebox explosion	1.3×10^{-3}	5.2×10^{-7}	4.5×10^{-4}	1.8×10^{-7}	1.0×10^{-4}
Ion exchange column explosion	8.4×10^{-9}	3.4×10^{-12}	2.9×10^{-9}	1.2×10^{-12}	7.0×10^{-4}
Expected Risk of Cancer Fatality (cancer fatalities per year)					
Loading dock fire	–	4.4×10^{-8}	–	1.5×10^{-8}	–
Process cell fire	–	5.6×10^{-13}	–	1.9×10^{-13}	–
Spill	–	9.0×10^{-17}	–	3.1×10^{-17}	–
Glovebox explosion	–	5.2×10^{-11}	–	1.8×10^{-11}	–
Ion exchange column explosion	–	2.4×10^{-15}	–	8.4×10^{-16}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using the source terms in table F.2.2.5.3-1 and the GENII computer code.

F.2.2.6 *Tritium Target Extraction Facility*

Scenario. A tritium target extraction facility removes tritium from the targets. The bounding accidents for the tritium extraction facility are based on the analysis of tritium operations at SRS. The bounding low-to-moderate consequence accident for the facility postulated an explosion in the extraction facility. The explosion was initiated by air leakage from furnace leaks, tank leaks, connection leaks, pump leaks, valve leaks or during process maintenance. The air leakage formed a flammable mixture that subsequently ignites. Approximately 1.4×10^6 Ci of tritium in oxide form could be released to the material handling room and subsequently to the environment. The accident annual frequency of occurrence is estimated at 2.0×10^{-5} per year at SRS (DOE 1994a).

Consequences. The estimated consequences of the postulated tritium target extraction facility bounding accident for each site are shown for the public in table F.2.2.6–1 and for the worker in table F.2.2.6–2 for 50 percent meteorology conditions. The estimates are based on the postulated release of 1.4×10^6 Ci of tritium in the oxide form directly to the environment during the accident using the GENII computer code.

TABLE F.2.2.6–1.—*Tritium Target Extraction Facility Bounding Low-to-Moderate Consequence Accident—Public Consequences*

	Individual at Site Boundary		**Population to 50 Miles**		
Accident Description	**Dose (rem)**	**Cancer Fatality[a]**	**Dose (person-rem)**	**Cancer Fatality**	**Accident Frequency (per year)**
Idaho National Engineering Laboratory	0.099	5.0×10^{-5}	900	0.45	2.0×10^{-5}
Nevada Test Site	0.043	2.2×10^{-5}	15	7.5×10^{-3}	2.0×10^{-5}
Oak Ridge Reservation	0.84	4.2×10^{-4}	9.0×10^{3}	4.5	2.0×10^{-5}
Pantex Plant	0.077	3.9×10^{-5}	320	0.16	2.0×10^{-5}
Savannah River Site	0.23	1.2×10^{-4}	1.2×10^{4}	6	2.0×10^{-5}
Expected Risk of Cancer Fatality (per year)					
Idaho National Engineering Laboratory	–	1.0×10^{-9}	–	9.0×10^{-6}	–
Nevada Test Site	–	4.4×10^{-10}	–	1.5×10^{-7}	–
Oak Ridge Reservation	–	8.4×10^{-9}	–	9.0×10^{-5}	–
Pantex Plant	–	7.8×10^{-10}	–	3.2×10^{-6}	–
Savannah River Site	–	2.4×10^{-9}	–	1.2×10^{-4}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using a source term of 1.4×10^{6} Ci of tritium in oxide form and the MACCS computer code.

TABLE F.2.2.6–2.—*Tritium Target Extraction Facility Bounding Low-to-Moderate Consequence Accident—Worker Consequences*

	Worker at 1,000 meters		**Worker at 2,000 meters**		
Accident Description	**Dose (rem)**	**Cancer Fatality[a]**	**Dose (rem)**	**Cancer Fatality[a]**	**Accident Frequency (per year)**
Idaho National Engineering Laboratory	4.3	1.7×10^{-3}	1.4	5.6×10^{-4}	2.0×10^{-5}
Nevada Test Site	1.3×10^{-4}	5.2×10^{-8}	4.2×10^{-5}	1.7×10^{-8}	2.0×10^{-5}
Oak Ridge Reservation	6.6	2.6×10^{-3}	2.2	8.8×10^{-4}	2.0×10^{-5}
Pantex Plant	0.51	2.4×10^{-4}	0.14	5.6×10^{-5}	2.0×10^{-5}
Savannah River Site	12	4.8×10^{-3}	4	1.6×10^{-3}	2.0×10^{-5}
Expected Risk of Cancer Fatality (per year)					
Idaho National Engineering Laboratory	–	3.4×10^{-8}	–	1.1×10^{-8}	–
Nevada Test Site	–	1.0×10^{-12}	–	3.4×10^{-13}	–
Oak Ridge Reservation	–	5.2×10^{-8}	–	1.8×10^{-8}	–
Pantex Plant	–	4.8×10^{-9}	–	1.1×10^{-9}	–
Savannah River Site	–	9.6×10^{-8}	–	3.2×10^{-8}	–

[a] Increased likelihood of cancer fatality.

Note: Values are shown for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using a source term of 1.4×10^{6} Ci of tritium in oxide form and the MACCS computer code.

F.2.3 Tritium Recycling Facility High Consequence Accident

The bounding accidents selected for the tritium recycling facility are based on the analysis of tritium operations at SRS. While the spectrum of accidents is representative of the types of accidents to be considered in the design, development, and analysis of the plant, the estimated consequences of the accidents may be conservative because they are based on analyses of facilities that may not all meet the general design and safety requirements that will be implemented for new tritium supply facilities.

If the tritium supply facility is located at either INEL, NTS, ORR, or Pantex, the tritium recycling facility could be collocated at the same site. If the tritium supply facility is located at SRS, the existing tritium recycling facilities at SRS would be upgraded.

Both high consequence accidents and design-basis/operational accidents are considered. High consequence accidents include accidents caused by natural phenomena (i.e., earthquake, flood, tornado, tornado-driven debris, and high winds) in excess of the module design basis for safety systems. Operational accidents include fire, explosion, and spills. All upgraded or new tritium recycling facility safety-class structures and safety systems will be designed and installed to meet the design-basis earthquake, flood, tornado, tornado driven debris, and wind natural phenomena requirements.

Scenario. The postulated bounding high consequence accident is a beyond design-basis earthquake that results in the spontaneous ignition of tritium released from ruptured reservoirs stored in the facility unloading station. The analysis postulated that the accident source term released to the environment during the accident is $8.4x10^6$ Ci of tritium in oxide form. The accident annual frequency of occurrence at SRS is $2.0x10^{-5}$ per year (DOE 1995g).

The accident annual frequency of occurrence for new tritium recycling facilities at the other candidate sites will be less than the frequency for existing facilities at SRS. It is assumed that the storage and confinement systems will be designed to maintain functional integrity following a design-basis earthquake or a safe shutdown earthquake with a return frequency of $1.0x10^{-4}$ per year. The evaluation also assumed that the storage and confinement systems may survive an earthquake with a return frequency of $1.0x10^{-5}$ per year but catastrophic failure of the facility could be expected after an earthquake with a return frequency of $1.0x10^{-6}$ per year. For the purpose of calculating the point estimate of risk for the postulated accident, the accident annual frequency of occurrence for all new facilities is assumed to be $1.0x10^{-6}$ per year.

Consequences. The estimated consequences of the postulated high consequence accident for each of the four sites and for the SRS upgrade are shown for the public in table F.2.3–1 and for the worker in table F.2.3–2. The dose and latent cancer fatality estimates were generated using the MACCS computer code and the postulated release of $8.4x10^6$ Ci of tritium in the oxide form directly to the environment during the accident.

Cancer Fatalities Complementary Cumulative Distribution Function for the Tritium Recycling Facility High Consequence Accident

Figure F.2.3-1 shows the annual probability that, in the event of the tritium recycling facility high consequence accident at one of the sites, the number of cancer fatalities exceeds the value N indicated on the horizontal axis. The curves, technically referred to as complementary cumulative distribution functions, reflect the probability of the accident's occurrence as well as the variability in the magnitude of its consequences. Generally, a curve that extends the farthest to the right has the highest accident consequences while a curve that is nearest to the left has the lowest accident consequences. A comparison of alternatives should include the information provided by these curves in conjunction with the point values shown in tables F.2.3-1 and F.2.3-2.

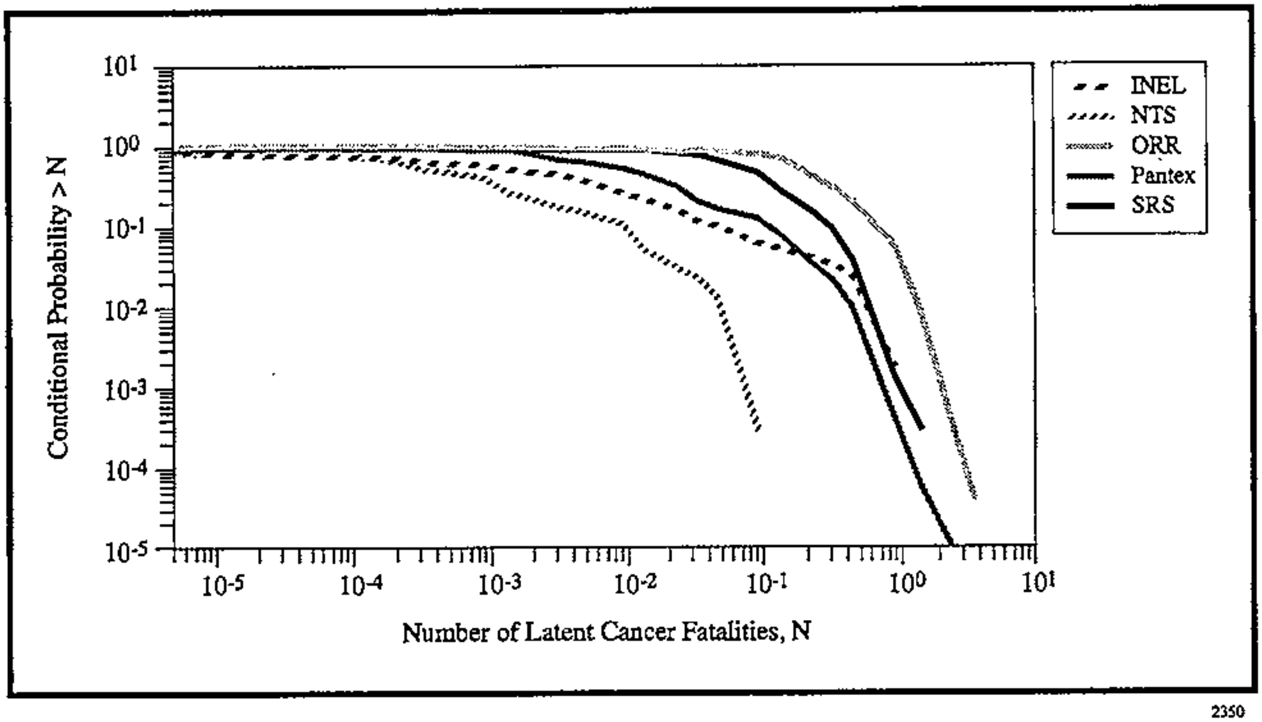


FIGURE F.2.3–1.—*Tritium Recycling Facility Cancer Fatalities Complementary Cumulative Distribution Functions for High Consequence Accident.*

TABLE F.2.3–1.—*Tritium Recycling Facility High Consequence Accident—Public Consequences*

Site	Individual at Site Boundary Dose (rem)	Individual at Site Boundary Cancer Fatality[a]	Population to 50 Miles Dose (person-rem)	Population to 50 Miles Cancer Fatality[a]	Accident Frequency (per year)
Idaho National Engineering Laboratory	0.048	2.4×10^{-5}	81	0.04	1.0×10^{-6}
Nevada Test Site	0.13	6.6×10^{-5}	7.7	3.9×10^{-3}	1.0×10^{-6}
Oak Ridge Reservation	1	5.2×10^{-4}	751	0.38	1.0×10^{-6}
Pantex Plant	0.7	3.5×10^{-4}	98	0.049	1.0×10^{-6}
Savannah River Site[b]	0.045	2.2×10^{-5}	302	0.15	2.0×10^{-5}
Expected Risk of Cancer Fatality (per year)					
Idaho National Engineering Laboratory	–	2.4×10^{-11}	–	4.0×10^{-8}	–
Nevada Test Site	–	6.6×10^{-11}	–	3.9×10^{-9}	–
Oak Ridge Reservation	–	5.2×10^{-10}	–	3.8×10^{-7}	–
Pantex Plant	–	3.5×10^{-10}	–	4.9×10^{-8}	–
Savannah River Site	–	4.4×10^{-10}	–	3.0×10^{-6}	–

[a] Increased likelihood of cancer fatality.

[b] Values shown are for the SRS tritium recycling facilities upgrade option.

Note: All values are mean values.

Source: Calculated using a source term of 8.4×10^6 Ci of tritium and the MACCS computer code.

TABLE F.2.3–2.—*Tritium Recycling Facility High Consequence Accident—Worker Consequences*

Site	Worker at 1,000 meters		Worker at 2,000 meters		Accident Frequency (per year)
	Dose (rem)	**Cancer Fatality[a]**	**Dose (rem)**	**Cancer Fatality[a]**	
Idaho National Engineering Laboratory	6	2.4x10^{-3}	2.2	8.8x10^{-4}	1.0x10^{-6}
Nevada Test Site	4.4	1.7x10^{-3}	1.7	6.7x10^{-4}	1.0x10^{-6}
Oak Ridge Reservation	5.9	2.3x10^{-3}	2.1	8.4x10^{-4}	1.0x10^{-6}
Pantex Plant	2.6	1.0x10^{-3}	0.98	3.9x10^{-4}	1.0x10^{-6}
Savannah River Site[b]	2.6	1.0x10^{-3}	0.98	3.9x10^{-4}	2.0x10^{-5}
Expected Risk of Cancer Fatality (per year)					
Idaho National Engineering Laboratory	–	2.4x10^{-9}	–	8.8x10^{-10}	–
Nevada Test Site	–	1.7x10^{-9}	–	6.7x10^{-10}	–
Oak Ridge Reservation	–	2.3x10^{-9}	–	8.4x10^{-10}	–
Pantex Plant	–	1.0x10^{-9}	–	3.9x10^{-10}	–
Savannah River Site[c]	–	2.0x10^{-8}	–	7.8x10^{-9}	–

[a] Increased likelihood of cancer fatality

[b] Values shown are for the SRS tritium recycling facilities upgrade option.

Note: All values are mean values.

Source: Calculate using a source term of 8.4x10^{6} Ci of tritium in oxide form and the MACCS computer code.

F.2.4 Tritium Recycling Facility Low-to-Moderate Consequence Accident

Scenario. The postulated bounding low-to-moderate consequence accident is the overheating and rupture of a hydride hed. Hydride beds are capable of being overheated to rupture due to equipment failures. Approximately 6,000 Ci of tritium in oxide form could be released to the environment. The accident annual frequency of occurrence is estimated at 2.0x10^{-4} per year at SRS (DOE 1995g).

Consequences. The estimated consequences of the postulated hydride bed rupture accident for each of the four tritium supply technologies and recycling sites and for the SRS recycling facilities upgrade option are shown for the public in table F.2.4–1 and for the workers in table F.2.4–2 for 50 percent meteorology conditions. The estimates are based on the analysis of the postulated release of 6,000 Ci of tritium in oxide form directly to the environment during the accident using the GENII computer code.

TABLE F.2.4–1.—*Tritium Recycling Facility Hydride Bed Rupture Accident—Public Consequences*

	Individual at Site Boundary		Population to 50 Miles		
Site	Dose (rem)	Cancer Fatality[a]	Dose (person-rem)	Cancer Fatality	Accident Frequency (per year)
Idaho National Engineering Laboratory	$4.2x10^{-4}$	$2.1x10^{-7}$	4.1	$2.1x10^{-3}$	$2.0x10^{-4}$
Nevada Test Site	$1.9x10^{-4}$	$9.5x10^{-8}$	0.064	$3.2x10^{-5}$	$2.0x10^{-4}$
Oak Ridge Reservation	$3.6x10^{-3}$	$1.8x10^{-6}$	41	0.021	$2.0x10^{-4}$
Pantex Plant	$3.3x10^{-4}$	$1.7x10^{-7}$	1.4	$7.0x10^{-4}$	$2.0x10^{-4}$
Savannah River Site[b]	$9.9x10^{-4}$	$4.9x10^{-7}$	49	0.025	$2.0x10^{-4}$
Expected Risk of Cancer Fatality (per year)					
Idaho National Engineering Laboratory	–	$4.2x10^{-11}$	–	$4.2x10^{-7}$	–
Nevada Test Site	–	$1.9x10^{-11}$	–	$6.4x10^{-9}$	–
Oak Ridge Reservation	–	$3.6x10^{-10}$	–	$4.2x10^{-6}$	–
Pantex Plant	–	$3.4x10^{-11}$	–	$1.4x10^{-7}$	–
Savannah River Site[b]	–	$9.8x10^{-11}$	–	$5.0x10^{-6}$	–

[a] Increased likelihood of cancer fatality.

[b] Values shown are for the SRS tritium recycling facilities upgrade.

Note: Values shown are for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using a source term of 6,000 Ci of tritium in oxide form and the GENII computer code.

TABLE F.2.4–2.—*Tritium Recycling Facility Hydride Bed Rupture Accident—Worker Consequences*

	Worker at 1,000 meters		Worker at 2,000 meters		
Site	Dose (rem)	Cancer Fatality[a]	Dose (rem)	Cancer Fatality[a]	Accident Frequency (per year)
Idaho National Engineering Laboratory	$1.8x10^{-6}$	$7.2x10^{-10}$	$6.1x10^{-7}$	$2.4x10^{-10}$	$2.0x10^{-4}$
Nevada Test Site	$5.4x10^{-3}$	$2.2x10^{-6}$	$1.8x10^{-3}$	$7.2x10^{-7}$	$2.0x10^{-4}$
Oak Ridge Reservation	0.028	$1.1x10^{-5}$	$9.0x10^{-3}$	$3.6x10^{-6}$	$2.0x10^{-4}$
Pantex Plant	$2.2x10^{-3}$	$8.8x10^{-7}$	$6.0x10^{-8}$	$2.4x10^{-11}$	$2.0x10^{-4}$
Savannah River Site[b]	0.049	$2.0x10^{-5}$	$1.7x10^{-2}$	$6.8x10^{-6}$	$2.0x10^{-4}$
Expected Risk of Cancer Fatality (per year)					
Idaho National Engineering Laboratory	–	$1.4x10^{-13}$	–	$4.8x10^{-14}$	–
Nevada Test Site	–	$4.4x10^{-10}$	–	$1.4x10^{-10}$	–
Oak Ridge Reservation	–	$2.2x10^{-9}$	–	$7.2x10^{-10}$	–
Pantex Plant	–	$1.8x10^{-10}$	–	$4.8x10^{-15}$	–
Savannah River Site[c]	–	$4.0x10^{-9}$	–	$1.4x10^{-9}$	–

[a] Increased likelihood of cancer fatality.

[b] Values shown are for the SRS tritium recycling facilities upgrade.

Note: Values shown are for inhalation and external doses with 50 percent meteorology conditions.

Source: Calculated using a source term of 6,000 Ci of tritium in oxide form and the GENII computer code.

F.3 SECONDARY IMPACTS OF ACCIDENTS

The primary impacts of accidents are measured in terms of public and worker exposures to radiation and toxic chemicals. The secondary impacts of accidents affect elements of the environment other than humans. For example, a radiological release may contaminate farmland, surface and underground water, recreational areas, industrial parks, historical sites, or the habitat of an endangered species. As a result, farm products may have to be destroyed; the supply of drinking water may be lowered; recreational areas may be closed; industrial parks may suffer economic losses during shutdown for decontamination; historical sites may have to be closed to visitors; and the endangered species may move closer to extinction.

This section addresses the secondary impacts of a reactor charge/discharge design-basis accident in the region of a radiological release. This accident was selected as representative of a design-basis accident although another accident for any other technology could also have been selected to illustrate the secondary effects. Other design-basis accidents with greater source terms could also be found that would show secondary effects extending over a larger region than shown in figures F.3.1–1 through F.3.5–1. The source term for the HWR charge/discharge accident is shown in table F.2.2.1–1. The level of exposure estimates are based on analysis of the source term in table F.2.2.1–1 using the GENII computer code with 50 percent meteorology conditions for each site.

The region of secondary effects extends out from the point of release in a pattern formed by dispersion parameters such as meteorology. The level of exposure is generally decreasing with increasing distance from the release point. Figures F.3.1–1 through F.3.5–1 show the shapes of patterns for each site at a distance at which the level of exposure from the accidental release would be equivalent to the level of annual exposure from natural background radiation at each site. Levels of exposure that are less than natural background can be expected in areas outside of the shaded pattern.

These results are useful for comparing the sensitivity of sites with respect to the secondary impacts for an accidental radiological release from a reactor. In reviewing the results, it is useful to note whether the impacted area extends beyond the site boundary where the economic impacts would be larger than if the area were contained within the site boundary. It is also useful to note the size of the contaminated area in which the level of exposure exceeds exposures from natural background.

F.3.1 Idaho National Engineering Laboratory

In the region of INEL, the natural background level of radiation (excluding radon) is 113 mrem per year. The results shown in figure F.3.1–1 indicate that, for an accidental release, the radiation levels exceeding 113 mrem per year (shaded area bounded by a bold line) are well within the site boundary. The size of the area in which exposure levels would exceed exposures from natural background radiation is $6.7\text{x}10^7$ square meters (16,556 acres). Section 4.2 describes the land, water, biotic, cultural, paleontological, and socioeconomic resources in the INEL environment that may receive secondary impacts from a design-basis accident.

F.3.2 Nevada Test Site

In the region of NTS, the natural background level of radiation (excluding radon) is 78 mrem per year. The results shown in figure F.3.2–1 indicate that, for an accidental release, the radiation levels exceeding 78 mrem per year (shaded area bounded by a bold line) are well within the site boundary. The size of the area in which exposure levels would exceed exposures from natural background radiation is $9.1\text{x}10^5$ square meters (225 acres). Section 4.3 describes the land, water, biotic, cultural, paleontological, and socioeconomic resources in the NTS environment that may receive secondary impacts from a design-basis accident.

F.3.3 Oak Ridge Reservation

In the region of ORR, the natural background level of radiation (excluding radon) is 67 mrem per year. The results shown in figure F.3.3–1 indicate that, for an accidental release, the radiation levels exceeding 67 mrem per year (shaded area bounded by a bold line) are well within the site boundary. The size of the area in which exposure levels would exceed exposures from natural background radiation is $1.4\text{x}10^7$ square meters (3,459 acres). Section 4.4 describes the land, water, biotic, cultural, paleontlogical, and socioeconomic resources in the ORR environment that may receive secondary impacts from a design-basis accident.

F.3.4 Pantex Plant

In the region of Pantex, the natural background level of radiation (excluding radon) is 107 mrem per year. The results shown in figure F.3.4–1 indicate that, for an accidental release, the radiation levels exceeding 107 mrem per year (shaded area bounded by a bold line) extend beyond the site boundary. The size of the area in which exposure levels would exceed exposures from natural background radiation is 9.3×10^7 square meters (22,980 acres). Section 4.5 describes the land, water, biotic, cultural, paleontological, and socioeconomic resources in the Pantex environment that may receive secondary impacts from a design-basis accident.

F.3.5 Savannah River Site

In the region of the SRS, the natural background level of radiation (excluding radon) is 76 mrem per year. The results shown in figure F.3.5–1 indicate that, for an accidental release, the radiation levels exceeding 76 mrem per year (shaded area bounded by a bold line) are well within the site boundary. The size of the area in which exposure levels would exceed exposures from natural background radiation is 2.9×10^7 square meters (7,166 acres). Section 4.6 describes the land, water, biotic, cultural, paleontological, and socioeconomic resources in the SRS environment that may receive secondary impacts from a design basis accident.

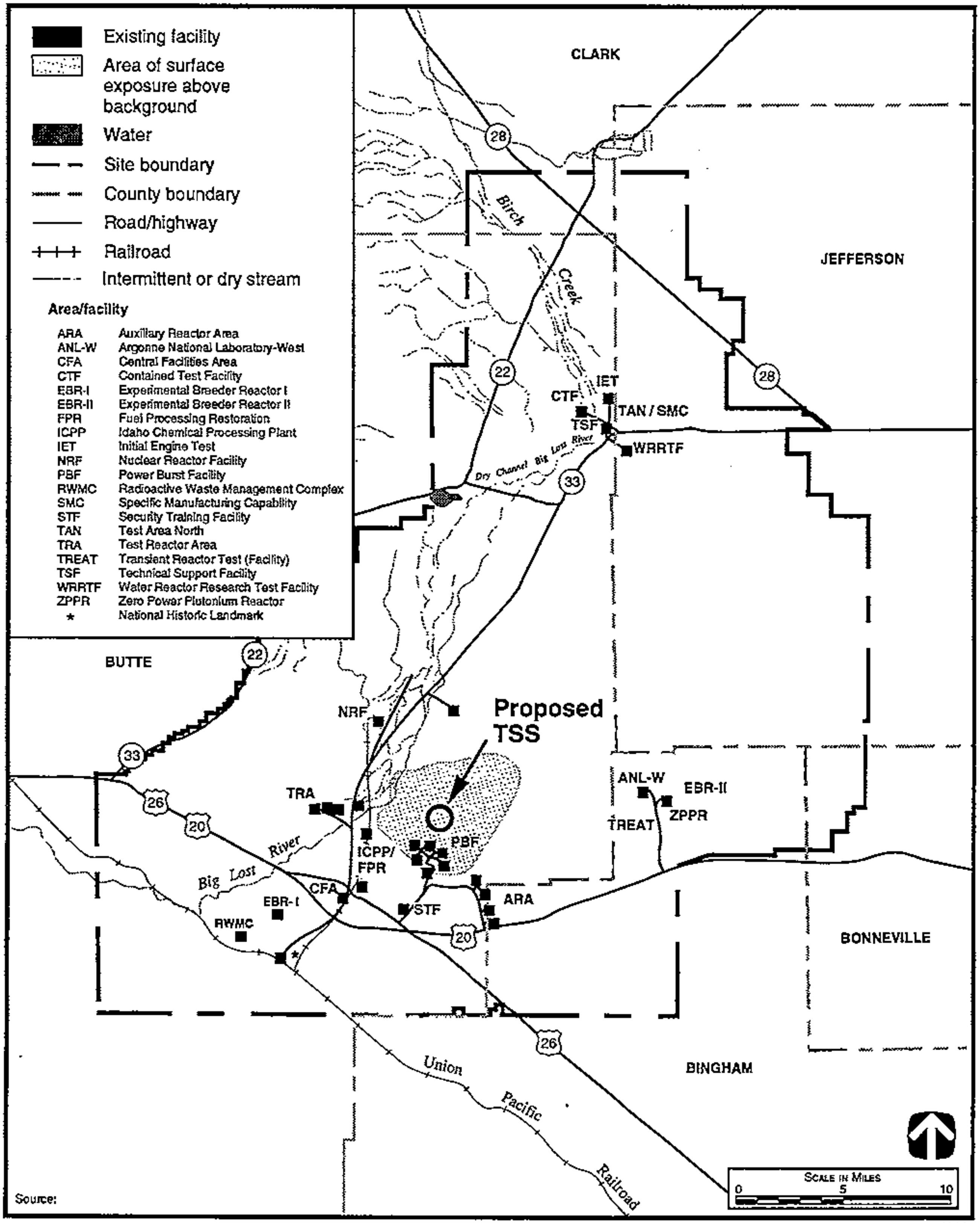


FIGURE F.3.1–1.—*Design-Basis Accident for Typical Reactor at Idaho National Engineering Laboratory (ground surface exposure–113 mrem per yr).*

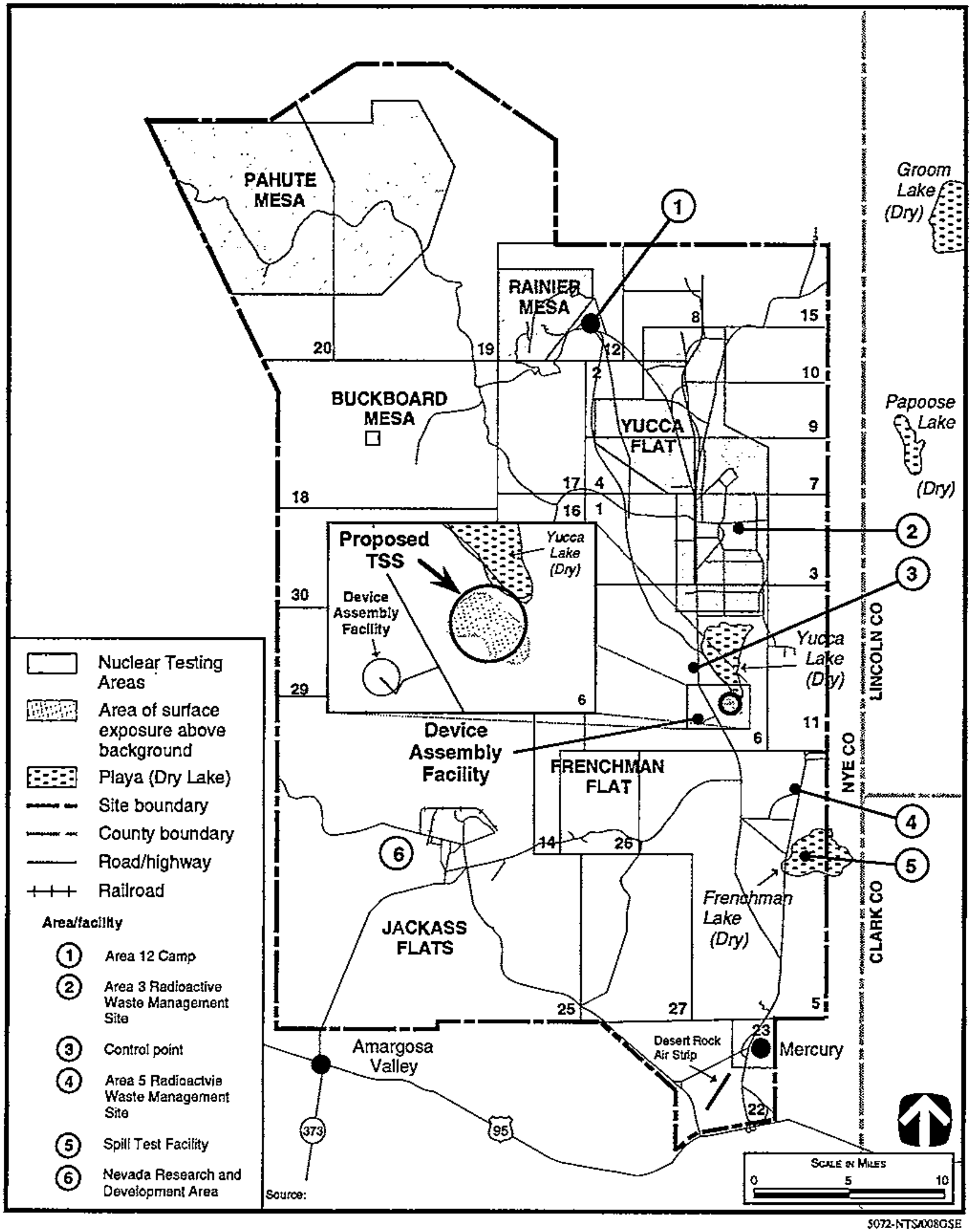


Figure F.3.2–1.—*Design-Basis Accident for Typical Reactor at Nevada Test Site (ground surface exposure–78 mrem per yr).*

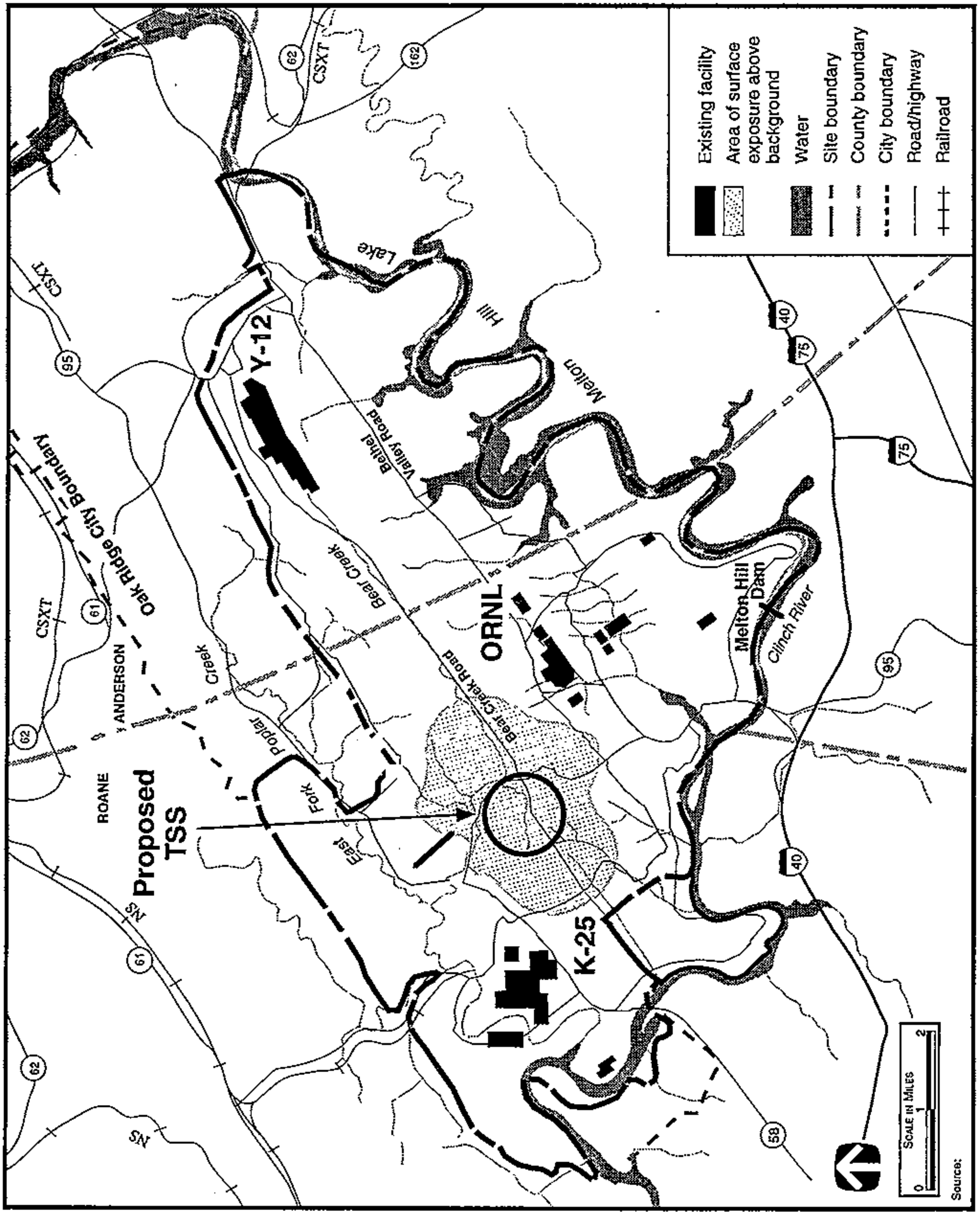
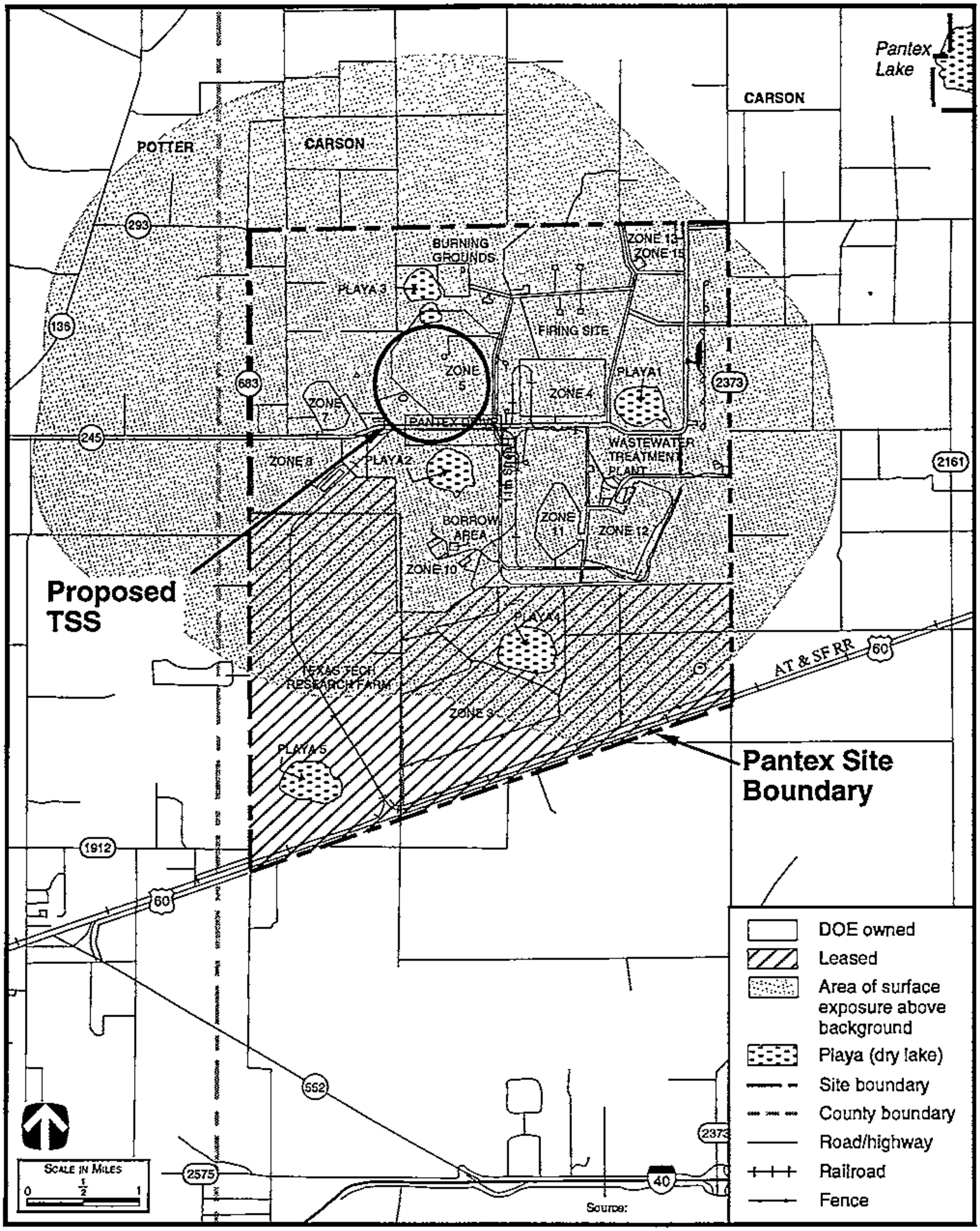
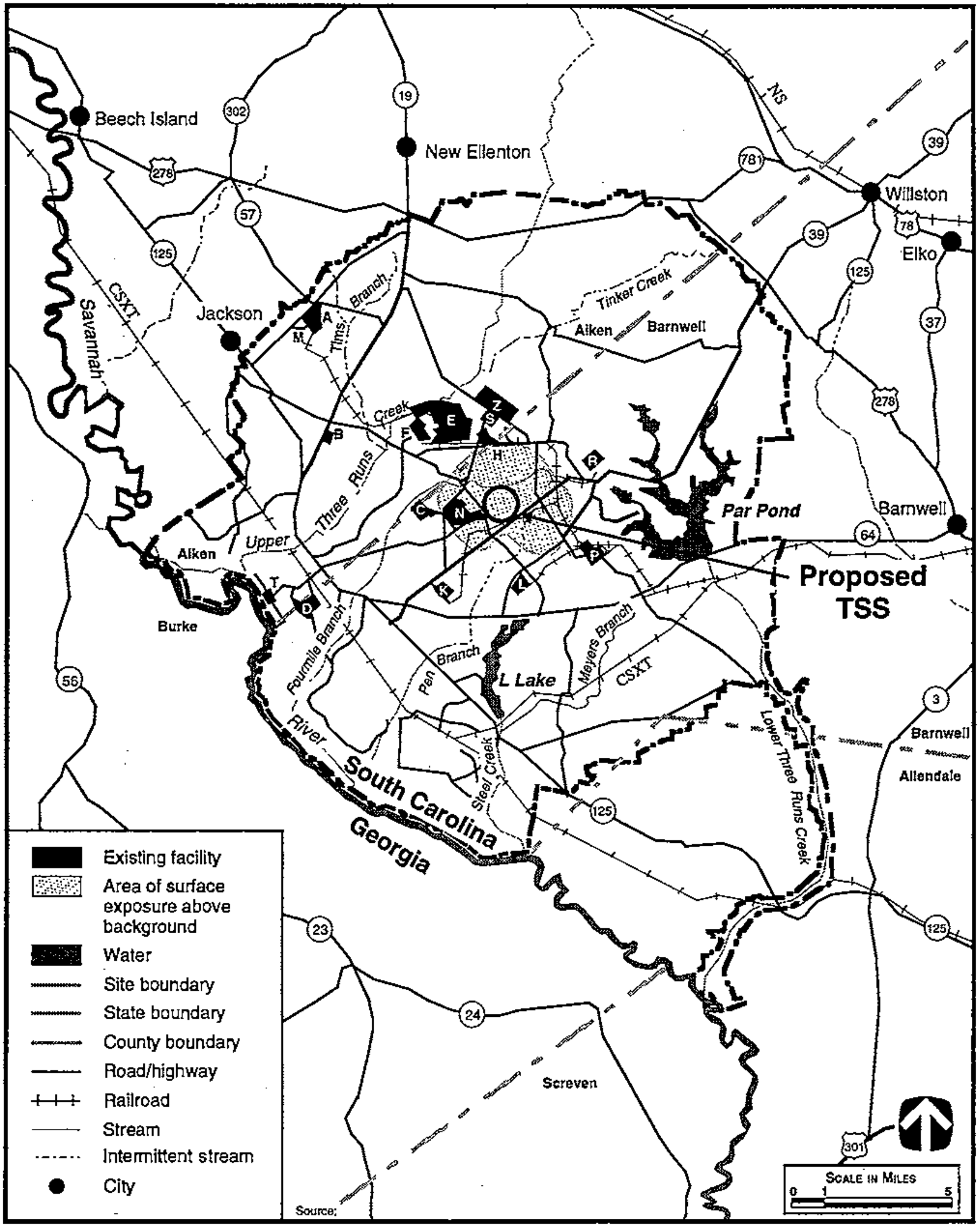


FIGURE F.3.3–1.—*Design-Basis Accident for Typical Reactor at Oak Ridge Reservation (ground surface exposure–67 mrem per yr).*



5085-PAN/002GSE

FIGURE F.3.4–1.—*Design-Basis Accident for Typical Reactor at Pantex Plant (ground surface exposure–107 mrem per yr).*



5117-SRS/003BGSE

FIGURE F.3.5–1.—*Design-Basis Accident for Typical Reactor at Savannah River Site (ground surface exposure–76 mrem per yr).*

APPENDIX G

Appendix G

APPENDIX G: INTERSITE TRANSPORTATION

G.1 SITE TRANSPORTATION INTERFACES FOR HAZARDOUS MATERIALS

The following is a brief description of the existing transportation modes that serve each Nuclear Weapons Complex (Complex) site and the links to those modes for the intersite transport of hazardous materials. The purpose of this analysis is to identify transportation constraints at each site that might limit tritium supply and recycling alternatives.

Transportation services at each site have been given an adjectival rating based on strengths and weaknesses. These ratings are: outstanding, good, satisfactory, poor, or unsatisfactory. The rating methodology and evaluation procedures were established by the Nuclear Weapons Complex Reconfiguration Site Evaluation Panel (DOE 1991j) for rating the Idaho National Engineering Laboratory (INEL), Oak Ridge Reservation (ORR), Pantex Plant (Pantex), and Savannah River Site (SRS). For consistency, the methodology was applied for the Nevada Test Site (NTS) as well.

Idaho National Engineering Laboratory. INEL transportation resources are good but would require additional roadway and railway construction. The northern route would cause delays of special nuclear material shipments due to winter ice and snow. The onsite rail system connects to the Union Pacific Railroad. Service is infrequent; due to lack of volume, and by special request only. Construction of an additional 7.5 miles of new rail spur would be needed for direct rail service to the proposed tritium supply site (TSS). The nearest interstate highway is approximately 46 miles from the proposed TSS via 40 miles of excellent two-lane road; however, approximately 6 miles of new connector road would need to be constructed to reach the site. The airport in Idaho Falls is 40 miles from the site.

Nevada Test Site. NTS transportation resources are good. The nearest interstate highway, I-15, is approximately 60 miles from the site via four-lane divided blacktop U.S. highway. The site does not have direct rail access. The nearest railhead is at Las Vegas, approximately 65 miles south, which is served by the Union Pacific Railroad. There are no navigable waterways in the region. All air shipments arrive at McCarran International Airport located in Las Vegas, NV. There is a limited-access air strip on the site at Desert Rock; however, nearby Indian Springs would be used by Ross Aviation because of available aircraft servicing support. The site reports no significant transportation delays due to weather (NTS 1992a:3).

Oak Ridge Reservation. ORR transportation resources are good, with minimal additional roadway and railway construction required. ORR has the advantage of southern routes, with minimal expected weather delays. The proposed TSS is approximately 2 miles from the ORR spur which connects to the Norfolk Southern Railroad and 4.6 miles from the Y-12 Plant (Y-12) spur which connects to the CSX Railroad. The nearest interstate highway is 4 miles away via good two-lane road. A regional airport in Knoxville, TN, is approximately 31 miles from the site. The airport is served by nine airlines and has adequate services, including a dedicated Ross Aviation loading and unloading facility. Barge shipments are possible using the Clinch River. A disadvantage is that routes to NTS, Pantex, and the Waste Isolation Pilot Plant (WIPP) located in New Mexico, pass through or close to six to nine large metropolitan areas.

Pantex Plant. Pantex transportation resources are outstanding. The site rail spur connects to the Burlington Northern and the Santa Fe Railroads. The Department of Energy (DOE) has a rail rolling stock repair capability onsite. Truck routes have the advantages of being southerly and of passing through or near, only two or three metropolitan areas en route to nearby DOE sites (e.g., NTS or WIPP). The Transportation Safeguards Division terminal with diesel and truck maintenance facility is located at Pantex. The nearest interstate highway is accessed via 7 miles of two-lane road. The Amarillo International Airport is 20 miles from the site and is served by 5 airlines.

Savannah River Site. SRS transportation resources are good. Routes to NTS and WIPP have the advantage of being southerly and the disadvantage of passing through six to nine major metropolitan areas, including local business districts. The proposed TSS is approximately 1.5 miles from the site rail system that connects to the CSX and the Norfolk Southern Railroads. Barge shipments are possible, but normally impractical due to the shallow depth of the Savannah River. The water mode will require prior review of river depths and coordination with the U.S. Army Corps of Engineers for water releases from the lock and dam. SRS has a cargo dock. The nearest interstate highway is 30 miles away via predominately 4-lane access road. Two regional airports are located in Augusta, GA, 20 miles away, and in Columbia, SC, 56 miles from the site. Both air fields can handle large aircraft. There are occasional landing and takeoff delays of 2 or 3 hours due to fog.

G.2 TRANSPORTATION SAFETY STUDIES

The Office of the Assistant Secretary for Defense Programs (DP) is undertaking a program to provide the basis for a documented DOE acceptance of hazards and risks associated with future defense program transportation operations. This program will be accomplished by preparing specialized studies and integrating the findings in a *Defense Programs Transportation Safety Analysis Report.* The specialized studies are as follows:

- The Albuquerque Operations Office studied the accident risk in the transport of nuclear weapons, nuclear weapons components, and special nuclear material in DOE/DP's transportation system. The study produced a probabilistic assessment of the risks associated with accidental dispersal of radioactive material being transported by DOE's Transportation Safeguards System; by DOE's air cargo contractor, Ross Aviation, Inc.; or by military airlift. The Albuquerque Operations Office assessment shows that the probability of an accident by Ross Aviation is 2.7×10^{-4} per year. The assessment also shows that the annual tritium release probability for Ross Aviation is 1.0×10^{-5} and the health risk from the accidental release of tritium is 9.0×10^{-8} latent cancer fatalities per year. A more detailed discussion of the assessment is included in the classified appendix of this *Programmatic Environmental Impact Statement* (PEIS).

- DOE is evaluating the results of accident-environment testing performed on the safe secure trailers to demonstrate the crashworthiness of the design, and the results will be incorporated into the Defense Programs Transportation Risk Assessment. The DOE historical safety record of the safe secure trailer has been exceptionally good. There has not been an accident fatality or release of radioactive material in over 27 million miles travelled.

- DOE evaluated air transport: (1) operations, aircraft, hazardous material/cargo management, and packaging; (2) operational safety requirements; (3) aircraft maintenance and quality assurance; (4) emergency response; (5) personnel training; and (6) environmental safety and health management practices. The accident risk for Ross Aviation was estimated using National Transportation Safety Board accident fatality data for commercial aircraft operations in accordance with 14 CFR 121, 125, and 127. The Ross Aviation accident probability is 2.7×10^{-4} per year and is documented in the Defense Programs Transportation Risk Assessment (DOE 1993n:5).

The *Defense Programs Transportation Safety Analysis Report* will also consider other transportation risk studies, such as the ongoing Department of Defense (DOD) and DOE's *Study on the Logistical Transportation of Nuclear Weapons*, which evaluates the transport of weapons to and from DOD sites.

G.3 HAZARDOUS MATERIALS PACKAGING (MATERIALS CONTAINMENT)

Hazardous materials are those substances or materials capable of posing an unreasonable risk to health, safety, and property. To protect the public health and safety, packaging must be selected based upon the nature of the hazardous material being shipped. All hazardous materials transported by or for DOE must meet the packaging (containment) requirements prescribed by the Department of Transportation (DOT) under 49 CFR and other applicable Federal regulations.

For purposes here, hazardous materials are characterized as either common or Complex-unique. Common hazardous materials are those transported in commerce by for-hire transportation carriers. Approximately 96 percent of the Complex's hazardous material shipments are transported this way.

Complex-unique hazardous materials are radioactive special materials that include limited-life components (e.g., tritium reservoirs). Complex-unique hazardous materials are produced by DOE and require special physical protection (safeguards) in transit for safety and security. Complex-unique hazardous materials are transported by government-controlled vehicles. The packagings for both common and Complex-unique hazardous materials are explained below.

G.3.1 Packaging for Common Hazardous Materials

Packaging used by DOE for most hazardous materials shipments is either certified to meet specific performance requirements or built to specifications described in DOT hazardous materials regulations (49 CFR). Most hazardous materials would be transported in relatively simple, unsophisticated 55-gallon or smaller steel drums, cardboard or wooden boxes, gas cylinders, and cargo tanks. For less harmful radioactive materials, DOT Specification Type A packaging is used. These packagings must retain their contents under normal conditions of transport.

Sensitive radioactive materials shipments require use of highly sophisticated Type B packaging, designed to prevent the release of its contents under all credible transportation accident conditions. Though packaging and transportation are regulated by DOT under 49 CFR, the Nuclear Regulatory Commission (NRC) promulgates the standards and regulations for the packaging used to transport highly radioactive and fissile materials under 10 CFR 71. Federal certification for these packaging types can take up to 5 years and cost over $1 million for each packaging design due to the severe testing conditions required.

Hazardous radioactive materials such as solidified high-level waste (HLW) and spent nuclear fuel must be packaged and transported in heavily shielded, virtually indestructible shipping casks in accordance with 10 CFR 71. Cold (unirradiated) fuel packaging must also meet 10 CFR 71 regulations. This packaging must retain its contents under credible accident conditions. There has not been a significant release of material under normal or accident transport environments in more than 40 years.

G.3.2 Packaging for Limited-Life Components

In addition to meeting the stringent Type B containment and confinement requirements of NRC's 10 CFR 71 and DOT's 49 CFR, packaging for nuclear weapons and components, including tritium reservoirs, must be certified separately by DOE. Limited-life components must be transported in DOE's closed, government-owned and operated Transportation Safeguards System for intersite transport. Contract air carrier (Ross Aviation), military airlift, and specially designed safe secure trailers are utilized to ensure high levels of safety and physical protection. Limited-life components are shipped in H1616 type packaging designed to contain the material and radiation in an accident.

G.4 TRANSPORTATION OF RADIOACTIVE WASTE

DOE's spent nuclear fuel and HLW produced by defense program activities are currently stored at reactor or DOE sites. The safe and permanent disposal of this nuclear waste, including its transportation, is the responsibility of DOE.

The *Nuclear Waste Policy Amendments Act* of 1987 specified that Yucca Mountain, NV, will be the one site evaluated as a permanent repository. Legislation prohibits the shipment of defense spent nuclear fuel to the repository; however, HLW from defense program activities may be shipped to the repository.

DOE has future plans to move the spent nuclear fuel to a monitored retrievable storage facility for temporary storage, where the material will be consolidated and prepared for further transport and final storage at a permanent repository. DOE expected the monitored retrievable storage facility to be operational by 1998; however, a monitored retrievable storage facility site has yet to be selected. By law, the monitored retrievable storage facility cannot handle or store military waste and can store commercial spent fuel only temporarily. If a monitored retrievable storage facility is licensed and becomes operational, spent nuclear fuel will be transported by truck, rail, barge, or a combination of these modes to the monitored retrievable storage facility. After consolidation at the monitored retrievable storage facility, the spent nuclear fuel would be shipped in dedicated trains to the repository. A 100-ton gross weight NRC-approved cask is being developed for the rail transportation of this spent nuclear fuel to the repository. Defense HLW would be shipped directly to the repository, mainly by rail from DOE sites where it is stored.

The tritium supply and recycling functions do not generate transuranic (TRU) waste. TRU waste, however, is generated at the proposed sites from unrelated activities. The following is a summary of the planned disposal for TRU waste. The WIPP, 26 miles from Carlsbad, NM, is scheduled to be the Nation's first geologic repository for TRU waste. Base facility construction was completed in 1989, but use is being delayed to satisfy legal, technical, environmental, and logistical requirements. DOE ultimately hopes to ship 8,500 drums of TRU waste to WIPP. Ninety-seven percent of the waste scheduled for WIPP will be contact-handled TRU waste that can be safely handled by workers without special protective clothing. Contact-handled TRU waste will be shipped via trucks in Transuranic Packaging Transporters, canisters designed to hold fourteen 55-gallon drums. Remote-handled TRU waste is to be handled and transported in specially shielded containers because of its higher level of radioactivity. No remote-handled TRU waste will be emplaced at WIPP during the initial 5-year test phase.

Radioactive low-level waste (LLW) results from industrial processes and includes radioactively contaminated paper, protective clothing, cleaning materials, metal and glass equipment, tools, and construction items. The Complex's LLW is disposed of at permitted onsite locations with the exception of Pantex, which ships LLW to NTS. Waste that is equivalent to NRC-designated Greater-Than-Class-C LLW has a higher concentration of radionuclides and is generally not acceptable for near-surface disposal. DOE has developed a long-range strategy to dispose of Greater-Than-Class-C LLW either in conjunction with a HLW repository or in a separate facility.

Mixed waste contains both radioactive and other hazardous components. Mixed HLW will be placed in a repository, mixed TRU waste will be shipped to WIPP, and mixed LLW will be held onsite or shipped to NTS after approval of its pending permit.

G.5 METHODOLOGY TO DETERMINE RISK OF TRANSPORTING LOW-LEVEL WASTE

With the exception of Pantex, all sites being considered for the tritium supply and recycling facilities either have or have planned an onsite LLW disposal facility. The incremental increase in risk of transporting LLW from Pantex as a result of locating tritium supply and recycling facilities at Pantex was estimated. The waste type reflects the isotopic composition of LLW produced by tritium supply and recycling facilities. The isotopic composition was developed based upon information in the *Integrated Data Base for 1992: U.S. Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics* (DOE/RW-0006). Because the actual waste composition in the future is uncertain, conservative assumptions were used where appropriate.

Argonne National Laboratory-West calculated the risks of transporting LLW from Pantex to NTS using the RADTRAN 4 computer code (PX DOE 1993a:1). This risk analysis model was developed by Sandia National Laboratories, NM, to calculate the risks associated with the transportation of radioactive materials by various modes. The code has been extensively updated since it was first issued in the late 1970s and has been used to assess risk for all recent DOE *National Environmental Policy Act* (NEPA) documents involving the transport of radioactive materials. The *RADTRAN 4: Volume 3 User Guide* (SAND89-2370) contains derivations of the model, assumptions, and other data necessary to use the code.

All LLW would be transported from Pantex to NTS in a solid form. A typical shipment consists of eighty 55-gallon (208-liter) drums transported in an enclosed semitrailer. Each drum is assumed to be fully loaded, resulting in a total shipment volume of 21.7 cubic yards (yd^3). The truck is assumed to operate as an "exclusive-use" vehicle. Risks were calculated separately for occupational (truck crew members) and nonoccupational exposure groups for normal (incident-free) conditions. Normal risk is directly proportional to the external exposure rate in the vicinity of a loaded shipment. For exclusive-use shipments, the dose rate may not exceed 2 millirem (mrem) per hour in the crew compartment and 10 mrem per hour at 2 meters from the lateral surfaces of the conveyance, in accordance with 10 CFR 71. In general, the dose rate measured 2 meters from a typical LLW shipment is on the order of 1 mrem per hour or less and seldom reaches the 10 mrem per hour regulatory limit (PX DOE 1993a:1). Since tritium LLW is a low-energy beta emitter that is shielded by its packaging, radiation outside the package is not detectable. Therefore, for normal operations, the transport of tritium LLW poses no increased risk to transportation workers or to the public.

The risk from accident conditions results from the release and dispersal of radioactive material to the environment following an accident and the subsequent exposure of people via a number of potential pathways. Because accident occurrences are infrequent and statistical in nature, accident risks are calculated by multiplying the consequences of an accident by the probability of the accident occurring; therefore, accident risk estimates can be directly compared to incident-free risks. A representative highway route from Pantex to NTS was calculated using the HIGHWAY computer code. The calculated route conforms to all applicable routing regulations and common practices but may not be the actual route used for LLW shipments. The representative route is 1,200 miles. Accident occurrence and fatality rates were determined using state-level and national statistics. The severity categories for the release of radioactive material during accidents are described in the NRC's regulation, *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes* (NUREG-0170). As a conservative measure, all 80 drums were assumed to be equally breached during an accident of sufficient severity. For a given release, 10 percent of the radioactive inventory was assumed to become aerosolized and dispersed, with 5 percent of the aerosolized fraction being respirable. Tritium is shipped in solid form, but could become vaporized in an accident. For tritium, 100 percent of the release was assumed to be respirable (PX DOE 1993a:1).

The *1990 Recommendations of the International Commission on Radiological Protection* (ICRP Publication 60) provides health risk factors to convert dose rates to fatal cancers (PX DOE 1993a:1). For occupational exposure groups, the conversion factor is 4.0×10^{-4} fatal cancers per person-rem and for nonoccupational exposure groups the conversion is 5.0×10^{-4} fatal cancers per person-rem.

The following formulas were used to estimate the accident-related health risk of transporting tritium LLW from Pantex to NTS.

(a) Effects of radiological release from an accident:

Latent cancer fatalities per year = 6.5×10^{-7} person-rem per shipment x 5.0×10^{-4} cancers per person-rem x number of shipments per year

(b) Effects of nonradiological accident:

Traffic fatalities per year = 4.3×10^{-6} fatalities per shipment x number of shipments per year

G.6 SUPPORTING TRANSPORTATION DATA

Table G.6–1 provides a 5-year summary of the hazardous and nonhazardous cargo shipped by commercial carrier to and from each of the five candidate sites from 1987 through 1991. For the entire Complex, cargo traffic by weight decreased approximately 15 percent per year during this period. Table G.6–1 shows that traffic in 1991 for the sites examined was down 57 percent from 1987 traffic, or about the same annual percentage decline experienced by the Complex as a whole.

Table G.6–2 lists all of the hazardous material shipments by chemical for 1991, for the five candidate sites. All of these shipments were by commercial carriage.

Table G.6–3 gives air distances between selected sites. These distances are those usually travelled when transporting limited-life components by Ross Aviation.

TABLE G.6–1.—*Five-Year Summary of Traffic To/From Proposed Tritium Supply and Recycling Sites*[a]

Site	1987		1988		1989		1990		1991	
	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)
Idaho National Engineering Laboratory										
Nonhazardous	19,239	42,898,007	20,815	44,405,718	23,062	20,088,963	26,075	12,803,235	29,999	11,615,910
Hazardous	1,849	46,575,944	2,321	66,214,775	1,879	51,740,159	1,455	43,140,437	1,542	51,584,218
All cargo	21,088	89,473,951	23,136	110,620,493	24,941	71,829,122	27,530	55,943,672	31,541	63,200,128
Nevada Test Site										
Nonhazardous	21,967	131,434,065	24,055	106,140,873	26,248	140,037,819	23,077	84,782,403	21,875	79,756,555
Hazardous	2,381	59,344,141	2,389	66,842,376	2,501	69,578,710	1,722	45,471,622	1,304	34,782,556
All cargo	24,348	190,778,206	26,444	172,983,249	28,749	209,616,529	24,799	130,254,025	23,179	114,539,111
Oak Ridge Reservation										
Nonhazardous	37,872	25,120,900	39,578	25,230,131	36,609	20,043,727	38,009	16,573,098	38,922	14,738,586
Hazardous	3,206	16,124,730	3,070	11,895,666	2,531	9,108,989	1,878	6,530,250	1,281	4,419,765
All cargo	41,078	41,245,630	42,648	37,125,797	39,140	29,152,716	39,887	23,103,348	40,203	19,158,351
Pantex Plant										
Nonhazardous	7,739	3,547,477	8,140	3,257,166	7,676	3,309,524	8,268	2,867,899	9,772	3,156,359
Hazardous	1,802	1,076,257	1,659	1,135,110	1,589	1,018,242	1,768	814,347	1,273	763,083
All cargo	9,514	4,623,734	9,799	4,392,276	9,265	4,327,766	10,036	3,682,246	11,045	3,919,442
Savannah River Site										
Nonhazardous	14,249	871,069,675	16,309	870,424,143	21,192	512,795,471	35,415	501,730,778	33,484	315,737,363
Hazardous	397	9,564,842	534	12,044,143	537	10,180,879	852	8,778,981	562	8,205,286
All cargo	14,646	880,634,517	16,843	882,468,286	21,729	522,976,350	36,267	510,509,759	34,046	323,942,649

[a] Includes both Complex and other DOE commercial shipments to and from these locations, including shipments to and from non-DOE activities. It does not include DOE-controlled classified shipments.

Source: SAIC 1992a:3; SAIC 1992a:5.

TABLE G.6–2.—*Hazardous Materials Shipments for Proposed Tritium Supply Technologies and Recycling Sites, 1991*[a] [Page 1 of 3]

Commodity	INEL		NTS		ORR		Pantex		SRS	
	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)
Acetylene gas	0	0	2	840	0	0	0	0	0	0
Aluminum sulfate, solid	0	0	0	0	0	0	0	0	3	50,800
Ammonia hydroxide	0	0	3	108	1	496	0	0	0	0
Ammonia, anhydrous	5	3,005	0	0	0	0	0	0	0	0
Ammonium fluoride	0	0	0	0	0	0	0	0	1	1
Argon	2	14,561	4	1,750	0	0	2	11,640	2	810
Asbestos articles	0	0	0	0	0	0	0	0	1	505
Asphalt	0	0	7	182,660	2	3,244	0	0	1	900
Beryllium metal	3	74	0	0	14	32,338	0	0	0	0
Blasting agents	1	150	0	0	0	0	4	278	0	0
Cadmium nitrate	0	0	0	0	2	1,386	0	0	0	0
Cadmium sulfate	1	125	0	0	0	0	0	0	0	0
Calcium nitrate	0	0	0	0	0	0	0	0	1	2
Chlorine	4	1,500	0	0	0	0	0	0	0	0
Class A explosives, n.o.s.	1	225	3	5,403	2	1,214	69	26,684	0	0
Class A poison	1	530	1	132	1	2	1	18	4	215
Class B explosives, n.o.s.	0	0	0	0	0	0	15	3,384	0	0
Class B poison	5	137	6	594	6	1,849	3	706	4	136
Class C explosives, n.o.s.	7	297	3	531	3	62	550	74,288	16	6,583
Combustible liquid, n.o.s.	9	143,696	26	313,837	2	1,759	0	0	10	7,397
Corrosive material, n.o.s.	92	693,757	94	220,153	126	562, 948	39	30,137	73	155,530
Dry ice	0	0	0	0	15	228	0	0	0	0
Empty hazmat containers, non-RAM	1	37,000	82	692,937	28	53,218	1	6,000	4	24,450
Ferrous sulfate	0	0	0	0	1	2,804	0	0	0	0
Flammable gas, n.o.s.	23	137,556	26	105,297	27	20,473	6	697	7	5,279
Flammable liquid, n.o.s.	45	479,105	106	84,386	88	91,163	35	10,497	106	120,882
Flammable solid, n.o.s.	12	249	2	6,002	13	2,846	37	2,370	6	301
Fluoboric acid	0	0	1	4	0	0	0	0	0	0
Fuel oil (e.g., diesel, 1-6)	458	29,210,972	176	13,075,374	1	176	0	0	2	14,950
Gasoline	96	4,510,733	177	11,156,027	2	6,509	0	0	0	0

TABLE G.6–2.—*Hazardous Materials Shipments for Proposed Tritium Supply Technologies and Recycling Sites, 1991*[a] [Page 2 of 3]

Commodity	INEL		NTS		ORR		Pantex		SRS	
	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)
Hazardous waste (non-RAM)	0	0	8	8,498	13	67,001	0	0	31	84,477
Helium	16	0	10	196,002	26	59,123	13	4,046	3	455
Hydrocarbon diluent	0	0	1	5,000	0	0	0	0	0	0
Hydrochloric acid	0	0	0	0	1	0	0	0	8	4,115
Hydrofluoric acid, concentrated	0	0	0	0	1	0	0	0	1	150
Hydrofluoric acid, solution, spent	0	0	0	0	1	100	0	0	0	0
Hydrogen gas	5	1,708	0	0	2	4,508	3	696	3	304
Hydrogen peroxide	1	20	0	0	3	3,940	0	0	6	1,125
Lithium metal	0	0	0	0	33	17,043	71	12,999	1	326
Lubricating oil	3	1,131	48	228,877	20	20,380	21	16,225	15	16,556
Magnesium, powder, metal and strip	0	0	1	70,000	3	708	0	0	0	0
Methyl isobutyl ketone	0	0	0	0	0	0	1	420	0	0
Nitric acid, (40 percent or less)	1	438	3	30	1	605	0	0	10	10,510
Nitric acid, (over 40 percent)	0	0	1	6	2	39,500	0	0	5	91,816
Nitric acid, fuming	1	15	0	0	0	0	0	0	14	2,420
Nitrogen	73	1,868,275	6	70,330	3	44	2	480	0	0
Nonflammable gas, n.o.s.	96	121,888	122	317,950	114	107,183	96	45,630	49	202,915
Organic peroxide, n.o.s.	0	0	0	0	0	0	3	529	5	129
ORM A, n.o.s.	3	702	2	804	0	0	8	322	2	387
ORM B, n.o.s.	2	4	0	0	0	0	0	0	0	0
ORM C, n.o.s.	1	2	3	270	0	0	0	0	0	0
ORM D, consumer commodity	7	45,813	26	9,608	0	0	2	594	14	13,658
ORM E, n.o.s.	1	2	2	4,150	0	0	0	0	1	496
Oxidizer, n.o.s.	4	1,378	18	4,886	0	0	7	3,485	28	231,114
Oxygen	137	5,741,266	7	12,833	2	33	0	0	0	0
RAM, empty packages	37	842,604	0	0	110	628,991	75	551,005	42	1,922,961
RAM, fissile, n.o.s.	12	236,232	0	0	16	18,223	0	0	1	504
RAM, fissile, <20 percent U-235	0	0	0	0	7	90,970	0	0	0	0
RAM, fissile, >20 percent U-235	0	0	0	0	2	13	0	0	0	0
RAM, fissile, HRCQ, IR PINS	6	219,900	0	0	0	0	0	0	45	4,214,075

TABLE G.6–2.—*Hazardous Materials Shipments for Proposed Tritium Supply Technologies and Recycling Sites, 1991*[a] [Page 3 of 3]

	INEL		NTS		ORR		Pantex		SRS	
Commodity	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)	Shipments (number)	Weight (pounds)
RAM, instr. and articles	4	235	5	1,480	0	0	0	0	4	773
RAM, LSA, n.o.s.	177	6,277,183	2	81,420	13	79,150	1	6	2	29
RAM, LSA, waste	0	0	204	7,293,198	1	18,750	0	0	0	0
RAM, LTD quant, n.o.s.	85	61,506	5	30,284	97	315,878	3	8,468	25	62,751
RAM, n.o.s.	69	546,097	22	825	426	1,062,587	198	159,731	20	162,534
RAM, n.o.s. HRCQ	0	0	0	0	1	50,300	0	0	2	1,040
RAM, n.o.s., special	24	11,181	27	2,078	21	43,924	0	0	2	2,185
RAM, n.o.s., waste	0	0	0	0	1	16,436	0	0	0	0
RAM, U-metal, PYROP	0	00	0	0	3	1,388	0	0	3	0
RAM, U-NO_3, solid	0	0	0	0	1	30	0	00	0	0
Small arms ammunition	2	6,498	4	4,168	31	45,359	40	19,581	0	0
Sodium hydroxide (caustic soda)	5	235,260	1	160	2	39400	0	0	17	0
Sodium metal (non-RAM)	0	0	0	0	0	0	1	815	0	0
Sodium nitrate	1	11	2	624	2	5,384	0	0	3	0
Sulfuric acid	5	192,870	1	15	28	1,160,833	2	141	11	0
1,1,1-Trichloroethane	1	3,170	0	0	2	42,355	0	0	1	0
Wet cell batteries	9	738	90	593,257	0	0	32	28,971	42	51,649

[a] Includes both Complex and other DOE commercial hazardous materials shipments to and from these locations. It does not include DOE-controlled classified shipments.

Note: n.o.s. - not otherwise specified; RAM - radioactive material; ORM - other regulated material; HRCQ - highway route controlled quantity; IR PINS - irradiated pins; LSA - low specific activity; LTD - limited; PYROP - pyrophoric.

Source: SAIC 1992a:2.

TABLE G.6–3.—*Air Mileage Between Selected Sites*

Site	SRS	Pantex	ORR	NTS	INEL
Idaho National Engineering Laboratory	1,550	720	1,395	495	–
Nevada Test Site	1,705	705	1,570	–	495
Oak Ridge Reservation	190	875	–	1,570	1,395
Pantex Plant	1,010	–	875	705	720
Savannah River Site	–	1,010	190	1,705	1,550

Source: DOE 1994b:1.

G.7 LARGEST COMPONENTS REQUIRING TRANSPORTATION

The reactor vessel and steam generator are unusually large components that require special consideration for transport to the site for installation. Table G.7–1 provides the weight and dimensions for representative reactor vessels and steam generators for each of the reactor technologies.

G.8 TRITIATED HEAVY WATER

Tritiated heavy water is required only for the Heavy Water Reactor (HWR) and the Accelerator Production of Tritium (APT) technologies.

Locating an HWR at INEL, NTS, ORR, or Pantex would require the 1-time shipment of approximately 680 metric tons of tritiated heavy water from SRS to the selected site for the initial filling of the reactor's primary coolant system. Transporting this amount would require an estimated 38 truckloads of 18 tons each, or eighty 55-gallon drums per truckload. The level of tritium contamination in the heavy water varies from 3 to 13 curies per liter. At the maximum concentration, a truckload would not exceed 2.0×10^5 Ci of tritium. Transporting heavy water for the initial filling would occur within a 1-year period (DOE 1991k:K-12, K-24). DOE evaluated the risk of transporting tritiated heavy water from SRS to INEL (DOE 1991k:K-30, K-32); this also represents a typical route in this PEIS. Based on the assessment, the estimated cancer fatalities resulting from potential traffic accidents associated with the transport of tritiated water would be 3.57×10^{-5}.

During the reactor's 40-year lifetime, additional heavy water would be needed for makeup from leaks, transport to the Spent Nuclear Fuel Storage Basin, and maintenance activities. The total amount of heavy water required to be transported could be the remainder of the 1,700 metric tons inventory available at SRS. The potential annual cancer fatalities from traffic accidents to transport the entire 1,700 metric tons inventory to meet both the initial filling and replenishment needs is estimated to be 8.94×10^{-5}.

Locating the APT technology at INEL, NTS, ORR, or Pantex would require the shipment of approximately 86 metric tons of tritiated heavy water from SRS for the initial fill of the helium-3 target and approximately 1 metric ton annually for makeup. The total amount of heavy water to be transported for the life of the APT would be approximately 126 metric tons. The potential annual cancer fatalities from traffic accidents to transport the entire amount of heavy water for the APT is estimated to be 6.63×10^{-6}.

Because tritium is a beta emitter, the radiological risk from incident-free transportation is extremely small.

TABLE G.7–1.—*Representative Vessel and Steam Generator Size*

	Reactor Vessel			Steam Generator		
Type of Reactor	Weight (tons)	Length (ft)	Outside Dimensions (ft)	Weight (tons)	Length (ft)	Outside Dimensions (ft)
Heavy Water Reactor	130	32	20	NA	NA	NA
Modular High Temperature Gas-Cooled Reactor	893	74	25	355	92	17
Advanced Light Water Reactor	480	43	20	310	75	16
Boiling Water/ Advanced Light Water Reactor	350	73	22	NA	NA	NA

Note: NA - not applicable.
Source: DOE 1994c:1.

APPENDIX H

Appendix II

APPENDIX H: ENVIRONMENTAL MANAGEMENT

This appendix provides: an overview of the Department of Energy (DOE) environmental restoration and waste management program including the categories of waste streams managed by the Department; the applicable Federal statutes and DOE orders; waste minimization and pollution prevention; waste treatment, storage, and disposal; transportation of wastes; and, finally, facility transition management. Site-specific waste management activities will follow in section H.2. Project-specific waste management activities are addressed in appendix section A.2.

H.1 OVERVIEW

H.1.1 Waste Categories

Wastes are generated in gaseous, liquid, and solid forms and are categorized by their health hazard and handling requirements. The categories are listed in table H.1.1–1.

H.1.2 Applicable Federal Statutes and Department of Energy Orders

In order to operate at most of its facilities, DOE has entered into numerous agreements with states and the Environmental Protection Agency (EPA) to address compliance issues concerning certain aspects of environmental regulatory requirements that have arisen due either to the age of the DOE facilities or the uniqueness of DOE operations. For the most part, the DOE facilities are in compliance with the major portion of all environmental regulatory requirements and these compliance agreements address only a few specific situations. At the same time, most of these compliance agreements include a commitment from DOE to achieve compliance with specific requirements by a certain date, and a schedule and milestones for achieving that compliance. These agreements guide DOE activities, at the sites, under applicable environmental laws, regulations, and other standards. Compliance with the terms of these negotiated agreements is one of the highest DOE priorities. Site operations will be conducted consistent with the commitments DOE has made. DOE will work with the regulators to amend existing agreements and to develop new agreements to ensure continued compliance. Under no circumstances will DOE's performance, pursuant to any existing compliance agreement, be compromised or diminished as a result of the proposed action.

Most of the regulations that impact the storage, treatment, and disposal of wastes were promulgated since the original Nuclear Weapons Complex (Complex) was established. In many cases, the technology available at the time the Complex was constructed does not meet current requirements for full compliance and, as a result, interim agreements have been made with the regulatory agencies. Through continuous upgrade programs, processes have been improved or added to meet the new regulations. Operations continue on the basis of using "best available technology" for facilities that were in operation before the regulation came into effect. In the siting and construction of new facilities, the intent is to meet current regulations and to reach the goal of maximum recycle, minimal waste generation, no liquid discharges to the surface, and to treat and stabilize unavoidable wastes sufficient for long-term storage or permanent disposal either onsite or offsite.

The following summarizes the applicable Federal statutes and DOE orders:

Atomic Energy Act. The *Atomic Energy Act* gives DOE the authority to manage and regulate nuclear materials handled and generated at its facilities; however, DOE seeks to make its internal guidelines consistent with standards applied to commercial nuclear facilities regulated by the Nuclear Regulatory Commission (NRC). Pursuant to the *Atomic Energy Act*, DOE is committed to the practice of "as low as reasonably achievable" exposure to radiation from its operations whereby exposures and resultant doses are maintained as low as social, economic, technical, and practical considerations permit.

Resource Conservation and Recovery Act. The *Resource Conservation and Recovery Act* (RCRA) was passed in 1976 as an amendment to the *Solid Waste Disposal Act* of 1965. RCRA regulates the "cradle to grave" management (generation, accumulation, storage, treatment, recycle, transport, and

TABLE H.1.1.–1.—*Spent Nuclear Fuel and Waste Categories*

Category	Characterization
Spent nuclear fuel	Nuclear reactor fuel that has been irradiated to the extent that it has undergone significant isotopic change to the point that fission-product poisons have reached an uneconomic threshold. DOE is no longer reprocessing spent nuclear fuel solely to recover fissile and fertile material.
High-level	Highly radioactive waste that results from the reprocessing of spent nuclear fuel used to make nuclear weapons or energy, including liquid waste produced directly in reprocessing, and any solid waste derived from the liquid that contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation.
Transuranic	Radioactive waste contaminated with alpha-emitting elements with a higher atomic number than uranium, half lives greater than 20 years, and in concentrations greater than 100 nanocuries per gram. Such wastes result primarily from fuel reprocessing and from the fabrication of plutonium weapons components and plutonium-bearing reactor fuel. Generally, little or no shielding is required ("contact-handled" transuranic waste), but energetic gamma and neutron emissions from certain transuranic nuclides and fission-product contaminants may require shielding or remote handling ("remote-handled" transuranic waste).
Low-level	Radioactive waste that is not spent nuclear fuel, high-level waste, transuranic waste, or by-product material as defined by DOE Order 5820.2A. Includes research and development fissionable test specimens with transuranic less than 100 nanocuries per gram. The radiation level from this waste may sometimes be high enough to require shielding for handling and transport. In 10 CFR 61, NRC defines four disposal categories of LLW that require differing degrees of confinement and/or monitoring: classes A, B, C, and Greater-Than-Class C.
Hazardous	Nonradioactive waste which has characteristics identified by either or both of the following Federal statutes: the RCRA, 40 CFR 261, as amended, or the *Toxic Substances Control Act*. These toxic, corrosive, reactive, or ignitable substances, or RCRA-listed wastes have been identified as posing health or environmental risks. Hazardous waste includes chemicals, such as chlorinated and nonchlorinated hydrocarbons, explosives, leaded oil, paint solvents, sludges, acid, organic solvents, heavy metals, and pesticides.
Mixed	Waste containing both hazardous and radioactive constituents.
Nonhazardous (Sanitary)	Solid sanitary waste includes garbage and is routinely generated by normal housekeeping activities and does not have a defined health risk (neither radioactive nor hazardous). Solid sanitary waste is regulated under RCRA, Subtitle D. Liquid sanitary waste includes sewage and industrial waste, which are treated in a wastewater process before discharge to a publicly owned treatment works or surface waters. The management of liquid sanitary waste is regulated by the *Clean Water Act* and the National Pollutant Discharge Elimination System.
Nonhazardous (Other)	Other wastes that do not have a defined health risk such as process wastewater.

disposal) of hazardous waste, nonhazardous waste, underground storage tanks containing petroleum products and hazardous substances, and medical waste. Subtitle C of RCRA mandates that hazardous wastes be treated, stored, and disposed of in a manner that will minimize the threat to human health and the environment. To carry out this mandate, RCRA requires that owners and operators of hazardous waste treatment, storage and disposal facilities obtain operating or post-closure care permits for certain waste management activities. RCRA defines the requirements for treatment, storage, and disposal facilities. Subtitle D of the law addresses the management of nonhazardous solid waste. Title 40 of the *Code of Federal Regulations* implements the statutory provisions of RCRA.

Land Disposal Restrictions. The Hazardous and Solid Waste Amendments to RCRA enacted in 1984 required EPA to evaluate all listed and characteristic hazardous wastes according to a strict schedule and to develop requirements by which disposal of these wastes would be protective of human health and the environment. The implementing regulations for accomplishing this statutory requirement are established with the Land Disposal Restrictions program. The Land Disposal Restrictions regulations (40 CFR 268) impose significant requirements on waste management operations and environmental restoration activities. For hazardous wastes restricted by statute from land disposal, EPA is required to set levels or methods of treatment that substantially reduce the waste's toxicity or the likelihood that the waste's hazardous constituents will migrate. After the Land Disposal Restrictions effective date, restricted wastes that do not meet treatment standards are prohibited from land disposal unless they qualify for certain variances or exemptions. EPA has promulgated standards for each of the five statutorily designated categories through the following Land Disposal Restrictions rulemakings:

- **Solvent Dioxin Rule.** Land Disposal Restrictions and corresponding treatment standards for solvents and dioxins, including mixed wastes containing solvents and dioxins, went into effect on November 8, 1986, and November 8, 1988, as set forth in 40 CFR 268.30 and 40 CFR 268.31, respectively.
- **California List Rule.** Land Disposal Restrictions and corresponding treatment standards for California list wastes, including mixed wastes containing California list wastes, went into effect on July 8, 1987, as set forth in 40 CFR 268.32.
- For the remaining listed or identified wastes, the Hazardous and Solid Waste Amendments directed EPA to establish a three-phased schedule for the effective date of Land Disposal Restrictions and the promulgation of treatment standards by EPA. Land Disposal Restrictions and corresponding treatment standards for these scheduled wastes are set forth in 40 CFR 268.33 through 268.35. For the "scheduled wastes" that were the hazardous waste component in mixed waste, EPA deferred issuing treatment standards until the issuance of the last phase (the Third Thirds Rule) on June 1, 1990. This rule established a national capacity variance for mixed wastes identified as hazardous because they contain a component that was a first third, second third, or third third scheduled hazardous waste.

In addition to prohibiting disposal before appropriate treatment, Land Disposal Restrictions prohibit any storage of Land Disposal Restrictions-prohibited hazardous wastes (including mixed waste) except "for the purpose of the accumulation of such quantities of hazardous waste as are necessary to facilitate proper recovery, treatment, or disposal" (40 CFR 268.50). EPA has determined that storage of hazardous waste pending development of treatment capacity does not constitute storage to accumulate sufficient quantities to facilitate proper recovery, treatment, or disposal.

Underground Storage Tank Provisions. The requirements for the facilities that use tank systems for storing or treating hazardous waste are outlined in 40 CFR 264, Subpart J. These requirements include the assessment of the existing tank system's integrity, the design and installation of new tank systems or components, and secondary containment. Hazardous wastes or treatment reagents are not placed in a tank system if they could cause the tank, its ancillary equipment, or the containment system to rupture, leak, corrode, or otherwise fail. Controls and practices to prevent spills and overflows from tank or containment systems are also required. Inspection requirements, procedures for response to leaks or spills, the disposition of leaking or unfit-for-use tanks, and closure and post-closure care requirements are also outlined in 40 CFR 264, Subpart J. Ignitable or reactive and incompatible hazardous wastes have special requirements.

Resource Conservation and Recovery Act Corrective Action Program. Hazardous waste permits require sites to institute corrective action programs for investigating Solid Waste Management Units. This program applies to all operating, closed, or closing RCRA facilities.

Federal Facility Compliance Act. The *Federal Facility Compliance Act* was passed in 1992 and includes provisions concerning DOE compliance with RCRA land disposal restrictions requirements for mixed waste. The *Federal Facility Compliance Act* requires DOE to have approved site-specific mixed waste treatment plans and related orders in place three years from the date of enactment in order to avoid the imposition of fines and penalties (except for sites already subject to a permit, agreement, or order addressing compliance with the RCRA land disposal restrictions storage prohibition).

In an April 6, 1993, *Federal Register* notice (58 FR 17875), DOE published its schedule for submitting plans for treating mixed wastes for each facility at which DOE generates or stores mixed waste. DOE has published two interim versions of the plans required by the *Federal Facility Compliance Act* for each of its sites to facilitate discussions among states and other interested parties. DOE is working on the plans with the regulatory agencies and will continue to do so throughout the process. For mixed waste for which identified treatment technologies exist, the plans must provide a schedule for submitting permit applications, entering into contracts, initiating construction, conducting systems testing, starting operations, and processing mixed wastes. For mixed waste without an identified treatment technology, the plans must include a schedule for identifying and developing technologies, identifying the funding requirements for research and development, submitting treatability study exemptions, and submitting research and development permit applications. In cases where DOE proposes radionuclide separation, the plan must also provide an estimate of the volume of waste that would exist without such separation, and cost estimates and underlying assumptions. DOE sites will provide treatment plans in three phases during the development process: Conceptual plans were completed in October 1993 and draft plans in August 1994. Final proposed plans are due to be completed no later than February 1995. DOE will also prepare summary documents of the conceptual, draft, and final plans to provide a national picture of DOE's technology needs and possible options for treatment of its mixed waste. The summaries will be provided to all states and made available to other interested parties.

Comprehensive Environmental Response, Compensation, and Liability Act. The *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), as amended by the *Superfund Amendments and Reauthorization Act* (SARA) of 1986, provides liability, compensation, cleanup, and emergency response for hazardous substances (including radionuclides) released to the environment. The cleanup of inactive waste disposal sites is one of the major requirements of CERCLA. It provides for prioritization of cleanup actions (National Priorities List (NPL) or Superfund List), and directs that a Federal Facility Agreement be negotiated with EPA and the state to coordinate CERCLA and RCRA compliance activities in one comprehensive strategy for each Federal facility. CERCLA also requires public participation in the selection of remediation alternatives, and this involvement or participation usually addresses the requirements of CERCLA, RCRA and the *National Environmental Policy Act* (NEPA). Title III of CERCLA further requires that the National Response Center (operated by the U.S. Coast Guard) be notified in the event that a non-permitted release of a reportable quantity of hazardous substance or radionuclide occurs. In the case of such a release, the National Response Center alerts the appropriate Federal emergency personnel who assess the event, formulate response, and notify cognizant local emergency agencies. SARA requires industries to report the hazardous substances used at their facilities to include reporting inventories of these substances.

National Contingency Plan. The National Contingency Plan is an implementation regulation that sets forth requirements necessary to comply with CERCLA and SARA. For every site that is targeted for remedial response action under Section 104 of CERCLA, the National Contingency Plan requires that a detailed Remedial Investigation/Feasibility Study be conducted. The Remedial Investigation emphasizes data collection and site characterization. Its purpose is to define the nature, extent, and significance of contamination at a site in order to evaluate, select, and design a cost-effective remedial action. The Feasibility Study emphasizes analysis of data and decision making; it uses results from the Remedial Investigation to develop response objectives and alternative remedial responses. These alternatives are then evaluated in terms of their engineering feasibility, public health protection, environmental impacts, and costs. The Remedial Investigation/Feasibility Study leads to a decision which sets forth the method selected for remedial action to clean up the National Priorities List site. Under the provisions of CERCLA, Federal facilities have the lead for CERCLA actions.

Toxic Substances Control Act. TSCA was enacted in 1976 to ensure that the manufacture, sale, storage, and disposal of toxic chemical substances do not present an unreasonable risk of injury to health or the environment. Its applicability to DOE sites deals principally with the management and disposal of polychlorinated biphenyls (PCBs), asbestos, and dioxin. The problem created by radioactively contaminated PCBs, asbestos, and dioxin is that currently there is a limited capability to treat these materials. Although the concentrations of radionuclides are relatively low, approximately 2 million pounds of radioactively contaminated PCBs and PCB-contaminated material are destroyed annually by the K-1435 TSCA Incinerator at K-25 at Oak Ridge Reservation (ORR).

Clean Air Act. The original *Clean Air Act* (CAA) was passed in 1955 and was wholly replaced by the *Air Quality Act* of 1967, although the name *Clean Air Act* is still used. It has been recently reauthorized. The CAA establishes air quality requirements and pollutant emission limits. The National Emissions Standards of Hazardous Air Pollutants (NESHAP) is a section of the CAA that sets air quality standards for air emissions such as radionuclides, benzene, beryllium, and asbestos. NESHAP regulations require the use of EPA-approved monitoring instrumentation, sampling methodology, calculations, and modeling for each Federal facility.

Clean Water Act. The *Federal Water Pollution Control Act* (CWA), as amended by the *Clean Water Act* of 1977 (commonly referred to as *Clean Water Act*), establishes a Federal/state scheme for controlling the introduction of pollutants into the Nation's water. The CWA created the National Pollutant Discharge Elimination System (NPDES) program. This program regulates nonradiological effluent discharges to ensure that surface water bodies meet applicable water quality standards. Each discharge point (outfall) is permitted through the NPDES program. New NPDES permit regulations for stormwater discharges will require DOE to characterize surface runoff during rain events.

Safe Drinking Water Act. The *Safe Drinking Water Act* (SDWA) was enacted in 1975 and is designed to protect drinking water resources. Primary drinking water standards set by the SDWA apply to drinking water "at the tap" as delivered by public water systems. Of equal significance is that drinking water standards are used to determine groundwater protection regulations under a number of other statutes. The SDWA requires DOE to obtain permits and complete sample analyses and site inspections of public/industrial water supplies and sources of drinking water. It also imposes requirements on installation and maintenance of drinking water wells.

Department of Energy Orders. The primary DOE orders governing waste management are as follows:

- DOE Order 5400.1, *General Environmental Protection Program.* Establishes environmental protection program requirements, authorities, and responsibilities for DOE operations for assuring compliance with applicable Federal, state, and local environmental protection laws and regulations, Executive orders, and internal department policies. Requires the preparation of waste minimization plans that describe how waste minimization activities will be promoted and implemented.

- DOE Order 5400.4, *Comprehensive Environmental Response, Compensation and Liability Act Requirements*. Establishes DOE's instructions for implementing CERCLA program and defines actions to identify and evaluate inactive waste sites at DOE installations. Directs the custodian to take action to improve control of substance migration from such sites.
- DOE Order 5480.3, *Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes*. Establishes the requirements for the packaging and transportation of hazardous materials, hazardous substances, and hazardous wastes.
- DOE Order 5820.2A, *Radioactive Waste Management*. Establishes policies and guidelines by which DOE manages its radioactive waste, waste by-products, and radioactively-contaminated surplus facilities.

H.1.3 Waste Minimization and Pollution Prevention

Waste minimization is the reduction, to the extent feasible, of radioactive and hazardous waste that is generated *before* treatment, storage, or disposal of the waste. Pollution prevention fully utilizes source reduction techniques in order to reduce risk to public health, safety, welfare, and the environment, and environmentally sound recycling to achieve these same goals. When planning for facilities to be constructed by 2010, it will be necessary to consider currently available technology while providing modular, flexible designs that can incorporate process improvements as they become available. In accordance with Executive Orders 12856, 12873, and DOE policy, the tritium supply and recycling facilities would be designed for waste minimization with an overall operating philosophy of pollution prevention. This waste minimization program will contribute to decreases in waste treatment, storage, and disposal costs and lower health risks to workers and the public. Technical approaches are being sought to optimize the number of production operations required, increase the use of nonhazardous chemicals and environmentally benign waste-producing chemicals, increase the use of recyclable chemicals and materials, and implement the new design or redesign of existing processes and products. Some criteria useful in determining successful technology include improved processing yield, reduced quantities of scrap, reduced waste and processing of by-products, reduced use of hazardous chemicals, positive return on investment, and continued product quality.

H.1.4 Waste Treatment, Storage, and Disposal

Treated waste is waste that, following generation, has been altered chemically or physically to reduce its toxicity or prepare it for storage or disposal. Waste treatment can include volume reduction activities, such as incineration or compaction, which may be performed on a waste prior to either storage or disposal or both. Stored waste is a waste that, following generation (and usually some treatment), is being (temporarily) retained in a retrievable manner and monitored pending disposal. Disposed waste is a waste that has been put in final emplacement to ensure its isolation from the environment, with no intention of retrieval. Deliberate action is required to regain access to the waste. Disposed wastes include materials placed in a geologic repository and buried in landfills.

Waste that is staged for processing will be stored according to its characterization and form. The disposal of waste from the Complex will be managed by the DOE Office of the Assistant Secretary for Environmental Management (EM). A facility for disposal of retrievable and newly generated transuranic (TRU) waste near Carlsbad, NM, is planned. All surface facilities at the Waste Isolation Pilot Plant (WIPP) have been completed. To date, only underground excavations for the test phase have been done and the remaining excavation will be completed once the facility is operational. The original planned test phase has been abandoned and in its place an experimental program, at INEL, will be conducted to develop the technical data to support the permit application under 40 CFR 191 and 40 CFR 268. Once operational, WIPP would become a permanent disposal site. The total projected capacity of WIPP is

229,600 yd^3, of which 9,260 yd^3 can be remote-handled. Options for the interim storage of TRU waste will be evaluated in the EM PEIS. Yucca Mountain is a site being studied to determine its suitability for the disposal of commercial spent nuclear fuel and defense high-level waste (HLW). Since the availability of offsite disposal sites for HLW, TRU waste, mixed waste, and spent nuclear fuel is uncertain at this time, this PEIS has evaluated the storage of mixed waste and spent fuel within the Complex for the life of the facilities that generate the waste. No HLW or TRU waste will be generated as part of tritium supply and recycling. The remainder of this section discusses some of the treatment, storage, and disposal options that may be utilized with the various waste streams from Complex facilities.

Gaseous Waste. Gaseous wastes can be nonhazardous (e.g., inert gases and air), hazardous (chlorinated hydrocarbon vapor, polyaromatic hydrocarbon vapor), or radioactive (e.g., tritium and xenon). Most hazardous gaseous wastes are combustible, and may be incinerated to destroy the hazardous constituents, converting the combustibles into carbon dioxide and water vapor, while capturing any particulates that may result. When a particulate (ash) is contaminated with heavy metals, the end product must be stabilized into an approved solid form suitable for disposal.

Gaseous radioactive wastes are held for interim storage in tanks; adsorbed on surfaces in filters, molecular sieves, or active beds; refrigerated and liquefied or solidified; or reacted to an aqueous solution. A minimal quantity of radioactive gas below the permitted limits will escape into the atmosphere because it is not possible to retain every atom of gas within the process with today's technology. The expected release of radioactive gases is listed in the project descriptions in appendix section A.2. Gaseous waste may be oxidized, mixed with other liquid wastes, or solidified in a stable form for long-term disposal. Reactive gases such as tritium are captured on reactive beds, in molecular sieves, or in cryogenic traps for recycling back to the process. Inert radioactive gases such as xenon and argon can be separated by cryogenic capture and held in storage tanks until they decay sufficiently to permit release. Gases that decay to metals can be captured on activated charcoal beds and held until they can be stabilized, packaged, and disposed of as solid waste. When sufficiently decayed, gases may be released to the atmosphere.

Liquid Waste. Liquid radioactive wastes are processed according to their chemical nature and radiological sources and activities. Liquid wastes that meet release criteria in applicable regulations can be released at permitted discharge points. Where conditions permit, liquids can be processed and recycled to replace virgin feedstocks. Waste processing removes the hazardous or radioactive contaminants from the releasable or recyclable liquids. The largest volume of liquid radioactive waste is LLW, typically in aqueous solution from process operations. Some of this waste is contaminated with hazardous compounds such as solvents or resins and the result is a liquid mixed waste. Liquid HLW or TRU waste will not be generated in tritium supply and recycling facilities, but will be part of the reference conditions at candidate sites where spent fuel or target processing was conducted. This includes wastes containing TRU, as from the extraction of plutonium. The desired final waste form for liquid wastes is a stable solid that is resistant to stresses from heat generation and from internal and external physical loads. The form must remain stable while stored and not allow the radioactive constituents to migrate to the surroundings.

Mixed waste will often have combustible constituents. These are most readily decomposed in thermal treatment (incineration) or chemical reaction resulting in the creation of an ash. The resulting material will be granular and suitable for stabilization in a cemented form in which the hazardous constituents (radionuclides and heavy metal compounds) are bound in compounds which have an affinity for heavy metals and radionuclides. These processes have been utilized in various forms, and their retention properties have been credibly demonstrated.

Liquid LLW is normally processed to reclaim or remove the excess water, leaving a saturated salt solution. This can be accomplished by clarification processes normal to water treatment, or by evaporation. This usually results in the greatest volume reduction for liquid waste. The subsequent stabilization and solidification of the concentrated solution results in a waste form that will not leach its active constituents for a time sufficient to allow the radioactive constituents to decay.

A method for stabilizing HLW for disposal is to process it into borosilicate glass cast within stainless steel cylinders. These are shock-resistant, elastic forms suitable for permanent disposal in an engineered repository. They also provide excellent retention during long-term interim storage. In the preferred practice, the liquid waste stored in large tanks is pumped directly into the vitrification process where the liquid is evaporated and the remaining salt is fused with borosilicate into the glass waste form. In some processes (i.e., at INEL's Idaho Chemical Processing Plant), the waste is evaporated to calcine which is stored in a granular form for later processing. The disadvantage of this process is that airborne particulate matter is generated when the product is handled. The advantage is that the calcine can be stored safely in a stable form until it can be vitrified.

Liquid radioactive and hazardous wastes are usually stored in tanks where they are staged for further processing. Processes are employed to concentrate the hazardous constituents. These processes result in very significant volume reductions, with the reclaimed water processed to a purity sufficient for permitted discharge or recycle.

Liquid hazardous waste concentrates may contain combustive hydrocarbons and/or heavy metal contaminants. These can be treated by incineration to produce a dry waste. If this waste is still hazardous after treatment, it can then be processed into a stabilized solid that will not leach its hazardous constituents while in storage or in a repository. Liquid low-level and noncombustible hazardous waste can also be processed into a stabilized solid form for storage and disposal.

Solid Waste. Solid radioactive wastes typically consist of contaminated materials (e.g., filters, clothing, storage vessels, cleaning materials, and tools) that have been used in or contaminated by nuclear materials processing. The term is also applied to those stabilized forms resulting from gaseous or liquid waste processing. In solid waste handling, forms and materials are segregated, combustibles are incinerated, and the resultant materials are reduced in volume, stabilized if necessary, and packaged in specified containers for storage or disposal.

HLW is stored at two of the sites considered for tritium supply and recycling. It is stored as calcine granules at Idaho National Engineering Laboratory (INEL) in underground vaults and in tanks as liquid at Savannah River Site (SRS). It will be processed to a glass/ceramic (INEL) and borosilicate glass (SRS), stored in an engineered facility onsite, and eventually shipped to a Federal repository.

Dry LLW that consists of protective clothing, containers, process materials, and equipment is stored in specified containers designed to retain the waste constituents for a time sufficient to permit decay of the radioactive constituents.

Solid hazardous wastes may contain combustible hydrocarbon compounds or mixtures with heavy metal contamination. These wastes are often treated by incineration and disposed of in a landfill if the ash is nonhazardous. If the ash contains heavy metals it can be stabilized with cement and binders and disposed of in a RCRA-permitted facility. Wastes that retain their hazardous constituents after processing must be packaged into forms that will retain the hazardous constituents safely within the waste form. For LLW or hazardous waste that results from liquid waste processing or incineration, the accepted form is a cemented solid.

Some mixed waste can be processed to remove its hazardous constituents and be disposed of as LLW. Otherwise, it can be processed into stabilized forms and packaged for retrievable storage in an engineered facility until a licensed facility is available for permanent disposal. Solid nonhazardous wastes from process wastewater evaporation ponds or from sanitary waste treatment plants are usually deposited as sludge in a landfill.

Spent Nuclear Fuel. As described in each of the technology descriptions in appendix section A.2, spent nuclear fuel from the reactor-based tritium supply alternatives will be stored within the tritium supply facility. The fuel will be kept in water-cooled storage until its decay heat has decreased sufficiently to permit dry storage. Several commercially available options for dry storage have been licensed by the NRC, and the facilities required will be relatively small, utilizing a small percentage of the land area required for the tritium supply plant. Spent nuclear fuel will not be reprocessed but will eventually be placed in a Federal repository. Spent nuclear fuel is considered a resource, not categorized with nuclear waste, and thus is not included in waste inventories. Since it is radioactive material that must be stored, managed and handled, it is included here for each site to provide baseline information on its impact on land and facility use.

H.1.5 Transportation

DOE complies with applicable Department of Transportation (DOT) regulations (10 CFR 71 and 49 CFR) when shipping hazardous materials over public roads. Transportation, especially for radioactive material, is highly regulated by Federal, state, and local laws. The stringent packaging requirements, combined with strict regulations and procedures governing the shipment of hazardous and radioactive material, ensure that transport is a safe activity. Federal DOT regulations require the use of appropriate warning placards on vehicles and labels on packages to alert workers, officials, and the public to the hazardous nature of the shipped material. The use of placards on vehicles and warning labels on packages is a joint responsibility of the carrier and the shipper. The labels and placards are familiar to emergency response personnel and are valuable in determining content and hazard information.

Shipments of hazardous materials, including radioactive materials, must be accompanied by properly completed shipping papers such as bills of lading and cargo manifests, which contain detailed information on the material being transported. These papers must be kept in the vehicle transporting the material and must be available for inspection by responsible officials at any time. The shipper must certify on the shipping papers that the hazardous material offered for transportation is properly classified, packaged, marked, labeled, and made ready for transportation according to all DOT regulations.

Radioactive material is shipped in secure packages. Type A packages contain small amounts of radioactive material and are designed to withstand normal conditions of transport. Type A packages are subjected to rigorous water spray, free-fall compression, and penetration tests carried out in sequence to ensure that radioactive materials are contained. Type B packaging is designed to contain more hazardous, and larger amounts of, radioactive waste. It can withstand severe accident conditions and contain radioactive materials under any credible circumstance.

All DOE sites under consideration for the tritium supply and recycling facilities except Pantex either have or have planned an onsite LLW disposal facility. For the purposes of analysis in this PEIS, it is assumed that all LLW to be generated at Pantex would be shipped to NTS per current practice. As shown in table H.1.5–1, data from the DOE Integrated Database Program was used to calculate LLW disposal land usage factors from 1990 to 1993 for INEL, NTS, and SRS. To determine a usage factor in the waste management impact analysis, an average value was calculated and then rounded down to the nearest hundred cubic yard. Therefore, the following disposal land usage factors were used for the impact assessments: 3,300 yd^3 per acre (INEL), 3,200 yd^3 per acre (NTS), and 4,500 yd^3 per acre (SRS). For

TABLE H.1.5–1.—*Low-Level Waste Disposal Land Usage Factors*

Site	Total Cumulative Volume (yd^3)	Estimated Area Utilized (acres)	Land Usage Factor (yd^3/acre)
1993			
INEL	192,379	79.8	2,411
NTS	599,610	430.4	1,393
SRS	870,099	167.8	5,185
1992			
INEL	191,353	52.4	3,652
NTS	575,106	135.9	4,232
SRS	849,775	193.2	4,398
1991			
INEL	190,045	52.4	3,627
NTS	548,816	135.9	4,038
SRS	832,772	193.2	4,310
1990			
INEL	188,345	52.4	3,594
NTS	534,167	[a]	[a]
SRS	801,512	178.2	4,498
Average			
INEL	NA	NA	3,321
NTS	NA	NA	3,221
SRS	NA	NA	4,598

[a] No data available.

Note: NA - not applicable.

Source: DOE 1991h; DOE 1992f; DOE 1994 c; DOE 1994d.

the proposed Class II LLW disposal facility at ORR, a 1,700 yd^3 per acre usage factor was assumed (OR DOE 1995e). The additional shipments of LLW from Pantex as a result of locating tritium supply and recycling functions at Pantex were estimated. All LLW would be transported in a solid form. A typical shipment consists of eighty 55-gallon (208-liter) drums loaded into an enclosed semi-trailer type truck. Each drum is assumed to be fully loaded, resulting in a total shipment volume of 21.7 yd^3. The truck is assumed to operate as an "exclusive-use" vehicle. The risks associated with these additional shipments are discussed in section 4.7 and appendix G.

H.1.6 Facility Transition Management

Any transition activities of facilities from a production mode to a cleanup mode that are part of the baseline for this PEIS are discussed in the facility impacts section of chapter 4 and in section H.2 of this appendix. Decontamination and decommissioning (D&D) considerations of Complex facilities will be planned for in the design.

Existing Facilities. The DOE Office of the Assistant Secretary for Defense Programs (DP) is responsible for the safe operation, shutdown, and ultimate disposition of facilities used to support the nuclear weapons program. EM is responsible for final facility disposition, which may include decontamination and decommissioning of inactive facilities or refurbishing them for further economic development. Transition activities will require appropriate NEPA evaluation and will proceed consistent with the PEISs within EM and DP. Depending on the site, facility transition activities are in different stages of planning. The dominant time-intensive activities are building characterizations of the environmental hazards related to the building and the deactivation of the facility.

Complex Facilities. At the end of their useful life, all potential facilities would require decommissioning. The transition process begins when DOE management decides to no longer operate the production facility and ends when responsibility for the facility is formally turned over to EM. Transition plans will be required for all facility transfers to EM. These plans define the actions necessary to bring the identified facilities into a condition acceptable for transfer to EM. Some facility transition issues raised in EM's scoping process for its PEIS which would be considered in the facilities design process are:

- Land use criteria defined for the period after cleanup.
- Interim storage of mixed waste and spent nuclear fuel.
- Disposal facilities for hazardous waste and LLW.

The cleanup of Complex facilities will be significantly less difficult because consideration for waste minimization and ease of decontamination will be included in the facility design. The Complex will be significantly smaller, consume less material, and generate far less contamination during process operations. The elimination of spent fuel processing and plutonium production would greatly reduce waste and contamination volumes. Large storage facilities will not be necessary for liquid radioactive wastes. The surfaces that come in contact with potential contaminants will be easier to decontaminate. In-process decontamination (to reduce operational exposures) will significantly reduce the cleanup required at the end of life.

In spite of the best design and process practices, many of the Complex facilities will require decontamination efforts at the end of life. Because of the necessity of working inside contaminated areas during the cleanup phase, the potential for exposure to cleanup workers is higher than during the operations phase. Workers would wear protective clothing and would be supplied breathing air to minimize their exposure.

Technologies for cleanup are established and are improving as the experience in working with nuclear facilities increases. The use of robotics, improved task planning, and new materials to prevent the spread of contamination has already improved current cleanup activities. By the time the Complex facilities are decommissioned, DOE will have gained 40 more years of cleanup experience; thus, further improvements should be expected.

H.2 WASTE MANAGEMENT ACTIVITIES

H.2.1 Idaho National Engineering Laboratory

The activities associated with the development of reactor technology and the extraction of useful nuclear materials at INEL have produced radioactive, mixed, and hazardous wastes that are treated, stored, or disposed of onsite. The ROD from the *Programmatic Spent Nuclear Fuel and INEL Environmental Restoration and Waste Management Programs EIS* published in the *Federal Register* (60 CFR 28680) on June 1, 1995, addresses cleaning up existing waste units and bringing operations into compliance with current applicable regulations. It deals with the current conditions, waste management, plans for remediation, and the development and funding of processes to minimize waste generation and to develop a process to dispose of future waste generation.

Pollution Prevention. The Idaho Operations Office has an active Waste Minimization and Pollution Prevention program to reduce the total amount of waste generated and disposed of at INEL. This is accomplished by eliminating waste through source reduction or material substitution, by recycling potential waste materials that cannot be minimized or eliminated, and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. The Idaho Operations Office published its first waste minimization plan in 1990 which defined specific goals, methodology, responsibility, and achievements of programs and organizations. The achievements and progress have since been updated at least annually.

Spent Nuclear Fuel. The inventory of spent nuclear fuel is cited here in metric tons of heavy metal based on current sources. One hundred and seventy-seven metric tons of spent nuclear fuel are in storage at the Idaho Chemical Processing Plant and 124 metric tons are stored at the Test Area North. Spent nuclear fuel is stored in facilities designed for a specific fuel type; therefore, storage capacities are not additive for the site. There are 11.6 metric tons of graphite reactor fuel, 10 metric tons of naval reactor fuel, and 279 metric tons of commercial and research reactor fuels in the inventory (DOE 1993r:b-2). Continued receipt of naval reactor and Ft. St. Vrain gas-cooled reactor fuel would add to this inventory. Spent nuclear fuel is stored at the Power Burst Facility, Test Reactor Area, Test Area North, Idaho Chemical Processing Plant, Argonne National Laboratory-West, and the Naval Reactor Facility. Naval Reactor Facility and Test Reactor Area fuel will be sent to the Idaho Chemical Processing Plant for storage. The Test Area North fuel pool is nearing its design life expectancy. The Three Mile Island core debris stored there will be repackaged and placed in dry storage. Alternatives are being considered to repackage fuel elements and provide long-term storage at INEL until a Federal repository (Yucca Mountain, NV) is ready to receive them. The receipt of additional fuel elements is also being considered.

The treatment of spent nuclear fuel for long-term storage and disposal is expected to continue at INEL for the next 40 years. Existing rulings designate spent nuclear fuel as a recoverable resource, and as such, waste regulations for treatment, storage, and disposal do not apply. There are no plans to dispose of spent nuclear fuel at INEL (DOE 1994e:2-8). Figure H.2.1–1 illustrates spent nuclear fuel management at INEL. The inventories and current plans for the treatment and storage of spent nuclear fuel are discussed in 60 FR 28680.

High-Level Waste. HLW has been generated in the reprocessing of spent nuclear fuel at the Idaho Chemical Processing Plant. Most of this fuel was from the naval reactors program. The liquid HLW is concentrated by evaporation and converted by calcination in a fluidized bed to metallic oxides which are stored in a stable granular solid form. This waste form is stored in stainless steel bins in concrete vaults, where it can be held long enough that the short half-life isotopes have decayed and its activity reduced. This waste form is a mixed HLW because of the toxic metals it contains.

Liquid HLW in acidic solution is stored in stainless steel tanks that may not meet all seismic regulations and do not have a secondary containment system that is acid resistant. The Idaho Operations Office entered into a Consent Order in April 1992 to resolve secondary containment issues. This Consent Order requires continued calcination, thus reducing waste volume and resulting in a material that is much easier to handle and store. The calcine, however, does not meet RCRA treatment standards for land disposal. Options for treatment of this waste are under study, and a facility is proposed where this waste will be prepared for disposal (IN DOE 1994a:5-6). The HLW inventory and treatment and storage facilities at INEL are listed in tables H.2.1–1, H.2.1–2, and H.2.1–3. Figure H.2.1–2 illustrates HLW management at INEL.

Transuranic Waste. TRU and mixed TRU wastes are stored at the Radioactive Waste Management Complex. Prior to 1970, when the Atomic Energy Commission determined that TRU wastes required segregation from other wastes, TRU wastes were buried in earthen trenches. Since that time, TRU wastes have been categorized as contact-handled and remote-handled, and packaged and stored for ultimate retrieval and transport to an offsite repository at WIPP. INEL contains more than 50 percent of DOE's TRU wastes. The majority of TRU wastes at INEL were shipped from other sites, particularly Rocky Flats Plant (now known as the Rocky Flats Environmental Technology Site), but this practice was stopped in 1989. The receipt of TRU waste at INEL for treatment is being considered on a case-by-case basis.

The existing treatment facilities for TRU wastes are limited to testing, characterization, and repackaging. The Idaho Waste Processing Facility, now in the planning phase, will process TRU wastes and either reclassify it (if it is found to be LLW) for disposal onsite, or prepare it so that it meets the WIPP Waste Acceptance Criteria. The use of commercial treatment facilities is also being considered. Approximately 60 percent of the TRU waste will require reprocessing. Volume reduction and the destruction of hazardous constituents in the mixed TRU wastes are being studied. Some of the TRU wastes have radioactivity levels high enough to require remote handling. No certified or licensed transportation capabilities exist for this waste, so this is another matter under study.

TRU wastes are being stored onsite pending the outcome of the WIPP program. Assuming WIPP is determined to be a suitable repository for these wastes, pursuant to the requirements of 40 CFR 191 and 40 CFR 268, these wastes will be transported there for disposal. If WIPP proves not suitable for a repository, then INEL would develop the treatment processes necessary to meet the criteria of the selected repository. Tables H.2.1–4, H.2.1–5, and H.2.1–6 list the TRU and mixed TRU waste inventory, and treatment and storage facilities at INEL. Figure H.2.1–3 illustrates TRU waste management at INEL. INEL is not expecting to generate or receive mixed TRU wastes in the next 5 years. Some TRU wastes at INEL will never meet WIPP waste acceptance criteria, and therefore cannot be sent to WIPP. Other options will have to be developed for these wastes. Approximately one-half of the TRU wastes are expected to be reclassified as alpha-contaminated LLW in the future. These wastes do not meet INEL waste acceptance criteria for LLW, and therefore will be managed as TRU waste until they can be repackaged to contain the alpha-type contamination to permit disposal as LLW.

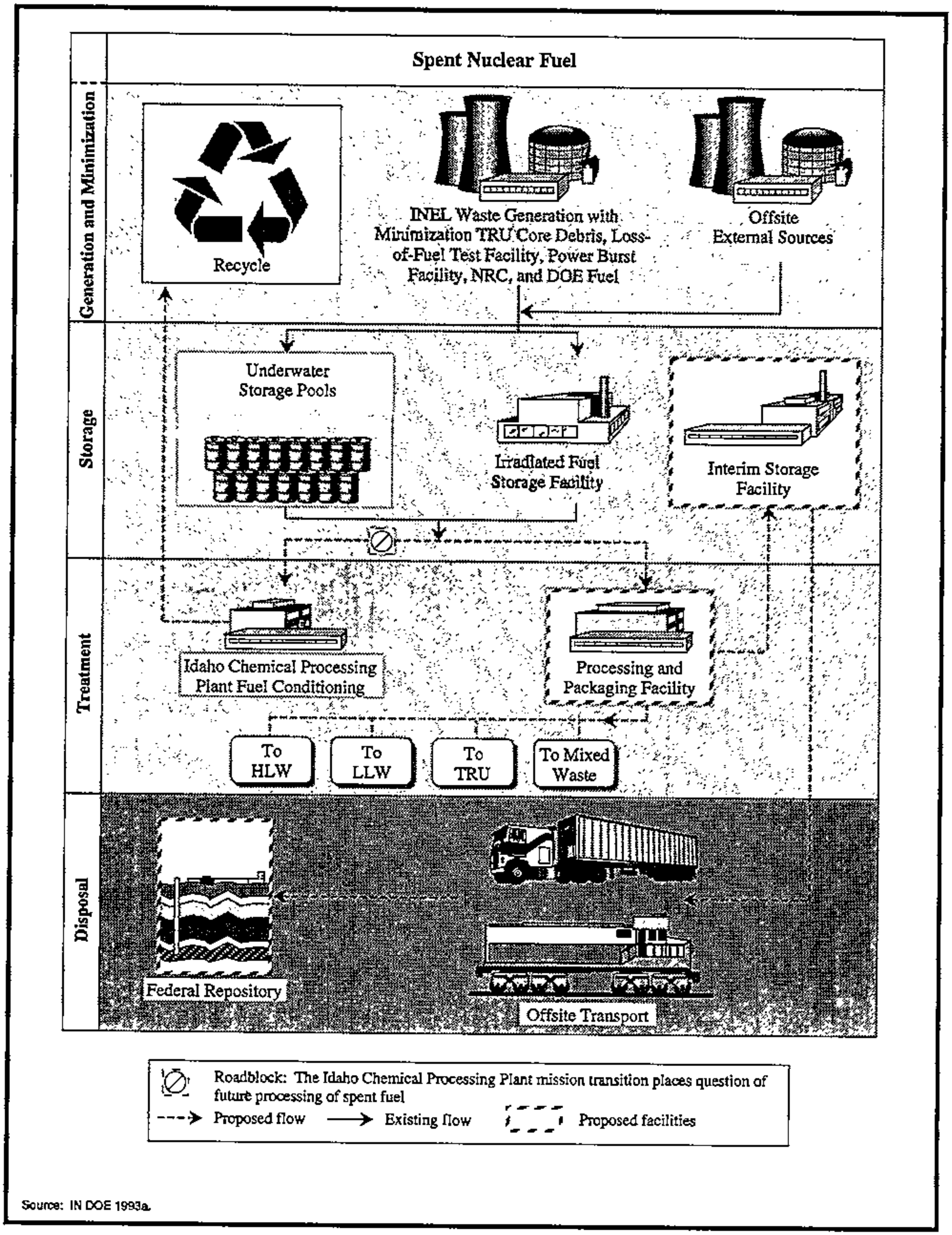
Low-Level Waste. LLW is generated in various forms at INEL facilities. This waste is disposed of at the Radioactive Waste Management Complex. Most of this waste is processed before disposal by incineration, compaction, or sizing to reduce volume and to stabilize the waste to the extent possible (the incinerator, which was shut down for modifications, is in startup and is expected to resume operations in 1996). Some LLW does not meet criteria for onsite disposal. This waste is stored temporarily until treatment and disposal options are developed. Liquid LLW is either evaporated and processed to calcine, or solidified and disposed of. The volume of LLW disposed of at INEL's Radioactive Waste Management Complex is 189,660 yd^3. As of 1991, the facility had a capacity for 235,345 yd^3, with an additional 88,000 yd^3 of expansion capacity available. Figure H.2.1–5 illustrates LLW management at INEL.

Mixed Low-Level Waste. Mixed LLW is generated in small quantities at INEL and is stored in several areas onsite (Argonne National Laboratory-West, Idaho Chemical Processing Plant, Special Power Excursion Reactors Test). Although its volume is small, it poses significant disposal problems because it is difficult to treat and cannot be disposed of until adequate treatment is developed. In the future, the Waste Experimental Reduction Facility incinerator at the Power Burst Facility will process mixed low-level (organic) wastes. Argonne National Laboratory-West plans to complete a multipurpose waste management facility by 1996 which will include provisions for mixed waste. Additional facilities planned for operation by the year 2000 at other INEL locations will be able to treat mixed waste and render it acceptable for disposal. Figure H.2.1–5 illustrates mixed waste management at INEL.

Although mixed wastes generated from past operations in liquid and solid form are stored in many locations at INEL, the bulk of that volume is solid waste stored at the Radioactive Waste Management Complex. Its volume is approximately 60 percent of the TRU waste volume also stored there and is 11 percent of the total volume of waste stored or disposed of at that facility. INEL has listed 34 facilities where mixed wastes are or will be treated to remove, destroy, or stabilize their hazardous constituents in the future, and prepare them for permitted disposal (INEL 1993a:5). The inventory of mixed LLW and its treatment and storage facilities at INEL are listed in tables H.2.1–7, H.2.1–8, and H.2.1–9.

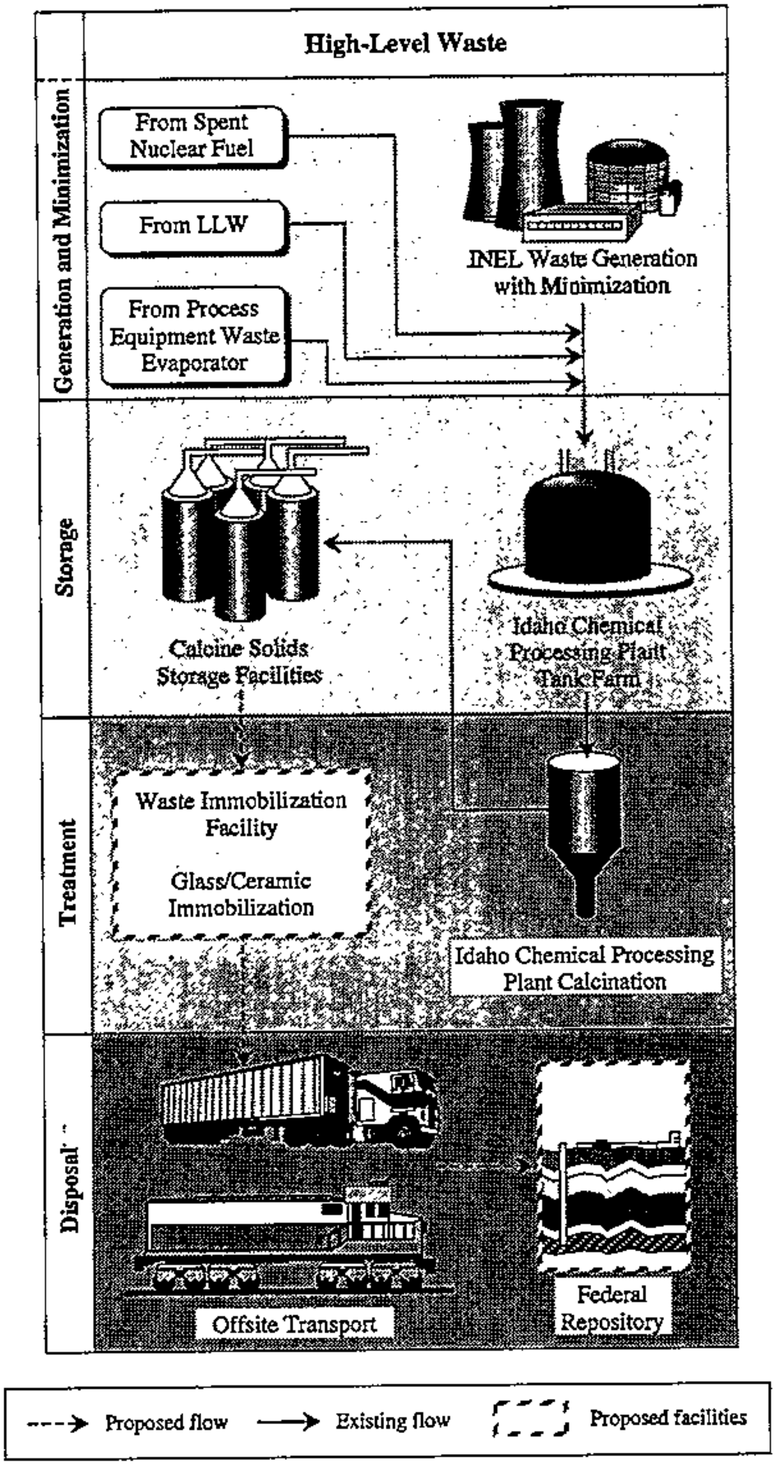
Hazardous Waste. Hazardous waste is staged in a RCRA-permitted building at the Central Facilities Area prior to shipment to an offsite commercial RCRA-permitted facility. The Hazardous Waste Storage Facility is nearing capacity since hazardous waste shipments to offsite permitted facilities have been temporarily suspended pending completion of a review by DOE. However, shipments are expected to be resumed in the near future. The INEL waste minimization program is expected to significantly reduce the quantities of hazardous wastes generated at INEL over the next 5 years. By that time, the use of nonhazardous chemicals and the recycle of those that cannot be substituted, should nearly eliminate the generation of hazardous waste.

Nonhazardous Waste. Nonhazardous wastes are processed at each facility on the INEL site. A nonhazardous industrial commercial waste landfill is located at the Central Facilities Area. Wastes are segregated into sanitary, industrial, and asbestos wastes before being placed in the landfill. Increased recycling is expected to reduce nonhazardous waste generation by 50 percent by 1997. In the future, sanitary wastes may be sent offsite for disposal in a permitted facility, while industrial and asbestos wastes will continue to be disposed of at INEL. A new multipurpose facility is planned to be in operation at Argonne National Laboratory-West by 1996 to collect, monitor, and consolidate Argonne National Laboratory-West nonhazardous wastes before shipment to the Central Facilities Area.



Source: IN DOE 1993a.

FIGURE H.2.1–1.—*Spent Nuclear Fuel Management at Idaho National Engineering Laboratory.*



Source: IN DOE 1993a.

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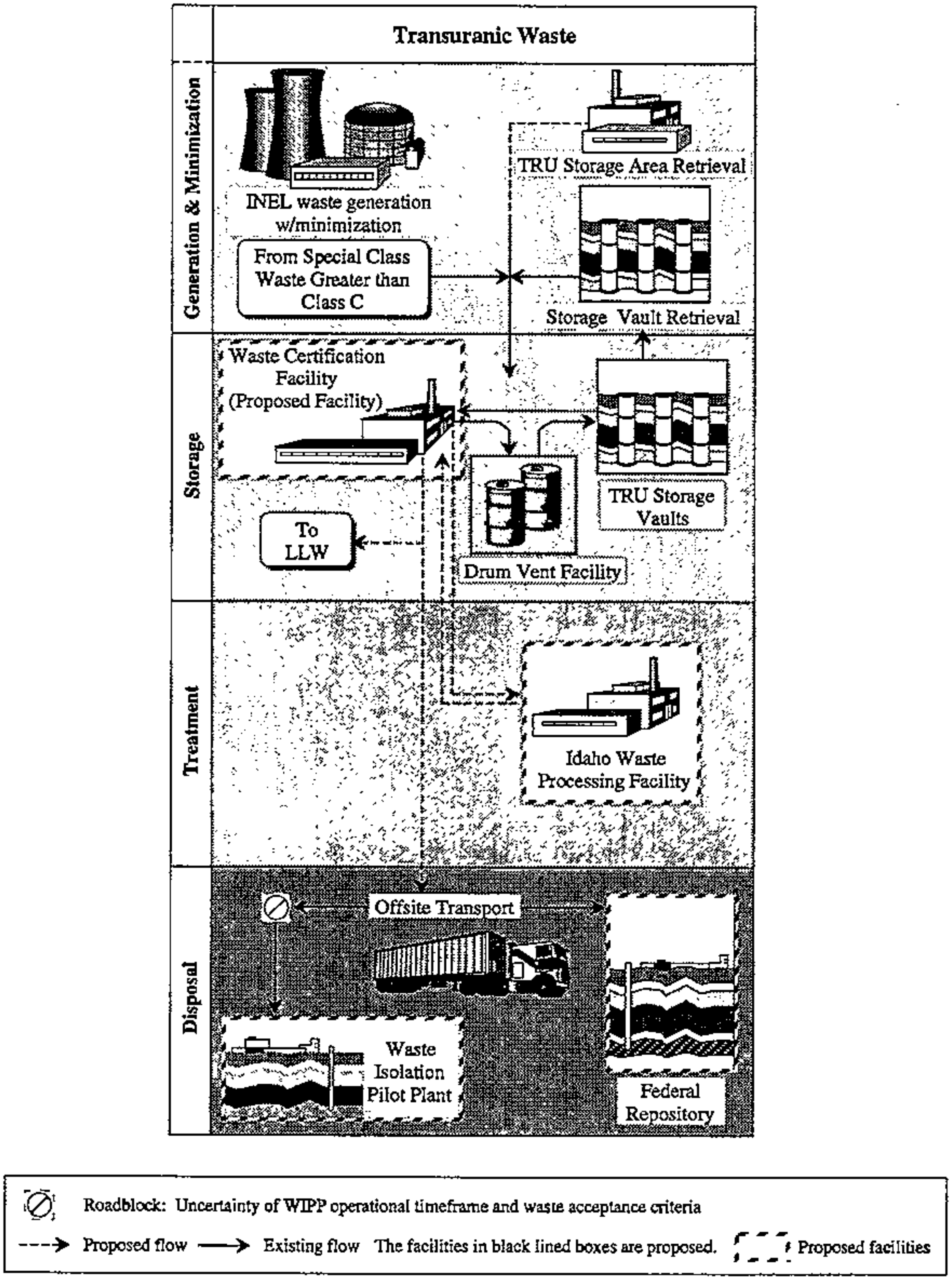
FIGURE H.2.1–2.—*High-Level Waste Management at Idaho National Engineering Laboratory.*



Source: IN DOE 1993a.

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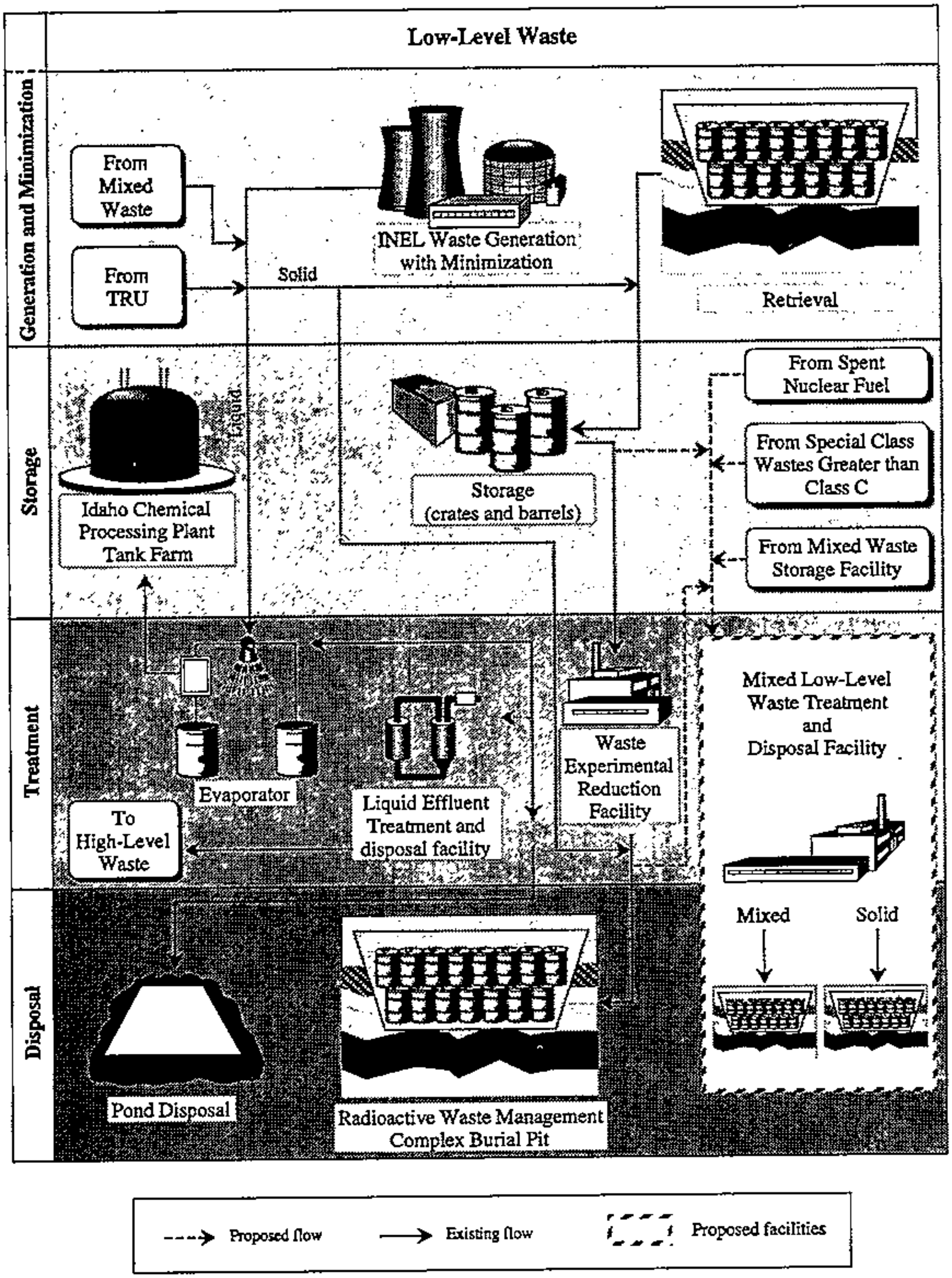
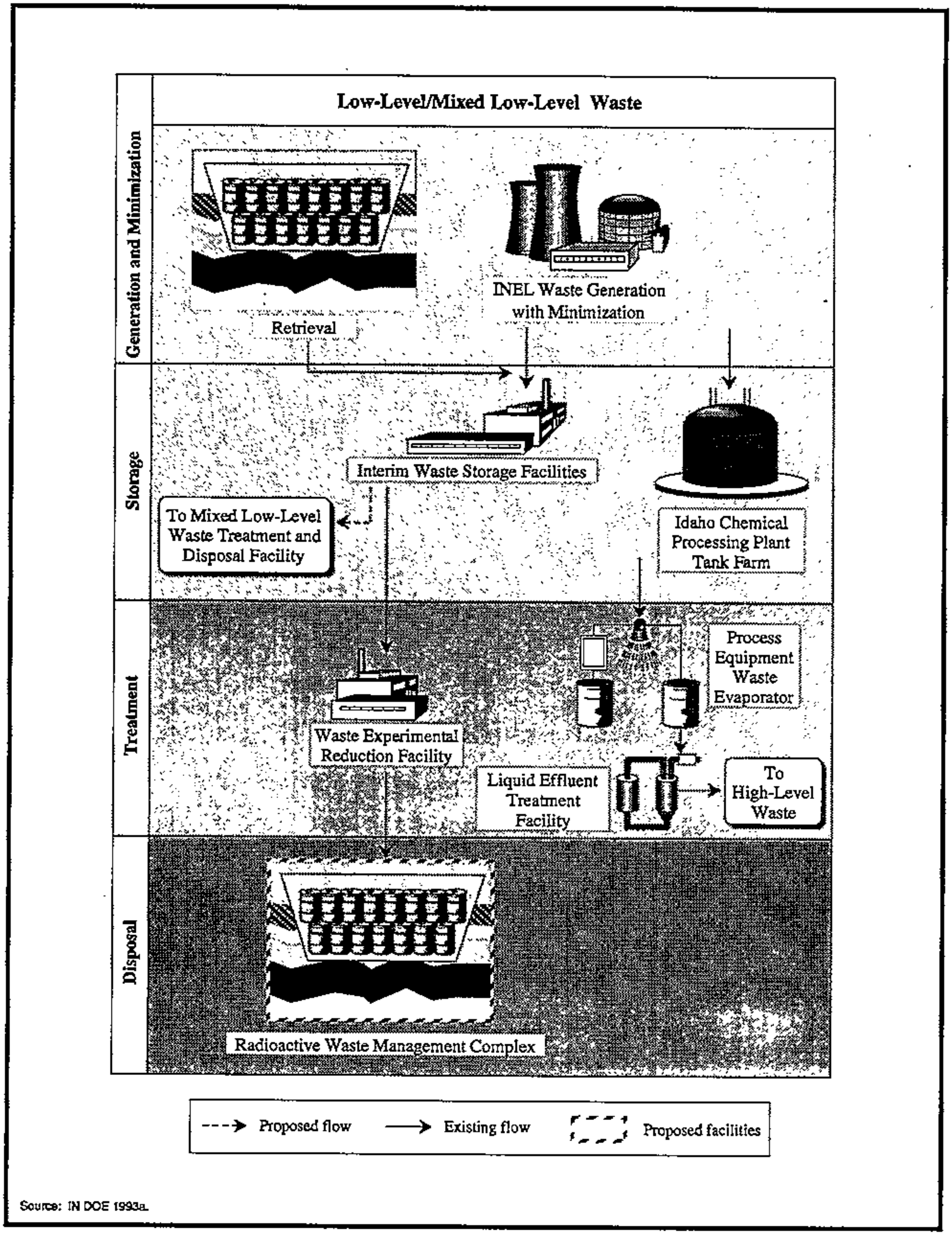
FIGURE H.2.1–3.—*Transuranic Waste Management at the Idaho National Engineering Laboratory.*



Source: IN DOE 1993a.

2205

FIGURE H.2.1–4.—*Low-Level Waste Management at Idaho National Engineering Laboratory.*



Source: IN DOE 1993a.

FIGURE H.2.1–5.—*Mixed Waste Management at Idaho National Engineering Laboratory.*

TABLE H.2.1–1.—*High-Level Waste at Idaho National Engineering Laboratory*

Waste Matrix	Number of Waste Streams	Inventory as of August 31, 1994 (yd^3)	Number of Waste Streams Five-Year Projection	Total Generation Inventory Five-Year Projection (yd^3)
Remote-handled				
Aqueous liquids/slurries	1	9,040 (1,830,000 gal)	1	3,519 (711,000 gal)
Inorganic process residues (calcined solids)	1	4,860	1	829
Total	**2**	**13,900**	**2**	**4,350**

Source: DOE 1993b; IN DOE 1994a.

TABLE H.2.1–2.—*High-Level Waste Treatment Capability at Idaho National Engineering Laboratory*

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (yd^3/yr)	Comment
HEPA Filter Leach Facility	Chemical extraction	HLW remote-handled - alpha, inorganic debris	Concentrated liquid HLW (to calcine), LLW solid	15 (2,990 GPY)	Under repair. Final RCRA 1990, interim NESHAP 1999
Idaho Chemical Processing Plant Decontamination Facility	Water washing, CO_2 decontamination	HLW remote-handled - debris	HLW-RH - solid HLW-remote-handled, LLW liquids	297	Operational 1993
Idaho Waste Immobilization Facility	Vitrification	HLW remote-handled - calcine solids	HLW-RH - solid, stabilized	3,960	Unapproved, planned
New Waste Calcining Facility Evaporator	Evaporation	HLW remote-handled - aqueous liquids	HLW-RH - aqueous liquids	183,329 (37,032,515 GPY)	Available 2000 interim RCRA 1990
New Waste Calcining Facility	Calcination	HLW remote-handled - aqueous liquid, toxic organic, metals w/mercury	HLW-RH - solid, (calcine)	6,673 (1,348,030 GPY)	Operational interim (RCRA 1990)

[a] For those facilities already in use, this is a normal operating capacity; whereas, for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

Source: DOE 1993b; IN DOE 1994a; IN MMES 1993a.

TABLE H.2.1–3.—*High-Level Waste Storage at Idaho National Engineering Laboratory*

Storage Unit	Input Capability	Total Capacity[a] (yd³)	Comment
Idaho Chemical Processing Plant Tank Farm	HLW remote-handled - liquid, corrosive, toxic, listed	17,500 (3,530,000 gal)	In operation; interim RCRA 1990; to be closed
New Waste Calcine Facility Tanks	HLW remote-handled - liquid, corrosive, toxic, listed	337 (68,074 gal)	In operation; staging tanks for calcined feed; interim RCRA 1990
Calcine Solid Storage Facility	HLW remote-handled - solid, toxic, listed (calcine)	9,305	In operation; State final permit 1992; RCRA Part B submitted 1994. Permit applications for new storage bins (#8 and #9) to be submitted.
FAST Reactor and New Waste Calcine Facility HEPA Filter Storage Facilities	HLW remote-handled - solid, toxic	217	In operation; RCRA Part B submitted 1993

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

Source: DOE 1993b; IN DOE 1994a; IN MMES 1993a.

TABLE H.2.1–4.—*Mixed Transuranic Waste at Idaho National Engineering Laboratory*

Waste Matrix	Number of Waste Streams	Inventory as of August 31, 1994 (yd³)	Number of Waste Streams Five-Year Projection	Total Generation Five-Year Projection (yd³)
Contact-Handled				
Inorganic process residues	31	8,511	0	0
Contaminated soils/debris	1	50	0	0
Contaminated debris	10	1,611	0	0
Contaminated metal debris	6	9,839	0	0
Inorganic, non-metal debris	5	719	0	0
Combustible debris	10	728	0	0
Heterogeneous debris	25	17,699	0	
Unknown solids	9	11,502	0	0
Uncategorized/unknown	3	486	0	0
Remote-Handled				
Inorganic process residue	2	15	0	0
Contaminated debris	1	7	0	0
Heterogeneous debris	2	29	1	44
Unknown solid	3	9	0	0
Total	**108**	**51,205**	**1**	**44**

Source: DOE 1994k.

TABLE H.2.1–5.—*Transuranic and Mixed Transuranic Waste Treatment Capability at Idaho National Engineering Laboratory*

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (yd^3/yr)	Comment
Idaho Chemical Processing Plant	Water washing	HLW, TRU, LLW, mixed LLW, alpha	HLW, TRU, LLW, mixed LLW	149	Operational
	HEPA filter leach	HLW, TRU, LLW, Mixed LLW	HLW, TRU, LLW, Mixed LLW	15	Existing, plan to use
Idaho Waste Processing Facility	Amalgamate, decontaminate, incinerate, encapsulate, size, stabilize, desorb, vitrify	TRU, Mixed TRU, LLW, mixed LLW, alpha, liquid, and solid	Mixed TRU, LLW	15,810	Unapproved, planned
Liquid Effluent Treatment and Disposal	Fractionate, evaporate	TRU, LLW, mixed LLW, alpha	TRU, LLW	14,376 (2,903,420 GPY)	Operational; RCRA final 1990; NESHAP final and State PSD 1988
New Waste Calcining Facility	Calcify	HLW, TRU, LLW, mixed LLW, alpha, liquid	HLW, TRU, LLW, mixed LLW	6,556 (1,324,250 GPY)	Operational; RCRA interim 1990
Remote Mixed Waste Treatment	Melt, drain, evaporate	TRU, LLW, alpha	TRU, LLW	37	Unapproved, planned
Waste Characterization and Storage Facility	Characterize, stabilize, amalgamate, neutralize, adsorb	Alpha mixed TRU, mixed LLW, liquid, and solid	Mixed TRU, mixed LLW, LLW	392	Planned, approved, available 1999
Waste Immobilization Facility	Vitrify or stabilize in ceramic	HLW, TRU, LLW, mixed LLW, alpha	HLW, TRU, LLW	3,960	Planned, unapproved

[a] For those facilities already in use, this is a normal operating capacity; whereas, for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

Source: DOE 1993b; IN DOE 1993a; IN MMES 1993a; IN DOE 1994a; INEL 1993a:5.

TABLE H.2.1–6.—*Transuranic and Mixed Transuranic Waste Storage at Idaho National Engineering Laboratory*

Storage Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
Argonne National Laboratory-West Sodium Storage	Mixed TRU solid	25	RCRA Part B submitted 1994
Argonne National Laboratory-West Scrap	Mixed TRU solid	252	RCRA Part B submitted 1994
Idaho Chemical Processing Plant HEPA Filters	Mixed TRU solid	185	RCRA Part B submitted 1993
Radioactive Waste Management Complex TSA-3	Mixed TRU solid	141	Partial Closure, RCRA Part B submitted 1994
Radioactive Waste Management Complex Waste Storage	Mixed TRU solid	147,019	RCRA Part B submitted 1991
Radioactive Waste Management Complex Intermediate-level TRU Storage	Mixed TRU solid	131	RCRA Part B submitted 1991
TSA-RE Retrieval Modification Facility	Mixed TRU solid	122,179	RCRA Part B submitted 1994

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

Source: IN DOE 1994a.

TABLE H.2.1–7.—*Mixed Low-Level Waste Streams at Idaho National Engineering Laboratory*

Waste Matrix	Number of Waste Streams	Inventory as of August 31, 1994 (yd^3)	Number of Waste Streams Five-Year Projection	Total Generation Five-Year Projection (yd^3)
Contact-handled				
Aqueous liquids	12	156 (31,500 gal)	5	10
Organic liquids	17	40 (8,080 gal)	3	5
Inorganic process residues	39	4,615	8	117
Organic process residues	3	<1	1	3
Contaminated soils/debris	6	286	1	8
Contaminated debris	11	1,990	1	8
Contaminated metal debris	12	9,353	2	16
Inorganic non-metal debris	6	459	0	0
Combustible debris	13	934	3	8
Heterogeneous debris	33	10,183	10	183
Labpacks	8	6	1	1
Reactive metals	1	<1	0	0
Elemental lead	5	544	4	62
Unknown solids	6	4,191	1	8
Uncategorized/unknown	2	397	0	0
Cement forms	0	0	1	4
Remote-handled				
Inorganic process residue	1	1	0	0
Contaminated debris	1	1	0	0
Heterogeneous debris	2	101	1	2,616
Reactive metals	1	1	0	0
Elemental lead	1	71	1	165
Total	**180**	**33,327**	**45**	**3,215**

Source: DOE 1994k.

TABLE H.2.1–8.—*Mixed Low-Level Waste and Low-Level Waste Treatment Capability at Idaho National Engineering Laboratory* [Page 1 of 2]

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (yd^3/yr)	Comment
HEPA Filter Leach (CPP-659)	Acid leach	HLW, TRU, mixed LLW-contact-handled, -remote-handled, alpha, solid, debris	LLW solid to RWMC[b], concentrated liquid to tank farm, nonhazardous to sanitary landfill	15	Under modification; RCRA final 1990; interim NESHAP to 1999
Idaho Chemical Processing Plant Debris Treatment and Containment	Water wash, CO_2, abrasion	HLW, TRU, mixed LLW-contact-handled, -remote-handled alpha, solid, debris	Mixed LLW, HLW, TRU solid, liquid	297	Water wash operational, CO_2 planned, available 1994
Idaho Waste Processing Facility	Amalgamation, incineration, macroencapsulation, sizing, stabilization, thermal desorption	Mixed TRU, mixed LLW, contact-handled, remote-handled alpha	Mixed TRU, mixed LLW, LLW solid	20,677	Unapproved, planned
INEL Waste Treatment, 40 CFR 262.34	Absorption, neutralization, solidification	Mixed LLW-contact-handled, aqueous liquid, solid, debris	Mixed LLW, LLW	Planned	Operational
Liquid Effluent Treatment and Disposal	Fractionation, evaporation	Mixed LLW-contact-handled, remote-handled liquid (PEW evaporator)	Mixed LLW-contact-handled, remote-handled liquid to acid recycle for NWCF, or tank farm	15,993 (3,230,569 GPY)	Operational; RCRA final 1990; NESHAP final and State PSD 1988
Mixed LLW Treatment Facility	Amalgamation, decontamination, incineration macroencapsulation, neutralization, precipitation, sizing, stabilization	Mixed LLW-contact-handled liquid, solid	Mixed LLW-contact-handled	525	Approved, planned
New Waste Calcining Facility (CPP 659)	Calcification	Mixed LLW, HLW, mixed TRU-remote-handled liquid	HLW-remote-handled solid	6,560 (1,320,000 GPY)	Operational; RCRA interim 1990
Portable Water Treatment System	Adsorption, filtration, neutralization	Mixed LLW-contact-handled, aqueous liquid	Mixed LLW	2,860 (577,000 GPY)	Operational; interim RCRA 1990; renewal 1995
Radioactive Sodium Waste Processing Facility	Steam oxidation	Mixed LLW-contact-handled	Mixed LLW-contact-handled, decontaminated sodium	911	Existing, needs modification
Remote Mixed Waste Treatment	Melt, drain, evaporate	MixedLLW-remote-handled, alpha	Mixed LLW, remote-handled, alpha	37	Unapproved, planned
Test Area North 726A Treatment Unit	Ion exchange	Mixed LLW-contact-handled, aqueous liquid	LLW, mixed LLW, nonhazardous liquid	249 (50,200 GPY)	Operational

TABLE H.2.1–8.—*Mixed Low-Level Waste and Low-Level Waste Treatment Capability at Idaho National Engineering Laboratory* **[Page 2 of 2]**

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (yd^3/yr)	Comment
Tan Cask Dismantlement	Disassembly, recovery	Mixed LLW-contact-handled	Mixed LLW-contact-handled	16	Operational
Waste Characterization Facility	Neutralization, stabilization, amalgamation, adsorption	Mixed LLW, MTRU, liquid, solid	Mixed LLW, mixed TRU, certified, pre-treated repackaged	Planned	Planned, approved
Waste Engineering Development Facility	Amalgamation	Mixed LLW-contact-handled, solid	LLW solid	0.04	Planned, approved
Waste Engineering Development Facility	Debris sizing	Mixed LLW, LLW-contact-handled, solid	Mixed LLW, LLW solid	44	Planned, approved
Waste Engineering Development Facility	Neutralization	Mixed LLW-contact-handled	LLW	3	Planned, approved
Waste Engineering Development Facility	Stabilization	Mixed LLW-contact-handled	LLW	110 2,407 solid	Existing, plan to use
Waste Experimental Reduction Facility	Incineration, stabilization, macroencapsulation	Mixed LLW-contact-handled, liquid, solid	LLW, mixed LLW solid to RWMC (stabilized solids and grout)	Input 64,910 (13,111,719 GPY); output 309 grout and 3,617 stabilized solids to RWMC	Operational; interim NESHAP 1987, 1992; RCRA interim 1987, 1992; State final 1992
Waste Immobilization	Vitrification or ceramic fusion	HLW, mixed TRU, mixed LLW solid	HLW solid ceramic	3,960	Unapproved, planned

[a] For those facilities already in use, this is a normal operating capacity; whereas, for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

[b] RWMC - Radioactive Waste Management Complex.

Source: DOE 1993a; DOE 1993b; IN MMES 1993a; IN DOE 1994a; INEL 1993a:5.

TABLE H.2.1–9.—*Low-Level Waste and Mixed Low-Level Waste Storage at Idaho National Engineering Laboratory*

Storage Unit	Input Capability	Total Capacity [a] (yd^3)	Comment
Argonne National Laboratory-West Sodium Storage	Mixed LLW-TRU	421	RCRA Part B submitted 1994
Argonne National Laboratory-West Scrap Storage	Mixed LLW-TRU	252	RCRA Part B submitted 1994
Idaho Chemical Processing Plant Fast HEPA Filter Storage	Mixed LLW	33	RCRA Part B submitted 1993
Idaho Chemical Processing Plant CPP-1619 Storage	Mixed LLW	59	RCRA Part B to be submitted 1995
Idaho Chemical Processing Plant CPP-1617 Staging	Mixed LLW	667	RCRA Part B to be submitted 1995
Idaho Chemical Processing Plant New Waste Calcining Facility HEPA Filter Storage	Mixed LLW, TRU	184	RCRA Part B submitted 1993
Power Burst Facility Waste Engineering Development Facility Storage	Mixed LLW	5	RCRA Part B to be submitted 1995
Power Burst Facility MLLW Storage	Mixed LLW	59	RCRA Part B submitted 1993
Power Burst Facility Waste Engineering Development Facility Containment	Mixed LLW	594	RCRA Part B to be submitted 1995
Portable Storage at SPERT IV	Mixed LLW	310	RCRA Part B submitted 1993
Power Burst Facility Waste Experimental Reduction Facility Storage	Mixed LLW	361	RCRA Part B submitted 1993
Radioactive Waste Management Complex TRU Modules	Mixed LLW, alpha LLW, TRU	147,019	RCRA Part B submitted 1990, Interim TSCA 1992
Radioactive Waste Management Complex Intermediate-level Storage	Mixed LLW, alpha LLW, TRU	131	RCRA Part B submitted 1991
Radioactive Waste Management Complex TSA-RE Retrieval Modification Facility	Alpha LLW, TRU	122,000	RCRA Part B submitted 1994
Test Area North 647 Waste Storage	Mixed LLW	136	RCRA Part B to be submitted 1995
Test Area North 628 SMC Container Storage	Mixed LLW	164	RCRA Part B submitted 1993

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

Source: IN DOE 1994a.

H.2.2 Nevada Test Site

Radioactive and hazardous materials have been extracted and analyzed after underground tests. These activities have resulted in the accumulation of low-level, hazardous, and mixed wastes which must be treated, stored, and disposed. No reactors or reprocessing facilities have operated at NTS. No inventory of spent fuel or HLW has been created, shipped to, or stored at NTS. The *Environmental Restoration and Waste Management Site Specific Plan Fiscal Years 1994-1998* (DOE/NV-336 UC-900) discusses the activities at NTS to achieve full compliance with environmental laws and regulations. The report addresses remediation activities, and the treatment, storage and disposal of current waste generation. *The Site Book for Waste Management* (May 1994) and *The Draft Site Treatment Plan* (August 1994) detail waste management activities at NTS.

Radioactive and hazardous wastes generated from past nuclear testing activities were disposed of at Areas 2, 3, 5, 6, 8, 9, 12, and 23. These were mixed wastes and LLW composed of debris, drilling mud, decontamination wastes, laboratory, and classified wastes. Areas 3 and 5 are still currently active for waste treatment, storage, and disposal. Area 3 receives offsite and onsite bulk waste for disposal in subsidence craters. A RCRA closure plan has been submitted to the Nevada Division of Environmental Protection for this facility. The Radioactive Waste Management Complex in the north of Area 5 contains the LLW management unit and receives packaged classified and unclassified low-level and mixed wastes. It also has TRU wastes from Lawrence Livermore National Laboratory in storage, and a hazardous waste accumulation site.

In the past waste disposal was accomplished through landfills, underground injection, and leachfields on NTS and through offsite disposal. NTS has a goal to achieve compliance with environmental laws and regulations and to remove or immobilize hazardous substances, pollutants, and contaminants. These activities are expected to result in an acceptable level of environmental restoration for all sites by 2007 (NT DOE 1993d:82). The Remedial Investigation/Feasibility Study that will guide this restoration is expected to be completed in 1996.

Pollution Prevention. The Nevada Operations Office is an active participant in DOE's national waste minimization and pollution prevention program. A comprehensive waste minimization plan for NTS was completed in 1991, which defines specific goals, methods, responsibility, and achievements for organizations. A Waste Minimization Coordinator has been identified to provide a point of contact for NTS waste minimization activities, and a Waste Minimization Task Force has been formed from NTS contractors and users. The management and operations contractor has three full-time employees in its Waste Minimization Project Office, dedicated to promoting waste minimization and pollution prevention, and assuring compliance with DOE Executive orders throughout the site.

Since the initiation of the waste minimization program, several steam-cleaning operations have been eliminated, and one-half of the hazardous solvents used at NTS have been replaced with nonhazardous solvents. Recycling and reclamation activities have been established to reuse lead, silver, lubricating oil, and trichlorotrifluoroethane. Automatic decontamination equipment, recycling fabrication tool coolant systems, and continuous oil change and reburn systems have been placed in service to reduce hazardous waste generation. Closed loop effluent recycling for steam cleaning has eliminated the production of 4.7 million gallons of wastewater annually, and has reduced hazardous wastes generation by 90 percent. Two solvent waste stills recycle 85 percent of all solvents and thinners used. Nonhazardous aqueous solution parts cleaners have eliminated the need for parts cleaning solvents (NT DOE 1993a:1).

The procurement of all materials is also reviewed for the opportunity to reduce the purchase of hazardous materials for NTS operations. For the future, planning for remediation (i.e. plutonium-contaminated soil cleanup) includes research and development for best available technology consistent with waste minimization goals. In addition, an education and training program for all site personnel and for the surrounding community is helping to increase awareness of best practices and lessons learned in waste reduction.

Transuranic Waste. TRU waste is stored on the TRU Pad Waste Storage in Area 5. This waste was generated at Lawrence Livermore National Laboratory and shipped to NTS between 1974 and 1990. All NTS mixed TRU waste is expected to be certified for disposal at WIPP in Carlsbad, NM, or another suitable repository should WIPP prove to be unsatisfactory. The Nevada Operations Office is planning to construct a TRU Waste Certification Building for breaching, sampling, and certifying containers of TRU waste to meet the WIPP Waste Acceptance Criteria. However, delays are expected, because the WIPP Waste Acceptance Criteria cannot be finalized until the conditions imposed by EPA (after testing is complete) are known. This waste inventory consists of 800 yd^3 of heterogeneous debris (NT DOE 1993f:37). NTS has areas of plutonium-contaminated soil as the result of nuclear weapons tests. The technology for the treatment of these soils is presently being developed. Table H.2.2–1 lists the mixed TRU waste storage units at NTS.

Low-Level Waste. LLW was generated from underground testing of nuclear weapons as contaminated soil surrounding the test cavity. Although the debris from a weapons test remains underground by design, samples of this debris are brought to the surface for analysis and then must be disposed. The majority of LLW generated at NTS is disposed of in subsidence craters in Area 3. This area also receives substantial quantities of containerized bulk waste from other offsite DOE facilities. Some waste disposal units are being closed in this area, while others are being readied for future use. Area 5 receives low-level radioactive waste from both onsite and offsite generators. New disposal capacity is planned for this area, and the onsite/offsite generators will be required to meet the NTS waste acceptance criteria (which includes periodic reviews by the Nevada Operations Office) to allow them to ship LLW for disposal at NTS.

Historically, the volume of waste received from offsite is approximately equal to or slightly greater than the volume of waste generated onsite. Onsite waste generation will decline due to cessation of nuclear testing. Remediation activities at NTS will produce waste streams that will have to be treated, stored, and disposed. Any onsite/offsite waste shipments must meet NTS waste acceptance criteria which require that the waste be ready for disposal at NTS. The planning for and progress of remediation activities is described in detail in the *Environmental Restoration and Waste Management Site Specific Plan Fiscal Years 1994-1998*. The LLW disposal capacity in use or planned is listed in table H.1.5–1.

Mixed Low-Level Waste. Mixed LLW is generated by defense program-related support activities, environmental restoration activities, and activities supporting TRU waste disposal at WIPP or another suitable repository should the WIPP prove to be unacceptable. Wastes were generated by the analytical activities supporting weapons tests and consisted of drilling muds and debris generated from tunnel reentry and rehabilitation. Additional wastes result from radiochemical analysis, and from the decontamination of equipment and facilities used in sample extraction and analysis. NTS has received mixed wastes from other DOE sites and may receive additional waste pending the completion of the Site Treatment Plans for all DOE sites and once proper permits are obtained.

Mixed LLW streams are being characterized to fully determine what technologies and capabilities are required for safe, environmentally sound and compliant disposal. Nine waste streams at NTS require additional characterization before a formal determination of whether the waste is mixed can be made. Currently, the Nevada Operations Office is planning to build the Liquid Waste Treatment System, a central facility for treating contaminated effluents from environmental restoration and defense programs activities. The Liquid Waste Treatment System would be comprised of double-lined receiving/holding tanks, evaporation reservoirs, process equipment for chemical separation of solids, and a batch plant to provide sludge/sediment stabilization through cementation. Receiving/holding and evaporation reservoirs and associated mixed waste processes will be RCRA-permitted.

Table H.2.2–2 lists mixed LLW storage and disposal facilities at NTS. Table H.2.2–3 lists the mixed LLW streams inventory and 5-year projected generation at NTS. Table H.2.2–3 does not include the nine potential mixed waste streams which are awaiting further characterization and evaluation. The total volume is 350 yd^3 including a 45,000-pound empty spent shipping cask. The 7,500 yd^3 of projected mixed wastes from environmental activities are also not included due to lack of characterization. Table H.2.2–4 lists mixed LLW treatment facilities at NTS.

Hazardous Waste. Hazardous wastes are generated from ongoing operations at NTS. Wastes consist of solvents, lubricants, fuel, lead, metals, and acids. Hazardous wastes are accumulated at various sites around NTS while they await shipment offsite to a RCRA-permitted facility. Over the next 5 years, additional satellite storage locations are planned. A separate accumulation site across the road from Area 5 is provided to avoid potential cross-contamination with radioactive waste. The generation of hazardous wastes at NTS is expected to decrease significantly because of the cessation of nuclear testing, the completion of environmental restoration activities, and because of the impact of waste minimization activities. Hazardous waste accumulation capacity in Area 5 is approximately 1,500 yd^3 (NT REECO 1994a:11).

Nonhazardous Waste. Nonhazardous sanitary wastes are expected to be generated at the current rate for the next several years, then decline due to the cessation of nuclear weapons testing. Recycling of paper, metals, glass, plastics, and cardboard has already resulted in some decreases in waste quantities.

TABLE H.2.2–1.—*Mixed Transuranic Waste Storage at Nevada Test Site*

Storage Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
Asphalt Storage Pad (covered building)	Mixed TRU solid	1,485	Available storage capacity on the TRU Pad to be used for storage of future, onsite generated mixed LLW that does not meet RCRA Land Disposal Restriction standards.

[a] Schedules and capacity for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

Source: NT DOE 1994a.

TABLE H.2.2–2.—*Low-Level and Mixed Low-Level Waste Storage and Disposal Capacity at Nevada Test Site*

Disposal Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
Mixed Waste, P03U Management Unit	Mixed LLW solid	155,532	Nonoperational. RCRA Part A 1988. EA published, withdrawn. Will be considered in site-specific EIS.
LLW Disposal, P04U	LLW solid, wood, metal, rubble, debris	87,565	Operational. Additional 801,300 yd^3 capacity available for expansion
LLW Disposal, P06U	LLW solid	35, 318	Operational, reserved for future use
Classified Shallow Land Burial, T02C	LLW solid, metal, solidified liquid in approved containers	2,220	Operational–No remaining capacity
Shallow Land Burial, T03U	LLW solid, metal, debris, unclassified, solidified liquid	9,268	Reserved for LLW disposal
Classified Shallow Land Burial, T04C	LLW solid, metal, solidified liquid in approved containers	1,985	Operational
Mixed Waste Storage Pad	Mixed LLW solid	Planned	Planned. RCRA Part B submitted in 1992
Bulk LLW Disposal, U3AHAT	LLW solid, wood, metal, solidified liquid, soil, biological	558,869	Operational

[a] Schedules and capacity for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

Source: DOE 1992f; DOE 1993c; NT REECO 1994a.

TABLE H.2.2–3.—*Mixed Low-Level Waste Streams at Nevada Test Site*

Waste Matrix	Number of Waste Streams	Inventory as of August 31, 1994 (yd^3)	Number of Waste Streams Five-Year Projection	Total Generation Five-Year Projection (yd^3)
Contact-Handled				
Aqueous liquids	0	0	1	5,440
Organic process residues	2	340	0	0
Contaminated soil	1	3.4	0	0
Uncategorized soil	2	1	3	2,040
Debris	4	7	1	10
Lab packs	2	0.3	0	0
Lead acid batteries	1	0.1	0	0
Total	**12**	**351.8**	**5**	**7,490**

Source: NT DOE 1994a.

TABLE H.2.2–4.—*Mixed Low-Level Waste and Low-Level Waste Treatment Capability at Nevada Test Site*

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity (yd^3 per year)	Comment
Liquid Waste Treatment System	Separation, evaporation, stabilization	Mixed LLW liquids and slurries	LLW solid	29,700 (6,000,000 GPY)	Now in Title I design; in the current design, RCRA organics cannot be accepted

Source: NT DOE 1994a.

H.2.3 Oak Ridge Reservation

ORR consists of three operating industrial complexes in and around the city of Oak Ridge. The Energy Systems Waste Management Organization provides the waste management oversight for ORR. It also provides guidance to each of the operating facility waste management divisions which are responsible for operating and managing their respective waste management facilities and activities.

Y-12 Plant. Laboratory, maintenance, construction, demolition, and cleanup activities; machining operations; and waste produced in the purification of uranium for recycle are the primary waste generation activities at the Y-12 Plant (Y-12). In addition, metal-plating operations generate plating waste solutions while various laboratory activities generate reactive wastes and waste laboratory chemicals. Liquid process waste and the sludge resulting from the treatment of these process wastes are generated throughout the plant. Waste oils and solvents are generated from machining and cleaning operations. Daily operations such as janitorial services and floor sweepings generate both noncontaminated and uranium-contaminated industrial trash.

Pollution Prevention. The Y-12 Pollution Prevention Awareness Program Plan describes the overall program in detail. The program is designed to maintain the flow of information pertaining to waste minimization and pollution prevention and to facilitate activities to implement real reductions in waste generation. A summary description of the four key elements of the Waste Minimization and Pollution Prevention Program includes a promotional campaign, information exchange, a waste tracking system, and waste assessment performance.

One goal of the program is to sustain an effective pollution prevention effort by improving the awareness of the employees of waste minimization opportunities and activities. Improved awareness is accomplished in many ways including training, posters, publications, seminars, promotional campaigns, and recognition of individuals and teams for activities that reduce waste generation. Waste minimization activities at other ORR sites and other weapons sites provide useful input to the program. Using ideas developed by others is an important aspect that can save time and resources.

Tracking waste generation in a manner that lends itself to waste minimization reporting is a prerequisite to documenting successes or failures in waste minimization efforts. Y-12 is improving its ability to record and track waste shipments. Process waste assessments are being conducted as part of the ongoing program to identify, screen, and analyze options to reduce the generation of waste. This determines the amount of material in a workplace that is disposed of as waste during work operations. The assessment provides a summary of hazardous materials usage and waste production and identifies those processes and operations that need to be improved or replaced to promote waste minimization.

Spent Nuclear Fuel. Y-12 does not generate any spent nuclear fuel; however, it does store and safeguard a small amount of reactor-irradiated nuclear material in Building 9720-5. It is a large warehouse facility containing numerous vaults for storage. Some features of the facility are classified and it is distinguished by its high level of security. Operations consist of transfers, storage, and inventory of highly enriched uranium (HEU) in containers of various types.

High-Level Radioactive Waste. Y-12 does not generate or manage HLW.

Transuranic Waste. Y-12 does not generate or manage TRU waste.

Low-Level Waste. Machining operations which use stock materials including steel, stainless steel, aluminum, depleted uranium, and other materials produce machine turnings and fines as waste products. Waste treatment provides controlled conversion of waste streams generated from operations to an environmentally acceptable, or to a more efficiently handled or stored, form. This activity includes continuing operation and maintenance of facilities that treat wastewaters and solid waste generated from production and production support activities. Waste minimization and planned treatment facilities are expected to reduce the magnitude of these wastes. In 1992, Y-12 treated approximately 128,000 gallons of liquid LLW and 170 yd^3 of solid LLW (OR DOE 1993b:9-3). Table H.2.3–1 summarizes the LLW treatment facilities at

Y-12 of which the major facilities are described below.

The Uranium Chip Oxidation Facility thermally oxidizes depleted and natural uranium (less than 1 percent enrichment) machine chips under controlled conditions to a stable uranium oxide. Upon arrival, chips are weighed, placed into an oxidation chamber, and ignited. The oxide is transferred into drums and transported to the Uranium Oxide Storage Vaults. The Uranium Chip Oxidation Facility is not designed to treat uranium sawfines. Hence, sawfines are currently blended with uranium oxide and placed in the Oxide Vaults as a short-term treatment method.

The Waste Feed Preparation Facility processes and prepares solid LLW for volume reduction by an outside contractor or storage at Y-12. The facility utilizes a 200-ton capacity baler to reduce the waste volume to one-eighth of its original size. Waste comes to the facility from areas known to generate contaminated material, or from dumpsters that were analyzed at the Trash Monitoring Station and deemed to be above the radioactive acceptability limits for the sanitary landfill. The compacted bales are placed in DOT-approved metal boxes and staged in an adjacent warehouse prior to offsite shipment for incineration or storage at Y-12.

The Uranium Treatment Unit is located near Building 9206 and is used to treat uranium-contaminated nitrate waste solutions which are generated in enriched uranium recovery operations in buildings 9212 and 9206. After the waste is processed through the Uranium Treatment Unit, it is transferred to the Y-12 Waste Management Division for storage, further treatment, and/or final disposal.

The Waste Coolant Processing Facility is a biodegradation and storage facility for waste coolants that may be LLW and utilizes the following equipment for coolant treatment:

- Three storage tanks;
- Feed tank;
- Waste processing reactor/clarifier;
- Sludge holding tank;
- Two sludge blenders/dryers;
- Effluent holding tank; and
- Transfer pumps.

Microorganisms biodegrade approximately 30,000 gallons of waste coolant per month into harmless products. Each batch of coolant takes approximately 30 days to treat. After treatment, the clarifier separates the wastes into three process streams: floating oily solids, liquid effluent, and settled biological solids. Floating solids are dewatered in the dryer/ribbon blender and are transferred to drums. Liquid effluent is sent to the Central Pollution Control Facility or West End Treatment Facility/West Tank Farm for final treatment prior to NPDES discharge. Biological solids are further treated in the aeration tank and are then recycled or sent through the blender for dewatering. Nonrecycled solids are currently pumped into tankers for storage. This practice will continue until adequate treatment and disposal methods are established.

Long-term storage options include storage in warehouses, tanks, and vaults, as well as storage of Y-12 wastes in buildings at K-25. The major Y-12 LLW storage facilities, described below, are summarized in table H.2.3–2. In 1992, approximately 600 yd^3 of LLW and 1,330 yd^3 of uranium-contaminated scrap metal was stored at Y-12 (OR DOE 1993b:9-6).

The Classified Waste Storage Facility will provide storage for Y-12 classified wastes contaminated with radionuclides. These wastes are currently being stored by the waste generators. The facility will meet plant security requirements for classified waste management and guidelines for the management of LLW and mixed LLW. The Classified Waste Storage Facility is equipped with a baler for volume reduction and shape-changing capabilities, but the baler will not become operational until the ventilation and fire-suppression systems are upgraded to meet health, safety, and fire protection requirements. Funding for this facility upgrade has not yet been made available. Wastes will be monitored by Health Physics personnel. The facility is located in Building 9720-25.

Buildings 9206 and 9212 containerized waste storage units provide for the storage of cans of ash resulting from the combustion of uranium-contaminated solid wastes. Combustible solid wastes contaminated with enriched uranium are ashed during the uranium recovery process. The resulting cans of ash are stored in buildings 9206 and 9212 containerized storage units until uranium accountability results have been obtained and the material can be returned to the uranium recovery process for further processing to recover the enriched uranium.

The Building 9720-25 classified containerized waste storage unit provides for the permitted storage of RCRA hazardous waste and mixed LLW, which is classified for national security purposes under provisions of the *Atomic Energy Act*. Waste is stored in this unit awaiting further processing, treatment, or ultimate disposal.

The Depleted Uranium Oxide Storage Vaults I and II are located on Chestnut Ridge northeast of Building 9213. The vaults are constructed of reinforced concrete and provide a retrievable storage repository for uranium oxide, uranium metal, and a blended mixture of uranium sawfines and oxide. The vaults contain a negative pressure exhaust system that operates during material entry. The exhaust is filtered and monitored prior to its release to the atmosphere. The facility utilizes forklift trucks, electric hoists, and a motorized drum dumper during operation. Depleted uranium oxide and blended sawfines are delivered in sealed 30- and 55-gallon drums. The containers have a weight limit of 850 pounds.

The Old Salvage Yard contains both low-level uranium-contaminated and nonradioactive scrap metal. However, most scrap currently sent to this facility is contaminated. The Contaminated Scrap Metal Storage is an area within the Old Salvage Yard that is used to store uranium-contaminated scrap metal. Contaminated scrap is being placed in B-25 boxes and eventually will be transferred to the above-grade storage pads. Noncontaminated scrap is sold when offsite shipments are allowed. This facility is located at the west end of Y-12.

Y-12 has no current onsite LLW disposal capability. All disposal activities at the Bear Creek Burial Ground were terminated on June 30, 1991. This landfill was used to dispose of radiologically-contaminated solid waste. These wastes are currently containerized and stored at Y-12 in above-grade storage pads or are shipped offsite for incineration. In 1992, approximately 220 yd^3 of solid nonmetallic LLW were sent offsite to be incinerated with the ash returned to Y-12 for storage (OR DOE 1993b:9-5). The Low-Level Waste Disposal Facilities project will provide new disposal facilities at a new centralized location of the ORR. The Low-Level Waste Disposal Facilities will utilize state-of-the-art disposal technologies, including lined trenches with leachate collection treatment capabilities and tumulus confinement disposal units. The Class-II facility, for wastes contaminated with very low concentrations of long half-life radionuclides, is expected to be operational in 1998. DOE has indefinitely postponed construction of the Class-I facility, for wastes contaminated with low concentrations of predominantly short half-life radionuclides.

Mixed Low-Level Waste. Mixed LLW is generated from the development, metal preparation, fabrication, and assembly/industrial engineering functions at Y-12. Mixed LLW are hazardous wastes such as solvents, degreasers, biodegradable coolants, organic and inorganic acids, biodenitrification sludge, and wastewater that are contaminated with enriched and/or depleted uranium. There is no disposal of mixed waste at Y-12; however, future plans include disposal of mixed wastes at a permitted offsite commercial facility. Mixed wastes are put in storage awaiting treatment, treated at Y-12, or sent to another ORR facility for treatment. Table H.2.3–3 presents the inventory of mixed LLW at Y-12 as of December 31, 1992 along with a 5-year projection. In 1992, approximately 354,000 gallons of liquid mixed LLW was treated at Y-12 (OR DOE 1993b:9-3). The Y-12 Waste Management Division operates several mixed LLW treatment facilities which are described below and were previously summarized in table H.2.3–1.

The Groundwater Treatment Facility treats wastewater from the Liquid Storage Facility and seepwater collected at K-25 to remove volatile and nonvolatile organic compounds and iron. It is part of the Disposal Area Remedial Action program to collect and treat contaminated groundwater from the Bear Creek Burial Grounds. The Groundwater Treatment Facility is located at the far west end of Y-12, adjacent to the West End Treatment Facility. This facility utilizes an air stripping operation to remove volatile organics. In addition, carbon adsorption eliminates nonvolatile organics and PCBs. Iron removal equipment is also operational. After treatment, wastewater is sampled and recycled if additional processing is required. Wastewater that meets discharge specifications is pumped into East Fork Poplar Creek through an NPDES monitoring station. The Groundwater Treatment Facility treated and discharged approximately 501,000 gallons during 1992 (OR DOE 1993b:9-3).

The West End Treatment Facility/West Tank Farm treats the following nitrate-bearing wastes generated by Y-12 production operations: nitric acid wastes; nitrate-bearing rinsewaters; mixed acid wastes; waste coolants; mop water; caustic wastes; and biodenitrification sludges. Treatment operations consist of biological denitrification, biological oxidation, metals precipitation, coagulation, flocculation, clarification, filtration, pH adjustment, degassification, and carbon adsorption. Wastes are received at the West End Treatment Facility/West Tank Farm in 5,000-gallon tankers, 600-gallon polytanks, and in smaller, approved waste transportation containers such as drums, bottles, and carboys. Detailed waste analysis documentation is used to determine the treatment scheme and temporary storage location of each shipment. The West End Treatment Facility Effluent Polishing System facilitates the removal of uranium, trace metals, and suspended solids. The treated wastewater is then discharged to East Fork Poplar Creek through an NPDES monitoring station. Sludges, spent carbon, and spent filter material generated during the treatment processes are currently stored in 500,000-gallon tanks. A major modification to the West End Treatment Facility/West Tank Farm is currently in the design phase. This modification will remove all heavy metals up front, thus separating the hazardous sludge from the nonhazardous sludge. Approximately two-thirds of the current sludge volume generated can then be disposed of as nonhazardous wastes.

The Y-12 Cyanide Treatment Unit provides storage and treatment of waste solutions containing metallic cyanide compounds from spent plating baths and precious metal recovery operations. The cyanide reduction process performed within the unit is currently performed in 55-gallon containers, although plans are under way to discontinue this method of treatment and initiate use of fixed tanks for use in the treatment process. After waste is treated at the Cyanide Treatment Unit, it is transferred to the West End Treatment Facility for further treatment and discharged to the East Fork Poplar Creek.

In 1992, approximately 450 yd^3 of mixed LLW including PCB and uranium waste were stored at Y-12 (OR DOE 1993b:9-6). Table H.2.3–2 summarized the mixed LLW storage facilities at Y-12 which are described below.

The Containerized Waste Storage Area consists of three concrete pads covering approximately 25,000 ft^2. These pads provide storage for LLW, RCRA hazardous, and mixed LLW. An impermeable dike surrounds each pad to provide one foot of spill containment. Fire protection at this facility is currently being upgraded.

The Building 9811-1 RCRA Storage Facility (OD7 and OD8) contains a diked storage area for tanks (OD7) and an enclosed storage area for containers (OD8) with a capacity of 1,000 drums. The OD7 contains four 30,000-gallon tanks, one 10,000-gallon tank, two 3,000-gallon tanks, associated piping and pumps, and an oil/water separator. RCRA waste oil/solvent mixtures containing various concentrations of chlorinated and nonchlorinated hydrocarbon solvents, uranium, trace PCBs, and water for specific chemical constituents are stored at OD8 in 55-gallon drums and 300-gallon Tuff-tanks to await sampling and analytical results. Wastes deemed compatible with OD7 materials are pumped into those tanks. Noncompatible wastes are transported to different facilities.

The Waste Oil/Solvent Storage Facility (OD9) is a permitted RCRA/TSCA hazardous waste storage facility. It consists of a diked area supporting five 40,000-gallon tanks, a tanker transfer station with five centrifugal transfer pumps, and a drum storage area. Three tanks house PCB wastes contaminated with uranium, one tank contains non-radioactive PCB wastes, and one tank holds RCRA hazardous wastes. Likewise, a diked and covered pad furnishes space for 35 drums. Wastes assigned to this facility are first stored at OD8 (Building 9811-1 RCRA Storage Facility) to await laboratory results. The diked area contains additional space for a sixth 40,000-gallon tank. This facility is projected to be used until 2010, due to the anticipated lack of disposal outlets for uranium-contaminated organic liquids.

The Liquid Organic Waste Solvent Storage Facility (OD10) contains four 6,500-gallon and two 3,000-gallon stainless steel tanks for storage of ignitable nonreactive liquids, including those contaminated with PCBs and uranium. In addition, a diked and covered storage area provides space for 1,000 drums of material. The facility is capable of segregating various spent solvents for collection and storage. Major solvent waste streams are transferred to tanks until commercial resale, disposal, or incineration at K-25 takes place.

Building 9720-9 Storage Area supplies a drum storage area for mixed and/or PCB wastes, including an area designed to contain flammable wastes. The western half, which contains space for approximately 1,500 drums, stores both PCB and RCRA hazardous waste. However a diking upgrade is planned to allow for the handling of RCRA materials. The facility's eastern half is not currently in use. Upgrades to the ventilation, diking, and fire-suppression systems will comply with RCRA, TSCA, and DOE standards and will allow for mixed and PCB waste storage. The design of these modifications is complete, and construction will begin when NEPA documentation has been submitted and approved.

The RCRA Staging and Storage Facility (Building 9720-31) prepares solid, liquid, and sludge wastes for offsite shipment. The facility consists of seven storage rooms and seven staging rooms, each with a separate ventilation system. The staging rooms house small containers that are packed with compatible materials and shipped. The storage rooms hold larger containers, such as 55-gallon drums. Each room, which can hold up to 90 drums, accommodates a different class of hazardous waste.

The RCRA and PCB Container Storage Area (Building 9720-58) is a warehouse facility utilized for staging prior to treatment of PCB-contaminated equipment (transformers, capacitors, and electrical switchgear) and nonreactive, nonignitable RCRA waste contaminated with uranium. Waste containers received at Building 9720-58 include 30- and 55-gallon drums, 330- and 660-gallon portable tanks, B-25 boxes, and self-contained PCB equipment.

The Solid Storage Facility provides 17,500 ft^2 of storage space for PCB- and uranium-contaminated soil. The facility also contains a synthetic liner for leachate collection and a leak detection system. Collected leachate is transferred to the Liquid Storage Facility for pretreatment. The Solid Storage Facility is currently undergoing the RCRA Part B permitting process. No additional wastes are being added to the facility.

Hazardous Waste. Plating rinsewaters; waste oil and solvents from machining and cleaning operations; contaminated soil, soil solutions, and soil materials from RCRA closure activities; and waste contaminated with hazardous constituents from construction/demolition activities are the major sources of hazardous waste. In 1992, approximately 150,300 gallons of hazardous liquid were treated (OR DOE 1993b:9-3). In addition 419,900 gallons of liquid leachate from the Bear Creek Burial Ground were processed. The Y-12 Waste Management Division operates several hazardous treatment facilities that are described below and are summarized in table H.2.3–4.

The Plating Rinsewater Treatment Facility treats dilute plating rinsewaters contaminated primarily with chromium, copper, nickel, and zinc. In addition, the facility can treat cyanide-bearing wastes and remove chlorinated hydrocarbons. In 1991, the Plating Rinsewater Treatment Facility treated 283,504 gallons of plating rinsewater. The facility is located across the street from the Building 9401-2 Plating Shop, which produces most of Y-12's rinsewaters. The facility neutralization, equalization, and cyanide destruction equipment is located outdoors in a diked basin. The remainder of the facility process is located in Building 9623. Rinsewaters are received via a direct pipeline from the Plating Shop. In addition, rinsewaters may be received in tankers, polytanks, or in any acceptable waste shipping container. The Plating Rinsewater Treatment Facility performs the following treatment operations: pH adjustment; flow equalization; heavy metal removal by electrochemical precipitation; flocculation; clarification; carbon adsorption; and filtration. After the clarification operation, the rinsewater is transferred to the Central Pollution Control Facility. The Central Pollution Control Facility provides the carbon adsorption operation, final filtration, and discharge to East Fork Poplar Creek through an NPDES monitoring station. Treated rinsewater is sometimes recycled for use as make-up water for Central Pollution Control Facility processes. Sludge from the clarification process is transferred to the Central Pollution Control Facility and then taken to the West Tank Farm for interim storage.

Hazardous waste is being stored until Martin Marietta Energy Systems and DOE approve shipment for offsite disposal under the DOE "No Rad Added" performance objective (OR DOE 1993a:9-11). In 1992, approximately 260 yd^3 of hazardous waste and 60 yd^3 of PCB wastes were placed in storage at Y-12 (OR DOE 1993b:9-6). Table H.2.3–5 summarizes the major existing Y-12 hazardous waste storage facilities described below.

The Oil Landfarm Soil Storage Facility contains approximately 550 yd^3 of soil contaminated with PCBs and volatile organics (OR DOE 1993a:9-21). The soil was excavated from the Oil Landfarm and Tributary 7 in 1989. The soil is contained in a covered, double-lined concrete dike with a leak-detection system. The leak-detection system will soon be modified to enhance detection capabilities.

The Liquid Storage Facility of the Disposal Area Remedial Actions Liquid Storage Treatment Unit is a hazardous waste storage facility built during the Bear Creek Burial Ground closure activities. It is located in Bear Creek Valley approximately two miles west of Y-12. It collects and stores groundwater and other wastewaters received from the Seep Collection Lift Station, the Solid Storage Facility, tankers, poly-tanks, and the diked area rainfall accumulation. Feed streams may contain oil contaminated with PCBs, volatile and nonvolatile organic compounds, and heavy metals. Processing and storage equipment include:

- Two 75,000-gallon bulk storage tanks;
- 6,000-gallon oil storage tank;
- Gravity separator;
- Filtering unit;
- Composite sampling station; and
- Tanker transfer station.

The wastewater travels through the gravity separator, cartridge filters, and composite sampling station prior to storage in the bulk tanks. A reinforced concrete dike surrounds all equipment to provide spill containment. After sufficient wastewater accumulates in the bulk storage tanks, it is processed at the Groundwater Treatment Facility. A new leachate collection system collects and pumps hazardous waste seepage from the burial ground to the Liquid Storage Facility.

In 1992, approximately 7,900 gallons of liquid hazardous waste from Y-12 was incinerated offsite (OR DOE 1993b:9-5). Other hazardous waste is sent offsite to commercial vendors or other ORR sites.

The Y-12 Waste Management Division operates the Sanitary and Industrial Landfill II which provides special waste disposal including asbestos materials, aerosol cans, materials contaminated with beryllium oxide, glass, fly ash, coal pile runoff sludge, empty pesticide containers, and Steam Plant Wastewater Treatment Facility sludge. The landfill area is located on Chestnut Ridge near the eastern end of the plant and serves Y-12, Oak Ridge National Laboratory, K-25, and other DOE prime contractors in Oak Ridge. The landfill utilizes shallow land burial by the large trench method and is permitted by the State of Tennessee. Requests are filed with the state to provide disposal for additional materials as needed.

The Chestnut Ridge Borrow Area Waste Pile (Industrial Waste Landfill III) consists of mercury-contaminated soil removed from the Oak Ridge Civic Center area and deposited at Y-12 Chestnut Ridge. No further disposal at this site has been made. Closure of this waste pile was initiated after a complete soil analysis following state sampling regulations was completed.

Nonhazardous Waste. Major waste-generating activities include construction and demolition activities that produce large volumes of noncontaminated wastes, including lumber, concrete, metal objects, soil, and roofing materials. Industrial trash is generated by daily operations throughout the plant. These operations include janitorial services, floor sweepings in production areas, and production activities. In 1992, about 375,700 gallons of wastewaters from the Central Pollution Control Facility and the Plating Rinsewater Treatment Facility and 37,860,000 gallons of wastewaters from the Steam

Plant were processed. In addition, approximately 280,700 gallons of other liquid nonhazardous waste was treated. The Waste Storage Facility in Building 9720-25 has solid waste baler with an 8:1 compaction ratio (DOE 1994n). Approximately 1,970 yd^3 of solid nonhazardous waste was compacted during 1992 (OR DOE 1993b:9-3).

The Steam Plant Wastewater Treatment Facility treats approximately 40 million gallons per year of wastewater from steam plant operations, demineralizers, and coal pile runoff. Treatment processes include wastewater collection/sedimentation, neutralization, clarification, pH adjustment, and dewatering. The treatment facility utilizes automated processes for continuous operation. All solids generated during treatment are nonhazardous and are disposed of in the sanitary landfill. The treated effluent is monitored prior to NPDES discharge to the East Fork Poplar Creek. The Y-12 Utilities Department manages this facility. Lake Reality is a lined containment basin with a surface area of about 2 acres. The pond serves to enhance the water quality of East Fork Poplar Creek downstream of Y-12.

The Sludge Handling Facility (T-118) was designed and constructed to provide water filtration and sludge dewatering in support of a storm sewer cleaning and relining project. Filtered water was reused by the sewer-cleaning contractor, and the dewatered sludge was stored in specially constructed containers for future disposal. The facility is currently being used to store containers of LLW.

The Steam Plant Ash Disposal Facility is used to collect, dewater, and dispose of sluiced bottom ash generated during operation of the coal-fired steam plant. An additional trench was constructed for the disposal of sanitary and industrial wastes generated by Oak Ridge National Laboratory, K-25, and Y-12. In order to comply with environmental regulations for landfill operations, the Steam Plant Ash Disposal Facility includes a leachate collection system, a transfer system to discharge the collected leachate into the Oak Ridge public sewage system, groundwater monitoring wells, and a gas migration/ventilation system. The landfill, Industrial Landfill V, is permitted to dispose of approximately 4 million ft^3 per year of industrial waste. The facility was designed and is operated in accordance with Tennessee solid waste disposal regulations and became operational in March 1994.

In 1992, approximately 1,100 yd^3 of clean scrap metal was stored at Y-12 (OR DOE 1993b:9-6). The salvage yard is used for the staging and public sale of nonradioactive, nonhazardous scrap metal. Sales have been suspended, however, until procedures to meet the DOE "No Rad Added" performance objective have been approved. The New Salvage Yard provides accumulation and sorting activities for nonradiologically contaminated scrap metal. Plans are in place to provide an automotive lead cell battery repository for used batteries until recycling options are initiated. This facility is located near the Bear Creek Burial Ground. Construction debris is buried at Landfill VI and VII on Y-12.

Oak Ridge National Laboratory. Because Oak Ridge National Laboratory is a research facility, it has many diverse waste-generating activities, each of which may produce only a small quantity of waste. Isotope production, utilities, and support functions such as photography are additional sources of waste. The radioactive wastes produced by each activity at Oak Ridge National Laboratory reflect the nature of its operation. A large number of radioisotopes are handled, in isotope production and packaging, in reactor and accelerator operations, in reprocessing studies on nuclear fuel, and in investigations into the interactions of radioactivity with living systems. The radioactive wastes generated by these activities can be classified as follows:

- Concentrates generated by the treatment of intermediate-level wastes, which are disposed of by hydrofracture;

- LLW contaminated with beta/gamma emitting radioactivity. These wastes, which have a low surface dose rate, are compacted if possible and disposed of in earthen trenches; those wastes which exhibit a high surface dose rate are disposed of in augered holes;

- TRU wastes, which are retrievably stored; and

- Low-level alpha-emitting wastes, which are evaluated for criticality hazards before disposal in augered holes.

Pollution Prevention. Waste segregation is used to minimize the generation of solid LLW. By providing collection barrels for both radioactive and nonradioactive wastes, the volume of wastes that requires handling as radioactive waste has been reduced. Before these procedures were implemented, radioactive and nonradioactive wastes were discarded in the same barrel. This contaminated the nonradioactive portion and required special disposal of an inflated amount of waste.

Spent Nuclear Fuel. Oak Ridge National Laboratory generates small quantities of spent nuclear fuel. Several facilities described below are used to house spent nuclear fuel (DOE 1993r:28-29). The interim management of spent nuclear fuel (pending availability of a geologic repository) will be in accordance with the ROD from the Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (DOE/EIS-0203-P).

Irradiated Fuels Examination Laboratory (Building 3525). The Irradiated Fuels Examination Laboratory only contains hot cells. Disassembly and examination of irradiated fuel and components continue to be the mission of the facility.

High Level Radiochemical Laboratory (Building 4501). The High Level Radiochemical Laboratory contains centrally located hot cells supported by various laboratories capable of handling radioactive material. It has been used in performing work on fission gas release in light water reactor fuel rods. The spent nuclear fuel is in dry storage.

Radiochemical Engineering Development Center (Building 7920). The Radiochemical Engineering Development Center is a multipurpose hot cell facility with the appropriate equipment, shielding, and containment provisions to safely process and store large quantities of highly radioactive fuel elements. It was specifically built to prepare and process targets for the High Flux Isotope Reactor.

Bulk Shielding Reactor. This pool-type research reactor is currently shut down with the core stored in racks. Fuel assemblies from the Oak Ridge Research Reactor are also stored in the pool.

High Flux Isotope Reactor. The High Flux Isotope Reactor is an 85 megawatt (MW), beryllium-reflected, light-water-moderated, flux-trap-type research reactor with associated support equipment and a storage pool. Missions include production of isotopes for medical and industrial applications, neutron-scattering experiments, and various material irradiation experiments. This is the only reactor that is still generating fuel elements that will need storage in the future.

Molten Salt Reactor Experiment. The Molten Salt Reactor Experiment is an 8 MW, homogeneous reactor consisting of uranium fluoride fuel in molten lithium salt. Its purpose was to test the practicality of a molten-salt reactor concept for central power station applications. The fuel is being stored in the salt storage tanks beneath the reactor.

Tower Shielding Reactor. The Tower Shielding Reactor is a reactor facility where experiments were conducted outdoors on a remote hilltop. It is a spherically symmetric 1 MW plate-type reactor. The purpose of the facility was to conduct large-scale experiments to test shielding design methods and obtain associated data. The original core is located in the reactor. Four fuel plates are stored in the underground site, and 1,200 low-enriched fuel pins are stored in DOT shipping containers.

7823A/7827/7829 Wells. These shielded, retrievable storage facilities are stainless-steel dry wells placed in the ground but are currently closed to further storage. The wells were used to store irradiated fuel and associated fission products from 1972 to 1989.

Waste Area Grouping 7 (Homogeneous Reactor Experiment Wells). In 1964, seven augered holes were drilled to store 135 gallons of a 40-molar fuel solution. Each well was filled with soil to ground level and marked by a concrete plug and brass plaque.

Classified Burial Ground. In the past, fuel materials were buried here. The exact quantity and location of this material is not known. This area is now closed to operations.

Solid Waste Area 6. This facility houses the Suspension Test Reactor fuel. Seven of the underground dry-storage units are empty although one unit has been found to contain water and another contains moist sand. These units are therefore not available for additional storage.

A summary table of the inventory of reactor-irradiated nuclear material is shown in table H.2.3–6.

High-Level Radioactive Waste. Oak Ridge National Laboratory does not generate or manage HLW.

Transuranic Waste. Table H.2.3–7 presents the inventory of mixed TRU wastes at Oak Ridge National Laboratory as of December 31, 1992 along with a five-year projection. The bulk of Oak Ridge National Laboratory's mixed TRU waste is in three liquid/sludge waste streams that are stored in tanks at the present time. Each of these tank's wastes must be remotely-handled because of the high radioactivity. Oak Ridge National Laboratory's Underground Storage Tank management program includes implementation of leak detection, corrosion protection, spill and overflow protection, annual tightness testing, operational controls, record keeping, reporting, and replacement of those systems that cannot be upgraded by 1998. The program also addresses the immediate removal from service and remediation of sites with tanks found to be leaking, and it implements any required closures, corrective actions, and any upgrading and/or replacement of affected tanks in accordance with the regulatory requirements. Status of the tanks managed under the Underground Storage Tank Program through 1991 is as follows:

- Twenty-six tanks have been excavated or permanently taken out of service (twenty approved by Tennessee as closed while six require additional investigation and/or corrective action before final closure approval).
- Twenty-four tanks are deferred from 40 CFR 280 regulations. These will be taken out of service or upgraded.
- Two tanks were upgraded in 1990 to meet the current leak detection requirements.
- Two tanks contain heating oil and are excluded from regulation under 40 CFR 280.
- Five tanks contain waste oil contaminated with radionuclides and are excluded under 40 CFR 280.

Solid TRU waste consisting of filters, paper, metals, and other items is generated at Oak Ridge National Laboratory through laboratory, pilot plant, and reactor operations. This includes both contact-handled and remote-handled TRU waste contaminated with lead and, in some cases, mercury. There is no treatment of TRU wastes at Oak Ridge National Laboratory. TRU wastes generated at Oak Ridge National Laboratory are being placed in retrievable storage. Contact-handled TRU waste is packaged predominantly in drums, while remote-handled TRU waste is packaged in concrete casks. In 1992, approximately 3 yd^3 of contact-handled and 2 yd^3 of remote-handled TRU waste were placed in storage (OR DOE 1993b:9-7). Current activities center around certification of contact-handled waste, planning and designing of a repackaging and certification facility for remote-handled wastes, and planning for shipment of wastes to WIPP or another suitable repository should WIPP prove to be unsatisfactory. The repackaging facility, which is in Building 7880, is called the Waste Handling and Packaging Plant and is planned for 2001. Table H.2.3–8 summarizes the storage capability for TRU and mixed TRU wastes at Oak Ridge National Laboratory.

Low-Level Waste. Isotope production and research activities generate a variety of low-level radioactive wastes to include low-level wastewater. Sources of solid LLW include contaminated equipment, filters, paper, rags, plastic, and glass, and sludge from the Process Waste Treatment Plant. Table H.2.3–9 shows the LLW treatment facilities that are operating. Solid LLW to include radioactive scrap metal is placed in storage prior to disposal. In 1992, approximately 884 yd^3 of solid LLW, 27 yd^3 of radioactive scrap metal, and 24 yd^3 of PCB-contaminated LLW were placed in storage awaiting disposal (OR DOE 1993b:9-7). Table H.2.3–10 lists the LLW and mixed LLW storage facilities currently operating at Oak Ridge National Laboratory.

The area designated as SWSA 6 is the only onsite disposal unit at Oak Ridge National Laboratory. It receives solid LLW, including radioactively-contaminated asbestos. In 1992, approximately 131 yd^3 of radioactive sanitary waste, 56 yd^3 of radioactive scrap metal, and 39 yd^3 of radioactively-contaminated asbestos was buried at SWSA 6 (OR DOE 1993b:9-4). Table H.2.3–11 lists the LLW disposal units at SWSA-6.

Mixed Low-Level Waste. Because Oak Ridge National Laboratory is a research facility, it has many diverse waste-generating activities, each of which may produce only a small quantity of waste. Isotope production, utilities, and support functions such as photography are additional sources of waste. Mixed wastes are generated by research projects and some facility operations. Isotope production and research activities generate a variety of mixed low-level and mixed TRU wastes. Table H.2.3–12 presents the inventory of mixed LLW at Oak Ridge National Laboratory as of December 31, 1992, along with a five-year projection.

As shown in table H.2.3–9 three facilities are currently treating mixed waste at Oak Ridge National Laboratory: the Process Waste Treatment Plant, the Liquid Low-Level Waste Evaporation Facility, and the Melton Valley Low-Level Waste Immobilization Facility (OR DOE 1993a:9-21). One other treatment facility at Oak Ridge National Laboratory, the Nonradiological Wastewater Treatment Plant, is operating and could be used to treat mixed waste.

The Process Waste Treatment Plant is designed to treat process wastewaters, groundwater, and evaporator condensate wastewaters that contain low levels of radioactivity. Small concentrations of radioactive materials have occasionally been processed. Process wastewaters may contain small quantities of radionuclides, metals, anions, and organic chemicals. Under normal operating conditions, the Process Waste Treatment Plant can process wastewater at a rate of 130 gallons per minute (gpm). The design capacity is 200 gpm. Wastewaters can contain organic materials and low levels of radioactivity. The facility can treat waste streams with some heavy metals but not streams containing PCBs.

The Liquid Low-Level Waste Evaporation Facility treats liquid LLW using evaporation. It operates in a semicontinuous mode; waste is accumulated in collection tanks and transferred through underground piping to an evaporator system. The design capacity is 28,000 gallons per day (GPD). The facility processes an average of 300 GPD of liquid wastes under normal operating conditions. The facility can treat waste streams containing organic contaminants.

The Melton Valley Low-Level Waste Immobilization Facility is used to solidify liquid mixed LLW that has a pH greater than 12.5 and that contains some heavy metals. This liquid mixed LLW is transferred from tanks by interconnecting pipelines. Batches of waste are pumped from a liquid decantation system to a solidification system as required to provide adequate storage-tank capacity. The facility operates only on a campaign basis to provide adequate storage capacity. Solidification is currently performed using cementation. Design capacity is 16,500 gallons per month of liquid waste. Under normal operating conditions, the facility can process 2,000 gallons per month as required to provide adequate storage-tank capacity. The facility cannot treat HLW, alpha-contaminated waste with TRU activity levels greater than 100 nanocuries per gram (nCi/g), organic wastes, or PCBs.

A summary of the mixed LLW storage facilities at Oak Ridge National Laboratory is shown in table H.2.3–10. An estimate of the capacity of these facilities is also given. In 1992, approximately 11 yd^3 of mixed waste were placed in storage at Oak Ridge National Laboratory (OR DOE 1993b:9-7).

The only disposal of mixed waste done at Oak Ridge National Laboratory is the burial of radioactive asbestos at SWSA-6. Asbestos contaminated with low-levels of radioactivity is placed in silos. In 1992, approximately 39 yd^3 of contaminated asbestos were buried (OR DOE 1993b:9-4). Low-level contaminated biological waste has also been buried at SWSA-6.

Hazardous Waste. Hazardous wastes are generated in laboratory research, electroplating operations, painting and maintenance operations, descaling, demineralizer regeneration, and photographic processes. Few hazardous wastes are treated in onsite facilities. Onsite treatment at Oak Ridge National

Laboratory includes elementary neutralization and detonation facilities. A summary of the hazardous waste treatment facilities at ORNL is shown in table H.2.3–13. In 1992, approximately 1,720 gallons of liquid hazardous wastes were treated at the Nonradiological Wastewater Treatment Plant and about 130 gallons of hazardous waste were evaporated (OR DOE 1993b:9-3).

The Nonradiological Wastewater Treatment Plant is designed to reduce pollutant concentrations in nonradiological wastewaters including hazardous wastes to levels acceptable for effluent discharge. The plant operates in a continuous mode and involves physical and chemical processing steps. The facility contains a heavy-metal removal system, where the pH of the wastewater is raised to 10.5 in a clarifier. Polymers are added to induce flocculation and settling of the metal precipitates. The wastewater is passed through a filtration system to remove particulates. An air stripper then removes volatile organics and activated carbon columns remove mercury.

The Chemical Detonation Facility treats small amounts of wastes that would be dangerous to transport offsite. Explosives such as aged picric acid are detonated in the detonation facility. Certain other wastes (e.g., spent photographic processing solutions) are processed onsite into a nonhazardous state. Those wastes that are safe to transport are shipped to offsite RCRA-permitted commercial treatment/disposal facilities.

In 1992, approximately 58 yd^3 of hazardous waste and 31 yd^3 of PCB waste were stored at Oak Ridge National Laboratory (OR DOE 1993b:9-7). PCB wastes are managed in storage facilities until they can be shipped offsite for treatment and/or disposal. PCB-contaminated and/or hazardous wastes are temporarily stored at Building 7507, and PCB-contaminated wastes are stored on the 7507W Storage Pad. Due to the "No Rad Added" policy, hazardous wastes are being stored as mixed waste. A listing of the hazardous waste storage facilities at Oak Ridge National Laboratory is shown in table H.2.3–14. Approximately 17 yd^3 of asbestos wastes were sent offsite to the Y-12 Sanitary and Industrial Landfill II. About 20 yd^3 of hazardous and PCB wastes were sent to K-25 for storage and incineration in the TSCA Incinerator (OR DOE 1993b:9-5).

Nonhazardous Waste. Nonhazardous wastes result from Oak Ridge National Laboratory maintenance and utilities. The steam plant and the sanitary waste treatment plant produce a sludge that is sampled to demonstrate that it is nonhazardous and meets the Y-12 Industrial and Sanitary Landfill II waste acceptance criteria. Scrap metals are discarded from maintenance and renovation activities and are recycled when appropriate. Construction and demolition projects also produce nonhazardous industrial wastes. All solid nonhazardous wastes and medical wastes after they are autoclaved to render them noninfectious except scrap metal are sent to the Y-12 Industrial and Sanitary Landfill II. Approximately 27 yd^3 of scrap metal were placed in storage at Oak Ridge National Laboratory in 1992 until it is definitely characterized as nonradioactive per the "No-Rad Added" policy (OR DOE 1993b:9-7).

K-25 Site. Enrichment, maintenance, decontamination, and research and development activities have generated a wide variety of waste at K-25. Because of its past uranium enrichment mission, uranium is the predominant radionuclide found in K-25 waste streams. Waste management activities are increasing. Low-level radioactive wastes from other DOE sites are being placed in building vaults until a final disposition strategy is identified. Also, PCB wastes and RCRA wastes contaminated with uranium began arriving from other DOE sites in 1987 for incineration in the K-1435 TSCA Incinerator. Tables H.2.3–16 and H.2.3–15 summarize the storage and treatment facilities at K-25 that are capable of storing and treating multiple categories of waste.

Pollution Prevention. K-25 policy mandates minimization of waste generated while achieving compliance with applicable environmental regulations. Five waste reduction options are used at K-25: segregation, material substitution, process innovation, mechanical volume reduction, and recycling/reuse. In recent years, some aluminum cans, worker clothing, and office furniture have been recycled for use at K-25. Such recycling has saved approximately 2,500,00 lb of materials as of 1991. K-25 management supports the waste reduction program. An example of this program is the conversion to gas-fired boilers to reduce opacity excursions and, in effect, reduce or eliminate fly ash production.

Spent Nuclear Fuel. K-25 does not generate or manage spent nuclear fuel.

High-Level Radioactive Waste. K-25 does not generate or manage HLW.

Transuranic Waste. K-25 does not generate or manage TRU waste.

Low-Level Waste. Solid LLW is generated by discarding radioactively-contaminated construction debris, wood, paper, asbestos, trapping media, and process equipment and by removing radionuclides from liquid and airborne discharges. Currently, solid LLW is being stored for future disposal. Table H.2.3–17 shows the storage facilities that deal only with LLW. Specifics on some of the storage facilities are described below. Treatment of the current inventory of contaminated scrap metal at K-25 (as well as at Portsmouth, Paducah, and Fernald facilities) is expected to occur over the next 3 to 5 years as part of a comprehensive DOE Scrap Metal Program to be managed through K-25. All contaminated scrap metal is stored aboveground at the K-770 scrap metal facility until further disposal methods are evaluated.

The Uranium Hexafluoride Cylinder Program is directed toward improving the safety and reliability of long-term storage for 7,000 cylinders currently at K-25. These cylinders remain from the now-terminated gaseous diffusion mission. In storage at the site are approximately 5,000 10-ton and 14-ton cylinders of depleted uranium hexafluoride; 1,000 cylinders of normal-assay feed uranium hexafluoride; 400 cylinders containing more than 50 pounds of "enriched" material; and 600 miscellaneous empty cylinders. The Uranium Hexafluoride Cylinder Program is being designed to develop a clear understanding of the current conditions of the cylinders and define any near-term and long-term actions for safe storage of the cylinders pending decisions on ultimate disposition of the uranium hexafluoride material. Some of the initial actions in the program are a baseline inspection, a corrosion coupon program, and an ultrasonic thickness measurement program. The baseline inspection identified a variety of cylinder defects which will require special attention and also identified four breached cylinders. Immediate corrective actions have been taken to handle the breached cylinders and a schedule of activities has been developed for moving and repairing the cylinders.

The cylinders containing normal-assay feed uranium hexafluoride are currently being shipped to the Paducah Gaseous Diffusion Plant. The current DOE direction for the 5,000 cylinders with depleted uranium hexafluoride is to store them until at least the year 2020, at which time conversion to oxide will be performed if no other uses have been determined. A plan for cleaning the cylinders containing more than 50 lb of enriched material and empties has not yet been approved (this may be performed at K-25 or at one of the operating gaseous diffusion plants).

Currently, there are no onsite disposal facilities being operated at K-25. Energy Systems Waste Management Organization has been established and assigned the responsibility to design, construct, and operate all new LLW disposal facilities for the ORR. This organization is physically located at K-25.

Mixed Low-Level Waste. Mixed LLW primarily consists of contaminated waste oils, solvents, sludges, soils, and acid wastes. Table H.2.3–18 presents the inventory of mixed LLW as of December 31, 1992 along with a 5-year projection. Sludges contaminated with low-level radioactivity were generated by settling and scrubbing operations and were stored in K-1407B and K-1407C ponds. Sludges have been removed from these ponds, and a portion have been fixed in concrete at the K-1419 Sludge Treatment Facility and stored above ground at the K-1417 Drum Storage Yard. These materials are considered mixed LLW; however, a delisting petition has been submitted to EPA. Disposition of this waste is pending a determination of this petition.

Most of the treatment of mixed waste is at the TSCA Incinerator and the Central Neutralization Facility. The majority of waste treated at the TSCA Incinerator cannot be treated by commercial incinerators because of radioactive contamination. All waste sent to this facility must be fully characterized and identified. DOE has an approved chain-of-custody system for all waste received from offsite. The K-1435 TSCA Incinerator is capable of incinerating waste that is mixed or that contains PCBs. In 1990, a limited amount of waste was incinerated as a part of the startup testing. The incinerator began full operations in early 1991 and met all regulatory requirements in processing 1,310 yd^3 of mixed waste. Mixed TSCA waste is being generated in the ash residue at the TSCA Incinerator. Compliance issues regarding the management of the mixed PCB and radioactive waste generated in the ash are being pursued with EPA by DOE.

Most of the radioactively-contaminated wastewater treated at the Central Neutralization Facility is generated at the TSCA Incinerator from the wet scrubber blowdown. Treated effluents are discharged through a designated release point. The contaminated sludges that precipitate in the sludge-thickener tank are stored in an approved above-ground storage area at K-25.

RCRA mixed, radioactive land disposal restricted waste (including some nonradiological classified land disposal restricted waste) has been stored in some areas for longer than 1 year (OR DOE 1993a:9-26). These wastes are currently subject to the land disposal restriction that permits storage only for accumulation of sufficient quantities to facilitate proper treatment, recycling, or disposal. This waste is being stored because of the nationwide shortage of treatment and disposal facilities for these types of waste. Private-sector technology demonstrations are being conducted that involve uranium extractions from sludge.

Uranium-contaminated PCB wastes (i.e., mixed wastes) are being stored in excess of the 1-year limit imposed by TSCA because of the lack of treatment and disposal capacities. DOE and EPA have sigued a Federal Facility Compliance Agreement, effective February 20, 1992, to bring the facility into compliance with TSCA regulations for use, storage, and disposal of PCBs. It also addressed the approximately 10,000 pieces of nonradioactive PCB-containing dielectric equipment associated with the shutdown of diffusion plant operations.

In 1989, during routine inspections of the drums of stabilized K-1407 Pond sludge at the K-1417 Storage Facility, it was discovered that many of the drums had begun to corrode. Free liquid (waste with a pH of 12) on top of the concrete in the drums was found to be causing the corrosion (OR DOE 1993a:9-16). An action plan has been implemented to decant and/or dewater the mixed waste contained in the drums. A total of 45,000 drums of stabilized material and 32,000 drums of raw sludge must be processed and moved to storage facilities that meet regulations governing mixed wastes. Of these 77,000 drums, 10,000 are currently stored in K-25 vaults and 67,000 are located at the K-1417A and K-1417B Drum Storage yards. It is planned that all containers will be transferred to and stored in new and existing facilities, the K-1065 site and K-31 and K-33 buildings, respectively.

Hazardous Waste. Hazardous wastes generated at K-25 include PCB articles and items, waste oils and items, and uncontaminated asbestos waste. All hazardous wastes are managed according to applicable state and Federal regulations and DOE orders. Several waste management facilities are already in place. Changing laws and regulations have made it necessary to upgrade several facilities and to design and construct new facilities that reflect the most recent environmental technology. The Central Neutralization Facility and the TSCA Incinerator are the two major facilities that treat hazardous waste.

The Central Neutralization Facility provides pH adjustment and chemical precipitation for several aqueous streams throughout K-25. The main purpose of the Central Neutralization Facility is to treat wastewater to ensure compliance with the requirements of NPDES discharge limits on pH, heavy metal concentrations, and suspended solids. The treatment system consists of two 25,000-gallon reaction tanks and a 60,000-gallon sludge-thickener tank. Acidic wastes are neutralized with a hydrated-lime slurry, and basic wastes are neutralized with sulfuric or hydrochloric acid. The hydrated lime bin and acid tanks are located at the facility. The treatment facility is physically divided into two distinct sections for treating both hazardous and nonhazardous waste streams.

The TSCA Incinerator consists of storage tanks, dikes, and the incinerator. The incinerator system consists of a liquid, solid, and sludge feed system; a rotary kiln incinerator; and a secondary combustion chamber. The wastes treated at this facility include oils, solvents, chemicals, sludges, and aqueous waste.

In general, most of the waste stored at K-25 is designated as hazardous waste which has been contaminated with PCBs. Recyclable materials such as mercury and silver-bearing photographic wastes are stored before recycling, while other hazardous wastes are stored until sufficient quantity is accumulated for an offsite shipment. All offsite disposals of hazardous wastes were halted in 1991 until procedures addressing a DOE performance objective of "No Rad Added" were developed by the sites and approved by DOE Headquarters. Incineration is the preferred method for offsite treatment or disposal of wastes, particularly PCB wastes; however, landfills and other types of disposal are used as needed. In 1992, 290 yd^3 of asbestos were placed in the Y-12 landfill.

Nonhazardous Waste. Computer paper is being recycled from the K-25 Computer Technology Center. The program for recycling paper is being reviewed for expansion into nonradiological areas. Product substitutions at the paint shop and photography lab have resulted in a decrease of waste generation. No percentage of reduction has been calculated due to the lack of baseline data.

Waste assay monitors have been purchased and are being used to screen solid, potentially radioactive waste to determine the potential to manage it as a nonhazardous waste. The K-770 clean scrap yard provides storage for nonradioactive scrap metal. The scrap metal is stockpiled before being sold to the public. The solid nonhazardous waste from K-25 is sent to the Y-12 Industrial and Sanitary Landfill II. Some materials such as furniture, file cabinets, and paper are sold through property sales. The only nonhazardous treatment facility at K-25 is the sanitary waste treatment plant. The sanitary sludge is disposed of in the Y-12 landfill.

TABLE H.2.3–1.—*Low-Level and Mixed Low-Level Waste Treatment Capability at Y-12* [Page 1 of 2]

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity[a] (yd^3 per year)	Change
Biodenitrification Unit (Bldg. 9818)	Neutralization pH adjustment nitrate removal	Liquid mixed LLW (nitrate solutions from enriched uranium recovery - Buildings 9212 and 9206)	Biosludge to West End Treatment Facility	1,500[b] (300,000 GPY)	RCRA permit-by-rule
Central Pollution Control Facility	Filtration carbon adsorption, oil/water separation, and sludge dewatering	Liquid LLW, mixed LLW, and hazardous waste (nonnitrate liquid wastes)	Treated wastewater discharged through NPDES outfall and solids to West Tank Farm	9,900[c] (2,000,000 GPY)	Final NPDES permit May 1, 1990. Permit only allows 28,000 gallons in three days. Includes 4,930 yd^3 of hazardous waste treated. Included in hazardous waste treatment table.
Cyanide Treatment Facility (Bldg. 9201-SN)	Chemical oxidation, pH adjustment	Liquid mixed LLW and hazardous waste (cyanide spent plating batches)	Wastewater to West End Treatment Facility	33 (6,600 GPY)	Interim RCRA status September 29, 1992.
Liquid Storage Facility (Bldg. 9416-35)	Oil/water separation by filter cartridges	Liquid mixed LLW (leachate from certain capped burial grounds in Bear Creek Valley)	Stored liquids to Groundwater Treatment Facility and PCB-laden oil to TSCA incinerator	12,400[d] (2,500,000 GPY)	Also a storage unit. Amount of mixed LLW treated is approximately 4,300 yd^3 per year.
Depleted Uranium Oxidation Facility	Calcination	Solid mixed LLW (uranium fines)	Uranium oxide to depleted uranium oxide storage vaults	Design feedrate is classified.	Scheduled construction startup in 1996.
Groundwater Treatment Facility (Bldg. 9616-7)	Carbon absorption and air stripping	Liquid mixed LLW (Liquid Storage Facility groundwater)	Groundwater air stripper effluent, spent carbon, and sludge to depleted uranium oxide storage vaults and liquid effluent through NPDES outfall	12,400[d] (2,500,000 gal/hr)	Final NPDES permit May 23, 1990, and RCRA permit submitted January 31, 1990. Amount of mixed LLW treated is approximately 4,300 yd^3 per year.
Interim Reactive Waste Treatment Area	Open burning	Solid LLW (sodium-potassium waste)	Treated residue waste to depleted uranium oxide storage vaults and treated waste to K-25	Campaign 2 times per year, 8 hours per campaign, 15 GPD	State air permit submitted September 29, 1992, and RCRA permit submitted January 31, 1990. Interim facility awaiting completion of Reactive Waste Treatment Facility. Design feedrates 0.9 yd^3 per year.
Mercury Treatment Facility	Metal precipitation, filtration, carbon absorption	Mercury contaminates from wastewater treatment stream	Wastewater effluent discharged via NPDES. Solids require further treatment at another facility	130,000 (26,300,000 GPY)	Planned, but unapproved. Anticipated that treatment rate limited to-50 gpm. Capacity is maximum design value.
Oak Ridge Reservation Mixed Waste Treatment Facility	Thermal desorption, decontamination, stabilization, and sorting	Liquid and solid mixed LLW		Planned	Scheduled for 2004.

TABLE H.2.3–1.—*Low-Level and Mixed Low-Level Waste Treatment Capability at Y-12* [Page 2 of 2]

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity[a] (yd^3 per year)	Change
Production Waste Treatment Facility Phase II	Decontamination, incineration, and neutralization	Solid mixed LLW (demolition waste, noncombustible LLW, and incinerator ash, mixed waste sludges, and mixed waste soils)		8,650	Planned and available October 1, 2000. Design feedrate is 1.4 yd^3/hr. Hours in operation is estimated to be 6,000 hours.
Uranium Chip Oxidation Facility	Incineration	Solid LLW (depleted and normal uranium chips)	Uranium oxide to depleted uranium oxide storage vaults	Classified yearly treatment	Final state air permit expires January 1, 1994 and final NPDES permit approved January 22, 1987. Design feedrate is 2,200 lbs/hr.
Uranium Recovery Operation (Bldg. 9206, 9272)	Leaching, filtration, dissolution, oxidation, evaporation, extraction	Metal and organic removal from aqueous stream, aqueous neutralization, purification for recycle	All waste diverted to Bioidentification Unit	1,500[b] (300,000 GPY)	System is exempt from permitting requirements under agreement with the State Same capacity as Biodenitrification Unit.
Uranium Treatment Unit (Portable)	Filtration and precipitation	Liquid mixed LLW (uranium-contaminated organic solvents)	Organic waste to TSCA Incinerator at K-25	2 yd^3/day (500 GPD)	Unit has been decommissioned and is in standby mode.
Waste Coolant Processing Facility (Bldg. 9983-78)	Extended activated sludge treatment, sludge drying	Liquid mixed LLW (contaminated waste coolants)	Oily solids to dewatering and drums, biological solids to dewatering, and liquid to Central Pollution Control Facility or West End Treatment Facility/West Tank Farm	990 (200,000 GPY)	Also a storage unit. May be capable of treating of mixed LLW.
Waste Feed Preparation Facility (Bldg. 9401-4)	Compaction	Compactible solid LLW	Compacted solid LLW to Y-12 Sludge Handling Pad	24,800	An exemption for the state air permit has been granted. Design feedrate is 30 yd^3/hr. Intermittent operation at 8 hours/day and 2 days/week
West End Treatment Facility (Bldg. 9616-7)	Absorption, anaerobic digestion, clarification, coagulation, filtration, flocculation, and precipitation	Liquid mixed LLW and hazardous waste (radioactive-contaminated and nonradioactive nitrate waste)	Liquid effluent through NPDES outfall	10,900 (2,200,000 GPY)	Final NPDES permit September 30, 1990 and interim RCRA status January 31, 1990. Design capacity is 2,700,000 GPY).

[a] For those facilities already in use, this is a normal operating capacity; whereas, for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

[b] Annual capacity based on reported capacity 1,000 gallons per day assuming 300 days per year.

[c] Normal capacity ranges from 1,350,000 to 2,000,000 GPY.

[d] Annual capacity based on reported capacity of 2 gal/min assuming 24-hour operation 300 days per year.

Source: DOE 1993h; DOE 1994k; DOE 1994n; OR DOE 1993a; OR DOE 1993b; OR DOE 1994a; OR DOE 1994k; OR MMES 1993f.

TABLE H.2.3–2.—*Low-Level and Mixed Low-Level Waste Storage Capability at Y-12* [Page 1 of 2]

Storage Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
9811-1 Tank Storage Unit (OD-7)	Liquid and solid hazardous (beryllium)- mixed LLW	671 (135,000 gal)	RCRA permit submitted January 23, 1992
Above Grade Storage Pads	Solid LLW	9,300	Above ground storage of low-level until Low-Level Waste Disposal Facility
Alpha-4 Container Storage Area	Solid mixed LLW (Old shutdown process waste)	1,970	RCRA permit submitted January 31, 1990. One area of building being modified for 95 yd^3 of storage.
(Bldg. 9404-7)	Solid PCB and uranium contaminated waste	52	Storage of liquid and/or hazardous waste not permitted except for PCB waste. Capacity for 496 drums. As of August, 1994, 10 yd^3 is available for storage.
Buildings 9206 and 9212	Liquid/solid LLW and mixed LLW	26	Part B permit
Building 9720-9 Storage Area	Liquid/solid LLW and mixed LLW	1,290 (260,000 gal)	Part B permit. As of August 1994 approximately 520 yd^3 of LLW and mixed LLW stored. Hazardous waste in table H.2.3–5.
Buildings 9825-1 and -2 oxide vault	Solid LLW (depleted uranium oxide and metal)	1,340	Two vaults of reinforced concrete.
Classified Waste Storage Area (Bldg 9720-25)	Solid LLW and mixed LLW	825	Part B permit. Estimated that inventory is approximately 670 yd^3 as of August 1994.
Container Storage Facility (Bldg. 9720-12)	Solid mixed LLW	133	RCRA permit submitted January 31, 1990
Contaminated Scrap Metal Storage Yard	Solid mixed LLW (uranium-contaminated scrap).	3600	Estimated that inventory is approximately 240 yd^3 as of August 1994.
Cyanide Treatment Facility	Cyanide spent plating batches, mixed LLW	11 (2,240 gal)	Interim RCRA status September 27, 1992. Also treatment facility for hazardous and mixed wastes.
DARA Solid Storage Facility	Solid mixed LLW	6,620	Facility full as of August 1994
East Chestnut Ridge Waste Pile	Solid mixed LLW (contaminated soil and spoil from closure of RCRA units)	1,200	RCRA permit submitted January 31, 1990. Facility is full as of August 1994.
Kerr Hollow Quarry	Liquid mixed LLW	802 (162,000 gal)	Part B permit
Liquid Organic Waste Storage (Bldg. 9720-45, OD-10)	Liquid and solid mixed LLW. Ignitable nonreactive and radioactive waste. Can also include hazardous waste	52 (10,600 gal)	RCRA permit submitted December 1, 1991. A diked and covered storage area for 120 drums of material. Also, included in hazardous waste storage table.
Liquid Organic Waste Storage Tank 600A (Bldg. 9720-45, OD-10)	Liquid hazardous (corrosive) waste and mixed LLW	15 (3,000 gal)	RCRA permit submitted January 31, 1990
Liquid Organic Waste Storage Tank 600B (Bldg. 9720-45, OD–10)	Liquid hazardous (corrosive) waste and mixed LLW	15 (3,000 gal)	RCRA permit submitted January 31, 1990
Liquid Organic Waste Storage Tank 700A (Bldg. 9720-45, OD-10)	Liquid mixed LLW (uranium-contaminated gasoline and diesel)	32 (6,500 gal)	RCRA permit submitted December 1, 1990
Liquid Organic Waste Storage Tank 700B (Bldg. 9720-45, OD-10)	Liquid mixed LLW (uranium-contaminated rinsewaters)	32 (6,500 gal)	RCRA permit submitted December 1, 1990

TABLE H.2.3–2.—*Low-Level and Mixed Low-Level Waste Storage Capability at Y-12* [Page 2 of 2]

Storage Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
Liquid Organic Waste Storage Tank 900A (Bldg. 9720-45, OD–10)	Radioactive rinsewater.	32 (6,500 gal)	RCRA permit submitted December 1, 1990
Liquid Organic Waste Storage Tank 900B (Bldg. 9720-45)	Radioactive liquid solvents and organics	32 (6,500 gal)	RCRA permit submitted December 1, 1990
OD-8/Container Warehouse (Bldg. 9811-1)	Liquid and solid hazardous - mixed LLW	530 (106,000 gal)	RCRA permit submitted January 23, 1992. Waste is eventually taken to OD-9 or OD-10.
Oil Land Farm Storage	Contaminated scrap metal	6,200	Facility is full as of August 1994
PCB, Shed (Bldg. 9720-58)	Solid LLW and mixed LLW (PCB-contaminated waste included)	250	Part B permit
RCRA and PCB Container Storage Area (Bldg. 9720-58)	Solid mixed LLW	630	RCRA permit submitted January 23, 1992
RCRA Staging Area (Bldg. 9720-31)	Liquid and solid mixed LLW and hazardous waste	220 (45,000 gal)	RCRA permit submitted January 31, 1990
Solid Storage Facility	Solid mixed LLW and hazardous waste to include PCB-contaminated waste	4,000 yd^{2b}	RCRA permit submitted January 31, 1990. Contains 4,000 yd^3 waste pile contaminated with radioactivity.
Waste Oil/Solvent Storage Facility I (Bldg. 9811-8)	Liquid mixed LLW (including PCBs) and hazardous waste	17 (3,400 gal)	RCRA permit submitted December 1, 1991. No reactives or ignitables. Interim storage until containers can be emptied into tanks.
Waste Oil/Solvent Storage Facility II (Bldg. 9811-8)	Liquid mixed LLW (including PCBs) and hazardous waste	200 (40,000 gal)	RCRA permit submitted December 31, 1991. No reactives or ignitables. Material has been shipped to TSCA incinerator.
Waste Oil/Solvent Storage Facility IV (Bldg. 9811-8)	Liquid and solid mixed LLW (including PCBs) and hazardous waste	200 (40,000 gal)	RCRA permit submitted December 1, 1991. No reactives or ignitables. Material has been shipped to K-25 TSCA incinerator.
Waste Oil/Solvent Storage Facility V (Bldg. 9811-8)	Liquid mixed LLW (including PCBs) and hazardous waste	200 (40,000 gal)	RCRA permit submitted January 31, 1990. No reactives or ignitables. Material has been shipped to K-25 TSCA incinerator.
West End Tank Farm	Mixed LLW (sludge)	12,400	Permit by rule

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

[b] Facility provides 1,940 yd^2 of storage space for PCB-and uranium-contaminated soil.

Source: DOE 1994n; OR DOE 1993a; OR DOE 1994a; OR MMES 1993f.

TABLE H.2.3–3.—*Mixed Low-Level Waste at Y-12*

Waste Matrix	Number of Waste Streams	Inventory as of December 31, 1992 (yd^3)	Number of Waste Streams Five-Year Projection	Total Generation Five-Year Projection (yd^3)
Contact-Handled				
Aqueous liquids	10	(880 gal)	6	6 (1,200 gal)
Organic liquids	42	450 (90,000 gal)	35	870 (176,000 gal)
Inorganic solids	25	6,500	15	800
Organic solids	23	55	14	90
Soils	8	8,400	4	40
Metal and inorganic debris	1	60	1	0.4
Combustible debris	41	120	29	310
Reactive metals	5	1	4	5
Beryllium waste	1	<0.1	None	None
Batteries	1	2	1	10
Other	22	20	10	12
Total	179	15,612	119	2,143

Source: DOE 1994k; OR DOE 1994a.

TABLE H.2.3–4.—*Hazardous Waste Treatment Capability at Y-12*

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity[a] (yd^3/yr)	Comment
Central Pollution Control Facility	Filtration, carbon adsorption, oil/water separation, and sludge dewatering	Liquid hazardous (concentrated plating waste, cyanide rinsewater waste, and plating rinsewater) and liquid low-level	Rinsewater sludge to West Tank Farm and liquid effluent to mixed waste storage (West Tank 9616-8)	9,900[b] (2,000,000 GPY)	Final NPDES, May 1, 1990. Permit only mows 28,000 gallons in three days. Total includes 4,970 yd^3 of mixed waste treatment. Also, included in mixed waste treatment table.
Cyanide Treatment Unit (Bldg. 9201-5N)	Oxidation	Cyanide spent plating batches	Plating Solution to West End Treatment Facility	33 (6,600 GPY)	Interim RCRA status September 19,1992. Also, has 11 yd^3 of mixed waste storage. Included in mixed waste treatment table.
Plating Rinsewater Treatment Facility (Bldg. 9409-11 and 9623)	Cyanide destruction, ph adjustment electrochemical chrome reduction, carbon adsorption, and filtration	Liquid hazardous (plating rinsewater) and mixed LLW	Treated wastewater discharged through Central Pollution Control Facility NPDES outfall and solids to West Tank Farm	40,000 (8,000,000 GPY)	Final NPDES and RCRA permit January 1, 1990. Also, included in mixed waste treatment table.

[a] These are design capacities.

[b] Normal capacity ranges from 1,350,000 to 2,000,000 GPY.

Source: DOE 1993h; DOE 1994k; DOE 1994n.

TABLE H.2.3–5.—*Hazardous Waste Storage Capability at Y-12*

Storage Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
Building 9418-9	PCB-contaminated mineral oil	70 (14,000 gal)	Below-grade, diked tank.
Building 9720-9 Storage Area	Liquid and solid hazardous wastes to include PCBs	1,290 (260,000 gal)	RCRA permit submitted September 24, 1991 and TSCA permit approved September 24, 1991. Part of building included in mixed waste storage table.
Disposal Area Remedial Actions Liquid Storage Facility (Bldg. 9416-35)	Liquid hazardous wastes	823 bulk (166,000 gal)	Interim status November 1, 1988. Also, a treatment unit. Provides temporary storage prior to treatment. Includes two 75,000-gal bulk storage tanks, a 6,000-gal oil storage tank, and a 10,000 gal tank for seep water.
Oil Drum Storage Area (OD-3)	PCB-contaminated oils	59 (11,900 gal)	Site is closed except for tankers.
Oil Landfarm Soils Storage Facility	Solid hazardous waste contaminated with PCBs and volatile organics (excavated soil from the closure of the Oil Landfarm)	550 (111,000 gal)	Final RCRA permit June 30, 1989. No new wastes are being stored.
RCRA Staging/Area	Liquid and solid hazardous waste to include PCB-contaminated waste	221 (44,600 gal)	RCRA permit submitted January 31, 1990.
Waste Oil/Solvent Storage Facility III (Bldg. 9811-6)	Liquid hazardous waste including PCBs	200 (40,000 gal)	RCRA permit submitted January 31, 1990. No radioactive contaminated waste, reactives, or ignitables.
Waste Oil/Solvent Storage Facility IV (Bldg. 9811-6, OD-9)	Liquid hazardous waste	200 (40,000 gal)	RCRA permit submitted January 31, 1990. No radioactive waste, PCB waste, reactives, or corrosives.

[a] These are design capacities.

Source: DOE 1994n; OR DOE 1993a; OR MMES 1993f.

TABLE H.2.3–6.—*Inventory of Reactor-Irradiated Nuclear Material at Oak Ridge Reservation*

Site	Facility	Type	Number and Form	Estimated Heavy Metal[a] (yd^3)
Oak Ridge National Laboratory	Building 3019	SRS production fuel	176 cans	0.006
	Building 3019	Hanford production fuel	42 cans	0.006
	Building 3019	Commercial fuel (Canada ConEd)	401 cans	0.08
	Building 4501	Commercial fuel	40 sections	0.0005
	Buildings 3525 and 7920, Dry Wells 7823A, 7827, and 7829	Research reactor fuel	Fuel samples and targets	0.007
	Bulk Shielding Reactor	Research reactor fuel	41 BSR elements and 32 ORR elements (pool 80 percent full)	0.004
	Classified Burial Ground	Unknown	Unknown	Unknown
	High Flux Isotope Reactor	Research reactor fuel	43 assemblies (pool 40 percent full)	0.04
	Homogeneous Reactor Experiment Wells	Research reactor fuel	135 gallons of uranyl sulphate[b]	0.0003
	Molten Salt Reactor Experiment	Research reactor fuel	LiF and BeF_2 salt mixture	0.003
	Tower Shield Reactor	Research reactor fuel	1 assembly (pool full)	0.0007
Y-12 Plant	Building 9720-5	Space Nuclear Auxiliary Power-10 Fuel	36 rods in NaK	0.0004
	Building 9720-5	Health Physics Research Reactor Fuel	31 HPRR fuel pieces	0.01

[a] Based on conversion factor 13,700 kg/yd^3.

[b] Solution in seven holes with volume of 11 yd^3.

Source: DOE 1993r; DOE 1994c; DOE 1994j.

TABLE H.2.3–7.—*Mixed Transuranic Waste at Oak Ridge National Laboratory*

Waste Matrix	Number of Waste Streams	Inventory as of December 31, 1992 (yd^3)	Number of Waste Streams Five-Year Projection	Total Generation Five-Year Projection (yd^3)
Contact-Handled				
Multiple, alpha	4	1,020	1	60
Remote-Handled				
Multiple, alpha	2	1,400	2	83
Total	6	2,420	3	143

Source: DOE 1994k; OR DOE 1994a.

TABLE H.2.3–8.—*Transuranic and Mixed Transuranic Waste Storage Capability at Oak Ridge National Laboratory*

Storage Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
TRU Retrievable Concrete Cask Storage Facility (Bldg. 7842)	Contact-handled solid mixed TRU waste and LLW	961	Interim Part A permit (included in Part B application)
TRU Retrievable Concrete Cask Storage Facility (Bldg. 7855)	Remote-handled solid mixed TRU waste	182	RCRA Part B submitted March 1992. May contain lead and mercury RCRA constituents.
TRU Retrievable Drum Storage Facility (Bldg. 7826)	Contact-handled solid mixed TRU waste	459	RCRA permit submitted May 21, 1984. Mainly 55-gallon drums. May contain lead. Only contact-handled TRU, less than 200 mrem per hour. RCRA closure is underway.
TRU Retrievable Drum Storage Facility (Bldg. 7834)	Contact-handled solid mixed TRU waste	534	RCRA permit submitted January 14, 1993. Mainly 55-gallon drums. May contain lead. Only contact-handled TRU, less than 200 mrem per hour. RCRA closure is underway.
TRU Retrievable Drum Storage Facility (Bldg. 7802N Trenches)	Contact-handled and remote-handled solid mixed TRU waste	939	Under CERCLA closure
TRU Retrievable Concrete Cask Storage Facility (Bldg. 7878)	Contact-handled solid mixed TRU waste	961	Interim Part A permit (included in Part B application)
TRU Retrievable Drum Storage Facility (Bldg. 7879)	Contact-handled solid mixed TRU waste	401	Interim RCRA Part A permit (included on RCRA Part B application).
TRU Retrievable Drum Storage Facility (Bldg. 7934)	Contact-handled solid mixed TRU waste	108	Interim Part A

[a] These are design capacities.

Source: DOE 1994k; DOE 1994n; OR DOE 1994a.

TABLE H.2.3–9.—*Low-Level and Mixed Low-Level Waste Treatment Capability at Oak Ridge National Laboratory*

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity (yd^3 per year)	Comment
Compactor (Bldg. 7831)	Compaction	Compactible solid LLW	Compacted solid LLW in B-25 (4x4x6 ft) boxes to K-25	14,800	Design capacity
Liquid Low-Level Waste Evaporation Facility	Evaporation and ion exchange	Liquid LLW and mixed LLW	Evaporator condensates to Process Waste Treatment Plant. Some evaporator bottoms are stored at Melton Valley Facility.	540 (109,360 GPY)	Normal operating capacity. Maximum capacity is 1,200 gal/hr for 20 hours per month.
Melton Valley Low-Level Waste Immobilization Facility	Decantation and stabilization	Remote-handled, alpha liquid mixed LLW	Solid LLW concrete block to storage	248 (49,900 GPY)	Design capacity of 982 m^3/yr. System is limited to 50,000 gallons per campaign.
Nonradiological Wastewater Treatment Plant (Bldg. 3608)	Clarification, dual media pressure filter, air stripper carbon adsorption, neutralization filter press dewatering, ion exchange	Liquid and mixed LLW	Dewatered waste, carbon liquid discharge	977,000 (197,100,000 GPY)	Normal generating capacity. Design capacity is 1,980,000 yd^3/yr.
Process Waste Treatment Plant (Bldg. 3544)	Ion exchange, neutralization, clarification, and filter presses	Liquid LLW and mixed LLW	Solid LLW (filter cake) to storage at K-25. Wastewater is sent to nonradiological Wastewater Treatment Plant.	347,000 (70,000,000 GPY)	Normal operating capacity. Design capacity is 521,000 yd^3/yr.
Waste Handling and Packaging Plant	Evaporation, microwave solidification, solid segregation and packaging	Solid mixed LLW	Drums and boxes	Planned	Remote handling capability for packaging

Source: DOE 1993h; DOE 1994k; DOE 1994n; OR DOE 1993a.

TABLE H.2.3–10.—*Low-Level and Mixed Low-Level Waste Storage Capability at Oak Ridge National Laboratory*

Storage Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
Eight Melton Valley Storage Tanks W-24 through W-31 (248 yd^3 each) - Bldg. 783B	Solid mixed TRU (sludge) and LLW	1,980	RCRA permit submitted January 17, 1982. Solidified waste from LLW Evaporation Facility.
Building 7823B, 7823E, 7827, 7829, 7831C, 7878A, B7823C, B7823D	LLW	2,750	No permit necessary
Buildings 7075, 7830A, 7934	Mixed waste	156	Interim RCRA Part A (included in RCRA Part B application)
Bulk Contaminated Soil Facility (Bldg. 7576)	Low-level contaminated soil	1,230	Planned and funded
Class III/IV Waste Storage	Class III and IV solid LLW	741	Planned and funded. RCRA Part B permit submitted March 30, 1992
Facility 7841	LLW (contaminated scrap metal)	578	No permit necessary
Five Evaporator Service Tanks - C-1 and C-2, W-21, W-23 (248 yd^3 each)	Solid mixed LLW	1,240	Final RCRA permit submitted January 17, 1992
Mixed Waste Drum Storage Pad (Bldg. 7507W)	Solid and liquid mixed LLW	96 (19,400 gal)	Interim Part B RCRA submitted May 21, 1992
SWSA-6 Staging Facility (Bldg. B7878)	Solid LLW and mixed waste	196	RCRA interim permit submitted January 14, 1993
Staging Facility-Semi Underground (Bldg. 7823)	Mixed waste oils, solvents, and other process wastes	144 (29,100 gal)	RCRA interim permit submitted January 14, 1993

[a] These are design capacities.

Source: DOE 1994n; OR DOE 1994a.

TABLE H.2.3–11.—*Low-Level Waste Disposal Units at Oak Ridge National Laboratory*

Disposal Unit	Input Capability	Capacity[a] (yd^3)	Comment
Asbestos Silos (SWSA-6)	Low-level contaminated asbestos	614	Unit accepts only Y-12 asbestos, if contaminated with other than uranium contamination, other than that no offsite waste accepted
Biological Trenches (SWSA-6)	Low-level contaminated biological waste	3,310	Landfill operation
High Range Silos (SWSA-6)	Solid LLW (200 mrem/hr to 1 rem/hr)	2,740	Concrete silos inside diameter (15 ft x 8 ft)
Interim Waste Management Facility	Solid LLW B-25 boxes encased in concrete	7,050	Planned - 6 Tumulus facilities (60 ft x 90 ft)
Low Range Silos (SWSA-6)	Solid LLW (<200 mrem/hr)	5,030	Concrete silos inside diameter (15 ft x 8 ft)
Tumulus Pad II (SWSA-6)	Noncompactible contact handled (<200 mrem/hr) solid LLW in B-25 boxes encased in concrete	783	Pad is 60 ft x 90 ft. Non-operational due to pending closure.

[a] These are design capacities.

Source: DOE 1994n; OR MMES 1993d.

TABLE H.2.3–12.—*Mixed Low-Level Waste at Oak Ridge National Laboratory*

Waste Matrix	Number of Waste Streams	Inventory as of December 31, 1992 (yd^3)	Number of Waste Streams Five-Year Projection	Total Generation Five-Year Projection (yd^3)
Contact-handled				
Aqueous liquid	7	70 (14,100 gal)	6	127 (33,400 gal)
Organic liquids	9	150 (30,200 gal)	6	130 (26,700 gal)
Inorganic liquids	8	100	4	70
Solids	1	5	None	None
Debris	6	4	2	0.3
Lab packs	5	90	5	15
Elemental mercury	1	2 (320 gal)	1	0.2 (30 gal)
Batteries	1	2	1	1
Others	1	80	1	50
Remote-handled				
Aqueous liquid, alpha	2	3,040 (613,000 gal)	1	459 (121,000 gal)
Total	**41**	**3,543**	**27**	**852**

Source: DOE 1994k; OR DOE 1994a.

TABLE H.2.3–13.—*Hazardous Waste Treatment Capability at Oak Ridge National Laboratory*

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity[a] (yd^3/yr)	Comment
Chemical Detonation Facility (Bldg. 7667)	Open burning	Solid and liquid explosive wastes (lab pack flammables)	Residue (ash) to Sludge Fixation Facility for treatment	Campaign	RCRA interim permit submitted January 14, 1993
Neutralization Facility (Bldg. 3518)	Neutralization	Liquid acids	Liquid effluent through NPDES and storage to Nonradiation Waste Treatment Plant	58,800 (11,900,000 GPY)	Final RCRA permit submitted January 17, 1992. Design feedrate is 30 yd^3/yr.
Nonradiological Wastewater Treatment Plant (Bldg. 3608)	Clarification, filtering, air stripping, absorption, neutralization, dewatering, and ion exchange	Liquid corrosive waste in storage.	Dewatered waste, carbon, liquid discharge	977,000 (197,100,000 GPY)	Normal operating capacity. Design capacity is 1,980,000 yd^3/yr. Also included in mixed waste treatment table.

[a] For those facilities already in use, this is a normal operating capacity; for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

Source: DOE 1994n.

TABLE H.2.3–14.—*Hazardous Waste Storage Capability at Oak Ridge National Laboratory*

Storage Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
Chemical Waste Storage Facility (Bldg. 7653)	Solid explosives, lab pack chemicals, and waste reactive metals	33 (6,720 gal)	RCRA interim permit application submitted January 14, 1993.
Clean Oil Storage Pad (Bldg. 7651)	Clean oil	37 (7,470 gal)	RCRA interim permit submitted January 14, 1993. Can be used for mixed wastes.
Hazardous Waste (PCB) Storage Facility (Bldg. 7507)	Liquid PCB	41 (8,220 gal)	RCRA interim permit submitted January 14, 1993. Can be used for mixed wastes.
Hazardous Waste Storage Facility (Bldg. 7652)	Hazardous bulk liquids and solids	74 (14,900 gal)	Final RCRA Part B September 1, 1986. Can be used for mixed wastes.
Long-term Hazardous Waste Storage Facility (Bldg. 7654)	Liquid solid hazardous wastes	81 (16,400 gal)	RCRA interim permit submitted January 14, 1993. Can be used for mixed wastes.

[a] These capacities are design capacities.

Source: DOE 1994n; OR DOE 1993a.

TABLE H.2.3–15.—*Low-Level, Mixed Low-Level, and Hazardous Waste Treatment Capability at K-25 Site* [Page 1 of 2]

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity	Comment
Central Neutralization Facility (K-1407H)	Clarification, thickening, and neutralization	Liquid LLW, mixed LLW, and hazardous waste	Liquid effluent through NPDES outfall and sludge to Hazardous Waste Storage Unit	189,000 yd^3/yr (38,000,000 GPY)	Final NPDES permit October 1, 1992. Normal operating capacity. Permitted capacity is 58,400 GPY.
Combustible Mixed Waste Treatment Facility	Thermal destruction	Combustible debris, heterogeneous debris	Ash, Wastewater, Ash-flyash	635 yd^3/yr	Planned and unapproved. Feasibility study estimated treatment capacity at 800 tons per year.
K-1420 Decon Facility	Decontamination	Solid LLW and mixed LLW metal debris, inorganic non-metal debris, contaminated equipment	Decon solution to Sludge Fixation Facility, degrease sludge and inorganic sludge to storage and rinsewater to Central Neutralization Facility	Campaign	Configured for LLW only. Can be modified to handle mixed waste.
TSCA Incinerator (K-1435)	Incineration (rotary kiln)	Liquid and solid - mixed LLW, LLW and mixed LLW contaminated with PCBs	Ash (solid mixed LLW and hazardous) to Hazardous Waste Storage Unit, WSU-012, ash water and blowdown water (mixed LLW and hazardous) to Central Neutralization Facility, and sludge (solid mixed LLW) to Sludge Fixation Facility	2,440 yd^3/yr (liquids) (491,000 GPY)	Final state air permit expires October 2, 1993; state RCRA permit expires September 27, 1997 and TSCA permit expires March 20, 1992. Normal operating capacity. Max. capacity is 20,600 yd^3/yr.

TABLE H.2.3–15.—*Low-Level, Mixed Low-Level, and Hazardous Waste Treatment Capability at K-25 Site* **[Page 2 of 2]**

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity	Comment
Waste Incinerator (K-1421)	Incineration	Type "O" waste contaminated trash	Ash (solid LLW) to Hazardous Waste Storage Unit, WSU-013	0.1 yd^3/hr	The facility is non-operational due to upgrades. Design feedrate.
Wastewater Treatment Facility (K-1232)	Centrifugation, neutralization, and precipitation	Liquid mixed LLW	Leachate (liquid LLW) to Central Neutralization Facility and sludge (solid mixed LLW) to Sludge Fixation Facility	1 yd^3/hr	RCRA permit submitted May 18, 1989. Design feedrate. Facility not currently being utilized.
Metal and Debris Waste Treatment Facility	Surface decontamination	Metal debris inorganic non-metal debris, heterogeneous	Wastewater treated debris, sludges	Planned and unapproved	Plan to treat mixed waste.
Mixed Sludge Treatment Infrastructure	Radioactivity concentration, stabilization precipitation, filtration, off-gas treatment sampling analysis	Wastewater, treatment sludges, ash, plating waste sludges	Stabilized sludges, stabilized solids-rad, wastewater	Planned and unapproved	Technologies and processes are still being determined. Plan to treat mixed waste.
Staging and Processing Facility	Repackaging/bulking/consolidation, rinsing PCB drum, pH adjustment	Aqueous/halogenated organic liquids, absorbed organic liquids, paint chip/solids, activated carbon, biological materials, organic chemicals, contaminated soils	Wastewaters, drums, organic rinsate	Planned and unapproved	Plan to treat mixed waste.
Waste Soils Treatment Facility	Thermal desorption (primary), possible soil watering	Contaminated soils	LDR soils, debris, scrubber residues	Planned and unapproved	Plan to treat mixed waste. Available December 2004.

Source: DOE 1994k; DOE 1994n; OR MMES 1993e.

TABLE H.2.3–16.—***Low Level, Mixed Low-Level, and Hazardous Waste Storage Capability at K-25 Site*** **[Page 1 of 3]**

Storage Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
Dewatered Raw Sludge Storage (Bldg. K-1065C)	Solid mixed LLW, hazardous, and LLW	19,700	RCRA permit expires 2023. Design capacity. Includes 1,670 yd^3 of mixed LLW.
Dewatered Raw Sludge Storage (Bldg. K-31)	Solid mixed LLW, hazardous, and LLW	10,500	RCRA permit expires 2002. Design capacity. Includes 8,660 yd^3 of mixed LLW.
Flammable Liquid Storage Tanks (K-1202)	Liquid and mixed LLW, and hazardous waste	140 (28,500 gal)	RCRA permit expires September 1, 2002. Two bulk storage tanks.
Flammable Liquid Storage Unit (K-1420A)	Liquid and mixed LLW, and hazardous waste	140 (28,500 gal)	RCRA permit expires September 1, 2002. Two bulk storage tanks.
Hazardous Waste Storage Unit, WSU-002 (K-311-1)	Solid mixed LLW and hazardous waste	601	RCRA permit expires September 1, 2002. Vault for radiogenic lead waste. Includes 11 m^3 of LLW as of June 1994.
Hazardous Waste Storage Unit, WSU-005 (K-310-1)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste	582 (117,000 gal)	RCRA permit expires September 1, 2002. RCRA sludges and ash from operation of K-1035 incinerator.
Hazardous Waste Storage Unit, WSU-006 (Vault 2A)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste	576 (116,000 gal)	RCRA permit expires September 1, 2002. Mixed waste capacity in 200 yd^3.
Hazardous Waste Storage Unit, WSU-007 (K-309-3)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste	545 (110,000 gal)	RCRA permit expires September 1, 2002. Has been used for RCRA, PCB, and mixed wastes from all sites at ORR. As of August 1994, 463 yd^3 of mixed LLW may be stored.
Hazardous Waste Storage Unit, Vault 4, WSU-011 (K-301-1)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste to include PCBs	563 (114,000 gal)	RCRA permit expires September 1, 2002. Storage of laboratory wastes, acids, bases, and organics.
Hazardous Waste Storage Unit, WSU-012 (K-301-1, Vault 4A)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste to include PCBs	796 (161,000 gal)	RCRA permit expires September 1, 2002. Waste consists of sludges and incinerator ash. As of August, 1994, 564 yd^3 of mixed LLW may be stored.
Hazardous Waste Storage Unit, WSU-013 (K-301-2, Vault 4B)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste to include PCBs	496 (100,000 gal)	RCRA permit expires September 1, 2002. Waste consists primarily of photographic waste and incinerator ash.
Hazardous Waste Storage Unit, WSU-023 (K-302-4)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste to include PCBs	659 (33,000 gal)	RCRA permit expires September 1, 2002. Storage of PCB organics and mercury-contaminated organics. As of August 1994, 500 yd^3 of mixed LLW can be stored.
Hazardous Waste Storage Unit, WSU-024 (Vault 8A)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste to include PCBs	711 (143,000 gal)	RCRA permit expires September 1, 2002. Storage of hazardous wastes from K-25 and Y-12.
Hazardous Waste Storage Unit, WSU-025 (K-302-5)	Liquid and solid LLW, mixed LLW, hazardous, and non-RCRA waste to include PCBs	519 (37,000 gal)	RCRA permit expires September 1, 2002. Storage of RCRA and mixed wastes from K-25 and Y-12. As of August 1994, 500 yd^3 of mixed LLW can be stored.
Hazardous Waste Storage Unit, WSU-026 (K-303-1)	Liquid/solid mixed LLW, LLW and hazardous waste	775 (156,000 gal)	RCRA permit expires September 1, 2002
Hazardous Waste Storage Unit, WSU-028 (K-303-2)	Liquid/solid mixed LLW	648 (131,000 gal)	RCRA permit expires September 1, 2002

TABLE H.2.3–16.—*Low Level, Mixed Low-Level, and Hazardous Waste Storage Capability at K-25 Site* [Page 2 of 3]

Storage Unit	Input Capability	Total Capacity[a] (yd³)	Comment
Buildings K-1232, K303-3, K-305-12, K306-4	Liquid and solid mixed waste	904 (182,000 gal)	Permitted
Building K-306-IT, WSU-067 vault, (K-25)	Liquid and solid hazardous waste	204 (41,200 gal)	Permit not necessary
Buildings K-1417 and K-1419	Solid mixed waste (sludge)	11,600	Under RCRA closure
Hazardous Waste Storage Unit, WSU-056 (Vault 19A)	Liquid/solid mixed LLW, mixed LLW and hazardous	774 (156,000 gal)	RCRA permit expires September 1, 2002.
Hazardous Waste Storage Unit, WSU-057 (K-305-6)	Liquid/solid LLW, mixed LLW, and hazardous	463 (93,400 gal)	RCRA permit expires September 1, 2002. Part of former K-305-6 vaults 19 and 19B. Storage of K-25 pond waste sludge from closure of K-1407B pond.
Hazardous Waste Storage Unit, WSU-066 (K-305-12)	Liquid/solid mixed LLW, LLW and hazardous	1,030 (208,000 gal)	RCRA permit expires September 1, 2002. As of August 1994, 476 yd^3 of mixed LLW can be stored.
Hazardous Waste Storage Unit, WSU-067 (K-306-1)	Liquid/solid LLW, mixed LLW, and hazardous waste	293 (59,200 gal)	RCRA permit expires September 1, 2002. Sludges generated during treatment of Y-12 wastewaters. As of August 1994, 130 yd^3 of mixed LLW may be stored.
Hazardous Waste Storage Unit, WSU-068 (Vault 23A)	Liquid/solid LLW, mixed LLW, and hazardous waste	562 (113,000 gal)	RCRA permit expires September 1, 2002. Sludges generated during treatment of Y-12 wastewaters at either K-1232 or Y-12 facilities. As of August 1994, 427 yd^3 of mixed LLW may be stored.
Hazardous Waste Storage Unit, WSU-070 (K-306-3)	Liquid/solid LLW, mixed LLW, and hazardous waste	483 (97,500 gal)	RCRA permit expires September 1, 2002. Storage of RCRA, PCB, and mixed wastes from K-25, Y-12, and ORNL. As of August 1994, 375 yd^3 of mixed LLW may be stored.
Hazardous Waste Storage Unit, WSU-072 (K-306-4)	Liquid/solid mixed LLW, LLW and hazardous waste	374 (75,400 gal)	RCRA permit expires September 1, 2002.
Hazardous Waste Storage Unit, WSU-074 (Vault 25A)	Liquid/solid mixed LLW, LLW and hazardous waste	1,350 (271,000 gal)	RCRA permit expires September 1, 2002. Design capacity. As of August 1994, 375 yd^3 of mixed LLW can be stored.
Hazardous Waste Storage Unit, WSU-1000 (K-1036-A)	Liquid/solid LLW, mixed LLW, hazardous	174 (35,100 gal)	RCRA permit expires September 1, 2002. Used for solvents and waste oil storage. Oil may be contaminated. Maximum capacity is 2,000 55-gal drums.
Hazardous Waste Storage Unit, WSU-1003 (K-711)	Liquid/solid LLW, mixed LLW, hazardous, and non-RCRA waste to include PCBs	409 (82,400 gal)	RCRA permit expires September 1, 2002. No reactives or incompatibles. Waste oils and solvents generated at Fernald, Ohio and other DOE facilities. Max. capacity of 1,800 55-gal drums. As of August 1994, 304 yd^3 of mixed LLW may be stored.
Hazardous Waste Storage Unit, WSU-1004 (K-1025C)	Liquid/solid LLW, mixed LLW, and hazardous wastes	11 (2,250 gal)	RCRA permit expires September 1, 2002. No incompatibles. Used for out-of-date or off-specification laboratory chemicals - disposed through offsite commercial facilities. As of August 1994, 7 yd^3 of mixed LLW may be stored.
Hazardous Waste Storage Unit, WSU-1005 (K-1302)	Liquid/solid LLW, mixed LLW, hazardous, and non-RCRA compressed gas	4 (747 gal)	RCRA permit expires September 1, 2002. Gases are commercial products that are to be discarded or treated.

TABLE H.2.3–16.—*Low Level, Mixed Low-Level, and Hazardous Waste Storage Capability at K-25 Site* [Page 3 of 3]

Storage Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
K-31 WP (Dewatered Raw Sludge Storage)	Hazardous/mixed waste	10,500	RCRA permit expires September 1, 2002. Storage of solidified pond waste sludge from closure of K-1407-B and -C ponds. As of August 1994, 8,680 yd^3 of mixed LLW can be stored.
K-33 WP	Mixed waste	15,700	RCRA permit expires September 1, 2002. Storage of solidified pond waste sludge from closure of K-1407-B and -C ponds. As of August 1994, 11,100 yd^3 of mixed LLW can be stored.
K-306-IT (Bldg K-25, WSU-067 vault)	Hazardous TSCA waste	204 (53,900 gal)	RCRA final permit expires September 1, 2002. Will be used for RCRA and mixed wastes from K-25, Y-12, and ORNL. Currently, empty PCB-contaminated containers from K-25 and Y-12 being stored in vault.
RCRA Storage Unit (WSU-009), Vault 3A	Liquid and solid LLW and hazardous wastes	381 (76,900 gal)	RCRA final permit expires September 1, 2002.
TSCA Container and Tank Storage (K-1435)	Non-PCB contaminated flammable liquid and mixed low-level that is also PCB-contaminated	689 (139,000 gal)	TSCA incinerator has three storage areas. The tank farm has 3 10,000-gal and 12 5,000-gal tanks for liquid only. Area B (TSCA waste) can store 352 55-gal drums and Area C (RCRA waste) can store 496 55-gal drums. Final state air permit expires October 1, 1993 and state RCRA permit submitted August 1, 1991.
TSCA Storage Unit (K-33)	Liquid and solid hazardous waste	1,260 (254,000 gal)	No permit required
TSCA Storage Unit (K-726)	Liquid and solid non-RCRA, nonradioactive waste contaminated with PCBs	124 (124,900 gal)	No permit required. As of August 1994, 111 yd^3 of hazardous waste is stored.
TSCA Storage Unit, WSU-031 (K-303-4)	Liquid and solid LLW and non-RCRA, nonradioactive waste contaminated with PCBs	764 (154,000 gal)	RCRA permit submitted October 1, 1991.
Waste Oil/Hazardous Wastes Storage I (K-1425 container)	Liquid and solid LLW and mixed LLW	244 (49,000 gal)	RCRA state permit submitted March 1, 1991. Wastes stored include oils, solvents, water, and organics. Maximum capacity is 480 55-gal drums.
Waste Oil/Hazardous Wastes Storage II (K-1425 tanks)	Liquid LLW and mixed LLW	450 (90,000 gal)	Final air permit expires October 1, 1995 and RCRA state permit submitted August 1, 1991. Wastes stored include oils, solvents, water, and organics. Four 22,500-gal tanks.
Waste Staging Facility (K-1423)	Liquid and solid non-RCRA, nonradioactive; hazardous; LLW; and mixed LLW	371 (74,800 gal)	Planned and funded for April 1, 1999
Vault 6	LLW	222	No permit necessary
K 303-3/Vault 6A, Vault 11A	Solid LLW and mixed LLW	10,400	Permitted. As of August 1994, 774 yd^3 of mixed LLW can be stored.

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance. These capacities are the practical capacity rather than the design capacity.

Source: DOE 1994n; OR DOE 1993a, OR DOE 1994a; OR MMES 1993e; ORR 1993a:11.

TABLE H.2.3–17.—*Low-Level Waste Storage Capability at K-25 Site*

Storage Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
LLW Drum and Container Facilities	Liquid and solid LLW	4,450 (897,000 gal)	No permit necessary
Contaminated Scrap Metal Yard (K-770)	Solid LLW (uranium-contaminated scrap metal, ferrous and nonferrous)	265,000	6.9 acres of contaminated scrap metal. As of August 1994, 29,600 yd^3 of LLW can be stored.
LLW Storage Unit, WSU-004 (K-310-2)	Solid LLW	753	Used for nonhazardous radioactively contaminated waste generated at ORNL.
LLW Storage Unit, WSU-008 (K-309-2)	Solid LLW	867	Used for nonhazardous radioactively contaminated waste from K-25.
LLW Storage Unit, WSU-032 (K-303-5)	Liquid and solid LLW	616 (124,000 gal)	RCRA permit expires September 1, 2002. Construction upgrades required before storage of mixed waste. Used for nonhazardous radioactively contaminated waste from K-25.
LLW Storage Unit, WSU-044 (Vault 15A)	Solid LLW	737	RCRA interim status September 1, 1990. Construction upgrades required before storage of mixed waste. Used for nonhazardous radioactively contaminated waste from K-25, Y-12, and ORNL.
LLW Storage Unit (K-306-2)	Solid LLW	519	Used for nonhazardous radioactively contaminated soil from Y-12. As of August 1994, 246 yd^3 of LLW can be stored.
LLW Storage Unit, WSU-076 (K-306-7)	Solid LLW	449	Used for nonhazardous radioactively contaminated soil from Y-12. As of August 1994, 412 yd^3 of LLW can be stored.
LLW Storage Unit, (K 1066-H)	Solid LLW	5,010	Outdoor storage area
RUBB-2 Tent (K-1313A)	Solid LLW	178	Permit not necessary
Vault 6 (K-25)	Solid LLW	170	No permit necessary

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

Source: DOE 1994n; OR DOE 1993a;OR DOE 1994a.

TABLE H.2.3–18.—*Mixed Low-Level Waste at K-25 Site*

Waste Matrix	Number of Waste Streams	Inventory as of December 31, 1992 (yd^3)	Number of Waste Streams Five-Year Projection	Total Generation Five-Year Projection (yd^3)
Contact-handled				
Aqueous liquids	15	359 (72,400 gal)	4	204 (41,200 gal)
Organic liquids	27	1,300 (263,000 gal)	9	6,070 (1,220,000 gal)
Inorganic residues	8	12,400	6	979
Organic residues	22	676	None	None
Uncategorized soils	1	5	1	12
Metal and inorganic debris	15	236	10	638
Reactive metals	1	<0.1	None	None
Labpacks	18	4	10	8
Compressed gases	5	3	2	9
Elemental mercury	3	221	1	10
Elemental lead	1	28	1	7
Batteries	2	8	1	37
Uncategorized	4	17	None	None
Cement forms	1	20,700	None	None
Total	**123**	**36,000**	**45**	**7,770**

Source: DOE 1994k.

H.2.4 Pantex Plant

This section describes the baseline conditions and specific waste management operations at Pantex. As part of its normal operations, Pantex generates low-level, mixed low-level, hazardous, and nonhazardous wastes. Tables H.2.4–1 and H.2.4–2 present a detailed description of treatment and storage facilities with estimated capacities.

Pantex's goals regarding the management of LLW, mixed LLW, and hazardous wastes are to:

- Minimize the volumes of low-level radioactive and hazardous wastes generated to the extent technologically and economically practicable.
- Recycle those wastes applicable to the best available technology.
- Minimize contamination of existing or proposed real property and facilities.
- Ensure safe and efficient long-term management of all wastes.

Pollution Prevention. Pantex has a waste minimization program that was formed to define an effective waste minimization system for the site. A committee provides awareness of the program, identifies tasks, and provides liaison between the site and outside entities. Some of the accomplishments of this program are as follows (PX MH 1991a:8-11):

- Compaction of 1,200 drums to approximately 250 drums. Disposal cost savings of approximately $300,000 was achieved.
- Separation of radioactive and hazardous waste materials when shearing weapons components. Reclamation of gold from this process netted $243,000.
- Reclamation of oil, antifreeze, and refrigerant.
- Substitution of scintillation solution that is nonhazardous.
- Reuse of explosives and solvents.
- Repackaging of paint into smaller containers.
- Substitution of naphtha with nonhazardous biodegradable cleaning solution.

Transuranic Waste. No TRU waste or mixed TRU wastes are currently generated at Pantex during normal operation. However, there is a potential for an off-normal event to generate small amounts of contact-handled TRU waste during a weapon dismantlement activity. Three drums of TRU waste were generated several years ago from an incident during weapon dismantlement. Ultimately, Pantex plans to ship its TRU waste to a DOE-approved storage site when available.

Low-Level Waste. The waste streams for LLW have the following options available for management consideration (PX MH 1990b:13):

- Continue to ship to a DOE-approved disposal site such as NTS.
- Compact solid waste, if possible.
- Computerize tracking of radioactive waste.
- Implement improved segregation program.

Solid LLW generated consists of contaminated parts from weapons assembly and disassembly functions and waste materials associated with these functions, such as protective clothing, cleaning materials, filters, and other similar materials. The compactible components of this waste are processed at the Pantex Solid Waste Compaction Facility and staged along with the noncompactible components for shipment to a DOE-approved disposal site. Table H.2.4–3 lists Pantex's primary LLW streams, how they are generated, primary radioactive constituents, and method of storage or disposal. Table H.2.4–4 provides an inventory of LLW at Pantex as of December 2, 1994, and a 5-year generation projection.

Mixed Low-Level Waste. The waste streams for mixed LLW have the following options available for management consideration:

- Treat to satisfy Land Disposal Restrictions requirements and ship to a DOE-approved facility for storage or disposal.
- Treat to satisfy Land Disposal Restriction requirements and ship to a commercial-approved facility for storage or disposal.
- Ship offsite for treatment and disposal.

Pantex generates solid mixed LLW during weapons component testing functions. These wastes consist primarily of depleted uranium and beryllium residue and fragments from explosive components tests, contaminated gravel, cleaning materials, and protective clothing associated with these operations (PX MH 1990b:35). Other mixed LLW streams include cleaning materials from weapons assembly and disassembly operations. Table H.2.4–5 lists Pantex's primary mixed waste streams, how they are generated, primary constituents, materials, and method of treatment. Table H.2.4–6 lists the mixed waste storage inventory as of April 15, 1994. Projections for the following 5 years are also included.

The FS-23 facility has a containment test fire chamber where oxides of depleted uranium and beryllium are generated from testing. The chamber and equipment are cleaned after each test and the residue (solid waste) is placed into shipping containers. The containers are monitored for contamination and then forwarded to a staging area for shipment offsite.

Mixed LLW (HE-contaminates only) is currently treated at the Burning Ground which has an operating capacity of 38 yd^3 per year (DOE 1994k). The Hazardous Waste Treatment and Processing Facility is being planned to treat mixed LLW in the future.

Hazardous Waste. The waste streams for hazardous waste have the following options available for management consideration:

- Continue to ship to approved hazardous waste disposal facilities.
- Encapsulate solid waste and ship to a DOE-approved disposal site.
- Treat onsite for neutralization of corrosive wastes.

Table H.2.4–7 lists Pantex's primary hazardous waste streams, how they are generated, primary constituents, and method of storage or disposal. Table H.2.4–8 presents the inventory and a 5-year projections for hazardous waste as of December 2, 1994.

The treatment of hazardous waste is done at the following facilities:

- The Burning Ground is an open-burning area where explosives, explosive-contaminated waste, and explosive-contaminated spent solvents are burned. A large volume reduction is attained using this method.
- The Hazardous Waste Treatment and Processing Facility will be involved in the processing of liquid/solid hazardous waste and classified materials made from hazardous materials. The facility has been planned and approved and should be available in 1998. Hazardous waste is also shipped offsite to commercial RCRA-permitted facilities.

There are several separate storage facilities for hazardous wastes.

- Hazardous Waste Drum Storage Area—All liquid drums are placed in spill-containment pans. The facility is inspected weekly for leakers. Small lab samples of hazardous waste are stored in two chemical storage containers in this area. The materials stored there are as follows:
  - Asbestos;
  - Mercury-contaminated wastes;
  - Burning Ground ash; and
  - Electroplating sludge.
- At Building 16-1, used crank case oil is stored underground until sufficient quantities are generated for offsite processing.

Nonhazardous Waste. The Sewage Community Treatment Quality Upgrade is a fiscal year 1996 EM project at Pantex. This project would upgrade the Pantex sanitary system to ensure that wastewater standards are met through secondary/tertiary treatment. Included in this project is the upgrade of the existing treatment lagoon to treat sewage, repair and replace existing deteriorated sewer lines, construct a closed system to eliminate the use of open ditches for conveyance of industrial wastewater discharges, and implement a plant stormwater management system.

TABLE H.2.4–1.—*Waste Treatment Capability at Pantex Plant*

Treatment Unit	Treatment Method(s)	Input Capability	Output Capability	Total Capacity[a]	Comment
Batch Master Hazardous Waste Tank System (Bldg. 12-68)	Filtration, neutralization, and precipitation	Bldg. 12-5C metal cleaning bath, plating process waste, sodium hydroxide radiator cleaner, and spent electrolyte solutions	Batch master metal precipitates to Hazardous Waste Storage Pad and effluent to Wastewater Treatment Plant	Process as needed	Nonoperational due to pending closure
Building 11-15A	Immobilization	Mixed LLW	To be determined	240 yd^3/yr	Planned
Building 11-9	Immobilization	Mixed LLW	To be determined	240 yd^3/yr	Planned
Burning Cages (2)	Open burning	HE-contaminated trash	Ash	164 yd^3/batch	Interim permit until December 31, 1999. Nonoperational due to upgrades/major repairs
Burning Pads (3) -Burning Ground	Open burning	HE and wet HE	Ash to 11-7N Storage Pad	Process as needed	Interim permit until December 31, 1999
Burning Trays (9) -Burning Ground	Open burning	Bulk explosives	Ash to 11-7N Storage Pad	0.7 yd^3/batch	No two adjacent trays are allowed to burn at the same time.
Closed-Loop Decon System	Reduction	Contaminated lead (solid mixed LLW)	Acid Bath (liquid mixed LLW) to NSSI	Campaign	One process per year. Standby mode.
Compactor (Bldg. 12-42)	Hydraulic ram compactor - in-drum compaction	Solid LLW (gloves, kim wipes, paper)	Compacted LLW in 17H 55-gallon drums to Storage Igloo 4-56	Process as needed	No TRU waste, Greater-than-Class C, mixed waste, free liquids, or gases
Flashing Pits (3) -Burning Ground	Open burning	Encased explosives, demilitarization, and sanitization, HE-contaminated equipment, and HE	Flashed scrap to sale as scrap	Process as needed	Interim permit until December 31, 1999
Hazardous Waste Treatment & Processing Facility	Immobilization repackaging, neutralization compaction, shredding, sorting, and solidification	Liquid and solid mixed LLW and hazardous waste	To be determined	655 yd^3/yr	Available for treating mixed waste by 1999

[a] For those facilities already in use this is a normal operating capacity; whereas, for facilities under design or construction this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability funds and permit issuance.

Source: DOE 1993h; DOE 1994n; PX MMES 1993a.

TABLE H.2.4–2.—*Waste Storage Capability at Pantex Plant*

Storage Unit	Input Capability	Total Capacity (yd^3)[a]	Comment
Buildings 11-7A and 11-7B	Liquid and solid mixed LLW	527 (106,000 gal)	Permitted and operating storage capacity.
Buildings 4-46, 4-72, and 4-74	Liquid and solid mixed LLW	245 (49,500 gal)	Permitted capacity pending permit modification. Operating capacity is 157 yd^3.
Conex Containers WM-1 to WM-8	Containerized solid mixed low-level and silver photo wastes	750	Permit dated April 1, 1991. Permitted capacity. Operating capacity is 157 yd^3.
Conex Container WM-1A, WM-1B, WM-3A, WM-5A, and WM-5B.	Containerized liquid and solid LLW	494 (99,700 gal)	No plans to receive offsite waste. Permitted capacity pending permit modification. Operating capacity is 98 yd^3.
Hazardous Waste Storage Pad (Bldg. 11-7N)	Various liquid and solid hazardous wastes	164 (33,000 gal)	Interim permit dated April 19, 1990. Permitted and operating capacity.
Hazardous Waste Storage Pad (Bldg. 11-9N)	Various liquid and solid hazardous wastes	496 (100,000 gal)	Permit dated March 1994. Permitted capacity. Operating capacity is 329 yd^3.
Igloo 4-50	Liquid and solid mixed LLW	552 (111,000 gal))	Final permit dated April 24, 1992. Permitted capacity. Operating capacity is 52 yd^3.
Igloo 4-56	Liquid and solid LLW	56 (11,400 gal)	No plans to receive offsite waste
RCRA Hazardous Waste Storage Staging Facility (Bldg. 16-16)	Containerized liquid and solid mixed LLW	1,370 (276,000 gal)	RCRA permit submitted April 1, 1990. Permitted capacity. Operating capacity is 426 yd^3. Expected to be operation in 1997.
Warehouse (Bldg. 12-42)	Solid LLW	21,900	Short-term storage for drums that go to Bldg. 4-56. Amount stored as of December 1993.

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

Source: DOE 1994n; PX MH 1994d.

TABLE H.2.4–3.—*Low-Level Waste Streams at Pantex Plant*

Source	Waste Description	Radioactive Constituents	Primary Materials	Disposal
Assembly/ dismantlement operations	Debris from demilitarization and sanitization operations	Thorium, U-238, tritium	General noncompactible crushed/granulated plastic and metal debris	Disposal at DOE-approved offsite facility.
Assembly/ dismantlement/ stockpile surveillance operations	Compactible material from normal assembly/dismantlement/stockpile surveillance.	U-238, tritium, thorium, and plutonium	Lab wipes and other support materials	Disposal at DOE-approved offsite facility.
Assembly/ dismantlement and stockpile surveillance operations	Radiological materials from normal operation associated with weapons assembly, dismantlement, facility surveillance, container monitoring, and routine sample counting operations.	U-238, tritium, thorium, and plutonium	Protective clothing, wipes, swipes, tape, plastic, and other material in the radiation protection program.	Disposal at DOE-approved offsite facility.
Weapon component testing and evaluation	Debris generated during past testing of mock devices associated with any known waste stream.	Depleted U-238 residue	Contaminated soil and gravel, additional miscellaneous materials.	Stored onsite pending eventual shipment to DOE-approved disposal site.
Decontamination products	Materials generated during the decontamination of a concrete assembly work cell (one time generation).	Tritium	Protective clothing, concrete rubble, solidified liquids, tools, equipment, and plastic and paper products containing tritium.	Stored onsite pending eventual shipment to DOE-approved disposal site.

Source: PX Battelle 1995a.

TABLE H.2.4–4.—*Low-Level Waste Inventory at Pantex Plant*

Waste Stream Name	Inventory as of December 2, 1994 (yd^3)	Total Generation Five-Year Projection (yd^3)
Beryllium solid waste	140	931
Tritium contaminated waste (solid/liquid)	72 (14,500 gal)	234 (47,300 gal)
Labpacks, nonregulated radioactive (solid)	1	1
Contaminated soil	10	10
Waste water	9 (1,760 gal)	12 (2,370 gal)
Contaminated metal	0.03	0.03
Desiccant	0.3	29
Plant refuse (paper, foam, rags, cardboard)	138	932
Total	**370**	**2,150**

Source: PX Battelle 1995a.

TABLE H.2.4–5.—*Mixed Low-Level Waste Streams at Pantex Plant* [Page 1 of 2]

Treatability Group	Waste Stream Name	Composition[a]	Process Description	Treatment Alternatives
Organic liquids	Paint waste and organic liquid	Paint and solvent	Stripping, surface preparation, and repainting.	Encapsulation, incineration, molten salt destruction, filtration, centrifugation, oxidation, reduction, and amalgamation (Hg only)
	Spent solvents	Freon, methyl ethyl ketone, HE, and dimethyl sulfoxide	Cleaning dissolution of HE	
	Mercury contaminated liquid	Mercury contaminated oil	Vacuum pump oil change	
	Organics, miscellaneous	Halogenated and non-halogenated solvents	Paint, solvent and special product material storage	
	Scintillation fluids	Scintillation fluids packaged with vermiculite	Radioactivity testing	
Aqueous liquids	Wastewater	Water, HE, chromium, lead	Water-jet and thermal shock activities	Incineration, wastewater treatment
	Alodine solution	Chromic acid, fluoride salts, and iron cyanide	Surface preparation before paint removal	
	Rinse water, equipment wash	Water, metals, and solvents	Rinsing equipment	
	Metal cleaning waste	Water, alodine, nitric acid, uranium, thorium cadmium, Cr, lead and Hg	Etching and cleaning of metals	
Inorganic solids	Lead waste	Portion of lead drum liner	Removal of lead liner from drum	Plasma melting, chemical leaching, and encapsulation
	Ash, Burning Ground	Inorganic ash residue	Burning of HE	
Soils	ER Program potential mixed waste (soils)	Spill cleanup, drill cuttings, sample waste	ER Program site contaminated soils	Encapsulation, thermal, physical, chemical, and containment
Debris	Organic debris: solvent-contaminated solids	Alcohol, kimwipes, filters, rags, leads, solvents	Weapon dismantlement and maintenance	Encapsulation, incineration, metal melting, slagging, plasma melting, molten salt, aqueous washing, chemical leaching, sonification, and amalgamation (mercury only)
	Inorganic debris: contaminated scrap metal	Contaminated scrap metal from demilitarized and sanitized weapons parts	Demilitarization activities	
	Inorganic debris: lead-contaminated waste	Seals and tape intermixed with glass and paper	Demilitarization sanitation activities	
	Inorganic debris: mercury-contaminated solids	Glass bulbs, mercury-contaminated solids	Maintenance of lighting	
	Heterogeneous debris; metal contaminated waste	Metals, solvents, lead, tritium, beryllium	Maintenance and special activities	
	Solvent contaminated solid waste and heterogenous debris	Solvents and heavy metals	Painting, paint removal, maintenance, testing, and dismantlement activities	

TABLE H.2.4–5.—*Mixed Low-Level Waste Streams at Pantex Plant* [Page 2 of 2]

Treatability Group	Waste Stream Name	Composition[a]	Process Description	Treatment Alternatives
Explosives	Wastewater sludge from explosives	Explosive contaminated solids, DMSO	Filtering of wastewater with HE	Open Burning (non-Plutonium contaminated) Aqueous washing, base hydrolysis, and chemical leaching
	Explosive contaminated support material	High-explosive residue, mercury	Assembly/disassembly processes	
Batteries (demilitarized and sanitized)	Batteries (demilitarized and sanitized)	Nickel cadmium, lead, nickel	Dismantlement activities	Encapsulation, metal melting, and slagging
Compressed gases (aerosol containers)	Aerosol containers	Discarded paint cans	General maintenance	Decontamination and disposal

[a] Typical radionuclides that may be present in the mixed waste include uranium, thorium, and tritium.

Source: DOE 1994k.

TABLE H.2.4–6.—*Mixed Low-Level Waste Inventory at Pantex Plant*

Treatability Group	Number of Waste Streams	Inventory as of April 15, 1994 (yd^3)	Total Generation Five-Year Projection (yd^3)
Aqueous liquids	3	7 (1,470 gal)	32 (6,450 gal)
Organic liquids	5	11 (2,310 gal)	3 (505 gal)
Inorganic solids	2	30	0.2
Soils	1	0.2	None
Debris	6	95	123
Lab packs	1	2	2
Explosives	2	11	76
Liquid mercury	1	1 liter	None
Batteries	1	0.1	2
Compressed gases	1	0.3	None
Total	**23**	**153**	**238**

Source: 69

TABLE H.2.4-7.—*Hazardous Waste Streams at Pantex Plant*

Process	Generation	Constituents	Materials	Disposal/Storage Method
High explosives	Materials generated during manufacture machining and retirement.	High explosives	HE machining coolant fluid, HE waste scrap, retired HE components	Filtration, settlement, Burning Ground treatment, monitor and bury burn residue
Spent solvents-explosive, contaminated	Materials generated from chemicals used in synthesis and solvents used in formation of HE.	High explosives, solvents	Explosives contaminated spent solvents	Evaporate solvents and ignite residue at Burning Ground, disposal offsite at EPA- and state-approved site
Mercury contaminated waste	Materials generated in lab glassware during vacuum pull down and in following clean-up.	Mercury, vacuum pump oil	Mercury, vacuum pump oil, pump filter, paper waste, rags, gloves, other miscellaneous clean-up materials	Held for recycle or disposal at offsite EPA- and State-approved site
Explosive contaminated, solid waste	Materials generated during explosive processing.	High explosives	Explosives, contaminated mops, rags, wipes, boxes, and paper.	Burn at Burning Ground, monitor and bury in landfill
Chrome plating waste	Materials generated during chrome electroplating process in machine shop plating room.	Chromium	Chromium-contaminated spent chemicals	Filter chromium, monitor liquid and discharge to sanitary sewer, drum CrOH cakes for disposal at authorized site
Cleaning liquid compounds	Materials generated during parts cleaning operations at vehicle maintenance facility.	Petroleum naphtha/ mineral spirits	Cleaning liquid compound	Offsite-approved disposal
Immersion carburetor cleaner	Materials generated during vehicle carburetor cleaning.	Waste compound cleaning liquid	Carburetor cleaning liquid	Offsite reclamation
Miscellaneous discarded lab chemicals	Materials generated during lab operations, collected through a periodic sweep of labs.	Miscellaneous lab chemicals	Miscellaneous lab chemicals	Offsite-approved disposal
Silver contaminated photo waste	Materials generated during photograph silver activities.	Photo chemicals	Silver contaminated photo chemicals, photo paper, recovery canisters	Reclamation of silver
Lead shields	Materials generated during removal of lead shields.	Lead	Lead shields	Sold as scrap lead
Radiator cleaner	Materials generated during vehicle radiator cleaning operations.	Sodium hydroxide	Radiator cleaner	Offsite-approved disposal site
Paint waste	Materials generated during vehicle product and industrial maintenance.	Paint and paint sludge	Paint and paint sludge	Offsite-approved recycler
Spent carbon	Materials generated during filtering explosives contaminated wastewater.	High explosives	Contaminated carbon filters	Burned at burning ground, ash to offsite approved disposal site

Source: PX MH 1988a; PX MH 1990b.

TABLE H.2.4–8.—*Hazardous Waste Inventory at Pantex Plant*

Waste Stream Name	Inventory as of December 2, 1994 (yd^3)	Total Generation Five-Year Projection (yd^3)
Explosive-contaminated solid waste	5	30
Burning Ground waste from thermal treatment	2	10
Labpacks (solid)	0.6	7
Photographic film	0	1
Lead waste	0	0.1
Spent halogenated and nonhalogenated solvents and mixtures	2 (462 gal)	45 (9,090 gal)
Heavy metal contaminated parts	0	1
Sodium hydroxide waste (solid)	0	10
Paint sludge	3 (610 gal)	4 (832 gal)
Wastewater from operations and monitoring	0.6 (116 gal)	15 (2,970 gal)
Metal cleaner and photographic waste	0.1 (13 gal)	17 (3,420 gal)
Recyclable and nonrecyclable used batteries	0.5	258
Solvent-contaminated solids	4	39
Mercury (solid/liquid)	0	<0.1 (3 gal)
Sandblasting waste	0.8	2
Lead-contaminated waste	0	0.9
Miscellaneous organics (solid/liquid)	0.6 (111 gal)	20 (4,040 gal)
Contaminated engine oil	0	3 (568 gal)
Oil filter waste	<0.1	0.6
Miscellaneous discards contaminated with heavy metals	30	932
Empty organic compressed gas cylinders	0.4	31
Recyclable scrap metal with precious metals	0.2	2
Total	50	1,430

Source: PX Battelle 1995a.

H.2.5 Savannah River Site

The process of manufacturing useful nuclear materials has produced radioactive, mixed, and hazardous wastes that are treated, stored, or disposed of on SRS. The *Savannah River Site Waste Management Draft Environmental Impact Statement* (DOE/EIS-0217D), addresses the tasks of cleaning up existing waste units and bringing current operations into compliance with applicable regulations. It deals in detail with the current conditions and plans for remediation. It also addresses the development and funding of processes to minimize waste generation and to safely process and dispose of future waste generation.

Pollution Prevention. Pollution prevention, previously driven by best management practices and economics, is now mandated by statutes, regulations, and agency directives. The SRS Waste Minimization and Pollution Prevention Program is designed to achieve continuous reduction of wastes and pollutant releases to the maximum extent feasible and in accordance with regulatory requirements while fulfilling national security missions. The SRS Waste Minimization and Pollution Prevention Awareness Plan addresses wastes and potential pollutants of all types and establishes priorities for accomplishing waste minimization and pollution prevention through source reduction, recycling, treatment, and environmentally safe disposal.

Spent Nuclear Fuel. Spent nuclear fuel is not designated as a waste and is not included in the waste inventory since, during processing, separation of useful isotopes from the spent nuclear fuel is accomplished, and only the remaining waste is classified as HLW, TRU, or LLW. DOE discontinued reprocessing spent nuclear fuel in 1992. DOE published the ROD in the *Federal Register* (60 FR 28680) on June 1, 1995, for the *Programmatic Spent Nuclear Fuel and Idaho National Laboratory Environmental Restoration and Waste Management Programs EIS* documenting its decisions for the treatment and stabilization of the current inventory of spent nuclear fuel after the completion of programmatic and site-specific reviews pursuant to the *National Environmental Policy Act.* SRS has been one of the receiving sites for returned domestic and foreign research reactor spent fuel. The preparation of production, commercial, and research reactor fuel for long-term storage and the receipt of fuel from offsite is addressed in the ROD and in the EIS on the proposed policy for the acceptance of U.S.-origin foreign research reactor spent fuel. There are 184 metric tons of production reactor spent fuel and targets and 17 metric tons of commercial, experimental, and research reactor spent fuel in storage at SRS (DOE 1994g:2-9).

High-Level Waste. Liquid HLW containing actinides and hazardous chemicals were generated from recovery and purification of TRU products and from spent fuel processing, and retreivably stored in 51 underground tanks. (One of these tanks is out of service.) The waste is segregated by heat generation rate, neutralized to excess alkalinity, and stored to permit the decay of short-lived radionuclides before its volume is reduced by evaporation. Of the 51 tanks, 29 are located in the H-Area Tank Farm, and 22 are located in the F-Area Tank Farm. The tanks are of four different designs, but all are of carbon steel. Wastes are transferred to and processed in the newer tanks which have full height secondary containment and forced water cooling. Some older tanks contain old salt and sludge awaiting waste removal. Other old tanks have had waste removed except for residue, and are used to store low activity waste. The older tanks will be taken out of service when space in other tanks becomes available due to transfer to the Defense Waste Processing Facility.

High-heat liquid waste is stored for 1- to 2-years to allow decay of radionuclides before being processed through evaporators. Low-heat waste is sent directly to the evaporator feed tanks. Each tank farm has one evaporator that is used to reduce the volume of the water and concentrate the solids. A replacement higher capacity evaporator is planned which may be used in conjunction with the current evaporators. Liquids can be reduced to 25 to 33 percent of original volume and stored as salts or sludges. Cesium removal columns can operate in conjunction with the evaporators. The evaporators obtain decontamination factors of 10,000 to 100,000 and the cesium removal columns can obtain another 10 to 200 decontamination factors. Decontaminated liquids (overheads) are sent to the Effluent Treatment Facility for processing before being released to Upper Three Runs Creek. The concentrated salt solution is processed to remove radionuclides and the decontaminated solution is sent to the Defense Waste

Processing Facility: Saltstone Facility for solidification and storage onsite in the Saltstone Vaults.

The remaining sludges and salts contain the majority of the radionuclides, and are stored separately, awaiting vitrification. Prior to vitrification, salt would be precipitated in the In Tank Precipitation process. The precipitate and sludge would be fed into the vitrification process in the Defense Waste Processing Facility. The waste will be mixed with borosilicate glass and immobilized by melting and pouring the mixture into stainless steel cylinders. These cylinders will be stored in a shielded facility at the Defense Waste Processing Facility until a repository is available. Figure H.2.5–1 illustrates HLW management at SRS. Tables H.2.5–1, H.2.5–2 and H.2.5–3 list HLW inventories and treatment and storage facilities at SRS.

Transuranic Waste. All TRU waste currently being generated is stored in containers on above ground storage pads. Older TRU wastes (prior to 1965) were buried in plastic bags and cardboard boxes in earthen trenches. Wastes containing more than 0.1 Ci per package were placed in concrete containers and buried. Wastes containing less than 0.1 Ci per package were buried unencapsulated in earthen trenches. Since 1974, TRU wastes containing more than 10 nCi/g have been stored in retrievable containers free of external contamination. Polyethylene lined galvanized drums containing more than 0.5 Ci are additionally protected by closure in concrete culverts.

Currently, approximately 85 percent of the TRU waste in storage is suspected of being contaminated with hazardous constituents. Presently, waste is characterized by onsite generators and is being stored prior to final disposal. TRU waste containing less than 100 nCi/g may be disposed of as LLW at SRS. Waste containing greater than 100 nCi/g and meeting the final WIPP waste acceptance criteria will be sent to WIPP, if WIPP is determined to be a suitable repository pursuant to the requirements of 40 CFR 191 and 40 CFR 268. Waste not meeting the acceptance criteria as currently packaged will be repackaged as necessary to meet the WIPP waste acceptance criteria. If additional treatment is necessary for disposal at WIPP, SRS would develop the appropriate treatment technology, or ship this waste to another facility for treatment. Studies are underway to solve the problem of high heat TRU waste which is unique to SRS. Wastes with high Pu-238 fractions generate too much heat to be shipped in the TRUPACT-II. TRU waste is currently stored on 17 pads at the Solid Waste Disposal Facility in the E-Area. The TRU waste management plan is illustrated in figure H.2.5–2. Table H.2.5–4 lists the mixed TRU waste inventories. Tables H.2.5–5 and H.2.5–6 present the TRU and mixed TRU waste treatment and storage facilities.

Low-Level Waste. Both liquid and solid LLW are treated at SRS. Liquids are processed to remove and solidify the radioactive constituents and to release the balance of the liquids to permitted discharge points. The bulk of liquid waste is aqueous process waste including effluent cooling water, purge water from storage basins for irradiated reactor fuel or target elements, distillate from the evaporation of process waste streams, and surface water runoff from areas where there is a potential for radioactive contamination.

Aqueous LLW streams are sent to the Effluent Treatment Facility where they are treated by filtration, reverse osmosis and ion exchange to remove the radionuclide contaminants. After treatment, the effluent is discharged to Upper Three Runs Creek. The resultant wastes are concentrated by evaporation and stored in the H-Area Tank Farm for eventual treatment in the Defense Waste Processing Facility: Saltstone Facility. In that facility, they will be processed with grout for onsite disposal. Figure H.2.5–3 illustrates the liquid LLW processing at SRS. Processing and disposal of solidified liquids is illustrated in figures H.2.5–4 and H.2.5–5. Inventory, treatment, and storage facilities for LLW and mixed LLW are listed in tables H.2.5–7, H.2.5–8, and H.2.5–9.

Disposal of solid LLW at the SRS traditionally has been accomplished using engineered trenches in accordance with the guidelines and technology existing at the time of disposal. The E-Area Vault project is a comprehensive effort for upgrading LLW disposal at SRS based on meeting the requirements of the current DOE orders, incorporating technological advances, and addressing more stringent Federal regulation and heightened environmental awareness. Four basic types of vaults/buildings are being constructed for the different waste categories: low-activity waste vault, intermediate-level nontritium vault, intermediate-level tritium vault, and long-lived waste storage building.

The vaults are below-grade concrete structures and the storage building is a metal building on a concrete pad. Long-lived waste is being stored until a final disposition can be determined. Additional information on these facilities is given in table H.2.5–10.

Solid LLW is segregated into several categories to facilitate proper treatment, storage, and disposal. Solid LLW that radiates less than 200 mrem per hour at 5 cm from the unshielded container is considered low-activity waste. If it radiates greater than 200 mrem per hour at 5 cm, it is considered intermediate-activity waste. This waste is typically contaminated equipment from separations, reactors, or waste management facilities. Intermediate activity tritium waste is intermediate-activity waste with greater than 10 Ci of tritium per container. Spent lithium-aluminum targets from tritium operations equipment is included in this waste. Long-lived waste is contaminated with long-lived isotopes that exceed the waste acceptance criteria for disposal. Resin contaminated with carbon-14 from reactor operations is an example. Excavated soil from radiological materials areas that is potentially contaminated soil and cannot be economically demonstrated to be uncontaminated is managed as suspect soil. Figure H.2.5–5 illustrates LLW management at SRS. Solid LLW typically consists of protective clothing, contaminated equipment, irradiated hardware that does contain spent fuel, spent lithium-aluminum targets (from tritium extraction), and spent deionizer resins. All LLW is disposed of in the Solid Waste Disposal Facility in the E-Area between the F- and H-Areas. Wastes are compacted and packaged for burial. The primary method of disposal of low-activity waste is burial in engineered low-level earthen trenches. Trenches are located above the water table in soil containing enough clay to maintain its integrity, in an area where surface runoff can be controlled. The trench floors are sloped to a sump to eliminate standing water. After emplacement, the waste containers are covered with a soil cap, planted with selected grasses, and graded to direct runoff away from the trench. Intermediate-level wastes are disposed of in poured-in-place, top loading below-grade facilities to achieve as close to a zero release criteria as possible. Monitoring wells are located near each disposed waste area to verify performance and to monitor groundwater in the vicinity of the vaults. The existing 195-acre burial ground is filled and new concrete lined facilities are under construction to meet future SRS requirements. As of June 1994, the total inventory of LLW disposed of at SRS is 980,000 yd^3 (DOE 1994n:SRS).

Mixed Low-Level Waste. Mixed LLW is in interim storage in the E- and G-Areas in various buildings in drums, concrete culverts, and metal boxes. These South Carolina Department of Health and Environmental Control-permitted facilities will remain in use until appropriate treatment and disposal is performed on the waste.

The planned and funded Hazardous/Mixed Waste Treatment and Disposal Facility will process both mixed and hazardous wastes. The mixed waste management plan for SRS, illustrated in figure H.2.5–6, is being reevaluated through the development of a Site Treatment Plan in accordance with the *Federal Facility Compliance Act* of 1992. Mixed waste inventories are listed in table H.2.5–7. Treatment facilities and processes are listed in table H.2.5–8. Storage facilities capacity and status are listed in tables H.2.5–9 and H.2.5–10.

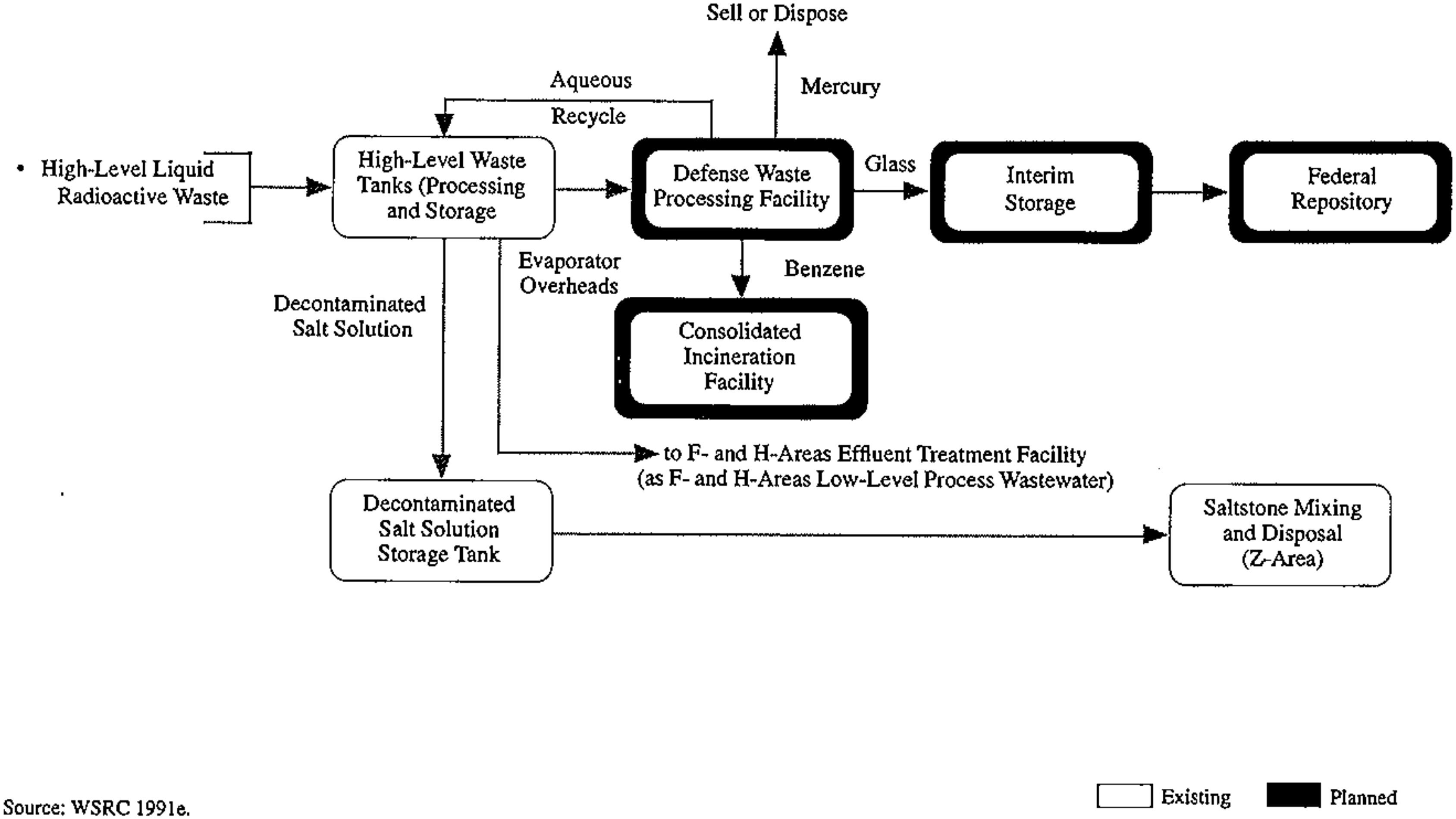
Hazardous Waste. Typical hazardous wastes at SRS are lead, mercury, cadmium, 1,1,1-trichloro-ethane, leaded oil, trichlorotrifluoroethane, benzene, and paint solvents. Figure H.2.5–7 illustrates the processing of hazardous wastes at SRS.

This waste is stored in three South Carolina Department of Health and Environmental Control-permitted buildings and facilities in the 700 area. One of these buildings is covered under a RCRA final permit. RCRA permits have been submitted for the other facilities. The buildings are constructed with sloped floors, dikes, and sumps to provide adequate containment in the event of a spill. Waste is stored in DOT-approved containers. Some of the waste is shipped to an offsite vendor for processing and disposal, thus allowing the site to maintain its current storage capabilities.

Nonhazardous (Sanitary) Waste. SRS operates its own sanitary waste landfill near road C, between C-3 and E. The first section of this landfill is at capacity, the second section reached capacity in 1993, and the third (interim) section is expected to provide capacity until 1997. Waste minimization and disposal method improvements are being employed to more efficiently utilize the landfill. The open pit method is used, and wastes are weighed and recorded before being disposed of in the facility. This facility has been found to be a source of groundwater contamination in the past, and is operating under a South Carolina Department of Health and Environmental Control permit which was valid through 1994. It will be modified, if necessary, to adequately assess the impact of continued use of this landfill. In the future, SRS is planning to contract with offsite facilities for the disposal of its sanitary waste.

Other Nonhazardous Waste. SRS disposes of other nonhazardous wastes in addition to the nonhazardous wastes disposed of in the sanitary landfill. These wastes consist of scrap metal, powerhouse ash, domestic sewage, scrap wood, construction debris, and used railroad ties.

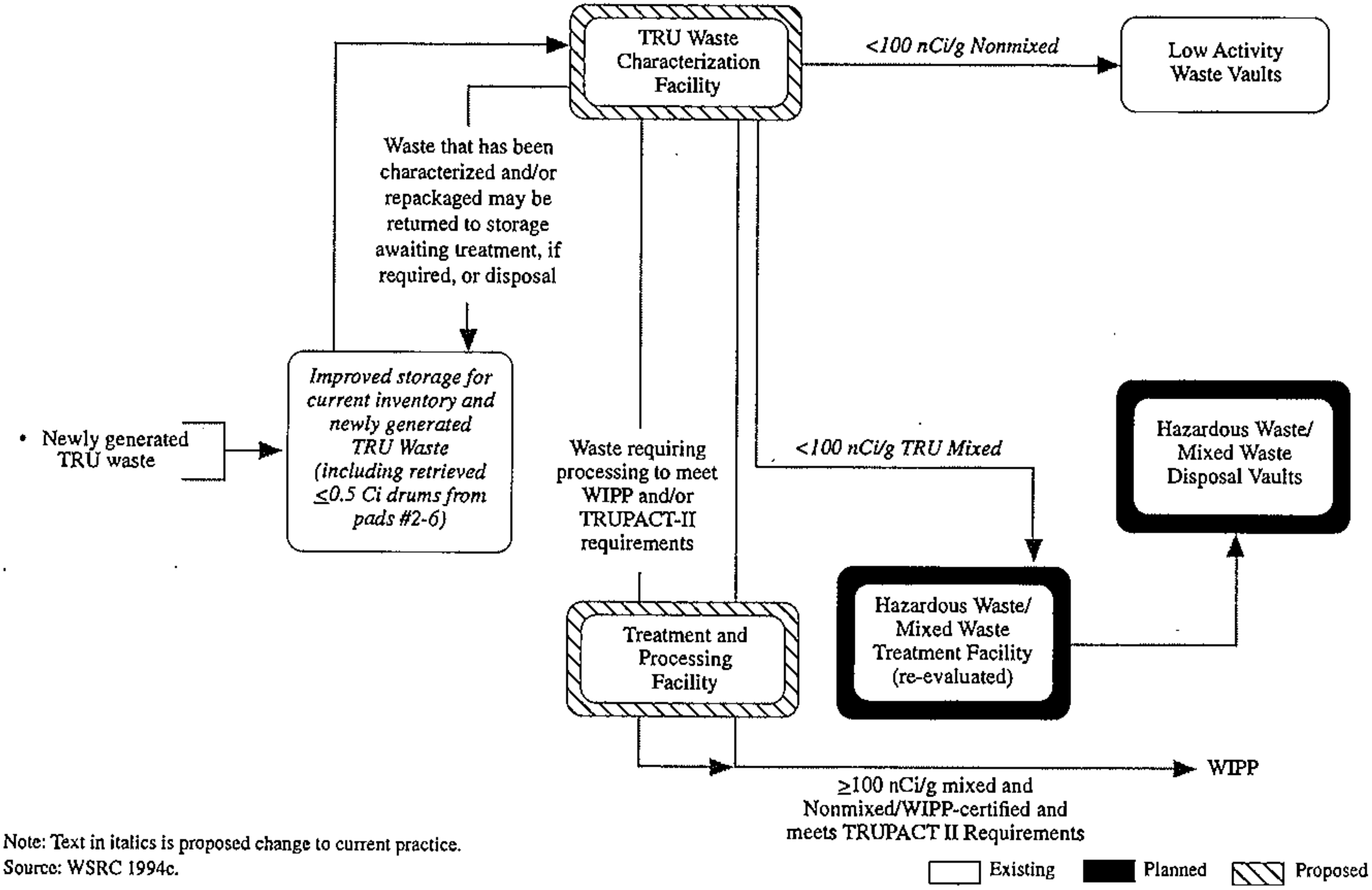
Scrap metal is sold to salvage vendors for reclamation. Powerhouse ash and domestic sewage sludge is used for land reclamation. Scrap wood is burned in the open. Construction debris is used for erosion control. Railroad ties have been processed into a biodegradable state. Nonhazardous waste management is illustrated in figure H.2.5–8.



Source: WSRC 1991e.

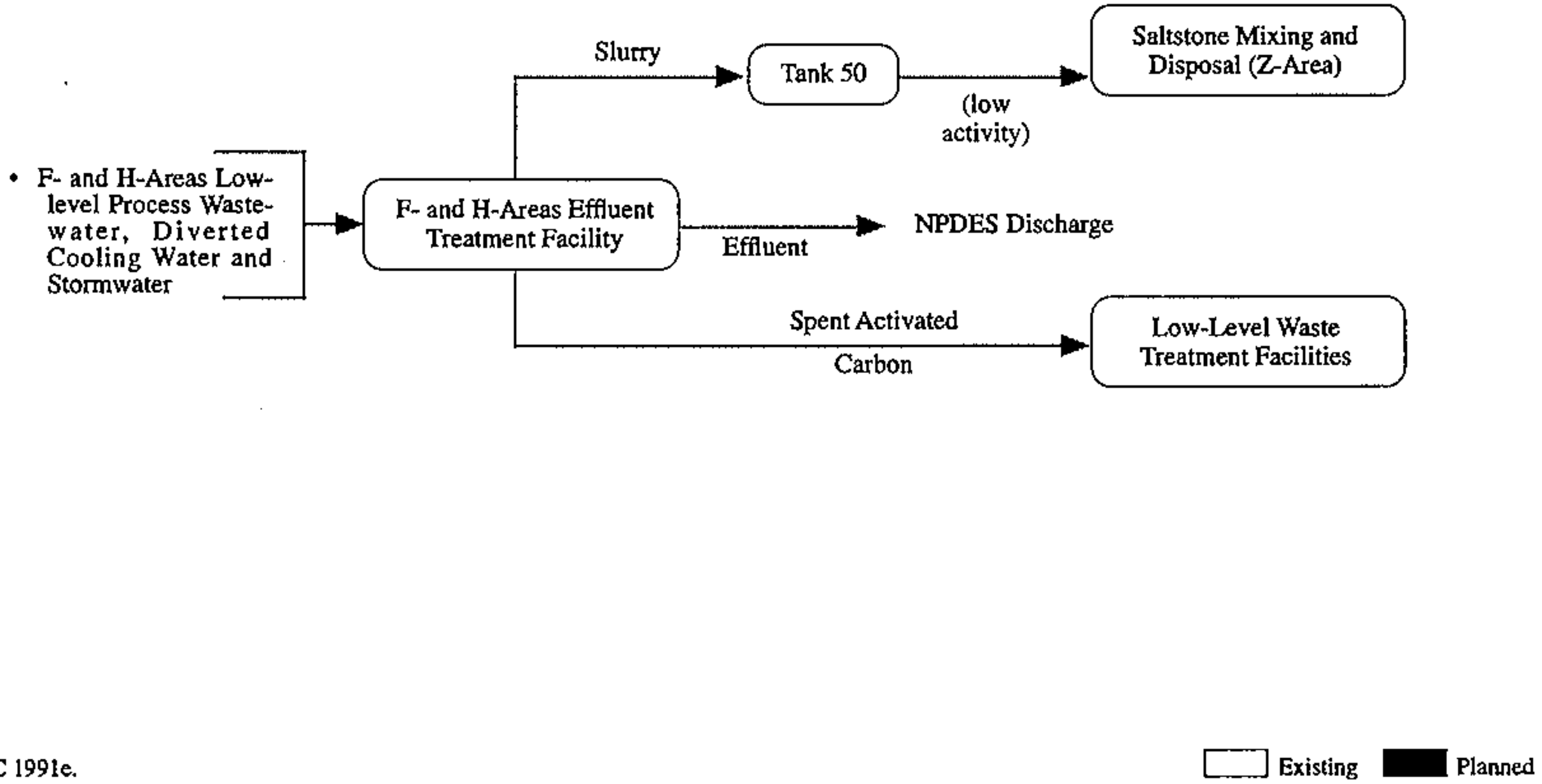
FIGURE H.2.5–1.—*High-Level Waste Management Plan at Savannah River Site.*

2143



Note: Text in italics is proposed change to current practice.
Source: WSRC 1994c.

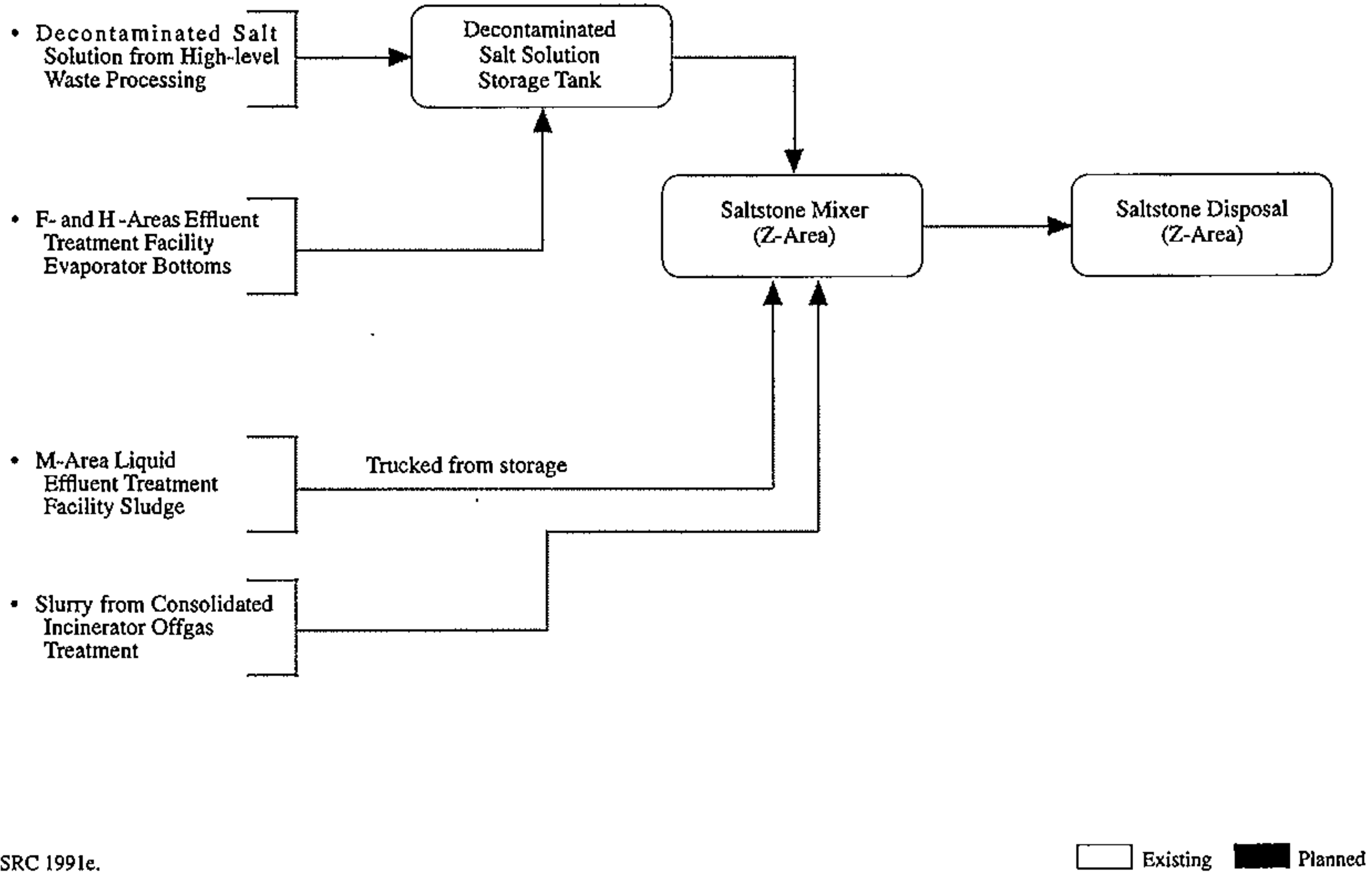
FIGURE H.2.5–2.—*Transuranic Waste Management Plan at Savannah River Site.*



Source: WSRC 1991e.

FIGURE H.2.5–3.—*F- and H-Areas Effluent Treatment Facility Waste Management Plan at Savannah River Site.*

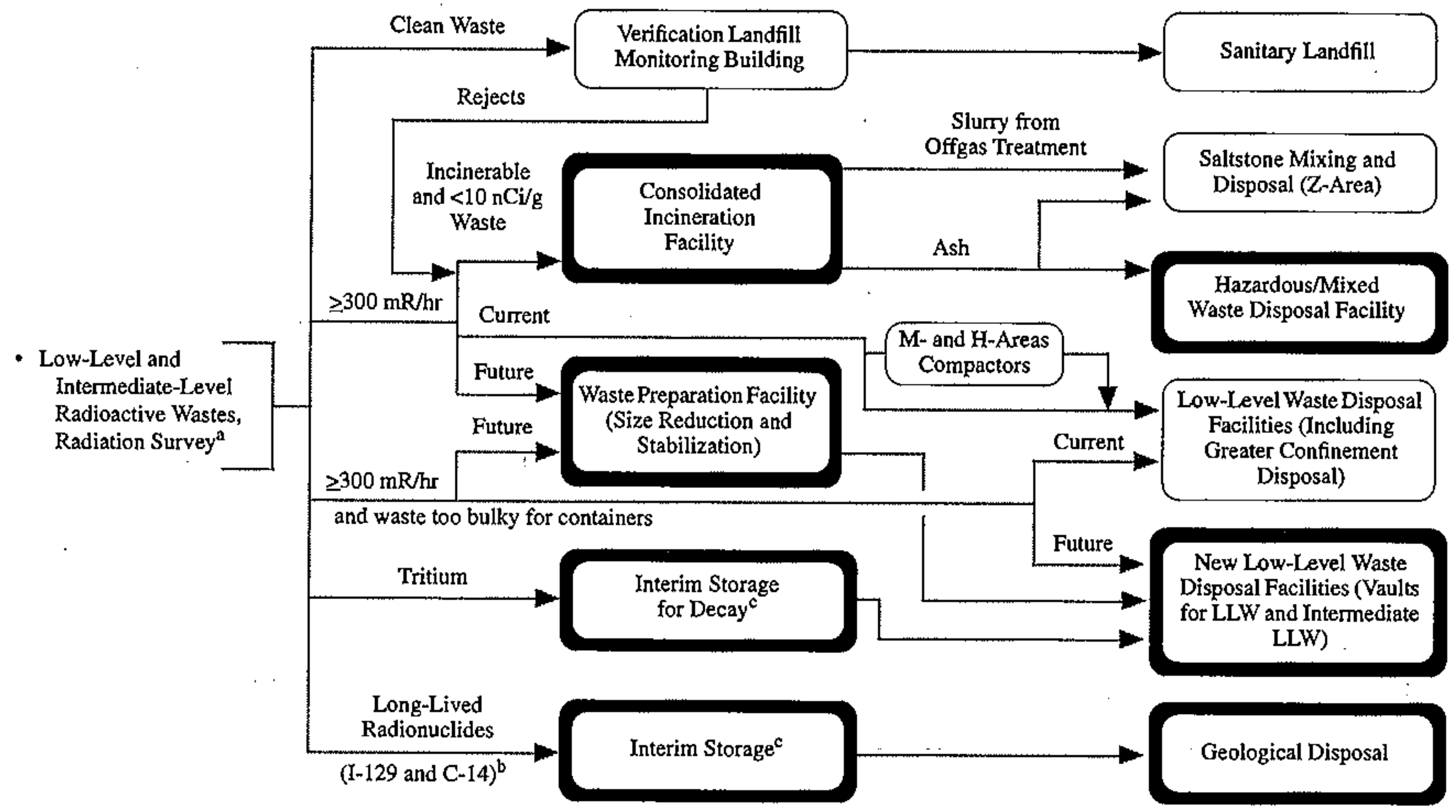
2148



Source: WSRC 1991e.

2149

FIGURE H.2.5–4.—*Saltstone (Low-Level Waste) Disposal Plan at Savannah River Site.*



[a] Excludes waste with tritium or alpha contamination.

[b] Iodine-129 is contained on silver-coated beryl saddles which may be mixed waste.

[c] Located at the new LLW disposal facilities.

Note: mR - millirad; I - iodine; C - carbon.
Source: WSRC 1991e.

☐ Existing ■ Planned

FIGURE H.2.5–5.—*Low-Level Waste Management Plan at Savannah River Site.*

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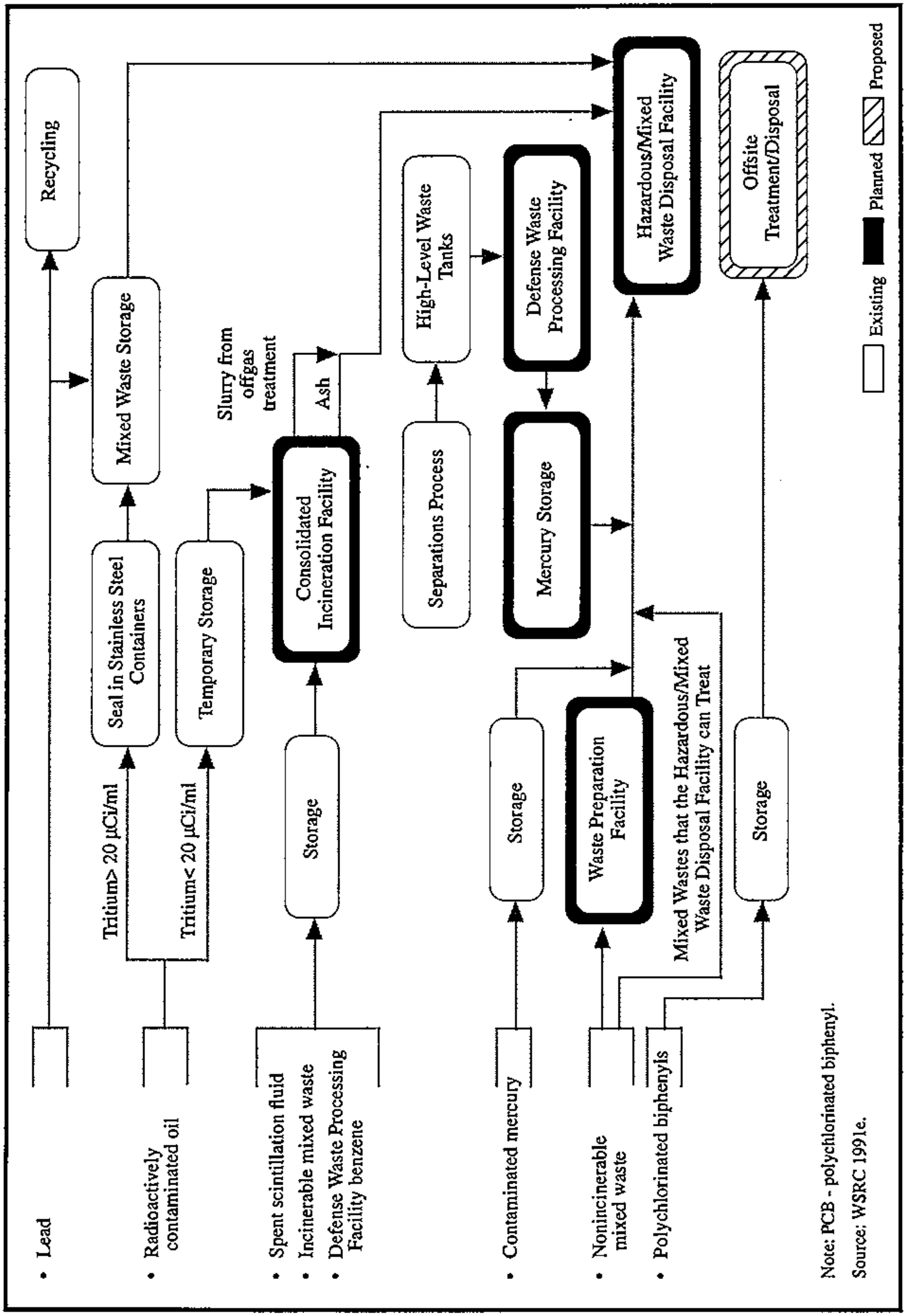
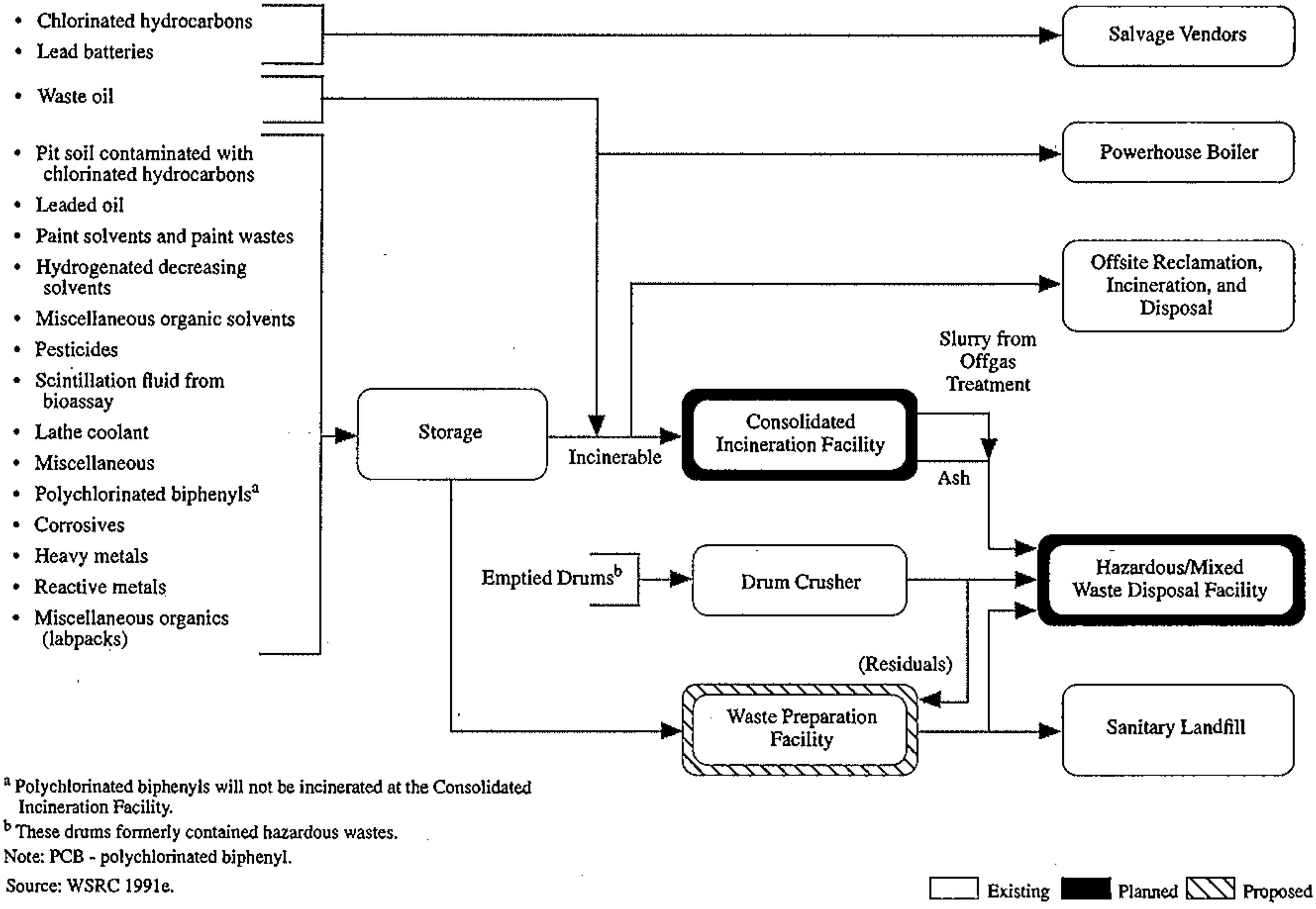


Note: PCB - polychlorinated biphenyl.

Source: WSRC 1991e.

FIGURE H.2.5–6.—*Mixed Waste Management Plan at Savannah River Site.*



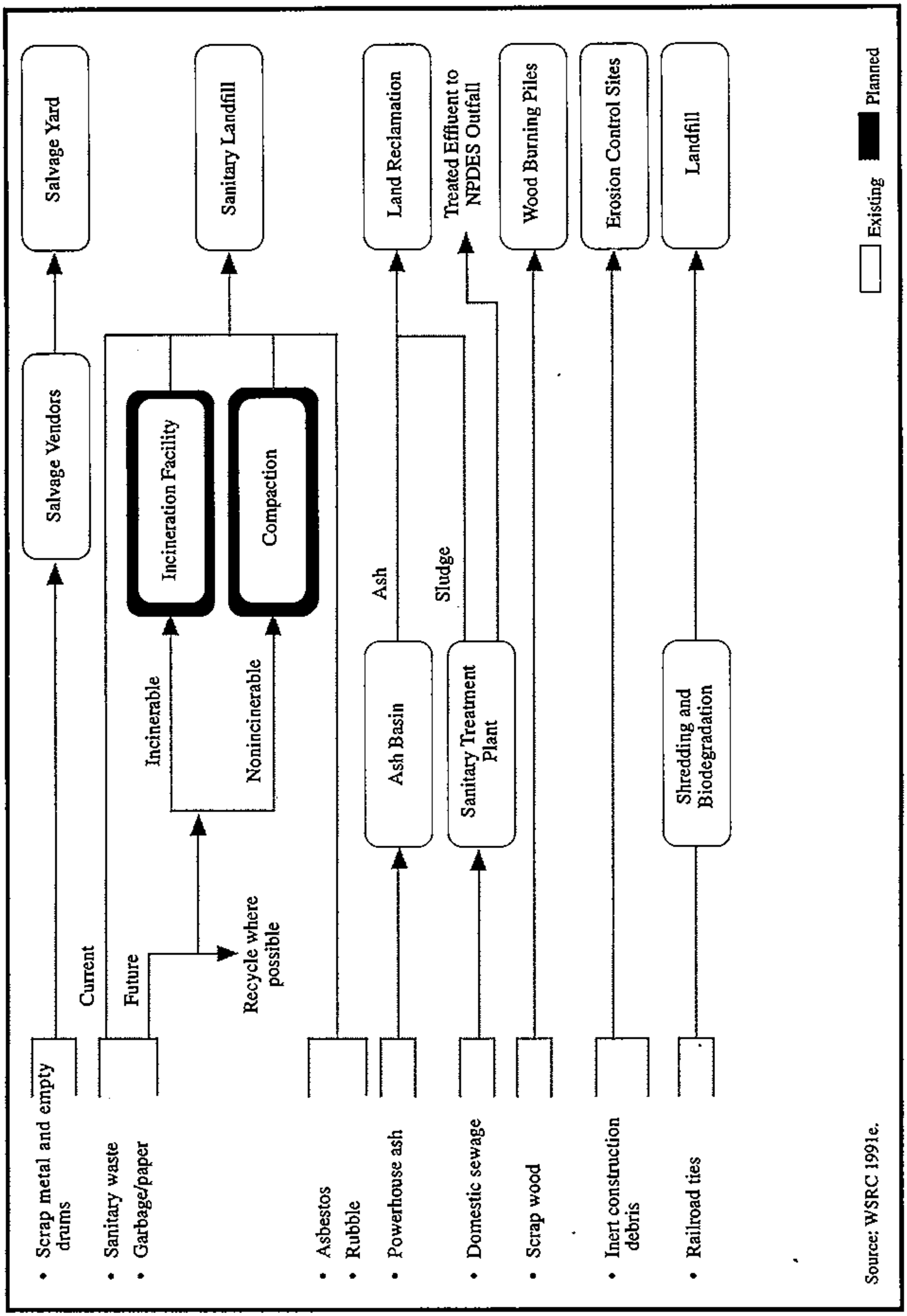
[a] Polychlorinated biphenyls will not be incinerated at the Consolidated Incineration Facility.

[b] These drums formerly contained hazardous wastes.

Note: PCB - polychlorinated biphenyl.

Source: WSRC 1991e.

FIGURE H.2.5–7.—***Hazardous Waste Management Plan at Savannah River Site.***



Source: WSRC 1991e.

FIGURE H.2.5–8.—*Nonhazardous Solid Waste Management Plan at Savannah River Site.*

TABLE H.2.5–1.—*High-Level Wastes at Savannah River Site*

Waste Matrix	Number of Waste Streams	Inventory as of September 30, 1993 (yd^3)	Number of Waste Streams Five-Year Projection	Total Generation Five-Year Projection (yd^3)
Remote-handled				
Aqueous liquids, slurries	3	167,900 (33,900,000 gal)	3	17,800 (3,600,000 gal)
Inorganic non-metal Debris	1	42	0	0
Total	4	**167,900**	3	**17,800**

Source: DOE 1994k; WSRC 1994a.

TABLE H.2.5–2.—*High-Level Waste Treatment Capability at Savannah River Site*

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (yd^3 per year)	Comment
F- and H-Tank Farms	Neutralization dissolution, chemical reaction	HLW aqueous liquid solutions and slurries	HLW aqueous liquid, sludge, solutions	[b]	Operational
Savannah River Technology Center high activity treatment probe	Ion exchange	HLW aqueous liquid	Mixed LLW liquid, HLW sludge	16,934 (457,229 GPY)	Operational
F- and H-Evaporators	Evaporation, ion exchange (cesium removal)	HLW aqueous liquid	HLW sludge, salt, slurry, organic solid	83,333[c] (2,250,000 GPY)	Operational
Replacement Evaporator	Evaporation, ion exchange (cesium removal)	HLW aqueous liquid	HLW sludge, salt, slurry, organic solid	120,000 (3,240,000 GPY)	Planned for 1997
Extended Sludge Processing	Decontamination	HLW sludge	HLW sludge	Dependent on tank inventory	Operational
In-Tank Precipitation	Precipitation, adsorption, filtration	HLW salt solution	HLW, LLW precipitate slurry	190,000[c] (5,130,000 GPY)	Startup December 1994
Defense Waste Processing Facility Vitrification Plant	Vitrification	HLW precipitate, sludge	HLW solid borosilicate glass	8,570 (1,731,000 GPY)	Planned available March 1996

[a] For those facilities already in use, this is a normal operating capacity; whereas, for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies and permit issuance.

[b] Batch process; depends on available tanks and process used.

[c] Based on net tank space gained. Input volume.

Source: DOE 1993g; SR DOE 1993b; SR MMES 1993a; WSRC 1994b; WSRC 1994c.

TABLE H.2.5–3.—*High-Level Waste Storage at Savannah River Site*

Storage Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
F-Area Tank Farm[b]	HLW, corrosive, toxic aqueous liquids, salt, sludge	64,400 (13,000,000 gal)	Operational
H-Area Tank Farm[b]	HLW, corrosive, toxic aqueous liquids, salt, sludge	109,000 (22,100,000 gal)	Operational
Total		**173,400** **(35,100,000 gal)**	
Defense Waste Processing Facility Vitrification Plant	HLW solid borosilicate glass in stainless steel cylinders	2,826	First unit available December 31, 1995
Defense Waste Processing Facility Vitrification Plant	HLW solid borosilicate glass in stainless steel cylinders	2,826	Second unit planned
Total Solid		**5,652**	

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

[b] Tanks that do not meet secondary containment criteria as described in the Federal facility agreement are not included.

Source: DOE 1993g; SR MMES 1993a; WSRC 1994a; WSRC 1994b.

TABLE H.2.5–4.—*Mixed Transuranic Waste at Savannah River Site*

Waste Matrix	Number of Waste Streams	Inventory as of September 30, 1993 (yd^3)	Number of Waste Streams Five-Year Projection	Total Generation Five-Year Projection (yd^3)
Contact-Handled				
Organic liquids	2	1.7 (343 gal)	0	0
Combustible debris	2	6,570	1	267
Ash	1	0.1	0	0
Total	**5**	**6,572**	**1**	**267**

Source: DOE 1994k; WSRC 1994a.

TABLE H.2.5–5.—*Transuranic and Mixed Transuranic Waste Treatment Capability at Savannah River Site*

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a]	Comment
Transuranic Waste Facility	Sorting, shredding, grouting, sampling, venting, repackaging	Miscellaneous TRU, extraction procedure toxic, listed	Solid TRU in drums	Proposed facility	Proposed facility

[a] For those facilities already in use this is a normal operating capacity; whereas, for facilities under design or construction this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

Source: DOE 1993g; SR MMES 1993a.

TABLE H.2.5–6.—*Transuranic and Mixed Transuranic Waste Storage at Savannah River Site*

Storage Unit	Input Capability	Total Capacity (yd^3)	Comment
TRU Storage Pads	Miscellaneous solid TRU waste, extraction procedure toxic, listed	22,900	Operational RCRA Part A. No offsite waste planned. Buried waste to be exhumed, processed at TRU Waste Facility, and shipped to WIPP

Source: DOE 1993g; SR MMES 1993a; WSRC 1994a.

TABLE H.2.5–7.—*Low-Level and Mixed Low-Level Wastes at Savannah River Site*

Waste Matrix	Number of Waste Streams	Inventory as of September 30, 1993 (yd^3)	Number of Waste Streams Five-Year Projection	Total Generation Five-Year Projection (yd^3)
Contact-Handled				
Aqueous liquids/slurries	6	130 (26,300 gal)	3	1,504 (304,000 gal)
Organic liquids	8	171 (34,500 gal)	4	506 (102,000 gal)
Inorganic process residues	10	2,931	4	654
Debris	2	1,584	0	0
Metal debris	4	147	1	4
Combustible debris	2	8	2	4
Homogeneous debris	4	3,662	2	36
Lab packs	1	0.2	0	0
Reactive metals	1	1	0	0
Elemental mercury	1	0.3	0	0
Elemental lead	1	226	1	78
Vitrified forms	0	0	1	654
Ash, alpha	0	0	1	81
Uncategorized soils, alpha	1	24	0	0
Remote-Handled				
Inorganic process residues	1	13	0	0
Metal debris	1	0.3	2	26
Total	**42**	**8,358**	**21**	**3,551**

Source: DOE 1994k; WSRC 1994a.

TABLE H.2.5–8.—*Low-Level and Mixed Low-Level Waste Treatment Capability at Savannah River Site*

Treatment Unit	Treatment Method	Input Capability	Output Capability	Total Capacity[a] (yd^3 per year)	comment
Consolidated Incineration Facility	Incineration	Mixed LLW, liquid, solid	Ash, slurry	71,555 (14,455,000 GPY)	Planned, approved, RCRA final, available 1996
Consolidated Incineration Facility Ashcrete	Stabilization	Mixed LLW, ash, slurry	Stabilized LLW, mixed LLW, solid	30	Planned, approved, RCRA final, available 1996
F- and H-Areas Effluent Treatment Facility	Neutralization, chemical precipitation, filtration, carbon adsorption, reverse osmosis, ion exchange, evaporation, mercury adsorption	Mixed LLW, aqueous liquids (F&H Area wastewater, evaporator overheads and condensate, cesium removal column effluent, etc.)	Corrosive LLW liquid concentrate, treated water effluent; used activated carbon, used ion exchange resins (solid LLW)	311,882 (63,000,000 GPY)	Operational, NPDES: Operating
H-Area Compactor	Compaction	Solid LLW job waste	Compacted LLW	36,624	Operational
Hazardous/Mixed Waste Treatment/ Disposal Facility	Distillation, electrochemical, encapsulation, solidification, precipitation, size reduction, amalgamation, stabilization	Liquids and solids, mixed LLW, toxic, corrosive, reactive, metal, sludge	Wastewater, solid stabilized LLW	1,163 (234,926 GPY)	Planned, approved, availability unknown
M-Area Compactor	Compaction	Solid LLW job waste	Compacted LLW	36,624	Operational
M-Area Dilute Effluent Treatment Facility	Filtration, neutralization, precipitation	Liquid mixed LLW	Wastewater, solid mixed LLW	130,080 (26,000,000 GPY)	Operational, NPDES: operating
M-Area Vendor Treatment Facility	Vitrification	Aqueous liquids and slurries, mixed LLW	Wastewater, solid mixed LLW	1,960 (396,000 GPY)	Planned, approved, NPDES: construction, available 1995
Savannah River Technology Center Ion Exchange Treatment Probe Low Activity	Ion exchange	Mixed LLW, aqueous liquids	Aqueous liquid, solid, mixed LLW	1,960 (396,000 GPY)	Operational, RCRA: interim
Z-Area Saltstone Facility	Stabilization (solidification with radio-nuclide binders)	Liquids, mixed LLW, sludges, toxic, corrosive	Solid LLW, nonhazardous	12,400 (2,500,000 GPY)	Operational, permitted disposal, CWA, RCRA: final

[a] For those facilities already in use, this is a normal operating capacity; whereas, for facilities under design or construction, this is a design capacity. Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds, results of treatability studies, and permit issuance.

Source: DOE 1993g; DOE 1994k; SR DOE 1993b; SR MMES 1993a.

TABLE H.2.5–9.—*Low-Level and Mixed Low-Level Waste Storage at Savannah River Site*

Storage Unit	Input Capability	Total Capacity[a] (yd^3)	Comment
Burial Ground Solvent Tanks (523-31)	Liquid mixed LLW	990 (200,000 gal)	To be closed, RCRA Part A
Defense Waste Processing Facility Organic Waste Storage Tank (430-3)	Liquid mixed LLW, ignitable, toxic	743 (150,000 gal)	Operational, RCRA Part A
Liquid Waste Solvent Tanks (533-36)	Liquid mixed LLW	990 (200,000 gal)	Proposed facility
M-Area Process Waste Interim Treatment/Storage Facility	Liquid mixed LLW, listed, (electroplate sludge)	10,900 (2,200,000 gal)	Operational, RCRA Part A
Mixed Waste Storage Buildings (643-29E and 643-43E)	Liquid mixed LLW solid, toxic, listed, ignitable, metal, sludge, soil	1,690 (341,000 gal)	Operational, RCRA Part A
Mixed Waste Storage Shed (316-M)	Liquid and solid mixed LLW	153 (30,800 gal)	Operational, RCRA Part A
Savannah River Laboratory High Activity Storage Tanks (772-2A)	Liquid mixed LLW, toxic, Toxicity Characteristic Leaching Procedure	259 (52,300 gal)	Operational, RCRA Part A
Hazardous Waste Storage Facility (645-2N)	Mixed LLW	761 (154,000 gal)	Operational, RCRA Part B
Total		**16,486** **(3,328,100 gal)**	

[a] Schedules and capacities for facilities under design or construction are subject to changes such as availability of funds and permit issuance.

Source: WSRC 1994b.

TABLE H.2.5–10.—*Waste Disposal at Savannah River Site*

Disposal Unit	Input Capability	Capacity[a] (yd^3)	Comment
Hazardous/Mixed Waste Disposal Vaults	Solid mixed LLW, listed (CIF, Ashcrete and blowdown)	3,920	Planned and funded, RCRA submitted 1990, available 2000.
Intermediate-Level Waste Vaults	Solid LLW	8,060	Under construction
Low- and Intermediate-Level Disposal Area	Solid LLW	994,000[b]	Operational
Low Activity Waste Vaults	Solid LLW, compacted waste, contaminated equipment, filters, sediment, job control waste, process beds, soils, resins, lithium-aluminum melted forms	44,000	Under construction
Z-Area Saltstone Vaults	Solid LLW	1,491,000	15 vaults operational, additional 27 vaults planned

[a] Schedules and capacities for the facilities under design or construction are subject to changes such as availability of funds and permit issuance.

[b] 40,500 yd^3 remaining as of June 1994.

Source: DOE 1992f; DOE 1994n; SR DOE 1993b; SR MMES 1993a.

APPENDIX I

Appendix I

APPENDIX I: COMPARISON OF ENVIRONMENTAL IMPACTS OF THE TRITIUM SUPPLY AND RECYCLING ALTERNATIVES

I.1 COMPARISON OF TRITIUM SUPPLY AND RECYCLING ALTERNATIVES

A comparison of the environmental consequences of the tritium supply and recycling alternatives is summarized in tables I.1–1 and I.1–2. These tables compare the impacts to environmental resources associated with No Action, the tritium supply technologies and recycling at each of the five candidate sites, and the commercial light water reactor alternative. Section 3.2 presents the possible alternatives in more detail.

The table I.1–1 comparison format presents the impacts of alternatives by resource or issue under two subcategories: collocated tritium supply and recycling; and tritium supply alone. Also included in the comparison table are impacts associated with "less than baseline operations" (section 3.1). At the end of each resource or issue is a subsection that discusses the impacts of phasing out the recycling mission at Savannah River Site (SRS) if any one of the tritium supply technologies with a new recycling facility is selected at a different site. For example, if the Heavy Water Reactor (HWR) is collocated with recycling at Idaho National Engineering Laboratory (INEL), the tritium recycling mission at SRS would be phased out and must be considered as part of the action at INEL. The tritium recycling phaseout discussion applies to any collocated tritium supply and recycling at all sites except SRS. Likewise, if a tritium supply alone is sited at INEL, the recycling facility at SRS would be upgraded as part of the action at INEL. At SRS there are no tritium supply alone alternatives since tritium recycling is already located at SRS and would be upgraded if a tritium supply were sited there. Therefore, the impacts for alternatives at SRS consist only of tritium supply and upgraded recycling. The tritium recycling upgrade at SRS would the part of the tritium supply alone alternatives at the other four candidate sites (INEL, Nevada Test Site [NTS], Oak Ridge Reservation [ORR] and Pantex Plant [Pantex]).

Table I.1–2 presents the impacts of the commercial reactor alternative for key resource fissure areas for construction and operation.

Under No Action, the Department of Energy (DOE) would not establish a new tritium supply capability, the current inventory of tritium would decay and DOE would not meet stockpile requirements of tritium. Sites would continue waste management programs to meet the legal requirements and commitments in formal agreements and would proceed with cleanup activities. Production facilities and support roles at specific sites, however, would be downsized or eliminated in accordance with the reduced workload projected for the year 2010 and beyond. The current DOE missions assumed to continue under No Action are listed in section 3.3 for each candidate site.

TABLE I.1–1.—*Comparison of Tritium Supply and Recycling Alternatives*

Land Resources

Technology	INEL	NTS
No Action (2010)	• No impacts to land use or visual resources.	• No impacts to land use or visual resources.
Heavy Water Reactor	• **Collocated Tritium Supply and Recycling**—Construction and operation would require 456 acres, which represents 0.08 percent of the available land. This use would be consistent with the INEL Landlord Site Development Plan and would not affect prime farmland, grazing allotments, other agricultural activities, or onsite or offsite land uses. The existing visual landscape characteristics would remain unchanged with a VRM classification of Class 4.	• **Collocated Tritium Supply and Recycling**—Construction and operation would require 456 acres, which represents 0.5 percent of the available land. This use would be consistent with the NTS Site Development Plan and would not affect prime farmland, grazing allotments, other agricultural activities, or onsite or offsite land uses. The VRM classification of the proposed site would change from Class 2 to Class 5. Depending on the final siting, the facilities may be visible from a portion of the Desert National Wildlife Range, a sensitive viewpoint about 10 to 13 miles away.
	• **Tritium Supply Alone**—Construction and operation would require 260 acres which represents 0.05 percent of the available land. Impacts would be the same as above.	• **Tritium Supply Alone**—Construction and operation would require 260 acres which represents 0.3 percent of the available land. Impacts would be the same as above.
	• **Less Than Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.
Modular High Temperature Gas-Cooled Reactor	• **Collocated Tritium Supply and Recycling**—Construction and operation would require 556 acres, which represents 0.1 percent of the available land. This use would be consistent with the INEL Landlord Site Development Plan and would not affect prime farmland, grazing allotments, other agricultural activities, or onsite or offsite land uses. The existing visual landscape characteristics would remain unchanged with a VRM classification of Class 4.	• **Collocated Tritium Supply and Recycling**—Construction and operation would require 556 acres, which represents 0.6 percent of the available land. This use would be consistent with the NTS Site Development Plan and would not affect prime farmland, grazing allotments, other agricultural activities, or onsite or offsite land uses. The VRM classification of the proposed site would change from Class 2 to Class 5. Depending on the final siting, the facilities may be visible from a portion of the Desert National Wildlife Range, a sensitive viewpoint about 10 to 13 miles away.
	• **Tritium Supply Alone**—Construction and operation would require 360 acres which represents 0.06 percent of the available land. Impacts would be the same as above.	• **Tritium Supply Alone**—Construction and operation would require 360 acres which represents 0.4 percent of the available land. Impacts would be the same as above.
	• **Less Then Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.	• **Less Then Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.

Land Resources

ORR	Pantex	SRS
• No impacts to land use or visual resources.	• No impacts to land use or visual resources.	• No impacts to land use or visual resources.
• **Collocated Tritium Supply and Recycling**—Construction and operation would require 456 acres, which represents 2.1 percent of the available land. A portion of this land is designated as National Environmental Research Park. Prime farmland or other agricultural activities would not be affected. The facilities would be visible from several highly sensitive viewpoints along high traffic volume roads in the area. The VRM classification of the proposed site would change from Class 4 to Class 5. Use of a wet cooling system would result in visible plumes during certain atmospheric conditions.	• **Collocated Tritium Supply and Recycling**—Construction and operation would require 456 acres, which represents 79 percent of industrial site A, 60 percent of B, 51 percent of C, and 5.7 percent of the total available land. The only land use impact would be the displacement of existing agricultural uses on soils classified as prime farmland. The existing visual landscape characteristics would remain unchanged with a VRM classification of Class 4.	• **Tritium Supply and Upgraded Recycling**—Construction and operation would require 260 acres which represents 0.1 percent of the available land. Prime farmland, agricultural activities, onsite or offsite land uses, or special study areas would not be affected. The VRM classification of the proposed site would change from Class 4 to Class 5, but the overall appearance of SRS would be unchanged from key sensitive viewpoints. Use of a wet cooling system would result in visible plumes during certain atmospheric conditions.
• **Tritium Supply Alone**—Construction and operation would require 260 acres which represents 1.2 percent of the available land. Impacts would be the same as above.	• **Tritium Supply Alone**—Construction and operation would require 260 acres which represents 3.3 percent of the available land. Impacts would be the same as above.	• No Tritium Supply Alone.
• **Less Than Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts would be expected to be the same as above for the tritium supply and upgraded recycling facility.
• **Collocated Tritium Supply and Recycling**—Construction and operation would require 556 acres, which represents 2.6 percent of the available land. A portion of this land is designated as National Environmental Research Park. Prime farmland or other agricultural activities would not be affected. The facilities would be visible from several highly sensitive viewpoints along high traffic volume roads in the area. The VRM classification of the proposed site would change from Class 4 to Class 5. Use of a wet cooling system would result in visible plumes during certain atmospheric conditions.	• **Collocated Tritium Supply and Recycling**—Construction and operation would require 556 acres, which represents 96 percent of industrial site A, 73 percent of B, 62 percent of C, and 7 percent of the total available land. The only land use impact would be the displacement of existing agricultural uses on soils classified as prime farmland. The existing visual landscape character would remain unchanged with a VRM classification of Class 4.	• **Tritium Supply and Upgraded Recycling**—Construction and operation would require 360 acres which represents 0.2 percent of the available land. Prime farmland, agricultural activities, onsite or offsite land uses, or special study areas would not be affected. The VRM classification of the proposed site would change from Class 4 to Class 5, but the overall appearance of SRS would be unchanged from key sensitive viewpoints. Use of a wet cooling system would result in visible plumes during certain atmospheric conditions.
• **Tritium Supply Alone**—Construction and operation would require 360 acre which represents 1.7 percent of the available land. Impacts would be the same as above.	• **Tritium Supply Alone**—Construction and operation would require 360 acres which represents 4.5 percent of the available land. Impacts would be the same as above.	• No Tritium Supply Alone.
• **Less Than Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts would be expected to be the same as above for the tritium supply and upgraded recycling facility.

Land Resources

Technology	INEL	NTS
Advanced Light Water Reactor	• **Collocated Tritium Supply and Recycling**—Construction and operation would require 546 acres for the Large and Small ALWR, which represents 0.1 percent of the available land. This use would be consistent with the INEL Landlord Site Development Plan and would not affect prime farmland, grazing allotments, other agricultural activities, or onsite or offsite land uses. The existing visual landscape characteristics would remain unchanged with a VRM classification of Class 4.	• **Collocated Tritium Supply and Recycling**—Construction and operation would require 546 acres for the Large and Small ALWR, which represents 0.6 percent of the available land. This use would be consistent with the NTS Site Development Plan and would not affect prime farmland, grazing allotments, other agricultural activities, or onsite or offsite land uses. The VRM classification of the proposed site would change from Class 2 to Class 5. Depending on the final siting, the facilities may be visible from a portion of the Desert National Wildlife Range, a sensitive viewpoint approximately 10 to 13 miles away.
	• **Tritium Supply Alone**—Construction and operation would require 350 acres which represents 0.06 percent of the available land. Impacts would be the same as above.	• **Tritium Supply Alone**—Construction and operation would require 350 acres which represents 0.4 percent of the available land. Impacts would be the same as above.
	• **Less Than Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.
Accelerator Production of Tritium	• **Collocated Tritium Supply and Recycling**—Construction and operation would require 369 acres, which represents 0.07 percent of the available land. This use would be consistent with the INEL Landlord Site Development Plan, and would not affect prime farmland, grazing allotments, other agricultural activities, or onsite or offsite land uses. The existing visual landscape characteristics would remain unchanged with a VRM classification of Class 4. The APT would be the least visually obtrusive technology since it consists of mostly low profile structures.	• **Collocated Tritium Supply and Recycling**—Construction and operation would require 369 acres, which represents 0.4 percent of the available land. This use would be consistent with the NTS Site Development Plan, would not affect prime farmland, grazing allotments, other agricultural activities, or onsite or offsite land uses. The VRM classification of the proposed site would change from Class 2 to Class 5. Depending on the final siting, the facilities may be visible from a portion of the Desert National Wildlife Range, a sensitive viewpoint approximately 10 to 13 miles away. The APT would be the least visually obtrusive technology since it consists of mostly low profile structures.
	• **Tritium Supply Alone**—Construction and operation would require 173 acres which represents 0.03 percent of the available land. Impacts would be the same as above.	• **Tritium Supply Alone**—Construction and operation would require 173 acres which represents 0.2 percent of the available land. Impacts would be the same as above.

Land Resources

ORR	Pantex	SRS
• **Collocated Tritium Supply and Recycling**—Construction nd operation would require 546 acres for the Large and Small ALWRs, which represents 2.5 percent of the available land. A portion of this land is designated as National Environmental Research Park. Prime farmland or other agricultural activities would not be affected. The facilities would be visible from several highly sensitive viewpoints along high traffic volume roads in the area. The VRM classification of the proposed site would change from Class 4 to Class 5. Use of a wet cooling system would result in visible plumes during certain atmospheric conditions.	• **Collocated Tritium Supply and Recycling**—Construction and operation of the Large and Small ALWRs would require 546 acres which represents 60 percent of industrial site A, 46 percent of B, 39 percent of C, and 3.9 percent of the total available land. The only land use impact would be the displacement of existing agricultural uses on soils classified as prime farmland. The existing visual landscape characteristics would remain unchanged with a VRM classification of Class 4.	• **Tritium Supply and Upgraded Recycling**—Construction and operation would require 350 acres for the Large and Small ALWRs which represents 0.2 percent of the available land. Prime farmland, agricultural activities, onsite or offsite land uses, or special study areas would not be affected. The VRM classification of the proposed site would change from Class 4 to Class 5, but the overall appearance of SRS would be unchanged from key sensitive viewpoints. Use of a wet cooling system would result in visible plumes during certain atmospheric conditions.
• **Tritium Supply Alone**—Construction and operation would require 350 acres which represents 1.6 percent of the available land. Impacts would be the same as above.	• **Tritium Supply Alone**—Construction and operation would require 350 acres which represents 2.5 percent of the available land. Impacts would be the same as above.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts would be expected to be the same as above for the tritium supply and upgraded recycling facility.
• **Collocated Tritium Supply and Recycling**—Construction and operation would require 369 acres, which represents 1.7 percent of the available land. A portion of this land is designated as National Environmental Research Park. These acreages represent 1.7 percent of the available land. Prime farmland or other agricultural activities would not be affected. The facilities would be visible from several highly sensitive viewpoints along high traffic volume roads in the area. The VRM classification of the proposed site would change from Class 4 to Class 5. The APT would be the least visually obtrusive technology since it consists of mostly low profile structures.	• **Collocated Tritium Supply and Recycling**—Construction and operation would both require 369 acres, which represents 64 percent of industrial site A, 49 percent of B, 41 percent of C, and 4.6 percent of the total available land. The only land use impact would be the displacement of existing agricultural uses on soils classified as prime farmland. The existing visual landscape characteristics would remain unchanged with a VRM classification of Class 4. The APT would be the least visually obtrusive technology since it consists of mostly low profile structures.	• **Tritium Supply and Upgraded Recycling**—Construction and operation would require 173 acres and represents 0.1 percent of the available land. Prime farmland, agricultural activities, onsite or offsite land uses, or special study areas would not be affected. The overall appearance of SRS would be unchanged from key sensitive viewpoints. Use of a wet cooling system would result in visible plumes during certain atmospheric conditions. The VMR classification of the proposed site would change from Class 4 to Class 5. The APT would be the least visually obtrusive technology since it consists of mostly low profile structures.
• **Tritium Supply Alone**—Construction and operation would require 173 acres which represents 0.8 percent of the available land. Impacts would be the same as above.	• **Tritium Supply Alone**—Construction and operation would require 173 acres which represents 2.2 percent of the available land. Impacts would be the same as above.	• **No Tritium Supply Alone.**

Land Resources

Technology	INEL	NTS
Accelerator Production of Tritium (Continued)	• **Less Then Baseline Operations—** Impacts would be the same as above for the collocated supply and recycling.	• **Less Then Baseline Operations—** Impacts would be the same as above for the collocated supply and recycling.
All Supply Technologies	• **Tritium Recycling Phaseout—**This action applies to any collocated tritium supply and new recycling facility at INEL. The phaseout of recycling at SRS would not impact land resources at the site.	• **Tritium Recycling Phaseout—**This action applies to any collocated tritium supply and new recycling facility at NTS. The phaseout of recycling at SRS would not impact land resources at the site.
Site Infrastructure		
No Action (2010)	• Reduction of 51 MWe in the peak electrical load requirement. Annual energy consumption would remain the same.	• Reduction of 7 MWe in the peak electrical load requirement. Annual energy consumption would remain the same.
Heavy Water Reactor	• **Collocated Tritium Supply and Recycling—**Operation would require 8 miles of additional onsite roads and 2 miles of railroads. The additional electrical load requirement over No Action would increase the sites peak requirement by 85 MWe and the annual consumption by 628,000 MWh per year. However, this would only exceed the current peak capacity of the site by 34 MWe and would utilize 0.62 percent of the regional power pools capacity margin. Six miles of new onsite transmission lines would be required. The additional fuel oil requirement would increase consumption by approximately 114 percent. The coal requirement would not increase.	• **Collocated Tritium Supply and Recycling—**Operation would require 2 miles of additional onsite roads. Should a railroad connection be needed, 120 miles of new rail and railbed would be required. The additional electrical load requirement would increase the sites peak requirement over No Action by 85 MWe and the annual consumption by 628,000 MWh per year. However, this would only exceed the current peak capacity of the site by 78 MWe and would utilize 0.72 percent of the regional power pools capacity margin. Twenty-five miles of new onsite transmission lines would be required. The additional fuel oil requirement would increase consumption by approximately 116 percent.
	• **Tritium Supply Alone—**Annual energy consumption would reduce by 88,000 MWh per year with a decrease in peak load of 16 MWe from above. The fuel oil requirement would reduce by 96,000 gal per year.	• **Tritium Supply Alone—** Annual energy consumption would reduce by 88,000 MWh per year with a decrease in peak load of 16 MWe from above. The fuel oil requirement would reduce by 96,000 gal per year.
	• **Less Than Baseline Operations—** Impacts are expected to be the same as for the collocated supply and recycling.	• **Less Than Baseline Operations—** Impacts are expected to be the same as for the collocated supply and recycling.

Land Resources

ORR	Pantex	SRS
• **Less Than Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts would be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts would be expected to be the same as above for the tritium supply and upgraded recycling facility.
• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at ORR. The phaseout of recycling at SRS would not impact land resources at the site.	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at Pantex. The phaseout of recycling at SRS would not impact land resources at the site.	• **No Tritium Recycling Phaseout with SRS Alternatives.**
Site Infrastructure		
• Reduction of 1,304 MWe in the peak electrical load requirement and 11,641,800 MWh per year in the annual energy consumption. Consumption of natural gas and fuel oil would reduce by 122 million ft^3 per year and 80,600 gal per year respectively, with an increase in coal consumption of 10,000 tons per year.	• Reduction of 1 MWe in the peak electrical load requirement and 7,000 MWh per year in the annual energy consumption. Consumption of natural gas and fuel oil would reduce by 50 million ft^3 per year and 14,000 gal per year respectively.	• Reduction of 214 MWe in the peak electrical load requirement and 878,000 MWh per year in the annual energy consumption.
• **Collocated Tritium Supply and Recycling**—Operation would require no additional onsite roads or railroads. The additional electrical load requirement would increase the sites peak requirement over No Action by 67 MWe and the annual consumption by 458,000 MWh per year. However, this would be 1,237 MWe less than the sites current peak capacity and would utilize 1.47 percent of the regional power pools capacity margin. No new onsite transmission lines would be required. The additional natural gas and fuel oil requirements would increase consumption over No Action by approximately 8 and 15 percent, respectively. The coal requirement would not increase.	• **Collocated Tritium Supply and Recycling**—Operation would require no additional onsite roads or railroads. The additional electrical load requirement would increase the sites peak requirement over No Action by 85 MWe and the annual consumption by 628,000 MWh per year. However, this would only exceed the current peak capacity of the site by 84 MWe and would utilize 2.09 percent of the regional power pools capacity margin. Nine miles of onsite transmission lines would need to be rerouted and connected to a new electrical substation. The additional natural gas and fuel oil requirements would increase consumption over No Action by approximately 53 and 51 percent, respectively.	• **Tritium Supply and Upgraded Recycling**—Operation would require an additional 6 miles of onsite roads and 6 miles of railroads. The additional electrical load requirement would increase the sites peak requirement over No Action by 51 MWe and the annual consumption by 370,000 MWh per year. However, this would be 163 MWe less than the site current peak capacity and would utilize 0.49 percent of the regional power pools capacity margin. Existing onsite transmission lines and facilities would need to be upgraded for the increased and redistributed electrical load. The additional fuel oil requirement would increase consumption by approximately 69 percent and the coal requirement would not increase. However, the overall increase in sitewide BTU consumption is only approximately 4 percent.
• **Tritium Supply Alone**—Annual energy consumption would reduce by 88,000 MWh per year with a decrease in peak load of 16 MWe from above. The natural gas and fuel oil requirements would reduce by 7 million ft^3 per year and 50,000 gal per year respectively.	• **Tritium Supply Alone**—Annual energy consumption would reduce by 88,000 MWh per year with a decrease in peak load of 16 MWe from above. The natural gas and fuel oil requirements would reduce by 7 million ft^3 per year and 50,000 gal per year respectively.	• **No Supply Alone.**
• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the tritium supply and upgraded recycling facilities.

Site Infrastructure

Technology	INEL	NTS
Modular High Temperature Gas-Cooled Reactor	• **Collocated Tritium Supply and Recycling**— Operation would require 8 miles of additional onsite roads and 2 miles of railroads. The additional electrical load requirement would increase the sites peak requirement over No Action by 62 MWe and the annual consumption by 448,000 MWh per year. However, this would only exceed the sites current peak capacity by 11 MWe and would utilize 0.45 percent of the regional power pools capacity margin. Six miles of new onsite transmission lines would be required. The additional fuel oil requirement would increase consumption over No Action by approximately 14 percent. The coal requirement would not increase. • **Tritium Supply Alone**—Operation power requirements would be reduced by 88,000 MWh per year with a decrease in peak load of 16 MWe. The fuel oil requirement would decrease by 96,000 gal per year. • **Less Than Baseline Operations**—Impacts are expected to be the same as for the collocated supply and recycling.	• **Collocated Tritium Supply and Recycling**— Operation would require 2 miles of additional onsite roads. Should a railroad connection be needed, 120 miles of new rail and railbed would be required. The additional electrical load requirement would increase the sites peak requirement over No Action by 62 MWe and the annual consumption by 448,000 MWh per year. However, this would only exceed the sites current peak capacity by 55 MWe and would utilize 0.53 percent of the regional power pools capacity margin. Twenty-five miles of new onsite transmission lines would be required. The additional fuel oil requirement would increase consumption over No Action by approximately 14 percent. • **Tritium Supply Alone**—Operation power requirements would be reduced by 88,000 MWh per year with a decrease in peak load of 16 MWe. The fuel oil requirement would decrease by 96,000 gal per year. • **Less Than Baseline Operations**—Impacts are expected to be the same as for the collocated supply and recycling.
Advanced Light Water Reactor	• **Collocated Tritium Supply and Recycling**— Operation of the Large and Small ALWRs would require 8 miles of additional onsite roads and 2 miles of railroads for both. The additional electrical load requirement would increase the sites peak requirement over No Action by 156 MWe or 91 MWe and the annual consumption by 1,188,000 MWh per year or 668,000 MWh per year, respectively. However, this would only exceed the current peak capacity of the site by 105 MWe or 40 MWe for the two size reactors. The Large and Small options of the ALWR would use either 1.14 or 0.67 percent of the regional power pools capacity margin. Six miles of new onsite transmission lines would be required. The additional fuel oil requirement would increase consumption over No Action by approximately 20 or 14 percent, respectively. The coal requirement would not increase for either ALWR.	• **Collocated Tritium Supply and Recycling**—Operation would require 2 miles of additional onsite roads. Should a railroad connection be needed, 120 miles of new rail and railbed would be required. The additional electrical load requirement would increase the peak requirement over No Action by 156 MWe or 91 MWe for the Large and Small ALWR and the annual consumption by 1,188,000 MWh per year or 668,000 MWh per year respectively. However, this would only exceed the current peak capacity by 149 MWe or 84 MWe for the two size reactors. The Large and Small options of the ALWR would use either 1.32 or 0.77 percent of the regional power pools capacity margin. Twenty-five miles of new onsite transmission lines would be required. The additional fuel oil requirement would increase consumption over No Action by approximately 20 or 14 percent, respectively.

Site Infrastructure

ORR	Pantex	SRS
• **Collocated Tritium Supply and Recycling**—Operation would require no additional onsite roads or railroads. The additional electrical load requirement would increase the sites peak requirement over No Action by 52 MWe and the annual consumption by 348,000 MWh per year. However, this would be 1,252 MWe less than the sites current peak capacity and would utilize 1.14 percent of the regional power pool capacity margin. No new onsite transmission lines would be required. The additional natural gas and fuel oil requirements would increase consumption over No Action by less than 1 percent and approximately 15 percent respectively. The coal requirement would not increase.	• **Collocated Tritium Supply and Recycling**—Operation would require no additional onsite roads or railroads. The additional electrical load requirement would increase the sites peak requirement over No Action by 62 MWe and the annual consumption by 448,000 MWh per year. However, this would only exceed the sites current peak capacity by 61 MWe and would utilize 53 percent of the regional power pools capacity margin. Nine miles of onsite transmission lines would need to be rerouted and connected to a new electrical substation. The additional natural gas and fuel oil requirements would increase consumption over No Action by approximately 3 and 50 percent respectively.	• **Tritium Supply and Upgraded Recycling**—Operation would require an additional 6 miles of onsite roads and 6 miles of railroads. The additional electrical load requirement would increase the sites peak requirement over No Action by 36 MWe and the annual consumption by 260,000 MWh per year. However, this would be 178 MWe less than the sites current peak capacity and would utilize 0.35 percent of the regional power pools capacity margin. Existing onsite transmission lines and facilities would need to be upgraded for the increased and redistributed electrical load. The additional fuel oil requirement would increase consumption by approximately 5 percent. The coal requirement would not increase.
• **Tritium Supply Alone**—Operation power requirements would be reduced by 88,000 MWh per year with a decrease in peak load of 16 MWe. The natural gas and fuel oil requirements would decrease by 7 million ft^3 per year and 50,000 gal per year respectively.	• **Tritium Supply Alone**—Operation power requirements would be reduced by 88,000 MWh per year with a decrease in peak load of 16 MWe. The natural gas and fuel oil requirements would decrease by 7 million ft^3 per year and 50,000 gal per year respectively.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—Impacts are expected to be the same as for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as for the tritium supply and upgraded recycling facilities.
• **Collocated Tritium Supply and Recycling**—Operation of the Large and Small ALWRs would require no additional onsite roads or railroads. The additional electrical load requirement would increase the sites peak requirement over No Action by 112 MWe or 68 MWe and the annual consumption by 788,000 MWh per year or 468,000 MWh per year, respectively. However, this would be 1,192 MWe or 1,236 MWe less than the sites current peak capacity for the two size reactors. The Large and Small options of the ALWR would use either 2.46 or 1.50 percent of the regional power pools capacity margin. No new onsite transmission lines would be required. The additional natural gas requirement would increase consumption by less than 1 percent for both reactors. The additional fuel oil requirement would increase consumption over No Action by approximately 28 or 18 percent, respectively. The coal requirement would not increase for either ALWR.	• **Collocated Tritium Supply and Recycling**—Operation of the Large and Small ALWRs would require no additional onsite roads or railroads. The additional electrical load requirement would increase the peak requirement over No Action by 156 MWe or 91 MWe and the annual consumption by 1,188,000 MWh per year or 668,000 MWh per year, respectively. However, this would only exceed the current peak capacity by 155 MWe or 90 MWe for the two size reactors. The Large and Small options of the ALWR would use either 3.84 or 2.24 percent of the regional power pool capacity margin. Nine miles of onsite transmission lines would need to be rerouted and connected to a new electrical substation. The additional natural gas requirement would increase consumption over No Action by approximately 2 percent for both reactors and the additional fuel oil requirement would increase consumption by approximately 96 or 62 percent respectively.	• **Tritium Supply and Upgraded Recycling**—Operation would require an additional 6 miles of onsite roads and 6 miles of railroads. The additional electrical load requirement would increase the peak requirement over No Action by 96 MWe or 52 MWe and the annual consumption by 700,000 MWh per year or 380,000 MWh per year, respectively. However, this would be 118 MWe or 162 MWe less than the sites current peak capacity for the two size reactors. The Large and Small options of the ALWR would use either 0.92 or 0.50 percent of the regional power pool capacity margin. Existing onsite transmission lines and facilities would need to be upgraded for the increased and redistributed electrical load. The additional fuel oil requirement would increase consumption by approximately 9 or 5 percent, respectively. The coal requirement would not increase for either ALWR.

Site Infrastructure

Technology	INEL	NTS
Advanced Light Water Reactor (Continued)	• **Tritium Supply Alone**—Operation power requirements would be reduced by 88,000 MWh per year with a decrease in peak load of 16 MWe. The fuel oil requirement would decrease by 96,000 gal per year.	• **Tritium Supply Alone**—Operation power requirements would be reduced by 88,000 MWh per year with a decrease in peak load of 16 MWe. The fuel oil requirement would decrease by 96,000 gal per year.
	• **Less Than Baseline Operations**—Impacts are expected to be the same as for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as for the collocated supply and recycling.
Accelerator Production of Tritium	• **Collocated Tritium Supply and Recycling**—Operation would require 11 miles of additional onsite roads and 2 miles of railroads. The additional electrical load requirement would increase the sites peak requirement over No Action by 566 MWe and the annual consumption by 3,828,000 MWh per year. However, this would only exceed the current sites peak capacity by 515 MWe and would utilize 4.15 percent of the regional power pools capacity margin. Six miles of new onsite transmission lines would be required. The additional fuel oil requirement would increase consumption over No Action by approximately 7 percent. The coal requirement would not increase.	• **Collocated Tritium Supply and Recycling**—Operation would require 4 miles of additional onsite roads. Should a railroad connection be needed, 120 miles of new rail and railbed would be required. The additional electrical load requirement would increase the sites peak requirement over No Action by 566 MWe and the annual consumption by 3,828,000 MWh per year. However, this would only exceed the sites current peak capacity by 559 MWe and would utilize 4.79 percent of the regional power pools capacity margin. Twenty-five miles of new onsite transmission lines would be required. The additional fuel oil requirement would increase consumption over No Action by approximately 7 percent.
	• **Tritium Supply Alone**—Operation power requirements would be reduced by 88,000 MWh per year with a decrease in peak load of 16 MWe. The fuel oil requirement would decrease by 96,000 gal per year.	• **Tritium Supply Alone**—Operation power requirements would be reduced by 88,000 MWh per year with a decrease in peak load of 16 MWe. The fuel oil requirement would decrease by 96,000 gal per year.
	• **Less Than Baseline Operations**—Except for electrical consumption, impacts are expected to remain the same as for the collocated supply and recycling. The Phased APT would use approximately 35 percent less electricity as the Full APT but would still increase the sites peak requirement by 371 MWe and the annual consumption by 2,488,000 MWh per year. However, this would only exceed the sites current peak capacity by 320 MWe and would utilize 2.72 percent of the regional power pool capacity margin.	• **Less Than Baseline Operations**—Except for electrical consumption, impacts are expected to remain the same as for the collocated supply and recycling. The Phased APT would use approximately 35 percent less electricity as the Full APT but would still increase the sites peak requirement by 371 MWe and the annual consumption by 2,488,000 MWh per year. However, this would only exceed the sites current peak capacity by 364 MWe and would utilize 3.14 percent of the regional power pools capacity margin.

Site Infrastructure

ORR	Pantex	SRS
• **Tritium Supply Alone**—Operation power requirements would be reduced by 88,000 MWh per year with a decrease in peak load of 16 MWe. The natural gas and fuel oil requirements would decrease by 7 million ft^3 per year and 50,000 gal per year, respectively.	• **Tritium Supply Alone**—Operation power requirements would be reduced by 88,000 MWh per year with a decrease in peak load of 16 MWe. The natural gas and fuel oil requirements would decrease by 7 million ft^3 per year and 50,000 gal per year, respectively.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—Impacts are expected to be the same as for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as for the tritium supply and upgraded recycling facilities.
• **Collocated Tritium Supply and Recycling**—Operation would require no additional onsite roads or railroads. The additional electrical load requirement would increase the sites peak requirement over No Action by 566 MWe and the annual consumption by 3,828,000 MWh per year. However, this would be 738 MWe less than the sites current peak capacity and would utilize 12.44 percent of the regional power pools capacity margin. No new onsite transmission lines would be required. The additional natural gas and fuel oil requirements would increase consumption over No Action by less than 1 percent and approximately 7 percent, respectively. The coal requirement would not increase.	• **Collocated Tritium Supply and Recycling**—Operation would require no additional onsite roads or railroads. The additional electrical load requirement would increase the sites peak requirement over No Action by 566 MWe and the annual consumption by 3,828,000 MWh per year. However, this would only exceed the sites current peak capacity by 565 MWe and would utilize 13.93 percent of the regional power pools capacity margin. Nine miles of onsite transmission lines would need to be rerouted and connected to a new electrical substation. The additional natural gas and fuel oil requirements would increase consumption over No Action by approximately 2 and 24 percent, respectively.	• **Tritium Supply and Upgraded Recycling**—Operation would require an additional 9 miles of onsite roads and 6 miles of railroads. The additional electrical load requirement would increase the sites peak requirement by 550 MWe and the annual consumption by 3,740,000 MWh per year. However, this would only exceed the sites current peak capacity by 336 MWe and would utilize 5.27 percent of the regional power pools capacity margin. Existing onsite transmission lines and facilities would need to be upgraded for the increased and redistributed electrical load. The additional fuel oil requirement would increase consumption by less than 1 percent. The coal requirement would not increase.
• **Tritium Supply Alone**—Operation power requirements would be reduced by 88,000 MWh per year with a decrease in peak load of 16 MWe. The natural gas and fuel oil requirements would decrease by 7 million ft^3 per year and 50,000 gal per year, respectively.	• **Tritium Supply Alone**—Operation power requirements would be reduced by 88,000 MWh per year with a decrease in peak load of 16 MWe. The natural gas and fuel oil requirements would decrease by 7 million ft^3 per year and 50,000 gal per year, respectively.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—Except for electrical consumption, impacts are expected to remain the same as for the collocated supply and recycling. The Phased APT would use approximately 30 percent less electricity as the Full APT but would still increase the sites peak requirement by 371 MWe and the annual consumption by 2,488,000 MWh per year. However, this would be 933 MWe less than the sites current peak capacity and would utilize 8.15 percent of the regional power pools capacity margin.	• **Less Than Baseline Operations**—Except for electrical consumption, impacts are expected to remain the same as for the collocated supply and recycling. The Phased APT would use approximately 35 percent less electricity as the Full APT but would still increase the peak requirement by 371 MWe and the annual consumption by 2,488,000 MWh per year. However, this would only exceed the current peak capacity by 370 MWe and would utilize 9.13 percent of the regional power pools capacity margin.	• **Less Than Baseline Operations**—Except for electrical consumption, impacts are expected to remain the same as for the tritium supply and upgraded recycling. The Phased APT would use approximately 30 percent less electricity than the Full APT but would still increase the sites peak requirement over No Action by 355 MWe and the annual consumption by 2,400,000 MWh per year. However, this would only exceed the sites current peak capacity by 141 MWe and would utilize 3.4 percent of the regional power pools capacity margin.

Site Infrastructure

Technology	INEL	NTS
All Supply Technologies	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at INEL. The phaseout of recycling at SRS would reduce the requirements for electrical current, current available electrical resources, fuel oil, and coal by 203 MWe, 1,037,000 MWh per year, 60,000 GPY, and 5,200 tons per year, respectively.	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at NTS. The phaseout of recycling at SRS would reduce the requirements for electrical current, current available electrical resources, fuel oil, and coal by 203 MWe, 1,037,000 MWh per year, 60,000 GPY, and 5,200 tons per year, respectively.
	Air Quality and Acoustics	
No Action (2010)	• Air quality or acoustics impacts would not differ substantially from what presently occurs at the site.	• Air quality or acoustics impacts would not differ substantially from what presently occurs at the site.
Heavy Water Reactor	• **Collocated Tritium Supply and Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} and TSP standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards. • An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public. • **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced. • **Less Than Baseline Operations**—Air emissions would be slightly reduced but negligible from those described above for the collocated supply and recycling. Noise impacts would not change during less than baseline operations.	• **Collocated Tritium Supply and Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards. • An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public. • **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced. • **Less Than Baseline Operations**—Air emissions would be slightly reduced but negligible from those described above for the collocated supply and recycling. Noise impacts would not change during less than baseline operations.
Modular High Temperature Gas-Cooled Reactor	• **Collocated Tritium Supply and Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} and TSP standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards. • An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.	• **Collocated Tritium Supply and Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards. • An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.

Site Infrastructure

ORR	Pantex	SRS
• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at ORR. The phaseout of recycling at SRS would reduce the requirements for electrical current, current available electrical resources, fuel oil, and coal by 203 MWe, 1,037,000 MWh per year, 60,000 GPY, and 5,200 tons per year, respectively.	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at Pantex. The phaseout of recycling at SRS would reduce the requirements electrical current, current available electrical resources, fuel oil, and coal by 203 MWe, 1,037,000 MWh per year, 60,000 GPY, and 5,200 tons per year, respectively.	• **No Tritium Recycling Phaseout with SRS Alternatives.**
Air Quality and Acoustics		
• Air quality or acoustics impacts would not differ substantially from what presently occurs at the site.	• Air quality or acoustics impacts would not differ substantially from what presently occurs at the site.	• Air quality or acoustics impacts would not differ substantially from what presently occurs at the site.
• **Collocated Tritium Supply and Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} and TSP standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards.	• **Collocated Tritium Supply and Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards.	• **Tritium Supply and Upgraded Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards.
• An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.	• An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.	• An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.
• **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced.	• **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced.	• No Tritium Supply Alone.
• **Less Than Baseline Operations**—Air emissions would be slightly reduced but negligible from those described above for the collocated supply and recycling. Noise impacts would not change during less than baseline operations.	• **Less Than Baseline Operations**—Air emissions would be slightly reduced but negligible from those described above for the collocated supply and recycling. Noise impacts would not change during less than baseline operations.	• **Less Than Baseline Operations**—Emissions would be slightly reduced but negligible from those described above from baseline operations. There would be no change in noise levels.
• **Collocated Tritium Supply and Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} and TSP standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards.	• **Collocated Tritium Supply and Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards.	• **Tritium Supply and Upgraded Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards.
• An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.	• An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.	• An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.

Air Quality and Acoustics

Technology	INEL	NTS
Modular High Temperature Gas-Cooled Reactor (Continued)	• **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced and negligible. • **Less Than Baseline Operations**—Air emissions from the two-reactor-module would not change because it would continue to operate at the same level as the baseline to maintain power levels for steam or electrical production. Noise impacts would not change due to less than baseline operations.	• **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced and negligible. • **Less Than Baseline Operations**—Air emissions from the two-reactor-module would not change because it would continue to operate at the same level as the baseline to maintain power levels for steam or electrical production. Noise impacts would not change due to less than baseline operations.
Advanced Light Water Reactor	• **Collocated Tritium Supply and Recycling**—Construction activities for the Large or Small ALWR would result in exceedances of 24-hour ambient PM_{10} and TSP standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards. • For both the Large or Small ALWR, an increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public. • **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced. • **Less Than Baseline Operations**—Air emissions would be the same as those described above for the collocated supply and recycling. Noise impacts would not change during less than baseline operations.	• **Collocated Tritium Supply and Recycling**—Construction activities for the Large or Small ALWR would result in exceedances of 24-hour ambient PM_{10} standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Pollutant concentrations would increase during operation but would be within standards. • For both the Large or Small ALWR, an increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public. • **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced. • **Less Than Baseline Operations**—Air emissions would be the same as those described above for the collocated supply and recycling. Noise impacts would not change during less than baseline operations.
Accelerator Production of Tritium	• **Collocated Tritium Supply and Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} and TSP standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards. • An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.	• **Collocated Tritium Supply and Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards. • An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.

Air Quality and Acoustics

ORR	Pantex	SRS
• **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced.	• **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—Air emissions from the two-reactor-module would not change because it would continue to operate at the same level as the baseline to maintain power levels for steam or electrical production. Noise impacts would not change due to less than baseline operations.	• **Less Than Baseline Operations**—Air emissions from the two-reactor-module would not change because it would continue to operate at the same level as the baseline to maintain power levels for steam or electrical production. Noise impacts would not change due to less than baseline operations.	• **Less Than Baseline Operations**—Emissions would be slightly reduced but negligible from those described above for baseline operations. There would be no change in noise levels.
• **Collocated Tritium Supply and Recycling**—Construction activities for the Large or Small ALWR would result in exceedances of 24-hour ambient PM_{10} and TSP standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards.	• **Collocated Tritium Supply and Recycling**—Construction activities for the Large or Small ALWR would result in exceedances of 24-hour ambient PM_{10} standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards.	• **Tritium Supply and Upgraded Recycling**—Construction activities for the Large or Small ALWR would result in exceedances of 24-hour ambient PM_{10} standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards.
• For both the Large or Small ALWR, an increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.	• For both the Large or Small ALWR, an increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.	• For both the Large or Small ALWR, an increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.
• **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced.	• **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—Air emissions would be the same as those described above for the collocated supply and recycling. Noise impacts would not change during less than baseline operations.	• **Less Than Baseline Operations**—Air emissions would be the same as those described above for the collocated supply and recycling. Noise impacts would not change during less than baseline operations.	• **Less Than Baseline Operations**—Emissions would be slightly reduced but negligible from those described above for baseline operations. There would be no change in noise levels.
• **Collocated Tritium Supply and Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} and TSP standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards.	• **Collocated Tritium Supply and Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards.	• **Tritium Supply and Upgraded Recycling**—Construction activities would result in exceedances of 24-hour ambient PM_{10} standards at peak times and in dry and windy conditions. All other pollutants would be within standards. Air pollutant concentrations would increase during operation but would be within standards.
• An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.	• An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.	• An increase in noise would result from construction and operation. Increases would not be expected to cause annoyance to the public.

Air Quality and Acoustics

Technology	INEL	NTS
Accelerator Production of Tritium (Continued)	• **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced. • **Less Than Baseline Operations**—Air emissions would be the same as those described above for the collocated supply and recycling. Noise impacts would not change due to less than baseline operations.	• **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced. • **Less Than Baseline Operations**—Air emissions would be the same as those described above for the collocated supply and recycling. Noise impacts would not change due to less than baseline operations.
All Supply Technologies	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at INEL. The air emissions contribution from recycling activities at SRS is so low that the reduction due to phaseout would not be measurable.	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at NTS. The air emissions contribution from recycling activities at SRS is so low that the reduction due to phaseout would not be measurable.

Air Quality and Acoustics

ORR	Pantex	SRS
• **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced.	• **Tritium Supply Alone**—Construction and operation air emissions would be slightly less than those expected from the collocated supply and recycling. Noise levels would also be slightly reduced.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—Air emissions would be the same as those described above for the collocated supply and recycling. Noise impacts would not change due to less than baseline operations.	• **Less Than Baseline Operations**—Air emissions would be the same as those described above for the collocated supply and recycling. Noise impacts would not change due to less than baseline operations.	• **Less Than Baseline Operations**—Emissions would be slightly reduced but negligible from those described above for baseline operations. There would be no change in noise levels.
• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at ORR. The air emissions contribution from recycling activities at SRS is so low that the reduction due to phaseout would not measurable.	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at Pantex. The air emissions contribution from recycling activities at SRS is so low that the reduction due to phaseout would not measurable.	• **No Tritium Recycling Phaseout with SRS Alternatives.**

Air Quality and Acoustics

Technology	INEL	NTS
No Action (2010)	• No impacts to water resources.	• No impacts to water resources.
Heavy Water Reactor	• **Collocated Tritium Supply and Recycling**—No surface water would be used during construction or operation, and there would be no discharges to surface water. Stormwater runoff would have negligible impacts on surface waters during construction and operation. • Groundwater use would increase by approximately 23 MGY (1 percent) during construction and by 62 MGY (3 percent) during operation. The increase in groundwater use over No Action would represent less than 1 percent of the groundwater allotment during construction and operation, respectively. There would be no discharges to groundwater, and impacts to groundwater quality would not be expected.	• **Collocated Tritium Supply and Recycling**—No surface water would be used during construction or operation, and there would be no discharges to surface water. Stormwater runoff would have negligible impacts on surface waters during construction and operation. • Groundwater use would increase by approximately 23 MGY (3 percent) during construction and by 62 MGY (9 percent) during operation. Withdrawals during operation would not exceed the lowest estimated aquifer recharge rate. There would be no discharges to groundwater, and impacts to groundwater quality would not be expected.

Air Quality and Acoustics

ORR	Pantex	SRS
• No impacts to water resources.	• Under No Action current groundwater usage of 257 MGY would increase to 286 MGY by the year 2005.	• No impacts to water resources.
• **Collocated Tritium Supply and Recycling**—Surface water use would increase by approximately 23 MGY (1 percent) during construction and by 5,914 MGY (320 percent) during operation. Total site surface water use would represent less than 0.002 percent and less than 1 percent of the flow of the primary source during construction and operation, respectively. Approximately 16.5 MGY of additional nonhazardous and/or sanitary wastewater generated during construction and 48 MGY during operation would be discharged to surface waters. Blowdown discharges to surface waters would be approximately 2,304 MGY, which could increase the flow of the receiving waters by 0.2 percent. Blowdown discharges are not expected to impact permitted water quality discharge levels. Stormwater runoff would have negligible impacts on surface waters during construction and operation.	• **Collocated Tritium Supply and Recycling**—No surface water would be used during construction or operation. Approximately 17 MGY of nonhazardous and/or sanitary wastewater generated during construction and 48 MGY during operation would be discharged to playas. These represent increases of approximately 9 percent and 26 percent change in flow of wastewater to playas. Stormwater runoff would have negligible impacts on surface waters during construction and operation.	• **Tritium Supply and Upgraded Recycling**—No surface water would be used during construction, but use would increase by approximately 5,888 MGY during operation. This represents approximately an 30 percent increase in use and less than 1 percent of the flow of the primary source. Approximately 17 MGY of additional nonhazardous and sanitary wastewater generated during construction and 78 MGY during operation would be discharged to surface waters. These represent increases of approximately 1 percent and 3 percent in stream flow. Blowdown discharges to surface waters would be approximately 2,304 MGY, which could increase the flow of the receiving waters by 168 percent. Stormwater runoff would have negligible impacts on surface waters during construction and operation.
• No groundwater would be used during construction or operation. There would be no discharges to groundwater, and impacts to groundwater quality would not be expected.	• Groundwater would not be used for construction or operation. Reclaimed wastewater will be available to meet water requirements of 23 MGY during construction and 62 MGY during operations. This represents an increase of less than 1 percent, respectively, of the projected available reclaimed wastewater. There would be no direct discharges to groundwater, but treated wastewater discharged to playas could percolate into the groundwater.	• Groundwater use would increase by 21 MGY (<1 percent) during construction and by 63 MGY (2 percent) during operation. Drawdown impacts are not expected. There would be no discharges to groundwater and impacts to groundwater quality are not expected.

Water Resources

Technology	INEL	NTS
Heavy Water Reactor (Continued)	• There would be no impacts associated with floodplains.	• There are no designated floodplains at NTS however, a 500-year floodplain assessment would be required.
	• **Tritium Supply Alone**—Total groundwater requirement would decrease 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced.	• **Tritium Supply Alone**—Total groundwater requirement would decrease 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced.
	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.
Modular High Temperature Gas-Cooled Reactor	• **Collocated Tritium Supply and Recycling**—No surface water would be used during construction or operation, and there would be no discharges to surface water. Stormwater runoff would have negligible impacts on the surface waters during construction and operation.	• **Collocated Tritium Supply and Recycling**—No surface water would be used during construction or operation, and there would be no discharges to surface water. Stormwater runoff would have negligible impacts on the surface waters during construction and operation.
	• Groundwater use would increase by approximately 19 MGY (1 percent) during construction and by 44 MGY (2 percent) during operation. The increase in groundwater use over No Action would represent less than 1 percent of the groundwater allotment during construction and operation, respectively. There would be no discharges to groundwater, and impacts to groundwater quality would not be expected.	• Groundwater use would increase by approximately 19 MGY (3 percent) during construction and by 44 MGY (7 percent) during operation. Withdrawals during operation would not exceed the lowest estimated aquifer recharge rate. There would be no discharges to groundwater, and impacts to groundwater quality would not be expected.

Water Resources

ORR	Pantex	SRS
• No construction will take place in areas designated as 100-year floodplains, however, a 500-year floodplain assessment would be required.	• No construction will take place in areas designated as 100-year floodplains, however, a 500-year floodplain assessment would be required.	• No construction will take place in areas designated as 100-year floodplains, however, a 500-year floodplain assessment would be required.
• **Tritium Supply Alone**—Total surface water requirement would decrease 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced. Wastewater discharge to surface waters would decrease by 0.9 MGY during construction and by 13 MGY during operation.	• **Tritium Supply Alone**—Total reclaimed wastewater requirement would decrease 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced. Wastewater discharge to playas would decrease by 0.9 MGY during construction.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the tritium supply and upgraded recycling facility.
• **Collocated Tritium Supply and Recycling**—Surface water use would increase by approximately 19 MGY (1 percent) during construction and by 4,014 MGY (217 percent) during operation. Total site surface water use would represent less than 0.002 percent and less than 1 percent of the flow of the primary source during construction and operation, respectively. Approximately 13.6 MGY of additional nonhazardous and/or sanitary wastewater generated during construction and 30 MGY during operation would be discharged to surface waters. Blowdown discharges to surface waters would be approximately 1,608 MGY, which could increase the flow of the receiving waters by 91 percent. Blowdown discharges are not expected to impact permitted water quality discharge levels. Stormwater runoff would have negligible impacts on surface waters during construction and operation.	• **Collocated Tritium Supply and Recycling**—No surface water would be used during construction or operation. Approximately 14 MGY of nonhazardous and/or sanitary wastewater generated during construction and 30 MGY during operation would be discharged to playas. These represent increases of approximately 7 percent and 16 percent. Stormwater runoff would have negligible impacts on surface waters during construction and operation.	• **Tritium Supply and Upgraded Recycling**—No surface water would be used during construction, but would increase by approximately 4,006 MGY during operation. This represents approximately a 20 percent increase in use and less than 1 percent of the flow of the primary source. Approximately 14 MGY of additional nonhazardous and sanitary wastewater generated during construction and 61 MGY during operation would be discharged to surface waters. These represent increases of approximately 1 percent and 3 percent in stream flow. Blowdown discharges to surface waters would be approximately 1,608 MGY, which could increase the flow of the receiving waters by 118 percent. Stormwater runoff would have negligible impacts on surface waters during construction and operation.
• No groundwater would be used during construction or operation. There would be no discharges to groundwater, and impacts to groundwater quality would not be expected.	• No groundwater would be used during construction or operation. Reclaimed wastewater will be available to meet water requirements of 19 MGY during construction and 44 MGY during operation. This represents a less than one and 1 percent increase, respectively, of the projected available reclaimed wastewater. There would be no direct discharges to groundwater, but treated wastewater discharged to playas could percolate into the groundwater.	• Groundwater use would increase by 18 MGY (<1 percent) during construction and by 45 MGY (1 percent) during operation. Drawdown impacts are not expected. There would be no discharges to groundwater, and impacts to groundwater quality are not expected.

Water Resources

Technology	INEL	NTS
Modular High Temperature Gas-Cooled Reactor (Continued)	• There would be no impacts associated with floodplains. • **Tritium Supply Alone**—Total groundwater requirement would decrease 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced. • **Less Than Baseline Operations**—Impacts to surface water and groundwater quality are expected to be the same as above for the collocated supply and recycling.	• There are no designated floodplains at NTS, however a 500-year floodplain assessment would be required. • **Tritium Supply Alone**—Total groundwater requirement would decrease 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced. • **Less Than Baseline Operations**—Impacts to surface water and groundwater quality are expected to be the same as above for the collocated supply and recycling.
Advanced Light Water Reactor	• **Collocated Tritium Supply and Recycling**—No surface water would be used during construction or operation for either the Large or Small ALWRs, and there would be no discharges to surface water. Stormwater runoff would have negligible impacts on surface waters during construction and operation.	• **Collocated Tritium Supply and Recycling**—No surface water would be used during construction or operation for either the Large or Small ALWRs, and there would be no discharges to surface water. Stormwater runoff would have negligible impacts on surface waters during construction and operation.

Water Resources

ORR	Pantex	SRS
• No construction will take place in areas designated as 100-year floodplains, however, a 500-year floodplain assessment would be required.	• No construction will take place in areas designated as 100-year floodplains, however, a 500-year floodplain assessment would be required.	• No construction will take place in areas designated as 100-year floodplains, however, a 500-year floodplain assessment would be required.
• **Tritium Supply Alone**—Total surface water requirement would decrease 1.5 MGY during construction and 14 MGY during operation; therefore the potential impacts to water resources would be slightly reduced. Wastewater discharge to surface waters would decrease by 0.9 MGY during construction and by 13 during operations.	• **Tritium Supply Alone**—Total reclaimed wastewater requirement would decrease 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced. Wastewater discharge to playas would decrease 0.9 MGY during construction.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the tritium supply and upgraded recycling facility.
• **Collocated Tritium Supply and Recycling**—Surface water use would increase by approximately 35 MGY (2 percent) during construction and by 16,014 MGY (866 percent) during operation for the Large ALWR and 22 MGY (1 percent) during construction and 7,214 MGY (390 percent) for the Small ALWR. Total site surface water use would represent less than 0.002 and 0.002 percent of the flow of the primary source during construction and 1 percent and less than 1 percent during operation for the Large and Small ALWRs, respectively. Approximately 27.5 and 15.5 MGY of additional nonhazardous and/or sanitary wastewater generated during construction and 90 and 50 MGY during operation would be discharged to surface waters for the Large and Small ALWRs, respectively. Blowdown discharges to surface waters would be approximately 6,192 and 2,808 MGY, which could increase the flow of the receiving waters by 0.5 and 0.2 percent for the Large and Small ALWRs, respectively. Blowdown discharges are not expected to impact permitted water quality discharge levels. Stormwater runoff would have negligible impacts on surface waters during construction and operation.	• **Collocated Tritium Supply and Recycling**—No surface water would be used during construction or operation for either the Large or Small ALWR. Approximately 28 MGY of nonhazardous and/or sanitary wastewater generated during construction and 90 MGY during operation for the Large ALWR, and approximately 16 MGY and 50 MGY and for the Small ALWR would be discharged to playas. These represent increases of approximately 15 percent, 49 percent, 8 percent, and 27 percent, respectively. Stormwater runoff would have negligible impacts on surface waters during construction and operation.	• **Tritium Supply and Upgraded Recycling**—No surface water would be withdrawn during construction, but use would increase by approximately 15,546 MGY and 7,186 MGY during operation of the Large ALWR and Small ALWR, respectively. This represents approximately 78 percent and 36 percent increase in use and 1 and less than 1 percent increase in the flow of the primary source. Approximately 28 and 16 MGY of nonhazardous and sanitary wastewater is generated during construction for the Large and Small ALWR and 121 MGY during operation for the Large ALWR and 81 MGY for the Small ALWR would be discharged to surface waters. These represent increases of approximately 2 percent, 1 percent, 7 percent and 4 percent in stream flow. Blowdown discharges to surface waters would be approximately 6,192 MGY and 2,808 MGY, which could increase the flow of the receiving waters by 452 and 205 percent, respectively. Stormwater runoff would have negligible impacts on surface waters during construction and operation.

Water Resources

Technology	INEL	NTS
Advanced Light Water Reactor (Continued)	• Groundwater use would increase by approximately 35 MGY (2 percent) during construction and by 104 MGY (5 percent) during operation for the Large ALWR and 22 MGY (1 percent) during construction and 64 MGY (3 percent) for the Small ALWR. The increase in groundwater use over No Action would represent less than 1 percent of the groundwater allotment during construction and operation of the groundwater allotment for the Large and Small ALWRs, respectively. There would be no discharges to groundwater, and impacts to groundwater quality would not be expected with either ALWR.	• Groundwater use would increase by approximately 35 MGY (5 percent) during construction and by 104 MGY (16 percent) during operation for the Large ALWR and 22 MGY (3 percent) during construction and 64 MGY (10 percent) for the Small ALWR. Withdrawals during operation would not exceed the lowest estimated aquifer recharge rate. There would be no discharges to groundwater, and impacts to groundwater quality would be not expected with either ALWR.
	• There would be no impacts associated with floodplains.	• There are no designated floodplains at NTS, however, a 500-year floodplain assessment would be required.
	• **Tritium Supply Alone**—Total groundwater requirement would decrease 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced.	• **Tritium Supply Alone**—Total groundwater requirement would decrease 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced.
	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.
Accelerator Production of Tritium	• **Collocated Tritium Supply and Recycling**—No surface water would be used during construction or operation, and there would be no discharges to surface water. Stormwater runoff would have negligible impacts on surface waters during construction and operation.	• **Collocated Tritium Supply and Recycling**—No surface water would be used during construction or operation, and there would be no discharges to surface water. Stormwater runoff would have negligible impacts on surface waters during construction and operation.

Water Resources

ORR	Pantex	SRS
• No groundwater would be used during construction or operation for either the Large or Small ALWRs. There would be no discharges to groundwater, and impacts to groundwater quality would not be expected.	• No groundwater would be used during construction or operation reclaimed wastewater will be available to meet water requirements of 35 MGY for the Large ALWR and 22 MGY for the Small ALWR during construction 104 MGY and 64 MGY, respectively, during operation. This represents an increase of projected available reclaimed wastewater of less than 1 percent during construction and 2 percent during operation. There would be no direct discharges to groundwater, but treated wastewater discharged to playas could percolate into the groundwater.	• Groundwater use would increase by 33 MGY (1 percent) during construction and by 105 MGY (3 percent) during operation for the Large ALWR and 20 MGY (<1 percent) and 65 MGY (2 percent) for the Small ALWR. Drawdown impacts are not expected. There would be no discharges to groundwater, and impacts to groundwater quality are not expected.
• No construction will take place in areas designated as 100-year floodplains, however, a 500-year floodplain assessment would be required.	• No construction will take place in areas designated as 100-year floodplains, however, a 500-year floodplain assessment would be required.	• No construction will take place in areas designated as 100-year floodplains, however, a 500-year floodplain assessment would be required.
• **Tritium Supply Alone**—Total surface water requirement would decrease 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced. Wastewater discharges to surface water would decrease by 0.9 MGY during construction and by 13 MGY during operation.	• **Tritium Supply Alone**—Total groundwater requirement would decrease 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced. Wastewater discharge to playas would decrease by 0.9 MGY during construction.	• No tritium Supply Alone.
• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as the above for the tritium supply and upgraded recycling facility.
• **Collocated Tritium Supply and Recycling**—Surface water use would increase by approximately 10 MGY (>1 percent) during construction for the Phased and Full APT and by 784 MGY (42 percent) and by 1,214 MGY (66 percent) during operation, respectively. Total site surface water use would represent less than 0.002 percent during construction and less than one percent of the flow of the primary source during operation for the Phased and Full APT, respectively. Approximately 0.3 MGY of additional nonhazardous and/or sanitary wastewater generated during construction and 0.2 MGY during operation would be discharged to surface waters, respectively.	• **Collocated Tritium Supply and Recycling**—No surface water would be used during construction or operation, and there would be no discharges to surface water. However, less than 1 MGY of nonhazardous and/or sanitary wastewater generated during construction would be discharged to playas. This represents an increase of <1 percent. Stormwater runoff would have negligible impacts on surface waters during construction and operation.	• **Tritium Supply and Upgrade Recycling**—No surface water would be used during construction, but use would increase by approximately 799 MGY and 1,229 MGY during operation for the Phased and Full APT. This represents approximately a 4 percent and 6 percent increase in use and less than 1 percent of the flow of the primary source. Approximately 0.3 MGY of additional nonhazardous and sanitary wastewater generated during construction for both the Phased and Full APT and 38 MGY during operation would be discharged to surface waters. The 38 MGY represents an increase of less than 1 percent change in stream flow.

Water Resources

Technology	INEL	NTS
Accelerator Production of Tritium (Continued)		
	• Groundwater use would increase by approximately 10 MGY (<1percent) during construction for the Phased and Full APT and by 784 MGY (39 percent) and by 1,214 MGY (61 percent) during operation, respectively. The increase in groundwater use over No Action would represent less than 1 percent of the groundwater allotment during construction for both the Full and Phased APT and 11percent and 7 percent during operation, respectively. There would be no discharges to groundwater, and impacts to groundwater quality would not be expected.	• Groundwater use would increase by approximately 10 MGY (1 percent) during construction for the Phased and Full APT and by 784 MGY (117 percent) and 1,214 MGY (181 percent) during operation, respectively. Withdrawals during operation of the Full APT would not exceed the lowest estimated-aquifer recharge rate. There would be no discharges to groundwater and impacts to groundwater quality would not be expected.
	• There would be no impacts associated with floodplains.	• There are no designated floodplains at NTS, however, a 500-year floodplain assessment would be required.

Water Resources

ORR	Pantex	SRS
Blowdown discharges to surface waters would be approximately 384 MGY, which could increase the flow of the receiving waters by 0.03 percent. Blowdown discharges are not expected to impact permitted water quality discharge levels. Stormwater runoff would have negligible impacts on surface waters during construction and operation.		Blowdown discharges to surface waters would be approximately 384 MGY, which could increase the flow of the receiving waters by 28 percent. Stormwater runoff would have negligible impacts on surface waters during construction and operation.
• No groundwater would be used during construction or operation. There would be no discharges to groundwater, and no impacts to groundwater quality would be expected.	• No groundwater would be used during construction operation. Reclaimed wastewater will be available to meet water requirements of 10 MGY for both the Full and Phased APT during construction and 1,214 MGY and 784 MGY during operation, respectively. This represents an increase of projected available reclaimed wastewater of less than 1 percent during construction and for the Full and Phased APT, 28 and 18 percent during operation, respectively. There would be no direct discharges to groundwater, but treated wastewater discharged to playas could percolate into the groundwater.	• Groundwater use would increase by 8 MGY (<1 percent) during construction and by 22 MGY (<1 percent) during operation for the Phased and Full APT. Drawdown impacts are not expected. There would be no discharges to groundwater, and impacts to groundwater quality are not expected.
• No construction will take place in areas designated as 100-year floodplains, however, a 500-year floodplain assessment would be required.	• No construction will take place in areas designated as 100-year floodplains, however, a 500-year floodplain assessment would be required.	• No construction will take place in areas designated as 100-year floodplains, however, a 500-year floodplain assessment would be required.

Water Resources

Technology	INEL	NTS
Accelerator Production of Tritium (Continued)	• **Tritium Supply Alone**—Total groundwater requirement would decrease from collocated by 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced.	• **Tritium Supply Alone**—Total groundwater requirement would decrease from collocated by 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced.
	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.
All Supply Technologies	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling at INEL. The phaseout of recycling at SRS would decrease wastewater discharges to Three Runs Creek and Fourmile Branch by 0.3 percent and 3.2 percent and decrease groundwater withdraws by 134.5 MGY. The reduced wastewater discharge and reduced groundwater withdrawals would slightly decrease the potential impacts to water resources.	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling at NTS. The phaseout of recycling at SRS would decrease wastewater discharges to Three Runs Creek and Fourmile Branch by 0.3 percent and 3.2 percent and decrease groundwater withdraws by 134.5 MGY. The reduced wastewater discharge and reduced groundwater withdrawals would slightly decrease the potential impacts to water resources.

Water Resources

ORR	Pantex	SRS
• **Tritium Supply Alone**—Total surface water requirement would decrease from collocated 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced. Wastewater discharges to surface water would decrease by 0.9 MGY during construction and by 13 MGY during operation.	• **Tritium Supply Alone**—Total groundwater requirement would decrease from collocated 1.5 MGY during construction and 14 MGY during operation, therefore the potential impacts to water resources would be slightly reduced. Wastewater discharge to playas would decrease 0.9 MGY during construction.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the tritium supply and upgraded recycling facility.
• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling at ORR. The phaseout of recycling at SRS would decrease wastewater discharges to Three Runs Creek and Fourmile Branch by 0.3 percent and 3.2 percent and decrease groundwater withdraws by 134.5 MGY. The reduced wastewater discharge and reduced groundwater withdrawals would slightly decrease the potential impacts to water resources.	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling at Pantex. The phaseout of recycling at SRS would decrease wastewater discharges to Three Runs Creek and Fourmile Branch by 0.3 percent and 3.2 percent and decrease groundwater withdraws by 134.5 MGY. The reduced wastewater discharge and reduced groundwater withdrawals would slightly decrease the potential impacts to water resources.	• **No Tritium Supply Recycling Phaseout with SRS Alternatives.**

Geology and Soils

Technology	INEL	NTS
No Action (2010)	• No impacts to geology or soils.	• No impacts to geology or soils.
Heavy Water Reactor	• **Collocated Tritium Supply and Recycling**—Construction and operation would not affect geologic conditions nor would the facilities be affected by geologic conditions. • Soil conditions would not affect construction or operation. A total of 462 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action. • **Tritium Supply Alone**—Construction and operation impacts to geology and soils would be the same as above. A total of 260 acres would be disturbed. • **Less Than Baseline Operations**—Impacts are the same as above for the collocated supply and recycling.	• **Collocated Tritium Supply and Recycling**—Construction and operation would not affect geologic conditions nor would the facilities be affected by geologic conditions. • Soil conditions would not affect construction or operation. A total of 462 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action. • **Tritium Supply Alone**—Construction and operation impacts to geology and soils would be the same as above. A total of 260 acres would be disturbed. • **Less Than Baseline Operations**—Impacts are the same as above for the collocated supply and recycling.
Modular High Temperature Gas-Cooled Reactor	• **Collocated Tritium Supply and Recycling**—Construction and operation would not affect geologic conditions and the facilities would not be affected by geologic conditions. • Soil conditions would not affect construction or operation. A total of 562 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action. • **Tritium Supply Alone**—Construction and operation impacts to geology and soils would be the same as above. A total of 360 acres would be disturbed. • **Less Than Baseline Operations**—Impacts are the same as above for the collocated supply and recycling.	• **Collocated Tritium Supply and Recycling**—Construction and operation would not affect geologic conditions and the facilities would not be affected by geologic conditions. • Soil conditions would not affect construction or operation. A total of 562 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action. • **Tritium Supply Alone**—Construction and operation impacts to geology and soils would be the same as above. A total of 360 acres would be disturbed. • **Less Than Baseline Operations**—Impacts are the same as above for the collocated supply and recycling.

Geology and Soils

ORR	Pantex	SRS
No impacts to geology or soils.	No impacts to geology or soils.	No impacts to geology or soils.
Collocated Tritium Supply and Recycling—Construction and operation would not affect geologic conditions, nor would the facilities be affected by geologic conditions.	**Collocated Tritium Supply and Recycling**—Construction and operation would not affect geologic conditions, nor would the facilities be affected by geologic conditions.	**Tritium Supply and Upgraded Recycling**—Construction and operation would not affect geologic conditions, nor would the facilities be affected by geologic conditions.
Soil conditions would not affect construction or operation. A total of 462 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action.	Soil conditions would not affect construction or operation. A total of 462 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action.	Soil conditions would not affect construction or operation. A total of 260 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action.
Tritium Supply Alone—Construction and operation impacts to geology and soils would be the same as above. A total of 260 acres would be disturbed.	**Tritium Supply Alone**—Construction and operation impacts to geology and soils would be the same as above. A total of 260 acres would be disturbed.	**No Tritium Supply Alone.**
Less Than Baseline Operations—Impacts are the same as above for the collocated supply and recycling.	**Less Than Baseline Operations**—Impacts are the same as above for the collocated supply and recycling.	**Less Than Baseline Operations**—Impacts are expected to be the same as above for the tritium supply and upgraded recycling facility.
Collocated Tritium Supply and Recycling—Construction and operation would not affect geologic conditions, nor would the facilities be affected by geologic conditions.	**Collocated Tritium Supply and Recycling**—Construction and operation would not affect geologic conditions, nor would the facilities be affected by geologic conditions.	**Tritium Supply and Upgraded Recycling**—Construction and operation would not affect geologic conditions, nor would the facilities be affected by geologic conditions.
Soil conditions would not affect construction or operation. A total of 562 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action.	Soil conditions would not affect construction or operation. A total of 562 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action.	Soil conditions would not affect construction or operation. A total of 360 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action.
Tritium Supply Alone—Construction and operation impacts to geology and soils would be the same as above. A total of 360 acres would be disturbed.	**Tritium Supply Alone**—Construction and operation impacts to geology and soils would be the same as above. A total of 360 acres would be disturbed.	**No Tritium Supply Alone.**
Less Than Baseline Operations—Impacts are the same as above for the collocated supply and recycling.	**Less Than Baseline Operations**—Impacts are the same as above for the collocated supply and recycling.	**Less Than Baseline Operations**—Impacts are expected to be the same as above for the tritium supply and upgraded recycling facility.

Geology and Soils

Technology	INEL	NTS
Advanced Light Water Reactor	• **Collocated Tritium Supply and Recycling**—Construction and operation would not affect geologic conditions, nor would the facilities be affected by geologic conditions. • Soil conditions would not affect construction or operation. A total of 552 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action. • **Tritium Supply Alone**—Construction and operation impacts to geology and soils would be the same as above. A total of 350 acres would be disturbed.	• **Collocated Tritium Supply and Recycling**—Construction and operation would not affect geologic conditions, nor would the facilities be affected by geologic conditions. • Soil conditions would not affect construction or operation. A total of 552 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action. • **Tritium Supply Alone**—Construction and operation impacts to geology and soils would be the same as above. A total of 350 acres would be disturbed.

Geology and Soils

ORR	Pantex	SRS
• **Collocated Tritium Supply and Recycling**—Construction and operation would not affect geologic conditions nor would the facilities be affected by geologic conditions.	• **Collocated Tritium Supply and Recycling**—Construction and operation would not affect geologic conditions nor would the facilities be affected by geologic conditions.	• **Tritium Supply and Upgraded Recycling**—Construction and operation would not affect geologic conditions nor would the facilities be affected by geologic conditions.
• Soil conditions would not affect construction or operation. A total of 552 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action.	• Soil conditions would not affect construction or operation. A total of 552 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action.	• Soil conditions would not affect construction or operation. A total of 350 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action. Phase out of recycling facilities would result in no impacts.
• **Tritium Supply Alone**—Construction and operation impacts to geology and soils would be the same as above. A total of 350 acres would be disturbed.	• **Tritium Supply Alone**—Construction and operation impacts to geology and soils would be the same as above. A total of 350 acres would be disturbed.	• **No Tritium Supply Alone.**

Geology and Soils

Technology	INEL	NTS
Advanced Light Water Reactor (Continued)	• **Less Than Baseline Operations—** Impacts are the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations—** Impacts are the same as above for the collocated supply and recycling.
Accelerator Production of Tritium	• **Collocated Tritium Supply and Recycling—**Construction and operation would not affect geologic conditions nor would the facilities be affected by geologic conditions. • Soil conditions would not affect construction or operation. A total of 375 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action. • **Tritium Supply Alone—**Construction and operation impacts to geology and soils would be the same as above. A total of 173 acres would be disturbed. • **Less Than Baseline Operations—** Impacts are the same as above for the collocated supply and recycling.	• **Collocated Tritium Supply and Recycling—**Construction and operation would not affect geologic conditions nor would the facilities be affected by geologic conditions. • Soil conditions would not affect construction or operation. A total of 375 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action. • **Tritium Supply Alone—**Construction and operation impacts to geology and soils would be the same as above. A total of 173 acres would be disturbed. • **Less Than Baseline Operations—** Impacts are the same as above for the collocated supply and recycling.
All Supply Technologies	• **Tritium Recycling Phaseout—**This action applies to any collocated tritium supply and new recycling facility at INEL. The phaseout of recycling at SRS would not impact geology or soils.	• **Tritium Recycling Phaseout—** This action applies to any collocated tritium supply and new recycling facility at NTS. The phaseout of recycling at SRS would not impact geology or soils.
Biotic Resources		
No Action (2010)	• No impacts to biotic resources.	• No impacts to biotic resources.
Heavy Water Reactor	• **Collocated Tritium Supply and Recycling—**Terrestrial resources would be affected by the disturbance of 462 acres of habitat during construction and operation. • Wetlands would not be affected by construction or operation. • Aquatic resources would not be affected by construction or operation.	• **Collocated Tritium Supply and Recycling—**Terrestrial resources would be affected by the disturbance of 462 acres of habitat during construction and operation. • Wetlands would not be affected by construction or operation. • Aquatic resources would not be affected by construction or operation.

Geology and Soils

ORR	Pantex	SRS
Less Than Baseline Operations—Impacts are the same as above for the collocated supply and recycling.	**Less Than Baseline Operations**—Impacts are the same as above for the collocated supply and recycling.	**Less Than Baseline Operations**—Impacts are expected to be the same as above for the tritium supply and upgraded recycling facility.
Collocated Tritium Supply and Recycling—Construction and operation would not affect geologic conditions nor would the facilities be affected by geologic conditions.	**Collocated Tritium Supply and Recycling**—Construction and operation would not affect geologic conditions nor would the facilities be affected by geologic conditions.	**Tritium Supply and Upgraded Recycling**—Construction and operation would not affect geologic conditions nor would the facilities be affected by geologic conditions.
Soil conditions would not affect construction or operation. A total of 375 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action.	Soil conditions would not affect construction or operation. A total of 375 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action.	Soil conditions would not affect construction or operation. A total of 173 acres would be disturbed. Erosion may occur as a result of stormwater runoff and wind action.
Tritium Supply Alone—Construction and operation impacts to geology and soils would be the same as above. A total of 173 acres would be disturbed.	**Tritium Supply Alone**—Construction and operation impacts to geology and soils would be the same as above. A total of 173 acres would be disturbed.	**No Tritium Supply Alone.**
Less Than Baseline Operations—Impacts are the same as above for the collocated supply and recycling.	**Less Than Baseline Operations**—Impacts are the same as above for the collocated supply and recycling.	**Less Than Baseline Operations**—Impacts are expected to be the same as above for the tritium supply and upgraded recycling facility.
Tritium Recycling Phaseout—This action applies to any collocated tritium supply and new recycling facility at ORR. The phaseout of recycling at SRS would not impact geology or soils.	**Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at Pantex. The phaseout of recycling at SRS would not impact geology or soils.	**No Tritium Recycling Phaseout with SRS Alternatives.**
	Biotic Resources	
No impacts to biotic resources.	No impacts to biotic resources.	No impacts to biotic resources.
Collocated Tritium Supply and Recycling—Terrestrial resources would be affected by the disturbance of 462 acres of habitat during construction and operation. Salt drift from wet cooling towers would likely impact less than 13 acres during operation.	**Collocated Tritium Supply and Recycling**—Terrestrial resources would be affected by the disturbance of 462 acres of habitat during construction and operation.	**Tritium Supply and Upgraded Recycling**—Terrestrial resources would be affected by the disturbance of 260 acres of habitat during construction and operation. Salt drift from wet cooling towers would likely impact less than 13 acres during operation.
If cooling tower blowdown is directed to East Fork Popular Creek, changes in water levels and sedimentation could effect wetlands associated with the stream. If directed to the Clinch River impacts would be limited to wetlands (if present) in the vicinity of the outfall.	Depending on the final site layout, some small areas of potential wetlands could be impacted; mitigation measures approved by the U.S. Army Corps of Engineers would be implemented. During construction and operation impacts to playas could include increase in open water area and shift in wetland plant communities.	If cooling tower blowdown is directed to Fourmile Branch, changes in flows and sedimentation could affect wetlands associated with the stream and Savannah River Swamp. Impacts to wetlands would be avoided if discharges are directed to Par Pond.
If cooling tower blowdown is directed to East Fork Popular Creek, increase in flow, sedimentation and temperature could impact aquatic communities. Impacts to aquatic communities would be reduced if discharges are directed to the Clinch River.	Aquatic resources would not be affected by construction or operation. Some temporary aquatic habitat may be created by discharges of nonhazardous wastewater to playas.	If cooling tower blowdown is directed to Fourmile Branch, increases in flow, sedimentation, and temperature could impacts aquatic communities. Impacts to aquatic communities would be reduced if discharges are directed to Par Pond.

Biotic Resources

Technology	INEL	NTS
Heavy Water Reactor (Continued)	• No Federal-listed, threatened, or endangered species would be affected during construction or operation, but several Federal candidate or state-listed species may be affected. During construction, the ferruginous hawk, loggerhead shrike and pygmy rabbit would lose 462 acres of potential foraging and nesting or burrowing habitat; the Townsend's western big-eared bat may roost in caves and forage throughout the disturbed area; and the plant species oxytheca may he affected. During operation, the Townsend's western big-eared bat may forage at stormwater retention ponds.	• One Federal-listed threatened species, the desert tortoise, could be affected during construction and operation. Several Federal candidate or state-listed species may be affected. The ferruginous hawk could lose 462 acres of foraging habitat; while the loggerhead shrike could lose the same acreage of foraging and breeding habitat. Neither species should be adversely affected due to the large extent of nearby suitable habitat.
	• **Tritium Supply Alone**—Construction and operation would disturb 260 acres; thus, impacts to biotic resources would be slightly reduced.	• **Tritium Supply Alone**—Construction and operation would disturb 260 acres; thus, impacts to biotic resources would be slightly reduced.
	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.
Modular High Temperature Gas-Cooled Reactor	• **Collocated Tritium Supply and Recycling**—Terrestrial resources would be affected by the disturbance of 562 acres of habitat during construction and operation.	• **Collocated Tritium Supply and Recycling**—Terrestrial resources would be affected by the disturbance of 562 acres of habitat during construction and operation.
	• Wetlands would not be affected by construction or operation.	• Wetlands would not be affected by construction or operation.
	• Aquatic resources would not be affected by construction or operation.	• Aquatic resources would not be affected by construction or operation.

Biotic Resources

ORR	Pantex	SRS
• No Federal-listed, threatened, or endangered species would be affected during construction or operation. Land clearing activities may impact several state-protected plant species. Four state-listed raptors would lose 462 acres of potential nesting and foraging habitat, however, this type of habitat is abundant in the area. The Tennessee dace and hellbender, both state-listed, could be affected by construction and operation, respectively.	• One Federal-listed, threatened species, the bald eagle, could be affected by disrupting foraging at playas during construction. Six Federal candidate or state-listed species may also be affected by construction activities. The black tern, white-faced ibis, ferruginous hawk and loggerhead shrike could lose 462 acres of foraging and/or nesting habitat. The swift fox would lose potential foraging and denning habitat. The Texas horned lizard could be impacted during land clearing activities.	• No Federal-listed, threatened, or endangered species would be affected during construction or operation. Several Federal candidate or state-listed species may be impacted during construction. These include the awned meadow-beauty, green-fringed orchid, Florida false loosestrife, beak-rush, star-nosed mole, and eastern tiger salamander. All of these could be destroyed during construction. In addition, the Cooper's hawk could be temporarily displaced during construction.
• **Tritium Supply Alone**—Construction and operation would disturb 260 acres, thus, impacts to biotic resources would be slightly reduced.	• **Tritium Supply Alone**—Construction and operation would disturb 260 acres, thus, impacts to biotic resources would be slightly reduced.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts to biotic resource are expected to be the same as above for the tritium supply and upgraded recycling facility.
• **Collocated Tritium Supply and Recycling**—Terrestrial resources would be affected by the disturbance of 562 acres of habitat during construction and operation. Salt drift from wet cooling towers would likely impact less than 13 acres during operation.	• **Collocated Tritium Supply and Recycling**—Terrestrial resources would be affected by the disturbance of 562 acres of habitat during construction and operation.	• **Tritium Supply and Upgraded Recycling**—Terrestrial resources would be affected by the disturbance of 360 acres of habitat during construction operation. Salt drift from wet cooling towers would likely impact less than 13 acres during operation.
• Increased stream flow in East Fork Popular Creek from construction dewatering discharge could alter wetlands bordering the stream. Cooling tower blowdown could also adversely affect wetlands during operation. If discharges are directed to the Clinch River impacts would be confined to wetlands (if present) near the outfall.	• Depending on the final site layout, some small areas of potential wetlands could be impacted; mitigation measures approved by the U.S. Army Corps of Engineers would be implemented. During construction and operation impacts to playa could include increases in open water area and shifts in wetland plant communities.	• Increased stream flow in Fourmile Branch from construction dewatering discharge could alter wetlands bordering the stream and within the Savannah River Swamp. Cooling tower blowdown could also adversely affect these wetlands during operation if discharged to Fourmile Branch. Impacts could be avoided if discharges are directed to Par Pond.
• If dewatering discharges from construction were directed to East Fork Popular Creek increased flows and sedimentation could adversely affect aquatic communities. Cooling tower blowdown could also displace aquatic communities if directed to the creek. Impacts to aquatic resources could be reduced if discharges are directed to the Clinch River.	• Aquatic resources would not be affected by construction or operation. Some temporary aquatic habitat may be created by discharges of nonhazardous wastewater to playas.	• If dewatering discharges from construction were directed to Fourmile Branch increased flows and sedimentation could adversely impact aquatic communities. Cooling tower blowdown could also displace aquatic communities if directed for Fourmile Branch. Impacts to aquatic communities could be reduced if discharges are directed to Par Pond.

Biotic Resources

Technology	INEL	NTS
Modular High Temperature Gas-Cooled Reactor (Continued)	• No Federal-listed, threatened, or endangered species would be affected during construction or operation, but several Federal candidate or state-listed species may be affected. During construction, the ferruginous hawk, loggerhead shrike, and pygmy rabbit would lose 562 acres of potential foraging and nesting or burrowing habitat; the Townsend's western big-eared bat may roost in caves and forage throughout the disturbed area; and the plant species oxytheca may be present. During operation, the Townsend's western big-eared bat may forage at stormwater retention ponds.	• One Federal-listed threatened species, the desert tortoise, could be affected during construction and operation. Several Federal candidate or state-listed species may be affected. The ferruginous hawk could lose 562 acres of foraging habitat; while the loggerhead shrike could lose the same acreage of foraging and breeding habitat. However, neither species should be adversely affected due to the large extent of nearby suitable habitat.
	• **Tritium Supply Alone**—Construction and operation would disturb 360 acres; thus, impacts to biotic resources would be slightly reduced. • **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Tritium Supply Alone**—Construction and operation would disturb 360 acres; thus, impacts to biotic resources would be slightly reduced. • **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.
Advanced Light Water Reactor	• **Collocated Tritium Supply and Recycling**—Terrestrial resources would be affected by the disturbance of 552 acres of habitat during construction and operation.	• **Collocated Tritium Supply and Recycling**—Terrestrial resources would be affected by the disturbance of 552 acres of habitat during construction and operation.
	• Wetlands would not be affected by construction or operation.	• Wetlands would not be affected by construction or operation.
	• Aquatic resources would not be affected by construction or operation.	• Aquatic resources would not be affected by construction or operation.

Biotic Resources

ORR	Pantex	SRS
• No Federal-listed, threatened, or endangered species would be affected during construction or operation. Land clearing activities may impact several state-protected plant species. Four state-listed raptors would lose 562 acres of potential nesting and foraging habitat, however, this type of habitat is abundant in the area. The Tennessee dace and hellbender, both state-listed, could be affected by construction and operation, respectively.	• One Federal-listed threatened species, the bald eagle, could be affected by disrupting foraging at playas during construction. Six Federal candidate or state-listed species may also be affected by construction activities. The black tern, white-faced ibis, ferruginous hawk, and the loggerhead shrike could lose 562 acres of foraging and/or nesting habitat. The swift fox would lose potential foraging and denning habitat. Texas horned lizards would be impacted during land clearing activities.	• No Federal-listed, threatened or endangered species would be affected during construction or operation. Several Federal candidate or state-listed species may be impacted during construction. These include the awned meadow-beauty, green-fringed orchid, Florida false loosestrife, beak-rush, star-nosed mole, and eastern tiger salamander. All of these could be destroyed during construction. In addition, the Cooper's hawk could be temporarily displaced during construction.
• **Tritium Supply Alone**—Construction and operation would disturb 360 acres; thus, impacts to biotic resources would be slightly reduced.	• **Tritium Supply Alone**—Construction and operation would disturb 360 acres; thus, impacts to biotic resources would be slightly reduced.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts to biotic resource are expected to be the same as above for the tritium supply and upgraded recycling facility.
• **Collocated Tritium Supply and Recycling**—Terrestrial resources would be affected by the disturbance of 552 acres of habitat during construction and operation. Salt drift from wet cooling towers would likely impact less than 13 acres during operation.	• **Collocated Tritium Supply and Recycling**—Terrestrial resources would be affected by the disturbance of 552 acres of habitat during construction and operation.	• **Tritium Supply and Upgraded Recycling**—Terrestrial resources would be affected by the disturbance of 350 acres of habitat during construction and operation. Salt drift from wet cooling towers would likely impact less than 13 acres during operation.
• If cooling tower blowdown is directed to East Fork Poplar Creek, changes in water levels and sedimentation could affect wetlands associated with the stream. If directed to the Clinch River, impacts would be limited to wetlands (if present) in the vicinity of the outfall.	• Depending on the final site layout, some small areas of potential wetlands could be impacted; mitigation measures approved by the U.S. Army Corps of Engineers would be implemented. During construction and operation impacts to playas could include increases in open water areas and shifts in wetland plant communities.	• If cooling tower blowdown is directed to Fourmile Branch, changes in flows and sedimentation could affect wetlands associated with the stream and Savannah River Swamp. Impacts to wetlands would be avoided if discharges are directed Par Pond.
• If cooling tower blowdown is directed to East Fork Poplar Creek, increase in flow, sedimentation and temperature could impact aquatic communities. Impacts to aquatic communities would be reduced if discharges are directed to the Clinch River.	• Aquatic resources would not be affected by construction or operation. Some temporary aquatic habitat may be created by discharges of nonhazardous wastewater to playas.	• If cooling tower blowdown is directed to Fourmile Branch, increases in flow, sedimentation, and temperature could impact aquatic communities. Impacts to aquatic communities would be reduced if discharges are directed to Par Pond.

Biotic Resources

Technology	INEL	NTS
Advanced Light Water Reactor (Continued)	• No Federal-listed, threatened, or endangered species would be affected during construction or operation, but several Federal candidate or state-listed species may be affected. During construction, the ferruginous hawk would lose 552 acres of potential foraging and nesting or burrowing habitat; the Townsend's western big-eared bat may roost in caves and forage throughout the disturbed area; and the plant species oxytheca may be affected. During operation, the Townsend's western big-eared bat may forage at stormwater retention ponds.	• One Federal-listed threatened species, the desert tortoise, could be affected during construction and operation. Several Federal candidate or state-listed species may be affected. The ferruginous hawk could lose 552 acres of foraging habitat; while the loggerhead shrike could lose the same acreage of foraging and breeding habitat. However, neither species should be adversely affected due to the large extent of nearby suitable habitat.
	• **Tritium Supply Alone**—Construction and operation would disturb 350 acres; thus, impacts to biotic resources would be slightly reduced.	• **Tritium Supply Alone**—Construction and operation would disturb 350 acres; thus, impacts to biotic resources would be slightly reduced.
	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.
Accelerator Production of Tritium	• **Collocated Tritium Supply and Recycling**—Terrestrial resources would be affected by the disturbance of 375 acres of habitat during construction and operation. Impacts from salt drift are possible with the APT.	• **Collocated Tritium Supply and Recycling**—Terrestrial resources would be affected by the disturbance of 375 acres of habitat during construction and operation. Impacts from salt drift are possible with the APT.
	• Wetlands would not be affected by construction or operation.	• Wetlands would not be affected by construction or operation.
	• Aquatic resources would not be affected by construction or operation.	• Aquatic resources would not be affected by construction or operation.

Biotic Resources

ORR	Pantex	SRS
• No Federal-listed, threatened, or endangered species to be affected during construction or operation. Land clearing activities may impact several state-protected plant species. Four state-listed raptors would lose 552 acres of potential nesting and foraging habitat, however, this type of habitat is abundant in the area. The Tennessee dace and hellbender, both state-listed, could be affected by construction and operation, respectively.	• One Federal-listed threatened species, the bald eagle, could be affected by disrupting foraging in playas during construction. Six Federal candidate or state-listed species may also be affected by construction activities. The black tern, bald eagle, white-faced ibis, ferruginous hawk, and loggerhead shrike could lose 552 acres of foraging and/or nesting habitat. The swift fox would lose potential foraging and denning habitat. The Texas horned lizards could be impacted during land clearing activities.	• No Federal-listed, threatened, or endangered species would be affected during construction or operation. Several Federal candidate or state-listed species may be impacted during construction. These include the awned meadow-beauty, green-fringed orchid, Florida false loosestrife, beak-rush, star-nosed mole, and eastern tiger salamander. All of these could be destroyed during construction. In addition, the Cooper's hawk could be temporarily displaced during construction.
• **Tritium Supply Alone**—Construction and operation would disturb 350 acres; thus, impacts to biotic resources would be slightly reduced.	• **Tritium Supply Alone**—Construction and operation would disturb 350 acres; thus, impacts to biotic resources would be slightly reduced.	• No Tritium Supply Alone.
• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts to biotic resource are expected to be the same as above for the tritium supply and upgraded recycling facility.
• **Collocated Tritium Supply and Recycling**—Terrestrial resources would be affected by the disturbance of 375 acres of habitat during construction and operation. Salt drift from wet cooling towers would likely impact less than 13 acres during operation.	• **Collocated Tritium Supply and Recycling**—Terrestrial resources would be affected by the disturbance of 375 acres of habitat during construction and operation. Impacts from salt drift are possible with the APT.	• **Tritium Supply and Upgraded Recycling**—Terrestrial resources would be affected by the disturbance of 173 acres of habitat during construction and operation. Salt drift from wet cooling towers would likely impact less than 13 acres during operation.
• Increased stream flow in East Fork Poplar Creek from construction dewatering discharge associated with an APT could alter wetlands bordering the stream. Cooling tower blowdown could also adversely effect these wetlands during operation. If these discharges are directed to Clinch River impacts would be confined to wetlands (if present) near the outfall.	• Depending on the final site layout, some small areas of potential wetlands could be impacted; mitigation measures approved by the U.S. Army Corps of Engineers would be implemented. During construction and operation, impacts to playa wetlands could include increases in open water area and shifts in wetland plant communities.	• Increased stream flow in Fourmile Branch from construction dewatering discharge associated with an APT could alter wetlands bordering the stream and within the Savannah River swamp. Cooling tower blowdown could also adversely effect these wetlands during operation if discharged to Fourmile Branch. Impacts could be avoided if discharges are directed to Par Pond.
• If dewatering discharges from construction of an APT were directed to East Fork Poplar Creek, increased flows and sedimentation could adversely affect aquatic communities. Cooling tower blowdown could also displace aquatics communities if directed to the creek. Impacts to aquatic resources could be reduced if discharges are directed to the Clinch River.	• Aquatic resources would not be affected by construction or operation. Some temporary aquatic habitat may be created by discharges of nonhazardous wastewater to playas.	• If dewatering discharges from construction of an APT were directed to Fourmile Branch, increased flows and sedimentation could adversely impact aquatic communities. Cooling tower blowdown could also displace aquatic communities if directed to Fourmile Branch. Impacts to aquatic communities could be reduced if discharges are directed to Par Pond.

Biotic Resources

Technology	INEL	NTS
Accelerator Production of Tritium (Continued)	- No Federal-listed threatened and endangered species would be affected during construction or operation, but several Federal candidate or state-listed species may be affected. During construction, the ferruginous hawk, loggerhead shrike, and pygmy rabbit would lose 375 acres of foraging and nesting or burrowing habitat; the Townsend's western big-eared bat may roost in caves and forage throughout the disturbed area; and the plant species oxytheca may be affected. During operation, the Townsend's western big-eared bat may forage at stormwater retention ponds.	- One Federal-listed threatened species, the desert tortoise, could be affected during construction and operation. Several Federal candidate or state-listed species may be affected. The ferruginous hawk could lose 375 acres of foraging habitat; while the loggerhead shrike could lose the same acreage of foraging and breeding habitat. However, neither species should be adversely affected due to the large extent of nearby suitable habitat.
	- **Tritium Supply Alone**—Construction and operation would disturb 173 acres; thus, impacts to biotic resources would be slightly reduced.	- **Tritium Supply Alone**—Construction and operation would disturb 173 acres; thus, impacts to biotic resources would be slightly reduced.
	- **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	- **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.
All Supply Technologies	- **Tritium Recycling Phaseout**— This action applies to any collocated tritium supply and new recycling facility at INEL. The phaseout of recycling at SRS would not impact biotic resources at the site.	- **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at NTS. The phaseout of recycling at SRS would not impact biotic resources at the site.

Biotic Resources

ORR	Pantex	SRS
• No Federal-listed, threatened, or endangered species would be affected during construction or operation. Land clearing activities may impact of several state-protected plant species. Four state-listed raptors would lose 375 acres of potential nesting and foraging habitat, however, this type of habitat is abundant in the area. The Tennessee dace and hellbender, both state-listed, could be affected by construction and operation, respectively.	• One Federal-listed threatened species, the bald eagle, could be affected by disrupting foraging in playas during construction. Six Federal candidate or state-listed species may also be affected by construction activities. The black tern, white-faced ibis, ferruginous hawk, and loggerhead shrike would lose 375 acres of foraging and/or nesting habitat. The swift fox would lose potential foraging and denning habitat. The Texas horned lizard could be impacted during land clearing activities.	• No Federal-listed threatened or endangered species would be affected during construction or operation. Several Federal candidate or state-listed species may be impacted during construction. These include the awned meadow-beauty, green-fringed orchid, Florida false loosestrife, beak-rush, star-nosed mole, and eastern tiger salamander. All of these could be destroyed during construction. In addition, the Cooper's hawk could be temporarily displaced during construction.
• **Tritium Supply Alone**—Construction and operation would disturb 173 acres; thus, impacts to biotic resources would be slightly reduced.	• **Tritium Supply Alone**—Construction and operation would disturb 173 acres; thus impacts to biotic resources would be slightly reduced.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts to biotic resource are expected to be the same as above for the tritium supply and upgraded recycling facility.
• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at ORR. The phaseout of recycling at SRS would not impact biotic resources at the site.	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at Pantex. The phaseout of recycling at SRS would not impact biotic resources at the site.	• **No Tritium Recycling Phaseout With SRS Alternatives.**

Cultural and Paleontological Resources

Technology	INEL	NTS
No Action (2010)	• No impacts to cultural and paleontological resources.	• No impacts to cultural and paleontological resources.
Heavy Water Reactor	• **Collocated Tritium Supply and Recycling**—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.	• **Collocated Tritium Supply and Recycling**—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.
	• Native American resources may be affected by land disturbance and audio or visual intrusions.	• Native American resources may be affected by land disturbance and audio or visual intrusions.
	• Paleontological resources would not be affected.	• Paleontological resources may be affected.
	• **Tritium Supply Alone**—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.	• **Tritium Supply Alone**—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.
	• **Less Than Baseline Operation**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operation**—Impacts are expected to be the same as above for the collocated supply and recycling.

Cultural and Paleontological Resources

ORR	Pantex	SRS
• No impacts to cultural and paleontological resources.	• No impacts to cultural and paleontological resources.	• No impacts to cultural and paleontological resources.
• **Collocated Tritium Supply and Recycling**—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.	• **Collocated Tritium Supply and Recycling**—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.	• **Tritium Supply and Upgraded Recycling**—Three NRHP-eligible historic sites occur within the disturbed area. No prehistoric resources would be affected.
• Native American resources may be affected by land disturbance and audio or visual intrusions.	• Native American resources may be affected by land disturbance and audio or visual intrusions.	• Native American resources may be affected by land disturbance and audio or visual intrusions.
• Paleontological resources may be affected.	• Paleontological resources may be affected.	• Paleontological resources may be affected.
• **Tritium Supply Alone**—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.	• **Tritium Supply Alone**—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operation**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operation**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operation**—Impacts are expected to be the same as above for the tritium supply and recycling facility.

Cultural and Paleontological Resources

Technology	INEL	NTS
Modular High Temperature Gas-Cooled Reactor	• **Collocated Tritium Supply and Recycling**—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.	• **Collocated Tritium Supply and Recycling**—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.
	• Native American resources may be affected by land disturbance and audio or visual intrusions.	• Native American resources may be affected by land disturbance and audio or visual intrusions.
	• Paleontological resources may be affected by excavations deeper than 50 feet.	• Paleontological resources may be affected.
	• **Tritium Supply Alone**—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.	• **Tritium Supply Alone**—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.
	• **Less Than Baseline Operation**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operation**—Impacts are expected to be the same as above for the collocated supply and recycling.
Advanced Light Water Reactor	• **Collocated Tritium Supply and Recycling**—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.	• **Collocated Tritium Supply and Recycling**—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.
	• Native American resources may be affected by land disturbance and audio or visual intrusions.	• Native American resources may be affected by land disturbance and audio or visual intrusions.
	• Paleontological resources would not be affected.	• Paleontological resources may be affected.
	• **Tritium Supply Alone**—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.	• **Tritium Supply Alone**—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.
	• **Less Than Baseline Operation**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operation**—Impacts are expected to be the same as above for the collocated supply and recycling.

Cultural and Paleontological Resources

ORR	Pantex	SRS
Collocated Tritium Supply and Recycling—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.	**Collocated Tritium Supply and Recycling**—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.	**Tritium Supply and Upgraded Recycling**—Three NRHP-eligible historic sites occur within the disturbed area. No prehistoric resources would be affected.
Native American resources may be affected by land disturbance and audio or visual intrusions.	Native American resources may be affected by land disturbance and audio or visual intrusions.	Native American resources may be affected by land disturbance and audio or visual intrusions.
Paleontological resources may be affected, but impacts would be negligible.	Paleontological resources may be affected.	Paleontological resources may be affected, but impacts would be negligible.
Tritium Supply Alone—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.	**Tritium Supply Alone**—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.	**No Tritium Supply Alone.**
Less Than Baseline Operation—Impacts to prehistoric/historic resources and Native American resources are expected to be the same as above for the collocated supply and recycling. Impacts to Paleontological resources may be slightly smaller.	**Less Than Baseline Operation**—Impacts to prehistoric/historic resources and Native American resources are expected to be the same as above for the collocated supply and recycling. Impacts to Paleontological resources may be slightly smaller.	**Less Than Baseline Operation**—Impacts are expected to be the same as above for the tritium supply and upgraded recycling facility.
Collocated Tritium Supply and Recycling—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.	**Collocated Tritium Supply and Recycling**—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.	**Tritium Supply and Upgraded Recycling**—Three NRHP-eligible historic sites occur within the disturbed area. No prehistoric resources would be affected.
Native American resources may be affected by land disturbance and audio or visual intrusions.	Native American resources may be affected by land disturbance and audio or visual intrusions.	Native American resources may be affected by land disturbance and audio or visual intrusions.
Paleontological resources may be affected, but impacts would be negligible.	Paleontological resources may be affected.	Paleontological resources may be affected, but impacts would be negligible.
Tritium Supply Alone—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.	**Tritium Supply Alone**—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.	**No Tritium Supply Alone.**
Less Than Baseline Operation—Impacts are expected to be the same as above for the collocated supply and recycling.	**Less Than Baseline Operation**—Impacts are expected to be the same as above for the collocated supply and recycling.	**Less Than Baseline Operation**—Impacts are expected to be the same as above for the tritium supply and upgraded recycling facility.

Cultural and Paleontological Resources

Technology	INEL	NTS
Accelerator Production of Tritium	• **Collocated Tritium Supply and Recycling**—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area. • Native American resources may be affected by land disturbance and audio or visual intrusions. • Paleontological resources may be affected by excavations deeper than 50 feet. • **Tritium Supply Alone**—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed. • **Less Than Baseline Operation**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Collocated Tritium Supply and Recycling**—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area. • Native American resources may be affected by land disturbance and audio or visual intrusions. • Paleontological resources may be affected. • **Tritium Supply Alone**—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed. • **Less Than Baseline Operation**—Impacts are expected to be the same as above for the collocated supply and recycling.
All Supply Technologies	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at INEL. The phaseout of recycling at SRS would not impact cultural or paleontological resources.	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at NTS. The phaseout of recycling at SRS would not impact cultural or paleontological resources.
	Socioeconomics	
No Action (2010)	• Between 1990 and 1994, employment at INEL decreased by 1,000 persons to 10,100, and will remain at this level through 2020. The total INEL payroll was $436 million in 1994 and is expected to remain at this level through 2010. • Employment in the regional economic area is expected to grow by less than 1 percent annually through 2009 and then decrease annually by less than 1 percent through 2020. Unemployment is expected to remain at 6.4 percent between 2001 and 2020, and per capita income is expected to increase from $17,800 to $20,900.	• Between 1990 and 1994, employment at NTS decreased by 1,170 persons to 6,850, and will remain at this level through 2020. The total NTS payroll was $276 million in 1994 and is expected to remain at this level through 2010. • Employment in the regional economic area is expected to grow by 1 percent annually through 2009 and then to continue growth at less than 1 percent annually through 2020. Unemployment is expected to remain at 5 percent between 2001 and 2020, and per capita income is expected to increase from $23,600 to $25,100.

Cultural and Paleontological Resources

ORR	Pantex	SRS
Collocated Tritium Supply and Recycling—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.	**Collocated Tritium Supply and Recycling**—Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area.	**Tritium Supply and Upgraded Recycling**—Three NRHP-eligible historic sites occur within the disturbed area. No prehistoric resources would be affected.
Native American resources may be affected by land disturbance and audio or visual intrusions.	Native American resources may be affected by land disturbance and audio or visual intrusions.	Native American resources may be affected by land disturbance and audio or visual intrusions.
Paleontological resources may be affected, but impacts would be negligible.	Paleontological resources may be affected.	Paleontological resources may be affected, but impacts would be negligible.
Tritium Supply Alone—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.	**Tritium Supply Alone**—Construction and operation impacts to cultural and paleontological would be slightly reduced, due to a smaller amount of land being disturbed.	**No Tritium Supply Alone.**
Less Than Baseline Operation—Impacts to prehistoric/historic resources and Native American resources are expected to be the same as above for the collocated supply and recycling. Impacts to Paleontological resources may be slightly smaller.	**Less Than Baseline Operation**—Impacts to prehistoric/historic resources and Native American resources are expected to be the same as above for the collocated supply and recycling. Impacts to Paleontological resources may be slightly smaller.	**Less Than Baseline Operation**—Impacts are expected to be the same as above for the tritium supply and upgraded recycling facility.
Tritium Recycling Phaseout—This action applies to any collocated tritium supply and new recycling facility at ORR. The phaseout of recycling at SRS would not impact cultural or paleontological resources.	**Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at Pantex. The phaseout of recycling at SRS would not impact cultural or paleontological resources.	**No Tritium Recycling Phaseout With SRS Alternatives.**
Socioeconomics		
Between 1990 and 1994, employment at ORR decreased by 300 persons to 15,000, and will remain at this level through 2020. The total ORR payroll was $513 million in 1994 and is expected to remain at this level through 2010.	Between 1990 and 1994, employment at Pantex decreased by 1,000 persons to 3,400. It will decrease to 1,790 in 2010 and is expected to remain at this level through 2020. The total Pantex payroll was $174 million in 1994 and is expected to decrease to $85 million in 2010.	Between 1990 and 1994, employment at SRS decreased by 2,000 persons to 20,300. It will decrease to 16,900 in 2010 and is expected to remain at this level through 2020. The total SRS payroll was $1.23 billion in 1994 and is expected to reach $1.09 billion in 2010.
Employment in the regional economic area is expected to grow by 1 percent annually through 2009 and then decrease at less than 1 percent annually through 2020. Unemployment is expected to remain at 6.2 percent between 2001 and 2020, and per capita income is expected to increase from $17,900 to $20,700.	Employment in the regional economic area is expected to grow by less than 1 percent annually between 2001 and 2009, with much less than 1 percent growth annually through 2020. Unemployment is expected to remain at 4.6 percent between 2001 and 2020, and per capita income is expected to increase from $22,300 to $25,700.	Employment in the regional economic area is expected to grow by less than 1 percent annually between 2001 and 2005 and to decrease by less than 1 percent annually between 2010 and 2020. Unemployment is expected to remain at 4.8 percent between 2001 and 2020, and per capita income is expected to increase from $18,300 to $21,000.

Socioeconomics

Technology	INEL	NTS
No Action (2010) (Continued)	• Population and housing annual average increases are expected to be less than 1 percent through 2010. Population in the region of influence is expected to reach 207,300 in 2010 and 215,200 in 2020. Total housing units in the region of influence are expected to reach 75,400 in 2010 and 78,300 in 2020.	• Population and housing annual average increases are expected to be 1 percent through 2020. Population in the region of influence is expected to reach 1,020,900 in 2010 and 1,103,500 in 2020. Total housing units in the region of influence are expected to reach 437,400 in 2010 and 472,800 in 2020.
	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of less than 1 percent from 2001 to 2020.	• Total revenues and expenditures for all region of influence counties, cities, and school districts are projected to increase by an annual average of less than 1 percent to 5 percent between 2001 and 2005, and by 1 to 2 percent between 2005 and 2010. Between 2010 and 2020 total revenues and expenditures are expected to increase by annual averages of 1 percent or less.
	• Any increase in traffic would not be a result of DOE activities.	• Any increase in traffic would not be a result of DOE activities.
Heavy Water Reactor	• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 7,500 persons during peak construction and by 4,900 persons during full operation. Unemployment is expected to decrease to 4.5 percent during peak construction and then increase to 4.6 percent during full operation. Per capita income is expected to increase by an annual averages of 1 to 2 percent during construction and 2 percent during operation.	• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 9,500 persons during peak construction and by 5,500 persons during full operation. Unemployment is expected to decrease to 3.9 percent during peak construction and then increase to 4.3 percent during full operation. Per capita income is expected to increase by an annual average of 1 percent during construction and operation.
	• Population and housing demand in the region of influence would not increase by more than 5 percent over No Action during construction, and would increase not by more than 2 percent during operation. Population in the region of influence is expected to reach 211,400 in 2010. Total housing units in the region of influence are expected to reach 77,000 in 2010.	• Population and housing demand in the region of influence would not increase by more than 1 percent over No Action during construction and operation. Population in the region of influence is expected to reach 1,024,900 in 2010. Total housing units in the region of influence are expected to reach 438,000 in 2010.
	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase annually between 2 and less than 1 percent between 2002 and 2005 and then remain flat until 2010. Between 2010 and 2020 total revenues and expenditures are both expected to increase by annual averages of less than 1 percent.	• Total revenues and expenditures for all region of influence counties, cities, and school districts are projected to increase by an annual average of less than 1 percent to 4 percent between 2001 and 2005, and then increase by about 1 to 2 percent by 2010. Between 2010 and 2020 total revenues and expenditures are both expected to increase by annual averages of less than 1 percent.

Socioeconomics

ORR	Pantex	SRS
• Population and housing annual average increases are expected to be 1 percent through 2009 and less than 1 percent between 2010 and 2020. Population in the region of influence is expected to reach 561,000 in 2010 and 586,000 in 2020. Total housing units in the region of influence are expected to reach 239,800 in 2010 and 250,500 in 2020.	• Population and housing annual average increases are expected to be less than 1 percent through 2020. Population in the region of influence is expected to reach 205,100 in 2010 and 209,000 in 2020. Total housing units in the region of influence are expected to reach 88,400 in 2010 and 90,000 in 2020.	• Population and housing annual average increases are expected to be less than 1 percent through 2010. Population in the region of influence is expected to reach 454,900 in 2010 and 473,000 in 2020. Total housing units in the region of influence are expected to reach 181,400 in 2010 and 188,400 in 2020.
• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of approximately 1 percent or less through 2010 and 2020.	• Total revenues and expenditures for all region of influence counties, cities, and school districts are projected to increase by an annual average of less than 1 percent through 2020.	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of less than 1 percent through 2020.
• Any increase in traffic would not be a result of DOE activities.	• Any increase in traffic would not be a result of DOE activities.	• Any increase in traffic would not be a result of DOE activities.
• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 8,300 persons during peak construction and by 5,200 persons during peak operation. Unemployment is expected to decrease to 5.2 percent during peak construction and then increase to 5.6 percent during full operation. Per capita income is expected to increase by an annual average of 1 percent during construction and operation.	• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 7,600 persons during peak construction and by 5,300 persons during full operation. Unemployment is expected to decrease to 2.2 percent during peak construction and then increase to 2.5 percent during full operation. Per capita income is expected to increase by an annual average of no more than 1 percent during construction and operation.	• **Tritium Supply and Upgraded Recycling**—Employment in the regional economic area is expected to increase by 7,200 persons during peak construction and by 2,400 persons during peak operation. Unemployment is expected to decrease to 3.9 percent during peak construction and then increase to 4.5 percent during full operation. Per capita income is expected to increase by an annual average of 1 percent during construction and operation.
• Population and housing demand in the region of influence would not increase by more than 1 percent over No Action during construction and operation. Population in the region of influence is expected to reach 563,500 in 2010. Total housing units in the region of influence are expected to reach 240,700 in 2010.	• Population and housing demand in the region of influence would not increase by more than 3 percent over No Action during construction and not increase by more than 2 percent during operation. Population in the region of influence is expected to reach 208,500 in 2010. Total housing units in the region of influence are expected to reach 89,600 in 2010.	• Population and housing demand in the region of influence would not increase by more than 1 percent over No Action during construction and operation. Population in the region of influence is expected to reach 456,100 in 2010. Total housing units in the region of influence are expected to reach 181,800 in 2010.
• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of approximately 1 percent or less through 2010. Between 2010 and 2020 total revenues and expenditures are both expected to increase by annual averages of less than 1 percent.	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase 1 to 3 percent annually to 2005, and then decrease annually by 1 percent remain flat until 2010. Between 2010 and 2020 total revenues and expenditures are expected to increase at annual averages of less than 1 percent.	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase on an annual average of less than 1 percent until 2010.

Socioeconomics

Technology	INEL	NTS
Heavy Water Reactor (Continued)	• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route, U.S. Route 20/26.	• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route, Mercury Highway.
	• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling.	• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling.
	• Population and housing demands in the region of influence would not increase by more than 8 percent over No Action during construction, and would not increase by more than 1 percent during operation.	• Population and housing demands in the region of influence would not increase by more than 2 percent over No Action during construction and operation.
	• Revenues and expenditures would increase for all region of influence county, city and school districts but these increases would be less than collocation with recycling.	• Total revenues and expenditures would be increased for all region of influence county, city and school districts but these increases would be less than collocation with recycling.
	• The effects on traffic on site access routes would be slightly less than collocation with recycling.	• The effects on traffic on site access routes would be slightly less than collocation with recycling.
	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.
Modular High Temperature Gas-Cooled Reactor	• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 7,200 persons during peak construction and by 4,900 persons during full operation. Unemployment is expected to decrease to 4.5 percent during peak construction and then increase to 4.6 percent during full operation. Per capita income is expected to increase by an annual average of 1 percent during construction and operation.	• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 9,100 persons during peak construction and by 5,500 persons during full operation. Unemployment is expected to decrease to 3.9 percent during peak construction and then increase to 4.3 percent during full operation. Per capita income is expected to increase by an annual average of 1 percent during construction and operation.
	• Population and housing demand in the region of influence would not increase by more than 5 percent over No Action during construction, and would not increase by more than 2 percent during operation. Population in the region of influence is expected to reach 211,300 in 2010. Total housing units in the region of influence are expected to reach 77,000 in 2010.	• Population and housing demand in the region of influence would not increase by more than 1 percent over No Action during construction or operation. Population in the region of influence is expected to reach 1,024,900 in 2010. Total housing units in the region of influence are expected to reach 438,000 in 2010.

Socioeconomics

ORR	Pantex	SRS
• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route, Bear Creek Road.	• Traffic conditions would worsen slightly on site access roads, particularly on the primary areas site, Farm-to-Market Road 683.	• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route, State Route 125.
• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling.	• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling.	• **No Tritium Supply Alone.**
• Population and housing demands would not increase by no more than 1 percent over No Action during construction and operation.	• Population and housing demands would not increase by more than 2 percent over No Action during construction, and would not increase by more than 1 percent during operation.	
• Revenues and expenditures would be increased for all region of influence county, city and school districts but these increases would be less than collocation with recycling.	• Revenues and expenditures would be increased for all region of influence county, city and school districts but these increases would be less than collocation with recycling.	
• The effects on traffic on site access routes would be slightly less than collocation with recycling.	• The effects on traffic on site access routes would be slightly less than collocation with recycling.	
• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the tritium supply and upgraded recycling facilities
• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 8,000 persons during peak construction and by 5,100 persons during full operation. Unemployment is expected to decrease to 5.2 percent during peak construction and to increase to 5.6 during full operation. Per capita income is expected to increase by an annual average of 1 percent during construction and operation.	• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 7,300 persons during peak construction and by 5,300 persons during full operation. Unemployment is expected to decrease to 2.2 percent during peak construction and increase to 2.5 percent during full operation. Per capita income is expected to increase by an annual average of no more than 1 percent during construction and operation.	• **Tritium Supply and Upgraded Recycling**—Employment in the regional economic area is expected to increase by 6,900 persons during peak construction and by 2,300 persons during full operation. Unemployment is expected to decrease to 4.0 percent during peak construction and then increase to 4.6 percent during full operation. Per capita income is expected to increase by an annual average of 1 percent during construction and operation.
• Population and housing demand in the region of influence would not increase by more than 1 percent over No Action during construction and operation. Population in the region of influence is expected to reach 563,400 in 2010. Total housing units in the region of influence are expected to reach 240,700 in 2010.	• Population and housing demand in the region of influence would not increase by more than 3 percent over No Action during construction, and would not increase by more than 2 percent during operation. Population in the region of influence is expected to reach 208,400 in 2010. Total housing units in the region of influence are expected to reach 89,600 in 2010.	• Population and housing demand in the region of influence would not increase by more than 1 percent over No Action during construction and operation. Population in the region of influence is expected to reach 456,000 in 2010. Total housing units in the region of influence are expected to reach 181,800 in 2010.

Socioeconomics

Technology	INEL	NTS
Modular High Temperature Gas-Cooled Reactor (Continued)	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase annually between 2 and less than 1 percent between 2002 and 2005 and then remain flat until 2010. Between 2010 and 2020 total revenues and expenditures are both expected to increase by annual averages of less than 1 percent.	• Total revenues and expenditures for all region of influence counties, cities, and school districts are projected to increase by an annual average of less than 1 percent to 4 percent between 2001 and 2005, and then increase about 1 to 2 percent by 2010. Between 2010 and 2020 total revenues and expenditures are both expected to increase by annual averages of not more than 1 percent.
	• Traffic conditions would degrade on site access roads, particularly on the primary access route, U.S. Route 20/26.	• Traffic conditions would degrade on site access roads, particularly on the primary access route, Mercury Highway.
	• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling.	• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling.
	• Population and housing demands would increase by more than 8 percent over No Action during construction, and would not increase by more than 1 percent during operation.	• Population and housing demands would not increase by more than 2 percent over No Action during construction and operation.
	• Revenues and expenditures would increase for all region of influence county, city and school districts but these increases would be less than collocation with recycling.	• Revenues and expenditures would increase for all region of influence county, city and school districts but these increases would be less than collocation with recycling.
	• The effects on traffic onsite access routes would be slightly less than collocation with recycling.	• The effects on traffic onsite access routes would be slightly less than collocation with recycling.
	• **Less Than Baseline Operations**—The impacts are expected to remain the same as above for the collocated supply and recycling except during operation when the impacts are expected to be reduced for employment, economics, revenues, and expenditures.	• **Less Than Baseline Operations**—The impacts are expected to remain the same as above for the collocated supply and recycling except during operation when the impacts are expected to be reduced for employment, economics, revenues, and expenditures.
Advanced Light Water Reactor	• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 10,800 persons during peak construction and by 4,700 persons during full operation for either ALWR. Unemployment is expected to decrease to 4.5 percent during peak construction and then increase to 4.7 during full operation. Per capita income is expected to increase by an annual average of almost 1 percent during construction and operation.	• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 13,700 persons during peak construction and by 5,200 persons during full operation for either ALWR. Unemployment is expected to decrease to 3.9 percent during peak construction and then increase to 4.4 percent during full operation. Per capita income is expected to increase by an annual average of 1 percent during construction and operation.

Socioeconomics

ORR	Pantex	SRS
• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of approximately 1 percent or less through 2010. Between 2010 and 2020 total revenues and expenditures are both expected to increase by annual averages of less than 1 percent.	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of 1 to 3 percent to 2005 and then decrease annually by 1 percent until 2010. Between 2010 and 2020 total revenues and expenditures are expected to increase at annual averages of less than 1 percent.	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of less than 1 percent through 2020.
• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route, Bear Creek Road.	• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route, Farm-to-Market Road 683.	• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route, State Route 125.
• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling.	• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling.	• **No Tritium Supply Alone.**
• Population and housing demands would increase by no more than 1 percent over No Action during construction and operation.	• Population and housing demands would increase by more than 2 percent over No Action during construction, and would not increase more than 1 percent during operation.	
• Revenues and expenditures would increase for all region of influence county, city and school districts but these increases would be less than collocation with recycling.	• Revenues and expenditures would increase for all region of influence county, city and school districts but these increases would be less than collocation with recycling.	
• The effects on traffic onsite access routes would be slightly less than collocation with recycling.	• The effects on traffic onsite access routes would be slightly less than collocation with recycling.	
• **Less Than Baseline Operations**—The impacts are expected to remain the same as above for the collocated supply and recycling except during operation when the impacts are expected to be reduced for employment, economics, revenues, and expenditures.	• **Less Than Baseline Operations**—The impacts are expected to remain the same as above for the collocated supply and recycling except during operation when the impacts are expected to be reduced for employment, economics, revenues, and expenditures.	• **Less Than Baseline Operations**—The impacts are expected to remain the same as above for the tritium supply and upgraded recycling facility except during operation when the impacts are expected to be reduced for employment, economics, revenues, and expenditures.
• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 12,000 persons during peak construction and by 4,900 persons during full operation for either ALWR. Unemployment is expected to decrease to 4.8 percent during peak construction and then increase to 5.6 percent during full operation. Per capita income is expected to increase by an annual average of 1 percent during construction and operation.	• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 10,900 persons during peak construction and by 5,000 persons during full operation for either ALWR. Unemployment is expected to decrease to 2.2 percent during peak construction and the increase to 2.7 percent during full operation. Per capita income is expected to increase by an annual average of no more than 1 percent during construction and operation.	• **Tritium Supply and Upgraded Recycling**—Employment in the regional economic area is expected to increase by 10,800 persons during peak construction and by 2,100 persons during full operation for either ALWR. Unemployment is expected to decrease to 3.9 percent during peak construction and then increase to 4.6 percent during full operation. Per capita income is expected to increase by an annual average of just under 1 percent during construcion and operation.

Socioeconomics

Technology	INEL	NTS
Advanced Light Water Reactor (Continued)	• For either ALWR, population and housing demand in the region of influence would not increase by more than 9 percent during construction, and would not increase by more than 2 percent during operation. Population in the region of influence is expected to reach 211,100 in 2010. Total housing units in the region of influence are expected to reach 76,900 in 2010.	• For either ALWR, population and housing demand in the region of influence would not increase by more than 2 percent during construction, and would not increase by more than 1 percent during operation. Population in the region of influence is expected to reach 1,024,700 in 2010. Total housing units in the region of influence are expected to reach 437,900 in 2010.
	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase annually between 4 percent to less than 1 percent in the first 3 years of construction, then decrease 1 to 2 percent annually until 2010. Between 2010 and 2020 total revenues and expenditures are both expected to increase by annual averages of less than 1 percent.	• Total revenues and expenditures for all region of influence counties, cities, and school districts are projected to increase by an annual average of less than 1 percent to 4 percent between 2001 and 2005, then increase about 1 to 2 percent annually by 2010. Between 2010 and 2020 total revenues and expenditures are both expected to increase by annual averages of less than 1 percent.
	• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route, U.S. Route 20/26.	• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route, Mercury Highway.
	• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling.	• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling.
	• Population and housing demands would not increase by more than 8 percent over No Action during construction, and would not increase by more than 1 percent during operation.	• Population and housing demands would not increase by more than 2 percent over No Action during construction, and would not increase by more than 1 percent during operation.
	• Revenues and expenditures would increase for all region of influence counties, cities and school districts but these increases would be less than collocation with recycling.	• Revenues and expenditures would increase for all region of influence counties, cities and school districts but these increases would be less than collocation with recycling.
	• The effects on traffic onsite access routes would be slightly less than collocation with recycling.	• The effects on traffic onsite access routes would be slightly less than collocation with recycling.
	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.

Socioeconomics

ORR	Pantex	SRS
• For either ALWR, population and housing demand in the region of influence would not increase by more than 1 percent over No Action during construction operation. Population in the region of influence is expected to reach 563,300 in 2010. Total housing units in the region of influence are expected to reach 240,700 in 2010.	• For either ALWR, population and housing demand in the region of influence would not increase by more than 7 percent over No Action during construction, and would not increase by more than 2 percent during operation. Population in the region of influence is expected to reach 208,200 in 2010. Total housing units in the region of influence are expected to reach 89,500 in 2010.	• For either ALWR, population and housing demand in the region of influence would not increase by more than 3 percent over No Action during construction, and would not increase by more than 1 percent during operation. Population in the region of influence is expected to reach 456,000 in 2010. Total housing units in the region of influence are expected to reach 181,800 in 2010.
• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of approximately 1 percent or less through 2010. Between 2010 and 2020 total revenues and expenditures are both expected to increase by annual averages of less than 1 percent.	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of 1 percent to 3 percent to 2005, and then decrease by 1 percent until 2010. Between 2010 and 2020 total revenues and expenditures are expected to increase at annual average of less than 1 percent.	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of less than 1 percent to 4 percent in the first 3 years and then remain flat to 2010. Between 2010 and 2020 total revenues and expenditures are expected to increase by annual averages of less than 1 percent.
• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route, Bear Creek Road.	• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route Farm-to-Market Road 683.	• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route, State Route 125
• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling.	• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling.	• **No Tritium Supply Alone.**
• Population and housing demands would increase by no more than 1 percent over No Action during construction and operation.	• Population and housing demands would increase by more than 6 percent over No Action during construction, and would not increase by more than 1 percent during operation.	
• Revenues and expenditures would increase for all region of influence counties, cities and school districts but these increases would be less than collocation with recycling.	• Revenues and expenditures would increase for all region of influence counties, cities and school districts but these increases would be less than collocation with recycling.	
• The effects on traffic onsite access routes would be slightly less than collocation with recycling.	• The effects on traffic onsite access routes would be slightly less than collocation with recycling.	
• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the collocated supply and recycling.	• **Less Than Baseline Operations**—Impacts are expected to be the same as above for the tritium supply and upgraded recycling facilities.

Socioeconomics

Technology	INEL	NTS
Accelerator Production of Tritium	• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 8,750 persons during peak construction and by 4,100 persons during full operation. Unemployment is expected to decrease to 4.5 percent during peak construction and then increase to 4.9 percent during full operation. Per capita income is expected to increase by an annual average of almost 1 percent during construction and operation.	• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 11,100 persons during peak construction and by 4,600 persons during full operation. Unemployment is expected to decrease to 3.9 percent during peak construction and then increase to 4.4 percent during full operation. Per capita income is expected to increase by an annual average of 1 percent during construction and operation.
	• Population and housing demand in the region of influence would not increase by more than 6.5 percent over No Action during construction and not by more than 2 percent over No Action during construction or operation. Population in the region of influence is expected to reach 210,000 in 2010. Total housing units in the region of influence are expected to reach 76,500 in 2010.	• Population and housing demand in the region of influence would not increase by more than 1 percent over No Action during construction or operation. Population in the region of influence is expected to reach 1,023,600 in 2010. Total housing units in the region of influence are expected to reach 438,600 in 2010.
	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of 2 percent and less than 1 percent through 2010. Between 2010 and 2020 total revenues and expenditures are both expected to increase by annual averages of less than 1 percent.	• Total revenues and expenditures for all region of influence counties, cities, and school districts are projected to increase by an annual average of less than 1 percent to 4 percent between 2001 and 2005, and then increase 1 to 2 percent annually by 2010. Between 2010 and 2020 total revenues and expenditures are both expected to increase by an annual average of less than 1 percent.
	• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route, U.S. Route 20/26.	• Traffic conditions would worsen slightly on site access roads, particularly on the primary access route, Mercury Highway.

Socioeconomics

ORR	Pantex	SRS
• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 9,700 persons during peak construction and by 4,300 persons during full operation. Unemployment is expected to decrease to 5.5 percent during peak construction and then increase to 5.0 percent during full operation. Per capita income is expected to increase by an annual average of 1 percent during construction and operation.	• **Collocated Tritium Supply and Recycling**—Employment in the regional economic area is expected to increase by 8,800 persons during peak construction and by 4,400 persons during full operation. Unemployment is expected to decrease to 2.2 percent during peak construction and then increase to 2.8 percent during full operation. Per capita income is expected to increase by an annual average of 1 percent during construction and operation.	• **Tritium Supply and Upgraded Recycling**—Employment in the regional economic area is expected to increase by 8,500 persons during peak construction and by 1,600 persons during full operation. Unemployment is expected to decrease to 3.9 percent during peak construction and then increase to 4.6 percent during full operation. Per capita income is expected to increase by an annual average of just under 1 percent during construction and operation.
• Population and housing demand in the region of influence would not increase by more than 1 percent over No Action during construction and operation. Population in the region of influence is expected to reach 562,800 in 2010. Total housing units in the region of influence are expected to reach 240,500 in 2010.	• Population and housing demand in the region of influence would not increase by more than 5 percent over No Action during construction, and would not increase by more than 1 percent during operation. Population in the region of influence is expected to reach 207,200 in 2010. Total housing units in the region of influence are expected to reach 89,100 in 2010.	• Population and housing demand in the region of influence would not increase by more than 1 percent over No Action during construction and operation. Population in the region of influence is expected to reach 455,400 in 2010. Total housing units in the region of influence are expected to reach 181,600 in 2010.
• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of approximately 1 percent or less through 2010. Between 2010 and 2020 total revenues and expenditures are both expected to increase by annual averages of less than 1 percent.	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of less than 1 to 3 percent through 2005, and then decrease by 1 percent until 2010. Between 2010 and 2020 total revenues and expenditures are expected to increase at annual average of less than 1 percent.	• Total revenues and expenditures for most region of influence counties, cities, and school districts are projected to increase by an annual average of less than 1 percent through 2020.
• Traffic conditions would worsen on site access roads, particularly on the primary access route, Bear Creek Road.	• Traffic conditions would worsen on site access roads, particularly on the primary access route, Farm-to-Market Road 683.	• Traffic conditions would worsen on site access roads, particularly on the primary access route, State Route 125.

Socioeconomics

Technology	INEL	NTS
Accelerator Production of Tritium (Continued)	• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling. • Population and housing demands would not by more than 8 percent over No Action during construction and not by more than 1 percent over No Action during operation. • Revenues and expenditures would be reduced for all region of influence county, city, and school districts but these increases would be less than collocation with recycling. • The effects on traffic onsite access routes would be slightly less than collocation with recycling.	• **Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling. • Population and housing demands would not increase by more than 1 percent over No Action during construction and operation. • Revenues and expenditures would be reduced for all region of influence county, city, and school districts but these increases would be less than collocation with recycling. • The effects on traffic onsite access routes would be slightly less than collocation with recycling.

Socioeconomics

ORR	Pantex	SRS
Tritium Supply Alone—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling. Population and housing demands would increase by no more than 1 percent over No Action during construction and operation. Revenues and expenditures would increase for all region of influence county, city, and school districts but these increases would be less than collocation with recycling. The effects on traffic onsite access routes would be slightly less than collocation with recycling.	**Tritium Supply Alone**—The effects on employment and income over No Action would be only slightly less than the effects of collocation with recycling. Population and housing demands would increase by no more than 4 percent over No Action during construction and by less than 1 percent during operation. Revenues and expenditures would increase for all region of influence county, city, and school districts but these increases would be less than collocation with recycling. The effects on traffic onsite access routes would be slightly less than collocation with recycling.	**No Tritium Supply Alone.**

Socioeconomics

Technology	INEL	NTS
Accelerator Production of Tritium (Continued)	• **Less Than Baseline Operations**—The impacts are expected to remain the same as above for the collocated supply and recycling except during construction when the effects are fewer for employment, economics, revenues, and expenditures.	• **Less Than Baseline Operations**—The impacts are expected to remain the same as above for the collocated supply and recycling except during construction when the effects are fewer for employment, economics, revenues, and expenditures.
All Supply Technologies	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at INEL. The phaseout of recycling at SRS would cause a loss of 800 jobs at SRS, unemployment would rise from 4.8 percent to 4.9 percent, per capita income would decrease $20, population and housing would decrease 1 percent, and there would be a less than 1 percent decrease in revenues and expenditures.	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at NTS. The phaseout of recycling at SRS would cause a loss of 800 jobs at SRS, unemployment would rise from 4.8 percent to 4.9 percent, per capita income would decrease $20, population and housing would decrease 1 percent, and there would be a less than 1 percent decrease in revenues and expenditures.
Radiological and Hazardous Chemical Impacts During Normal Operation		
No Action (2010)	• **Emissions of Radiation**—The dose to the maximally exposed member of the public from 1 year of operation is $6.0x10^{-3}$ mrem. The associated risk of fatal cancers from 40 years of operation is $1.2x10^{-7}$.	• **Emissions of Radiation**—The dose to the maximally exposed member of the public from 1 year of operation is 0.040 mrem. The associated risk of fatal cancers from 40 years of operation is $8.1x10^{-7}$.
	• The annual population dose of 0.037 person-rem from total site operation in 2030 would result in $7.4x10^{-4}$ fatal cancers over 40 years of operation.	• The annual population dose of $8.2x10^{-3}$ person-rem from total site operation in 2030 would result in $1.6x10^{-4}$ fatal cancers over 40 years of operation.
	• The average annual dose to a site worker is 30 mrem with an associated $4.8x10^{-4}$ risk of fatal cancer from 40 years of operation. The annual dose of 220 person-rem to the total site workforce would result in 3.5 fatal cancers over 40 years of operation.	• The average annual dose to a site worker is 5 mrem with an associated $7.8x10^{-5}$ risk of fatal cancer from 40 years of operation. The annual dose of 3 person-rem to the total site workforce would result in 0.048 fatal cancers over 40 years of operation.
	• **Emissions of Hazardous Chemicals**—The Hazard Index (HI) is $1.7x10^{-4}$ with no cancer risk to the maximally exposed member of the public. The site worker HI is 0.021 with no cancer risk. These values are within regulatory limits.	• **Emissions of Hazardous Chemicals**—The HI is 0 with no cancer risk to the maximally exposed member of the public or onsite worker.

Socioeconomics

ORR	Pantex	SRS
Less Than Baseline Operations—The effects are expected to remain the same as above for the collocated supply and recycling except during construction when the effects are fewer for employment, economics, revenues and expenditures.	**Less Than Baseline Operations**—The effects are expected to remain the same as above for the collocated supply and recycling except during construction when the effects are fewer for employment, economics, revenues and expenditures.	**Less Than Baseline Operations**—The impacts are expected to remain the same as above for the tritium supply and upgraded recycling facility except during operation when the effects are fewer for employment, economics, revenues and expenditures.
Tritium Recycling Phaseout—This action applies to any collocated tritium supply and new recycling facility at ORR. The phaseout of recycling at SRS would cause a loss of 800 jobs at SRS, unemployment would rise from 4.8 percent to 4.9 percent, per capita income would decrease $20, population and housing would decrease 1 percent, and there would be a less than 1 percent decrease in revenues and expenditures.	**Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at Pantex. The phaseout of recycling at SRS would cause a loss of 800 jobs at SRS, unemployment would rise from 4.8 percent to 4.9 percent, per capita income would decrease $20, population and housing would decrease 1 percent, and there would he a less than 1 percent decrease in revenues and expenditures.	**No Tritium Recycling Phaseout With SRS Alternatives.**
Radiological and Hazardous Chemical Impacts During Normal Operation		
Emissions of Radiation—The dose to the maximally exposed member of the public from 1 year of operation is 3.9 mrem from atmospheric release and 14 mrem from liquid release. The associated risk of fatal cancer from 40 years of operation is 7.8×10^{-5} and 2.7×10^{-4}, respectively.	**Emissions of Radiation**—The dose to the maximally exposed member of the public from 1 year of operation is 1.3×10^{-3} mrem. The associated risk of fatal cancer from 40 years of operation is 2.6×10^{-8}.	**Emissions of Radiation**—The dose to the maximally exposed member of the public from 1 year of operation is 2.8 mrem from atmospheric release and 0.077 mrem from liquid release. The associated risk of fatal cancer from 40 years of operation is 5.6×10^{-5} and 1.5×10^{-6}, respectively.
The annual population dose of 57 person-rem from total site operation in 2030 would result in 1.1 fatal cancers over 40 years of operation.	The annual population dose of 5.7×10^{-4} person-rem from total site operation in 2030 would result in 1.1×10^{-5} fatal cancers over 40 years of operation.	The annual population dose of 250 person-rem from total site operation in 2030 would result in 4.9 fatal cancers over 40 years of operation.
The average annual dose to a site worker is 17 mrem with an associated 2.8×10^{-4} risk of fatal cancer from 40 years of operation. The annual dose of 320 person-rem to the total site workforce would result in 5.1 fatal cancers over 40 years of operation.	The average annual dose to a site worker is 15 mrem with an associated 2.4×10^{-4} risk of fatal cancer from 40 years of operation. The annual dose of 37 person-rem to the total site workforce would result in 0.59 fatal cancers over 40 years of operation.	The average annual dose to a site worker is 32 mrem with an associated 5.2×10^{-4} risk of fatal cancer from 40 years of operation. The annual dose of 480 person-rem to the total site workforce would result in 7.7 fatal cancers over 40 years of operation.
Emissions of Hazardous Chemicals—The HI is 0.36 with no cancer risk to the maximally exposed member of the public. The site worker HI is 0.26 with no cancer risk. These values are within regulatory limits.	**Emissions of Hazardous Chemicals**—The HI is 3.7×10^{-3} and a cancer risk of 1.8×10^{-9} to the maximally exposed member of the public. The site worker HI is 0.26 and the cancer risk is 7.7×10^{-7}. The site worker cancer risk exceeds the typical threshold of regulatory concern.	**Emissions of Hazardous Chemicals**—The HI is 0.70 and a cancer risk of 3.3×10^{-5} to the maximally exposed member of the public. The site worker HI is 1.8 and the cancer risk is 5.9×10^{-3}. All values exceed the typical threshold of regulatory concern except for the HI to the maximally exposed member of the public.

Radiological and Hazardous Chemical Impacts During Normal Operation

Technology	INEL	NTS
Heavy Water Reactor	• **Collocated Tritium Supply and Recycling For Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Collocated Tritium Supply and Recycling For Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.
	• The dose to the maximally exposed member of the public from 1 year of operation would be 0.29 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 5.9×10^{-6}.	• The dose to the maximally exposed member of the public from 1 year of operation would be 0.31 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 6.2×10^{-6}.
	• The annual population dose of 53 person-rem from total site operation in 2030 would result in 1.1 fatal cancers over 40 years of operation.	• The annual population dose of 0.20 person-rem from total site operation in 2030 would result in 4.0×10^{-3} fatal cancers over 40 years of operation.
	• The average annual dose to a site worker would be 33 mrem with an associated 5.2×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 261 person-rem to the total site workforce would result in 4.2 fatal cancers over 40 years of operation.	• The average annual dose to a site worker would be 34 mrem with an associated 5.4×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 44 person-rem to the total site workforce would result in 0.7 fatal cancers over 40 years of operation.
	• **Emissions of Hazardous Chemicals**—The HI is 2.1×10^{-4} with no cancer risk to the maximally exposed member of the public. The site worker HI is 0.031 with no cancer risk. These values are within regulatory limits.	• **Emissions of Hazardous Chemicals**—The HI is 6.3×10^{-6} with no cancer risk to the maximally exposed member of the public. The site worker HI is 3.2×10^{-3} with no cancer risk. These values are within regulatory limits.
	• **Tritium Supply Alone Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Tritium Supply Alone Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.

Radiological and Hazardous Chemical Impacts During Normal Operation

ORR	Pantex	SRS
• **Collocated Tritium Supply and Recycling for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Collocated Tritium Supply and Recycling for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Tritium Supply and Upgraded Recycling for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.
• The dose to the maximally exposed member of the public from 1 year of operation would be 7.1 mrem from atmospheric release and 14 mrem from liquid release. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is $1.4x10^{-4}$ and $2.7x10^{-4}$, respectively.	• The dose to the maximally exposed member of the public from 1 year of operation would be 3.8 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is $7.6x10^{-5}$.	• The dose to the maximally exposed member of the public from 1 year of operation would be 3.4 mrem from atmospheric release and 0.16 mrem from liquid release. This is within DOE Order 5400.5 regulatory limits. The associated risk of fatal cancer from 40 years of operation is $6.9x10^{-5}$ and $3.3x10^{-6}$, respectively.
• The annual population dose of 82 person-rem from total site operation in 2030 would result in 1.6 fatal cancers over 40 years of operation.	• The annual population dose of 28 person-rem from total site operation in 2030 would result in 0.55 fatal cancers over 40 years of operation.	• The annual population dose of 300 person-rem from total site operation in 2030 would result in 6.1 fatal cancers over 40 years of operation.
• The average annual dose to a site worker would be 19 mrem with an associated $3.0x10^{-4}$ risk of fatal cancer from 40 years of operation; the annual dose of 360 person-rem to the total site workforce would result in 5.8 fatal cancers over 40 years of operation.	• The average annual dose to a site worker would be 25 mrem with an associated $4.0x10^{-4}$ risk of fatal cancer from 40 years of operation; the annual dose of 78 person-rem to the total site workforce would result in 1.2 fatal cancers over 40 years of operation.	• The average annual dose to a site worker would be 34 mrem with an associated $5.4x10^{-4}$ risk of fatal cancer from 40 years of operation; the annual dose of 520 person-rem to the total site workforce would result in 8.3 fatal cancers over 40 years of operation.
• **Emissions of Hazardous Chemicals**—The HI is 0.36 with no cancer risk to the maximally exposed member of the public. The site worker HI is 0.27 with no cancer risk. These values are within regulatory limits.	• **Emissions of Hazardous Chemicals**—The HI is $4.1x10^{-3}$ with a cancer risk of $1.8x10^{-9}$ to the maximally exposed member of the public. The site worker HI is 0.26 and the cancer risk is $7.7x10^{-7}$. These values are within regulatory limits.	• **Emissions of Hazardous Chemicals**—The HI is 0.70 with a cancer risk of $3.3x10^{-5}$ to the maximally exposed member of the public. The site worker HI is 1.8 and the cancer risk is $5.9x10^{-3}$. The HI value for the public is within regulatory limits, however, the worker HI exceeds OSHA's action level of 1. The cancer risks to both the public and site worker exceed the typical threshold of regulatory concern of $1.0x10^{-6}$.
• **Tritium Supply Alone For Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Tritium Supply Alone For Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **No Tritium Supply Alone.**

Radiological and Hazardous Chemical Impacts During Normal Operation

Technology	INEL	NTS
Heavy Water Reactor (Continued)	- The dose to the maximally exposed member of the public from 1 year of operation would be 0.18 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 3.7×10^{-6}.	- The dose to the maximally exposed member of the public from 1 year of operation would be 0.19 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 3.8×10^{-6}.
	- The annual population dose of 31 person-rem from total site operation in 2030 would result in 0.66 fatal cancers over 40 years of operation.	- The annual population dose of 0.13 person-rem from total site operation in 2030 would result in 2.6×10^{-3} fatal cancers over 40 years of operation.
	- The average annual dose to a site worker would be 34 mrem with an associated 5.4×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 260 person-rem to the total site workforce would result in 4.2 fatal cancers over 40 years of operation.	- The average annual dose to a site worker would be 47 mrem with an associated 7.5×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 42 person-rem to the total site workforce would result in 0.67 fatal cancers over 40 years of operation.
	- **Emissions of Hazardous Chemicals**—Relative to the collocated supply and recycling, the HI to the maximally exposed member of the public would be reduced by 0.3 percent and the site worker HI reduced by 0.15 percent with no cancer risk to either. These values are within regulatory limits.	- **Emissions of Hazardous Chemicals**—Relative to the collocated supply and recycling, the HI to the maximally exposed member of the public would be reduced by 1.4 percent and the site worker HI reduced by 0.5 percent with no cancer risk to either. These values are within regulatory limits.
Modular High Temperature Gas-Cooled Reactor	- **Collocated Tritium Supply and Recycling for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	- **Collocated Tritium Supply and Recycling for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.
	- The dose to the maximally exposed member of the public from 1 year of operation would be 0.19 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 3.8×10^{-6}.	- The dose to the maximally exposed member of the public from 1 year of operation would be 0.21 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 4.1×10^{-6}.

Radiological and Hazardous Chemical Impacts During Normal Operation

ORR	Pantex	SRS
• The dose to the maximally exposed member of the public from 1 year of operation would be 4.3 mrem from atmospheric release and 14 mrem from liquid release. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 8.4×10^{-5} and 2.7×10^{-4}, respectively.	• The dose to the maximally exposed member of the public from 1 year of operation would be 2.4 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 4.8×10^{-5}.	
• The annual population dose of 71 person-rem from total site operation in 2030 would result in 1.4 fatal cancers over 40 years of operation.	• The annual population dose of 19 person-rem from total site operation in 2030 would result in 0.37 fatal cancers over 40 years of operation.	
• The average annual dose to a site worker would be 19 mrem with an associated 3.0×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 360 person-rem to the total site workforce would result in 5.8 fatal cancers over 40 years of operation.	• The average annual dose to a site worker would be 28 mrem with an associated 4.5×10^{-4} risk of fatal cancer over 40 years of operation; the annual dose of 76 person-rem to the total site workforce would result in 1.2 fatal cancers over 40 years of operation.	
• **Emissions of Hazardous Chemicals—** Relative to the collocated supply and recycling, the HI to the maximally exposed member of the public and the site worker would both be reduced by about 0.01 percent with no cancer risk to either. These values are within regulatory limits.	• **Emissions of Hazardous Chemicals—** Relative to the collocated supply and recycling, the HI for the maximally exposed member of the public would be reduced by about 10 percent and that to the site worker by about 0.003 percent with no change in either of the cancer risk values. These values are within regulatory limits.	• **No Tritium Supply Alone.**
• **Collocated Tritium Supply and Recycling for Emissions of Radiation—**There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Collocated Tritium Supply and Recycling for Emissions of Radiation—**There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Tritium Supply and Upgraded Recycling for Emissions of Radiation—**There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.
• The dose to the maximally exposed member of the public from 1 year of operation would be 5.7 mrem from atmospheric release and 14 mrem from liquid release. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 1.1×10^{-4} and 2.7×10^{-4}, respectively.	• The dose to the maximally exposed member of the public from 1 year of operation would be 2.4 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 4.8×10^{-5}.	• The dose to the maximally exposed member of the public from 1 year of operation would be 3.0 mrem from atmospheric release and 0.077 mrem from liquid release. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 5.9×10^{-5} and 1.5×10^{-6}, respectively.

Radiological and Hazardous Chemical Impacts During Normal Operation

Technology	INEL	NTS
Modular High Temperature Gas-Cooled Reactor (Continued)	- The annual population dose of 37 person-rem from total site operation in 2030 would result in 0.73 fatal cancers over 40 years of operation.	- The annual population dose of 0.13 person-rem from total site operation in 2030 would result in 2.6×10^{-3} fatal cancers over 40 years of operation.
	- The average annual dose to a site worker would to be 31 mrem with an associated 5.0×10^{-4} risk of fatal cancer from 40 years of operation. The annual dose of 250 person-rem the total site workforce would result in 4.0 fatal cancers over 40 years of operation.	- The average annual dose to a site worker would to be 26 mrem with an associated 4.2×10^{-4} risk of fatal cancer from 40 years of operation. The annual dose of 33 person-rem the total site workforce would result in 0.53 fatal cancers over 40 years of operation.
	- **Emissions of Hazardous Chemicals**—The calculated HI is 1.8×10^{-4} with no cancer risk to the maximally exposed member of the public. The site worker Hazard Index is 0.021 with no cancer risk. These values are within regulatory limits.	- **Emissions of Hazardous Chemicals**—The calculated HI is 2.2×10^{-7} with no cancer risk to the maximally exposed member of the public. The site worker Hazard Index is 3.4×10^{-5} with no cancer risk. These values are within regulatory limits.
	- **Tritium Supply Alone for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	- **Tritium Supply Alone for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.
	- The dose to the maximally exposed member of the public from 1 year of operation would be 0.08 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 1.6×10^{-6}.	- The dose to the maximally exposed member of the public from 1 year of operation would be 0.09 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 1.7×10^{-6}.
	- The annual population dose of 15 person-rem from total site operation in 2030 would result in 0.29 fatal cancers over 40 years of operation.	- The annual population dose of 0.06 person-rem from total site operation in 2030 would result in 1.2×10^{-3} fatal cancers over 40 years of operation.
	- The average annual dose to a site worker would be 33 mrem with an associated 5.3×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 250 person-rem the total site workforce would result in 4.0 fatal cancers over 40 years of operation.	- The average annual dose to a site worker would be 37 mrem with an associated 6.0×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 31 person-rem the total site workforce would result in 0.50 fatal cancers over 40 years of operation.

Radiological and Hazardous Chemical Impacts During Normal Operation

ORR	Pantex	SRS
• The annual population dose of 76 person-rem from total site operation in 2030 would result in 1.5 fatal cancers over 40 years of operation.	• The annual population dose of 16 person-rem from total site operation in 2030 would result in 0.31 fatal cancers over 40 years of operation.	• The annual population dose of 260 person-rem from total site operation in 2030 would result in 5.2 fatal cancers over 40 years of operation.
• The average annual dose to a site worker would to be 18 mrem with an associated 2.9×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 350 person-rem to the total site workforce would result in 5.6 fatal cancers over 40 years of operation.	• The average annual dose to a site worker would to be 22 mrem with an associated 3.5×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 67 person-rem the total site workforce would result in 1.1 fatal cancers over 40 years of operation.	• The average annual dose to a site worker would to be 33 mrem with an associated 5.3×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 510 person-rem the total site workforce would result in 8.2 fatal cancers over 40 years of operation.
• **Emissions of Hazardous Chemicals**—The calculated HI is 0.36 with no cancer risk to the maximally exposed member of the public. The site worker HI is 0.32 with no cancer risk. These values are within regulatory limits.	• **Emissions of Hazardous Chemicals**—The calculated HI is 3.7×10^{-3} with a cancer risk of 1.8×10^{-9} to the maximally exposed member of the public. The site worker HI is 0.26 and the cancer risk is 7.7×10^{-7}. These values are within regulatory limits.	• **Emissions of Hazardous Chemicals**—The calculated HI is 0.70 with a cancer risk of 3.3×10^{-5} to the maximally exposed member of the public. The site worker HI is 1.8 and the cancer risk is 5.9×10^{-3}. The HI value for the public is within regulatory limits, however, the HI value to the worker exceeds the action level of 1.0 based on OSHA's exposure limits. Cancer risks to the public and site workers both exceed the typical threshold of regulatory concern of 1.0×10^{-6}.
• **Tritium Supply Alone for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Tritium Supply Alone for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **No Tritium Supply Alone.**
• The dose to the maximally exposed member of the public from 1 year of operation would be 2.9 mrem from atmospheric release and 14 mrem from liquid release. This is within DOE Order 5400.5 regulatory limits. The associated risk of fatal cancer from 40 years of operation is 5.4×10^{-5} and 2.7×10^{-4}, respectively.	• The dose to the maximally exposed member of the public from 1 year of operation would be 1.0 mrem. This is within DOE Order 5400.5 regulatory limits. The associated risk of fatal cancer from 40 years of operation is 2.0×10^{-5}.	
• The annual population dose of 65 person-rem from total site operation in 2030 would result in 1.3 fatal cancers over 40 years of operation.	• The annual population dose of 7 person-rem from total site operation in 2030 would result in 0.13 fatal cancers over 40 years of operation.	
• The average annual dose to a site worker would be 19 mrem with an associated 3.0×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 350 person-rem to the total site workforce would result in 5.6 fatal cancers over 40 years of operation.	• The average annual dose to a site worker would be 24 mrem with an associated 3.9×10^{-4} risk of fatal cancer of 40 years of operation; the annual dose of 65 person-rem the total site workforce would result in 1.1 fatal cancers over 40 years of operation.	

Radiological and Hazardous Chemical Impacts During Normal Operation

Technology	INEL	NTS
Modular High Temperature Gas-Cooled Reactor (Continued)	- **Emissions of Hazardous Chemicals—** Relative to the collocated supply and recycling, the HI for the maximally exposed member of the public would be reduced by about 0.03 percent and that for the site worker by 0.15 percent. There are no cancer risks. The resulting values are within regulatory limits.	- **Emissions of Hazardous Chemicals—** Relative to the collocated supply and recycling, the HI for the maximally exposed member of the public would be reduced by about 41 percent and that for the site worker by 50 percent. There are no cancer risks. The resulting values are within regulatory limits.
Advanced Light Water Reactor	- **Collocated Tritium Supply and Recycling for Emissions of Radiation—**There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	- **Collocated Tritium Supply and Recycling for Emissions of Radiation—**There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.
	- The dose to the maximally exposed member of the public from 1 year of operation would be 0.36 mrem for the Large or Small ALWR. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is $7.3x10^{-6}$.	- The dose to the maximally exposed member of the public from 1 year of operation would be 0.40 mrem for the Large or Small ALWR. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is $8.0x10^{-6}$.
	- The annual population dose of 73 and 71 person-rem for the Large and Small ALWRs from total site operation in 2030 would result in 1.5 and 1.4 fatal cancers, respectively, over 40 years of operation.	- The annual population dose of 0.24 and 0.25 person-rem for the Large and Small ALWR from total site operation in 2030 would result in $4.9x10^{-3}$ and $5.1x10^{-3}$ fatal cancers, respectively, over 40 years of operation.
	- The average annual dose to a site worker of 49 and 41 mrem for the Large and Small ALWRs would result in an associated fatal cancer risk of $7.9x10^{-4}$ and $6.6x10^{-4}$, respectively, from 40 years of operation; the annual dose of 392 and 322 person-rem to the total site workforce would result in 6.3 and 5.2 fatal cancers over 40 years of operation.	- The average annual dose to a site worker of 140 and 92 mrem for the Large and Small ALWRs would result in associated risk of fatal cancer risk of $2.3x10^{-3}$ and $1.5x10^{-3}$, respectively, from 40 years of operation; the annual dose of 180 and 100 person-rem to the total site workforce would result in 2.8 and 1.7 fatal cancers over 40 years of operation.

Radiological and Hazardous Chemical Impacts During Normal Operation

ORR	Pantex	SRS
Emissions of Hazardous Chemicals—Relative to the collocated supply and recycling, the HI for the maximally exposed member of the public and site worker would both be reduced by about 0.01 percent. There are no cancer risks. The resulting values are within regulatory limits.	**Emissions of Hazardous Chemicals**—Relative to the collocated supply and recycling, the HI to the maximally exposed member of the public would be reduced by about 10.6 percent and that for the site worker by about 0.003 percent with no change in either of the cancer risk values. These values are within regulatory limits.	**No Tritium Supply Alone.**
Collocated Tritium Supply and Recycling for Emissions of Radiation—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	**Collocated Tritium Supply and Recycling for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	**Tritium Supply and Upgraded Recycling for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.
The dose to the maximally exposed member of the public from 1 year of operation would be 8.8 and 7.6 mrem for the Large and Small ALWR from atmospheric release and 14 mrem from liquid release, for both sizes. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 1.8×10^{-4}, 1.5×10^{-4}, and 2.8×10^{-4} for these doses.	The dose to the maximally exposed member of the public from 1 year of operation would be 4.9 and 4.8 mrem for the Large and Small ALWR, respectively. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 9.8×10^{-5} and 9.6×10^{-5}.	The dose to the maximally exposed member of the public from 1 year of operation would be 3.9 and 3.6 mrem for the Large and Small ALWR from atmospheric release and 0.16 and 0.26 mrem from liquid release, respectively. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 7.8×10^{-5}, 7.1×10^{-5}, 3.3×10^{-6} and 5.39×10^{-6} for these doses.
The annual population dose of 90 and 87 person-rem for the Large and Small ALWRs from total site operation in 2030 would result in 1.8 and 1.7 fatal cancers, respectively, over 40 years of operation.	The annual population dose of 37 and 35 person-rem for the Large and Small ALWRs from total site operation in 2030 would result in 0.73 and 0.69 fatal cancers, respectively, over 40 years of operation.	The annual population dose of 340 and 310 person-rem for the Large and Small ALWRs from total site operation in 2030 would result in 6.8 and 6.2 fatal cancers, respectively, over 40 years of operation.
The average annual dose to a site worker of 26 and 22 mrem for the Large and Small ALWRs would result in an associated fatal cancer risk of 4.2×10^{-4} and 3.6×10^{-4}, respectively, from 40 years of operation; the annual dose of 490 and 420 person-rem to the total site workforce would result in 7.9 and 6.7 fatal cancers over 40 years of operation.	The average annual dose to a site worker of 68 and 46 mrem for the Large and Small ALWRs would result in an associated fatal cancer risk of 1.1×10^{-3} and 7.4×10^{-4}, respectively, from 40 years of operation; the annual dose of 210 and 140 person-rem to the total site workforce would result in 3.3 and 2.2 fatal cancers over 40 years of operation.	The average annual dose to a site worker of 42 and 38 mrem for the Large and Small ALWRs would result in an associated fatal cancer risk of 6.7×10^{-4} and 6.1×10^{-4}, respectively, from 40 years of operation; the annual dose of 650 and 580 person-rem to the total site workforce would result in 10 and 9.3 fatal cancers over 40 years of operation.

Radiological and Hazardous Chemical Impacts During Normal Operation

Technology	INEL	NTS
Advanced Light Water Reactor (Continued)	• **Emissions of Hazardous Chemicals**—The calculated HI for either ALWR is $6.3x10^{-4}$ with no cancer risk to the maximally exposed member of the public. The site worker HI is 0.13 with a cancer risk of 0. These values are within regulatory limits.	• **Emissions of Hazardous Chemicals**—The calculated HI for the ALWR is $7.7x10^{-5}$ with no cancer risk to the maximally exposed member of the public. The site worker HI is 0.038 with no cancer risk. These values are within regulatory limits.
	• **Tritium Supply Alone for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Tritium Supply Alone for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.
	• The dose to the maximally exposed member of the public from 1 year of operation would be 0.25 mrem for the Large or Small ALWR. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is $5.1x10^{-6}$.	• The dose to the maximally exposed member of the public from 1 year of operation would be 0.28 mrem for the Large or Small ALWR. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is $5.6x10^{-6}$.
	• The annual population dose of 51 and 49 person-rem for the Large and Small ALWRs from total site operation in 2030 would result in 1.1 and 0.96 fatal cancers, respectively, over 40 years of operation.	• The annual population dose of 0.17 and 0.18 person-rem for the Large and Small ALWR from total site operation in 2030 would result in $3.5x10^{-3}$ and $3.7x10^{-3\ \text{fatal}}$ cancers over 40 years of operation.
	• The average annual dose to a site worker of 52 and 43 mrem for the Large and Small ALWRs would result in an associated fatal cancer risk of $8.3x10^{-4}$ and $6.9x10^{-4}$, respectively, from 40 years of operation; the annual dose of 390 and 320 person-rem to the total site workforce would result in 6.3 and 5.2 fatal cancers over 40 years of operation	• The average annual dose to a site worker of 220 and 130 mrem for the Large and Small ALWRs would result in associated 40-year risk of fatal cancer risk of $3.5x10^{-3}$ and $2.2x10^{-3}$, respectively, from 40 years of operation; the annual dose of 180 and 98 person-rem to the total site workforce would result in 2.8 and 1.7 fatal cancers over 40 years of operation.

Radiological and Hazardous Chemical Impacts During Normal Operation

ORR	Pantex	SRS
• **Emissions of Hazardous Chemicals—** The calculated HI for either ALWR is 0.38 with no cancer risk to the maximally exposed member of the public. The site worker HI is 0.35 with no cancer risk. These values are within regulatory limits.	• **Emissions of Hazardous Chemicals—** The calculated HI for either ALWR is 7.5×10^{-3} with a cancer risk of 1.8×10^{-9} to the maximally exposed member of the public. The site worker HI is 0.26 and the cancer risk is 7.7×10^{-7}. These values are within regulatory limits.	• **Emissions of Hazardous Chemicals—** The calculated HI for either ALWR is 0.71 with a cancer risk of 3.3×10^{-5} to the maximally exposed member of the public. The site worker HI is 1.8 and the cancer risk is 6.0×10^{-3}. The HI value for the public is within regulatory limits, however, the HI value to the worker exceeds the level of 1.0 based on OSHA's exposure limits. Cancer risks to the public and site workers both exceed the typical threshold of regulatory concern of 1.0×10^{-6}.
• **Tritium Supply Alone for Emissions of Radiation—**There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Tritium Supply Alone for Emissions of Radiation—**There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **No Tritium Supply Alone.**
• The dose to the maximally exposed member of the public from 1 year of operation would be 6.0 and 4.8 mrem for the Large and Small ALWR from atmospheric release and 14 mrem from liquid release for both sizes. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 1.2×10^{-4}, 9.4×10^{-5} and 2.8×10^{-4}.	• The dose to the maximally exposed member of the public from 1 year of operation would be 3.5 and 3.4 mrem for the Large and Small ALWR, respectively. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 7.0×10^{-5} and 6.8×10^{-5}.	
• The annual population dose of 79 and 76 person-rem for the Large and Small ALWRs from total site operation in 2030 would result in 1.6 and 1.5 fatal cancers, respectively, over 40 years of operation.	• The annual population dose of 28 and 26 person-rem for the Large and Small ALWRs from total site operation in 2030 would result in 0.55 and 0.51 fatal cancers, respectively, over 40 years of operation.	
• The average annual dose to a site worker 26 and 23 mrem for the Large and Small ALWRs would result in associated 4.3×10^{-4} and 3.7×10^{-4} fatal cancers respectively from 40 years of operation; the annual dose of 490 and 420 person-rem to the total site workforce would result in 7.9 and 6.7 fatal cancers over 40 years of operation.	• The average annual dose to a site worker of 78 and 53 mrem for the Large and Small ALWRs would result in an associated fatal cancer risk of 1.3×10^{-3} and 8.6×10^{-4}, respectively; the annual dose of 210 and 140 person-rem to the total site workforce would result in 3.3 and 2.2 fatal cancers over 40 years of operation.	

Radiological and Hazardous Chemical Impacts During Normal Operation

Technology	INEL	NTS
Advanced Light Water Reactor (Continued)	• **Emissions of Hazardous Chemicals**—Relative to the collocated supply and recycling, the HI for the public would be reduced by about 0.1 percent and that for the worker by about 0.3 percent. There are no cancer risks. The resulting values are within regulatory limits.	• **Emissions of Hazardous Chemicals**—Relative to collocated supply and recycling, the HI for the public would be reduced by about 0.1 percent and that for the worker by about 0.04 percent. There are no cancer risks. The resulting values are within regulatory limits.
Accelerator Production of Tritium	• **Collocated Tritium Supply and Recycling For Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Collocated Tritium Supply and Recycling For Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.
	• The dose to the maximally exposed member of the public from 1 year of operation would be 0.16 mrem with a spallation-induced lithium conversion target and 0.11 mrem with a helium-3 target. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is $3.3\text{x}10^{-6}$ and $2.3\text{x}10^{-6}$, respectively.	• The dose to the maximally exposed member of the public from 1 year of operation would be 0.18 mrem with a spallation-induced lithium conversion target and 0.13 mrem with a helium-3 target. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is $3.6\text{x}10^{-6}$ and $2.6\text{x}10^{-6}$, respectively.
	• The annual population dose of 32 person-rem with a spallation-induced lithium conversion target and 23 person-rem with a helium-3 target from total site operation in 2030 would result in 0.64 and 0.45 fatal cancers, respectively, over 40 years of operation.	• The annual population dose of 0.11 person-rem with a spallation-induced lithium conversion target and 0.08 person-rem with a helium-3 target from total site operation in 2030 would result in $2.3\text{x}10^{-3}$ and $1.6\text{x}10^{-3}$ fatal cancers, respectively, over 40 years of operation.
	• The average annual dose to a site worker for spallation-induced lithium conversion target and helium-3 target are both 33 mrem with an associated $5.2\text{x}10^{-4}$ risk of fatal cancer from 40 years of operation; the annual doses of 262 and 260 person-rem to the total site workforce would result in 4.2 fatal cancers over 40 years of operation.	• The average annual dose to a site worker for spallation-induced lithium conversion and helium-3 target are 36 and 34 mrem respectively with an associated $5.7\text{x}10^{-4}$ and $5.5\text{x}10^{-4}$ risk of fatal cancer from 40 years of operation; the annual dose of 45 and 43 person-rem to the total site workforce would result in 0.72 and 0.69 fatal cancers over 40 years of operation.

Radiological and Hazardous Chemical Impacts During Normal Operation

ORR	Pantex	SRS
• **Emissions of Hazardous Chemicals**—Relative to the collocated supply and recycling, the HI would be reduced by less than 0.01 percent for either the maximally exposed member of the public or site worker. There are no cancer risks. The resulting values are within regulatory limits.	• **Emissions of Hazardous Chemicals**—Relative to the collocated supply and recycling, the HI for the public would be reduced by about 9.3 percent and that for the site worker by about 0.003 percent with no change in either of the cancer risk values. These values are within regulatory limits.	• **No Tritium Supply Alone.**
• **Collocated Tritium Supply and Recycling for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Collocated Tritium Supply and Recycling for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Tritium Supply and Upgraded Recycling for Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.
• The dose to the maximally exposed member of the public from 1 year of operation would be 5 and 4.3 mrem from atmospheric release with a spallation-induced lithium conversion and helium-3 target, respectively, and 14 mrem from liquid release with either target. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer is 1.0×10^{-4} and 8.6×10^{-5} for the atmospheric release with the respective targets and 2.8×10^{-4} for the liquid release with either target.	• The dose to the maximally exposed member of the public from 1 year of operation would be 2.1 mrem with a spallation-induced lithium conversion target and 1.4 mrem with a helium-3 target. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 4.2×10^{-5} and 2.9×10^{-5}, respectively.	• The dose to the maximally exposed member of the public from 1 year of operation would be 2.8 and 2.5 mrem from atmospheric release with a spallation-induced lithium conversion and helium-3 target, respectively, and 0.077 mrem from liquid release for both targets. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 5.6×10^{-5}, 4.9×10^{-5}, and 1.5×10^{-6}, respectively.
• The annual population dose of 73 person-rem with a spallation-induced lithium conversion target and 68 person-rem with a helium-3 target from total site operation in 2030 would result in 1.5 and 1.4 fatal cancers, respectively, over 40 years of operation.	• The annual population dose of 14 person-rem with a spallation-induced lithium conversion target and 9.2 person-rem with a helium-3 target from total site operation in 2030 would result in 0.27 and 0.18 fatal cancers, respectively, over 40 years of operation.	• The annual population dose of 250 person-rem with a spallation-induced lithium conversion and 220 person-rem with a helium-3 target, from total site operation in 2030 would result in 4.9 and 4.4 fatal cancers respectively, over 40 years of operation.
• The average annual dose to a site worker for spallation-induced lithium conversion and helium-3 targets are 19 and 18 mrem, respectively with an associated 3.0×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 362 and 360 person-rem to the total site workforce would result in 5.8 fatal cancers over 40 years of operation.	• For either target, the average annual dose to a site worker would be 25 mrem with an associated 4.0×10^{-4} and 3.9×10^{-4} risk of fatal cancer from 40 years of spallation-induced lithium conversion and helium-3 target operation, respectively; the annual dose of 79 and 77 person-rem to the total site workforce would result in 1.3 and 1.2 fatal cancers over 40 years of operation.	• For the spallation-induced lithium conversion and helium-3 targets, the average annual dose to a site worker would be 33 mrem with an associated 5.3×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 522 and 520 person-rem, respectively, to the total site workforce would result in 8.4 and 8.3 fatal cancers over 40 years of operation.

Radiological and Hazardous Chemical Impacts During Normal Operation

Technology	INEL	NTS
Accelerator Production of Tritium (Continued)	• **Emissions of Hazardous Chemicals**—The HI for either target is $1.8x10^{-4}$ with no cancer risk to the maximally exposed member of the public. The site worker HI is 0.021 with no cancer risk. These values are within regulatory limits.	• **Emissions of Hazardous Chemicals**—The HI for either target is $1.8x10^{-7}$ with no cancer risk to the maximally exposed member of the public. The site worker HI is $3.4x10^{-5}$ with no cancer risk. These values are within regulatory limits.
	• **Tritium Supply Alone For Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Tritium Supply Alone For Emissions of Radiation**—There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.
	• The dose to the maximally exposed member of the public from 1 year of operation would be 0.05 mrem with a spallation-induced lithium conversion target and $4.8x10^{-3}$ mrem with a helium-3 target from 40 years of operation. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is $1.1x10^{-6}$ and $1.0x10^{-7}$, respectively.	• The dose to the maximally exposed member of the public from 1 year of operation would be 0.06 mrem with a spallation-induced lithium conversion target and 0.01 mrem with a helium-3 target from 40 years of operation. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is $1.2x10^{-6}$ and $2.0x10^{-7}$, respectively.
	• The annual population dose of 10 person-rem with a spallation-induced lithium conversion target and 1 person-rem with a helium-3 target from total site operation in 2030 would result in 0.2 and 0.01 fatal cancers, respectively, over 40 years of operation.	• The annual population dose of 0.04 person-rem with a spallation-induced lithium conversion target and 0.01 person-rem with a helium-3 target from total site operation in 2030 would result in $9.0x10^{-4}$ and $2.0x10^{-4}$ fatal cancers, respectively, over 40 years of operation.
	• For either target, the average annual dose to a site worker would be 34 mrem with an associated $5.5x10^{-4}$ and $5.4x10^{-4}$ risk of fatal cancer from 40 years of spallation-induced lithium conversion and helium-3 target operation, respectively; the annual dose of 261 and 258 person-rem to the total site workforce would result in 4.2 and 4.4 fatal cancers over 40 years of operation.	• The average annual dose to a site worker would be 51 mrem with the spallation-induced lithium conversion target and 48 mrem with a helium-3 target with an associated $8.2x10^{-4}$ and $7.9x10^{-4}$ risk of fatal cancer from 40 years of operation; the annual doses of 44 and 41 person-rem to the total site workforce would result in 0.70 and 0.66 fatal cancers over 40 years of operation.

Radiological and Hazardous Chemical Impacts During Normal Operation

ORR	Pantex	SRS
• **Emissions of Hazardous Chemicals—** The HI for either target is 0.36 with no cancer risk to the maximally exposed member of the public. The site worker HI is 0.26 with no cancer risk. These values are within regulatory limits	• **Emissions of Hazardous Chemicals—** The calculated HI for either target is 3.8×10^{-3} with a cancer risk of 1.8×10^{-9} to the maximally exposed member of the public. The site worker HI is 0.26 and the cancer risk is 7.7×10^{-7}. These values are within regulatory limits	• **Emissions of Hazardous Chemicals—** The calculated HI for either target is 0.70 with a cancer risk of 3.3×10^{-5} to the maximally exposed member of the public. The site worker HI is 1.8 and the cancer risk is 5.9×10^{-3}. The HI value for the public is within regulatory limits, however, the HI value to the worker exceeds the action level of 1 based on OSHA's exposure limits. The cancer risks to the public and site worker exceed the typical threshold of regulatory concern of 1×10^{-6}.
• **Tritium Supply Alone For Emissions of Radiation—**There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **Tritium Supply Alone For Emissions of Radiation—**There would be no radiological releases during construction. Limited hazardous chemical releases are anticipated and would be within regulated exposure limits resulting in no adverse health effects.	• **No Tritium Supply Alone.**
• The dose to the maximally exposed member of the public from 1 year of operation would be 2.2 and 1.5 mrem from atmospheric release with a spallation-induced lithium conversion and helium-3 target, respectively, and 14 mrem from liquid release with either target. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer is 4.4×10^{-5} and 3.0×10^{-5} for the atmospheric release with the respective targets and 2.8×10^{-4} for the liquid release with either target from 40 years of operation.	• The dose to the maximally exposed member of the public from 1 year of operation would be 0.7 mrem with a spallation-induced lithium conversion target and 0.048 mrem with a helium-3 target. This is within DOE Order 5400.5 limits. The associated risk of fatal cancer from 40 years of operation is 1.4×10^{-5} and 1.0×10^{-6}, respectively.	
• The annual population dose of 62 person-rem with a spallation-induced lithium conversion target and 57 person-rem with a helium-3 target from total site operation in 2030 would result in 1.3 and 1.2 fatal cancers, respectively, over 40 years of operation.	• The annual population dose of 5 person-rem with a spallation-induced lithium conversion target and 0.2 person-rem with a helium-3 target from total site operation in 2030 would result in 0.09 and 3.9×10^{-3} fatal cancers, respectively, over 40 years of operation.	
• For either target, the average annual dose to a site worker would be 19 mrem with an associated 3.0×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 360 person-rem to the total site workforce would result in 5.8 fatal cancers over 40 years of operation.	• The average annual dose to a site workers would be 29 mrem with the spallation-induced lithium conversion target and 28 mrem with the helium-3 target with an associated 4.6×10^{-4} and 4.4×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 78 and 75 person-rem, respectively, to the total site workforce would result in 1.2 fatal cancers over 40 years of operation.	

Radiological and Hazardous Chemical Impacts During Normal Operation

Technology	INEL	NTS
Accelerator Production of Tritium (Continued)	• **Emissions of Hazardous Chemicals**—Relative to the collocated supply and recycling, the HI for the maximally exposed member of the public would be reduced by about 0.3 percent and that for the worker by about 0.2 percent. There are no cancers. The resulting values are within regulatory limits.	• **Emissions of Hazardous Chemicals**—Relative to the collocated supply and recycling, the HI for the maximally exposed member of the public would be reduced by about 51 percent and that for the site worker by about 50 percent. There are no cancer risks. The resulting values are within regulatory limits.
All Supply Technologies	• **Less Than Baseline Operations**—Radiological and hazardous chemical impacts from less than baseline operations with the HWR, MHTGR, or ALWR would be identical for each site. • The impacts from the HWR operating at the reduced tritium production capacity to meet a less than baseline operation requirement would be proportional to the level of operation, approximately 40 percent of baseline. • The normal operation impacts of the ALWR or three reactor module MHTGR would not change because the reactor would maintain power requirements to produce steam or electricity. • For the Phased APT with recycling, the dose to the maximally exposed member of the public from 1 year of operation would be 0.11 mrem and would result in an associated risk of fatal cancer from 40 years of operation of 2.3×10^{-6}. The dose is within DOE Order 5400.5 limits. The annual population dose of 23 person-rem to the total site operation in 2030 would result in 0.45 fatal cancers over 40 years of operation. The average annual dose to a site worker would be 33 mrem with an associated 5.2×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 260 person-rem to the total site workforce would result in 4.2 fatal cancers over 40 years of operation. Impacts from hazardous chemical emissions would be identical to those associated with the Full APT.	• **Less Than Baseline Operations**—Radiological and hazardous chemical impacts from less than baseline operations with the HWR, MHTGR, or ALWR would be identical for each site (see INEL). • The impacts from the HWR operating at the reduced tritium production capacity to meet a less than baseline operation requirement would be proportional to the level of operation, approximately 40 percent of baseline. • The normal operation impacts of the ALWR or three reactor module MHTGR would not change because the reactor would maintain power requirements to produce steam or electricity. • For the Phased APT with recycling, the dose to the maximally exposed member of the public from 1 year of operation would be 0.13 mrem and would result in an associated risk of fatal cancer from 40 years of operation of 2.6×10^{-6}. The dose is within DOE Order 5400.5 limits. The annual population dose of 0.08 person-rem from total site operation in 2030 would result in 1.6×10^{-3} fatal cancers over 40 years of operation. The average annual dose to a site worker would be 34 mrem with an associated 5.5×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 43 person-rem to the total site workforce would result in 0.69 fatal cancers over 40 years of operation. Impacts from hazardous chemical emissions would be identical to those associated with the Full APT.

Radiological and Hazardous Chemical Impacts During Normal Operation

ORR	Pantex	SRS
• **Emissions of Hazardous Chemicals—** Should the recycling process not be included, the HI for the maximally exposed member of the public and site worker would be reduced by about 0.01 percent for each and for either target. The resulting values are within regulatory limits.	• **Emissions of Hazardous Chemicals—** Should recycling processes not be included, the HI for the public would be reduced by about 10.6 percent and that of site workers by about 0.003 percent with no change in either of the cancer risk values. These values are within regulatory limits.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations—** Radiological and hazardous chemical impacts from less than baseline operations with the HWR, MHTGR, or ALWR would be identical for each site (see INEL).	• **Less Than Baseline Operations—** Radiological and hazardous chemical impacts from less than baseline operations with the HWR, MHTGR, or ALWR would be identical for each site (see INEL).	• **Less Than Baseline Operations—** Radiological and hazardous chemical impacts from less than baseline operations with the HWR, MHTGR, or ALWR would be identical for each site (see INEL).
• The impacts from the HWR operating at the reduced tritium production capacity to meet a less than baseline operation requirement would be proportional to the level of operation, approximately 40 percent of baseline.	• The impacts from the HWR operating at the reduced tritium production capacity to meet a less than baseline operation requirement would be proportional to the level of operation, approximately 40 percent of baseline.	• The impacts from the HWR operating at the reduced tritium production capacity to meet a less than baseline operation requirement would be proportional to the level of operation, approximately 40 percent of baseline.
• The normal operation impacts of the ALWR or three reactor module MHTGR would not change because the reactor would maintain power requirements to produce steam or electricity.	• The normal operation impacts of the ALWR or three reactor module MHTGR would not change because the reactor would maintain power requirements to produce steam or electricity.	• The normal operation impacts of the ALWR or three reactor module MHTGR would not change because the reactor would maintain power requirements to produce steam or electricity.
• For the Phased APT with recycling, the dose to the maximally exposed member of the public from 1 year of operation would be 4.3 and 14 mrem from atmospheric and liquid releases, respectively, and would result in an associated risk of fatal cancer from 40 years of operation of 8.6×10^{-5} and 2.8×10^{-4}. The doses are within DOE Order 5400.5 limits.	• For the Phased APT with recycling, the dose to the maximally exposed member of the public from 1 year of operation would be 1.4 mrem and would result in an associated risk of fatal cancer from 40 years of operation of 2.9×10^{-5}. The doses are within DOE Order 5400.5 limits.	• For the Phased APT with recycling, the dose to the maximally exposed member of the public from 1 year of operation would be 2.5 and 0 mrem from atmospheric and liquid releases, respectively, and would result in an associated risk of fatal cancer from 40 years of operation of 4.9×10^{-5} and 0. The doses are within DOE Order 5400.5 limits.
The annual population dose of 68 person-rem from total site operation in 2030 would result in 1.4 fatal cancers over 40 years of operation.	The annual population dose of 9.2 person-rem from total site operation in 2030 would result in 0.18 fatal cancers over 40 years of operation.	The annual population dose of 220 person-rem from total site operation in 2030 would result in 4.4 fatal cancers over 40 years of operation.
The average annual dose to a site worker would be 18 mrem with an associated 3.0×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 360 person-rem to the total site workforce would result in 5.8 fatal cancers over 40 years of operation.	The average annual dose to a site worker would be 25 mrem with an associated 3.9×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 77 person-rem to the total site workforce would result in 1.2 fatal cancers over 40 years of operation.	The average annual dose to a site worker would be 33 mrem with an associated 5.3×10^{-4} risk of fatal cancer from 40 years of operation; the annual dose of 520 person-rem to the total site workforce would result in 8.4 fatal cancers over 40 years of operation.
Impacts from hazardous chemical emissions would be identical to those associated with the Full APT.	Impacts from hazardous chemical emissions would be identical to those associated with the Full APT.	Impacts from hazardous chemical emissions would be identical to those associated with the Full APT.

Radiological and Hazardous Chemical Impacts During Normal Operation

Technology	INEL	NTS
All Supply Technologies (Continued)	• For the Phased APT without recycling, the dose to the maximally exposed member of the public from 1 year of operation would be 4.8×10^{-3} mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancers from 40 years of operation is 1.0×10^{-7}. The annual population dose of 1 person-rem from total site operation in 2030 would result in 0.01 fatal cancers over 40 years of operation. The average annual dose to a site worker is 34 mrem with an associated 5.4×10^{-4} risk of fatal cancer over 40 years of operation; the annual dose of 258 person-rem to the total site workforce would result in 4.1 fatal cancers over 40 years of operation.	• For the Phased APT without recycling, the dose to the maximally exposed member of the public from 1 year of operation would be 0.010 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancers from 40 years of operation is 2.0×10^{-7}. The annual population dose of 0.01 person-rem from total site operation in 2030 would result in 2.0×10^{-4} fatal cancers over 40 years of operation. The average annual dose to a site worker is 48 mrem with an associated 7.7×10^{-4} risk of fatal cancer over 40 years of operation; the annual dose of 41 person-rem to the total site workforce would result in 0.66 fatal cancers over 40 years of operation.
	• **Tritium Extraction and Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at INEL. The phaseout of recycling at SRS would decrease the annual dose to the maximally exposed member of the public located at SRS by 2.4 mrem from No Action, lowering the associated 40-year fatal cancer risk by 4.9×10^{-5}. The annual population dose to the population surrounding SRS in 2030 would decrease by 210 person-rem, resulting in 4.2 fewer fatal cancers over a 40 year period. The doses and associated health effects among site workers would remain virtually the same as No Action.	• **Tritium Extraction and Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at NTS. The phaseout of recycling at SRS would decrease the annual dose to the maximally exposed member of the public located at SRS by 2.4 mrem from No Action, lowering the associated 40-year fatal cancer risk by 4.9×10^{-5}. The annual population dose to the population surrounding SRS in 2030 would decrease by 210 person-rem, resulting in 4.2 fewer fatal cancers over a 40 year period. The doses and associated health effects among site workers would remain virtually the same as No Action.
	• Any reduction in the emissions of hazardous chemicals is so small that it fails to change the HI or cancer risk to the public or site worker. This action applies to any collocated tritium supply and new recycling at INEL.	• Any reduction in the emissions of hazardous chemicals is so small that it fails to change the HI or cancer risk to the public or site worker. This action applies to any collocated tritium supply and new recycling at NTS.

Radiological and Hazardous Chemical Impacts During Normal Operation

ORR	Pantex	SRS
• For the Phased APT without recycling, the dose to the maximally exposed member of the public from 1 year of operation would be 15 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancers from 40 years of operation is $3.0x10^{-4}$. The annual population dose of 57 person-rem from total site operation in 2030 would result in 1.2 fatal cancers over 40 years of operation. The average annual dose to a site worker is 19 mrem with an associated $3.0x10^{-4}$ risk of fatal cancer over 40 years of operation; the annual dose of 358 person-rem to the total site workforce would result in 5.7 fatal cancers over 40 years of operation.	• For the Phased APT without recycling, the dose to the maximally exposed member of the public from 1 year of operation would be 0.048 mrem. This is within DOE Order 5400.5 limits. The associated risk of fatal cancers from 40 years of operation is $1.0x10^{-6}$. The annual population dose of 0.20 person-rem from total site operation in 2030 would result in $3.9x10^{-3}$ fatal cancers over 40 years of operation. The average annual dose to a site worker is 28 mrem with an associated $4.4x10^{-4}$ risk of fatal cancer over 40 years of operation; the annual dose of 75 person-rem to the total site workforce would result in 1.2 fatal cancers over 40 years of operation.	
• **Tritium Extraction and Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at ORR. The phaseout of recycling at SRS would decrease the annual dose to the maximally exposed member of the public located at SRS by 2.4 mrem from No Action, lowering the associated 40-year fatal cancer risk by $4.9x10^{-5}$. The annual population dose to the population surrounding SRS in 2030 would decrease by 210 person-rem, resulting in 4.2 fewer fatal cancers over a 40 year period. The doses and associated health effects among site workers would remain virtually the same as No Action.	• **Tritium Extraction and Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at Pantex. The phaseout of recycling at SRS would decrease the annual dose to the maximally exposed member of the public located at SRS by 2.4 mrem from No Action, lowering the associated 40-year fatal cancer risk by $4.9x10^{-5}$. The annual population dose to the population surrounding SRS in 2030 would decrease by 210 person-rem, resulting in 4.2 fewer fatal cancers over a 40 year period. The doses and associated health effects among site workers would remain virtually the same as No Action.	• **No Tritium Extraction and Recycling Phaseout With SRS Alternatives.**
• Any reduction in the emissions of hazardous chemicals is so small that it fails to change the HI or cancer risk to the public or site worker. This action applies to any collocated tritium supply and new recycling at ORR.	• Any reduction in the emissions of hazardous chemicals is so small that it fails to change the HI or cancer risk to the public or site worker. This action applies to any collocated tritium supply and new recycling at Pantex.	

Radiological and Hazardous Chemical Impacts — Accidents

Technology	INEL	NTS
No Action	- No impact.	- No impact.
Heavy Water Reactor	- **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences*: The radiological impacts from the recycling facility are not negligible when compared to those of the HWR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the HWR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 5.0×10^{-5}. The associated risk of cancer fatality is 1.0×10^{-9} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.45 with an associated risk of cancer fatalities of 9.0×10^{-6} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 1.7×10^{-3}. The associated risk of cancer fatality to the worker is 3.4×10^{-8} per year.	- **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences*: The radiological impacts from the recycling facility are not negligible when compared to those of the HWR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the HWR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 2.2×10^{-5}. The associated risk of cancer fatality is 4.4×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 7.5×10^{-3} with an associated risk of cancer fatalities of 1.5×10^{-7} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 5.2×10^{-8}. The associated risk of cancer fatality to the worker is 1.0×10^{-12} per year.

Radiological and Hazardous Chemical Impacts — Accidents

ORR	Pantex	SRS
- No impact	- No impact	- The dose of 0.045 rem for the beyond design-basis earthquake to a maximally exposed member of the public from a radioactive release accident would result in an increased likelihood of cancer fatality of 2.2×10^{-5}. The associated risk of cancer fatalities per year is 4.4×10^{-10}. The dose of 300 person-rem for the beyond design-basis earthquake to a population within 50 miles would result in 0.15 cancer fatalities. The associated risk of cancer fatalities per year is 3.0×10^{-6}.
- **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences:* The radiological impacts from the recycling facility are not negligible when compared to those of the HWR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the HWR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 4.2×10^{-4}. The associated risk of cancer fatality is 8.4×10^{-9} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 4.5 with an associated risk of cancer fatalities of 9.0×10^{-5} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 2.6×10^{-3}. The associated risk of cancer fatality to the worker is 5.2×10^{-8} per year.	- **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences:* The radiological impacts from the recycling facility are negligible compared to those of the HWR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the HWR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 3.9×10^{-5}. The associated risk of cancer fatality is 7.8×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.16 with an associated risk of cancer fatalities of 3.2×10^{-6} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 2.4×10^{-4}. The associated risk of cancer fatality to the worker is 4.8×10^{-9} per year.	- **Tritium Supply and Upgraded Recycling**—*Low-to-Moderate Consequences:* The radiological impacts from the recycling facility are not negligible when compared to those of the HWR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the HWR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 1.2×10^{-4}. The associated risk of cancer fatality is 2.4×10^{-9} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 6.0 with an associated risk of cancer fatalities of 1.2×10^{-4} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 4.8×10^{-3}. The associated risk of cancer fatality to the worker is 9.6×10^{-8} per year.

Radiological and Hazardous Chemical Impacts — Accidents

Technology	INEL	NTS
Heavy Water Reactor (Continued)	• *High Consequence/Low Probability*–The radiological impacts from the recycling and extraction facilities are negligible compared to those of the HWR supply technology. For the HWR, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 7.1×10^{-4}. The associated risk of cancer fatality is 6.5×10^{-9} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 1.6 with an associated risk of cancer fatalities of 1.4×10^{-5} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 0.034. The associated risk of cancer fatality to the worker is 3.2×10^{-7} per year. • **Tritium Supply Alone**—*Low-to-Moderate Consequences:* The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 8.1×10^{-6}. The associated risk of cancer fatality is 8.1×10^{-9} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.074 with an associated risk of cancer fatalities of 7.4×10^{-5} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 1.1×10^{-4}. The associated risk of cancer fatality to the worker is 1.1×10^{-7} per year.	• *High Consequence/Low Probability*–The radiological impacts from the recycling and extraction facilities are negligible compared to those of the HWR supply technology. For the HWR, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 2.0×10^{-3}. The associated risk of cancer fatality is 1.8×10^{-8} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.15 with an associated risk of cancer fatalities of 1.4×10^{-6} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 0.031. The associated risk of cancer fatality to the worker is 2.8×10^{-7} per year. • **Tritium Supply Alone**—*Low-to-Moderate Consequences:* The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 4.2×10^{-6}. The associated risk of cancer fatality is 4.2×10^{-9} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 1.2×10^{-3} with an associated risk of cancer fatalities of 1.2×10^{-6} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 2.8×10^{-5}. The associated risk of cancer fatality to the worker is 2.8×10^{-8} per year.

Radiological and Hazardous Chemical Impacts — Accidents

ORR	Pantex	SRS
• *High Consequence/Low Probability*–The radiological impacts from the recycling and extraction facilities are negligible compared to those of the HWR supply technology. For the HWR, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 0.015. The associated risk of cancer fatality is $1.4x10^{-7}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 13 with an associated risk of cancer fatalities of $1.2x10^{-4}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 0.035. The associated risk of cancer fatality to the worker is $3.2x10^{-7}$ per year.	• *High Consequence/Low Probability*–The radiological impacts from the recycling and extraction facilities are negligible compared to those of the HWR supply technology. For the HWR, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 0.010. The associated risk of cancer fatality is $9.5x10^{-8}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 1.7 with an associated risk of cancer fatalities of $1.5x10^{-5}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 0.024. The associated risk of cancer fatality to the worker is $2.2x10^{-7}$ per year.	• *High Consequence/Low Probability*–The radiological impacts from the recycling and extraction facilities are negligible compared to those of the HWR supply technology. For the HWR, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $6.6x10^{-4}$. The associated risk of cancer fatality is $6.0x10^{-9}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 5.5 with an associated risk of cancer fatalities of $5.1x10^{-5}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 0.023. The associated risk of cancer fatality to the worker is $2.1x10^{-7}$ per year.
• **Tritium Supply Alone**—*Low-to-Moderate Consequences:* The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $6.8x10^{-5}$. The associated risk of cancer fatality is $6.8x10^{-8}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.75 with an associated risk of cancer fatalities of $7.5x10^{-4}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $1.6x10^{-4}$. The associated risk of cancer fatality to the worker is $1.6x10^{-7}$ per year.	• **Tritium Supply Alone**—*Low-to-Moderate Consequences:* The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $6.2x10^{-6}$. The associated risk of cancer fatality is $6.2x10^{-9}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.026 with an associated risk of cancer fatalities of $2.6x10^{-5}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $1.2x10^{-5}$. The associated risk of cancer fatality to the worker is $1.2x10^{-8}$ per year.	• **No Tritium Supply Alone.**

Radiological and Hazardous Chemical Impacts — Accidents

Technology	INEL	NTS
Heavy Water Reactor (Continued)	• *High Consequences/Low Probability*–The accident impacts from the recycling and extraction facilities are negligible compared to those from the supply technologies. Therefore, the impacts from supply technologies alone are identical to those listed above.	• *High Consequences/Low Probability*–The accident impacts from the recycling and extraction facilities are negligible compared to those from the supply technologies. Therefore, the impacts from supply technologies alone are identical to those listed above.
Modular High Temperature Gas-Cooled Reactor	• **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences:* The radiological impacts from the recycling facility are not negligible when compared to those of the MHTGR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the MHTGR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $5.0\text{x}10^{-5}$. The associated risk of cancer fatality is $1.0\text{x}10^{-9}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.45 with an associated risk of cancer fatalities of $9.0\text{x}10^{-6}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $1.7\text{x}10^{-3}$. The associated risk of cancer fatality to the worker is $3.4\text{x}10^{-8}$ per year. • *High Consequence/Low Probability*–The radiological impacts from the recycling and extraction facilities are negligible compared to those of the MHTGR supply technology. For the MHTGR, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $5.9\text{x}10^{-5}$. The associated risk of cancer fatality is $9.4\text{x}10^{-10}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.18 with an associated risk of cancer fatalities of $2.9\text{x}10^{-6}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $6.7\text{x}10^{-3}$. The associated risk of cancer fatality to the worker is $1.1\text{x}10^{-7}$ per year.	• **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences:* The radiological impacts from the recycling facility are not negligible when compared to those of the MHTGR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the MHTGR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $2.2\text{x}10^{-5}$. The associated risk of cancer fatality is $4.4\text{x}10^{-10}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $7.5\text{x}10^{-3}$ with an associated risk of cancer fatalities of $1.5\text{x}10^{-7}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $5.2\text{x}10^{-8}$. The associated risk of cancer fatality to the worker is $1.0\text{x}10^{-12}$ per year. • *High Consequence/Low Probability*–The radiological impacts from the recycling and extraction facilities are negligible compared to those of the MHTGR supply technology. For the MHTGR, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $1.7\text{x}10^{-4}$. The associated risk of cancer fatality is $2.7\text{x}10^{-9}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.017 with an associated risk of cancer fatalities of $2.8\text{x}10^{-7}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $5.0\text{x}10^{-3}$. The associated risk of cancer fatality to the worker is $8.1\text{x}10^{-8}$ per year.

Radiological and Hazardous Chemical Impacts — Accidents

ORR	Pantex	SRS
• *High Consequences/Low Probability*—The accident impacts from the recycling and extraction facilities are negligible compared to those from the supply technologies. Therefore, the impacts from supply technologies alone are identical to those listed above.	• *High Consequences/Low Probability*—The accident impacts from the recycling and extraction facilities are negligible compared to those from the supply technologies. Therefore, the impacts from supply technologies alone are identical to those listed above.	
• **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences:* The radiological impacts from the recycling facility are not negligible when compared to those of the MHTGR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the MHTGR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 4.2×10^{-4}. The associated risk of cancer fatality is 8.4×10^{-9} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 4.5 with an associated risk of cancer fatalities of 9.0×10^{-5} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 2.6×10^{-3}. The associated risk of cancer fatality to the worker is 5.2×10^{-8} per year.	• **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences:* The radiological impacts from the recycling facility are not negligible when compared to those of the MHTGR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the MHTGR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 3.9×10^{-5}. The associated risk of cancer fatality is 7.8×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.16 with an associated risk of cancer fatalities of 3.2×10^{-6} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 2.4×10^{-4}. The associated risk of cancer fatality to the worker is 4.8×10^{-9} per year.	• **Tritium Supply and Upgraded Recycling**—*Low-to-Moderate Consequences:* The radiological impacts from the recycling facility are not negligible when compared to those of the MHTGR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the MHTGR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 1.2×10^{-4}. The associated risk of cancer fatality is 2.4×10^{-9} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 6.0 with an associated risk of cancer fatalities of 1.2×10^{-4} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 4.8×10^{-3}. The associated risk of cancer fatality to the worker is 9.6×10^{-8} per year.
• *High Consequence/Low Probability*—The radiological impacts from the recycling and extraction facilities are negligible compared to those of the MHTGR supply technology. For the MHTGR, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 1.5×10^{-3}. The associated risk of cancer fatality is 2.4×10^{-8} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 1.4 with an associated risk of cancer fatalities of 2.3×10^{-5} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 7.1×10^{-3}. The associated risk of cancer fatality to the worker is 1.1×10^{-7} per year.	• *High Consequence/Low Probability*—The radiological impacts from the recycling and extraction facilities are negligible compared to those of the MHTGR supply technology. For the MHTGR, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 1.0×10^{-3}. The associated risk of cancer fatality is 1.6×10^{-8} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.19 with an associated risk of cancer fatalities of 3.0×10^{-6} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 3.1×10^{-3}. The associated risk of cancer fatality to the worker is 5.0×10^{-8} per year.	• *High Consequence/Low Probability*—The radiological impacts from the recycling and extraction facilities are negligible compared to those of the MHTGR supply technology. For the MHTGR, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 6.3×10^{-5}. The associated risk of cancer fatality is 1.0×10^{-9} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.63 with an associated risk of cancer fatalities of 1.0×10^{-5} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 3.2×10^{-3}. The associated risk of cancer fatality to the worker is 5.1×10^{-8} per year.

Radiological and Hazardous Chemical Impacts — Accidents

Technology	INEL	NTS
Modular High Temperature Gas-Cooled Reactor (Continue)	• **Tritium Supply Alone**—*Low-to-Moderate Consequences:* The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 5.1×10^{-9}. The associated risk of cancer fatality is 1.3×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 2.0×10^{-5} with an associated risk of cancer fatalities of 5.0×10^{-7} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 1.3×10^{-9}. The associated risk of cancer fatality to the worker is 3.3×10^{-9} per year. • *High Consequences/Low Probability*–The accident impacts from the recycling and extraction facilities are negligible compared to those from the supply technologies. Therefore, the impacts from supply technologies alone are identical to those listed above.	• **Tritium Supply Alone**—*Low-to-Moderate Consequences:* The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 2.2×10^{-9}. The associated risk of cancer fatality is 5.5×10^{-11} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 6.8×10^{-7} with an associated risk of cancer fatalities of 1.7×10^{-8} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 3.3×10^{-8}. The associated risk of cancer fatality to the worker is 8.3×10^{-10} per year. • *High Consequences/Low Probability*–The accident impacts from the recycling and extraction facilities are negligible compared to those from the supply technologies. Therefore, the impacts from supply technologies alone are identical to those listed above.

Radiological and Hazardous Chemical Impacts — Accidents

ORR	Pantex	SRS
• **Tritium Supply Alone**—*Low-to-Moderate Consequences:* The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 4.4×10^{-8}. The associated risk of cancer fatality is 1.1×10^{-9} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 4.3×10^{-4} with an associated risk of cancer fatalities of 1.1×10^{-5} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 1.9×10^{-7}. The associated risk of cancer fatality to the worker is 4.8×10^{-9} per year. • *High Consequences/Low Probability*–The accident impacts from the recycling and extraction facilities are negligible compared to those from the supply technologies. Therefore, the impacts from supply technologies alone are identical to those listed above.	• **Tritium Supply Alone**—*Low-to-Moderate Consequences:* The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 4.0×10^{-9}. The associated risk of cancer fatality is 1.0×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 1.2×10^{-5} with an associated risk of cancer fatalities of 3.0×10^{-7} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 1.5×10^{-8}. The associated risk of cancer fatality to the worker is 3.8×10^{-10} per year. • *High Consequences/Low Probability*–The accident impacts from the recycling and extraction facilities are negligible compared to those from the supply technologies. Therefore, the impacts from supply technologies alone are identical to those listed above.	• **No Tritium Supply Alone.**

Radiological and Hazardous Chemical Impacts — Accidents

Technology	INEL	NTS
Advanced Light Water Reactor	• **Collocated Supply and Recycling—** *Low-to-Moderate Consequences:* The radiological impacts from the recycling facility are not negligible when compared to those of the ALWR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the ALWR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 5.0×10^{-5}. The associated risk of cancer fatality is 1.0×10^{-9} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.45 with an associated risk of cancer fatalities of 9.0×10^{-6} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 1.7×10^{-3}. The associated risk of cancer fatality to the worker is 3.4×10^{-8} per year. • *High Consequence/Low Probability*–The radiological impacts from the recycling and extraction facilities are negligible compared to those of the ALWR supply technology. The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 2.3×10^{-3} and 2.3×10^{-3} for the Large and Small ALWRs, respectively. The associated risk of cancer fatality would be 3.5×10^{-10} and 3.6×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents would be 0.36 and 4.1 and the associated risk of cancer fatalities would be 5.5×10^{-8} and 6.4×10^{-7} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 0.033 and 0.094 for the Large and Small ALWRs, respectively. The associated risk of cancer fatality to the worker would be 5.0×10^{-9} and 1.5×10^{-8} per year.	• **Collocated Supply and Recycling—** *Low-to-Moderate Consequences:* The radiological impacts from the recycling facility are not negligible when compared to those of the ALWR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the ALWR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 2.2×10^{-5}. The associated risk of cancer fatality is 4.4×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 7.5×10^{-3} with an associated risk of cancer fatalities of 1.5×10^{-7} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 5.2×10^{-8}. The associated risk of cancer fatality to the worker is 1.0×10^{-12} per year. • *High Consequence/Low Probability*–The radiological impacts from the recycling and extraction facilities are negligible compared to those of the ALWR supply technology. The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 5.5×10^{-3} and 6.3×10^{-3} for the Large and Small ALWRs, respectively. The associated risk of cancer fatality would be 8.3×10^{-10} and 9.8×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents would be 0.035 and 0.39 and the associated risk of cancer fatalities would be 5.3×10^{-9} and 6.1×10^{-8} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 0.030 and 0.087 for the Large and Small ALWRs respectively. The associated risk of cancer fatality to the worker would be 4.5×10^{-9} and 1.4×10^{-8} per year.

Radiological and Hazardous Chemical Impacts — Accidents

ORR	Pantex	SRS
• **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences:* The radiological impacts from the recycling facility are not negligible when compared to those of the ALWR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the ALWR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $4.2x10^{-4}$. The associated risk of cancer fatality is $8.4x10^{-9}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 4.5 with an associated risk of cancer fatalities of $9.0x10^{-5}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $2.6x10^{-3}$. The associated risk of cancer fatality to the worker is $5.2x10^{-8}$ per year.	• **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences:* The radiological impacts from the recycling facility are not negligible when compared to those of the ALWR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the ALWR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $3.9x10^{-5}$. The associated risk of cancer fatality is $7.8x10^{-10}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.16 with an associated risk of cancer fatalities of $3.2x10^{-6}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $2.4x10^{-4}$. The associated risk of cancer fatality to the worker is $4.8x10^{-9}$ per year.	• **Tritium Supply and Upgraded Recycling**—*Low-to-Moderate Consequences:* The radiological impacts from the recycling facility are not negligible when compared to those of the ALWR supply technology. The radiological impacts from the extraction facility are more severe for the population within 50 miles of the accident than those of the ALWR supply technology. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $1.2x10^{-4}$. The associated risk of cancer fatality is $2.4x10^{-9}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 6.0 with an associated risk of cancer fatalities of $1.2x10^{-4}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $4.8x10^{-3}$. The associated risk of cancer fatality to the worker is $9.6x10^{-8}$ per year.
• *High Consequence/Low Probability*–The radiological impacts from the recycling and extraction facilities are negligible compared to those of the ALWR supply technology. The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 0.020 and 0.042 for the Large and Small ALWRs, respectively. The associated risk of cancer fatality would be $3.1x10^{-9}$ and $6.6x10^{-9}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents would be 6.2 and 33 and the associated risk of cancer fatalities would be $9.4x10^{-7}$ and $5.1x10^{-6}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 0.032 and 0.10 for the Large and Small ALWRs, respectively. The associated risk of cancer fatality to the worker would be $4.9x10^{-9}$ and $1.6x10^{-8}$ per year.	• *High Consequence/Low Probability*–The radiological impacts from the recycling and extraction facilities are negligible compared to those of the ALWR supply technology. The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 0.015 and 0.029 for the Large and Small ALWRs, respectively. The associated risk of cancer fatality would be $2.3x10^{-9}$ and $4.6x10^{-9}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents would be 0.72 and 4.3 and the associated risk of cancer fatalities would be $1.1x10^{-7}$ and $6.7x10^{-7}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 0.023 and 0.070 for the Large and Small ALWRs, respectively. The associated risk of cancer fatality to the worker would be $3.5x10^{-9}$ and $1.1x10^{-8}$ per year.	• *High Consequence/Low Probability*–The radiological impacts from the recycling and extraction facilities are negligible compared to those of the ALWR supply technology. The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $1.3x10^{-3}$ and $1.9x10^{-3}$ for the Large and Small ALWRs, respectively. The associated risk of cancer fatality would be $2.0x10^{-10}$ and $2.9x10^{-10}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents would be 1.7 and 14 and the associated risk of cancer fatalities would be $2.6x10^{-7}$ and $2.3x10^{-6}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 0.023 and 0.067 for the Large and Small ALWRs, respectively. The associated risk of cancer fatality to the worker would be $3.4x10^{-9}$ and $1.1x10^{-8}$ per year.

Radiological and Hazardous Chemical Impacts — Accidents

Technology	INEL	NTS
Advanced Light Water Reactor (Continued)	• **Tritium Supply Alone**—*Low-to-Moderate Consequences:* The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 5.0×10^{-6} and 6.8×10^{-6} for the Large and Small ALWRs, respectively. The associated risk of cancer fatality would be 5.0×10^{-11} and 6.8×10^{-11} per year. The estimated cancer fatalities for the population within 50 miles of the accidents would be 0.038 and 0.062 and the associated risk of cancer fatalities would be 3.8×10^{-7} and 6.2×10^{-7} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 1.0×10^{-4} and 1.3×10^{-4} for the Large and Small ALWRs, respectively. The associated risk of cancer fatality to the worker would be 1.0×10^{-9} and 1.3×10^{-9} per year. • *High Consequences/Low Probability*–The accident impacts from the recycling and extraction facilities are negligible compared to those from the supply technologies. Therefore, the impacts from supply technologies alone are identical to those listed above.	• **Tritium Supply Alone**—*Low-to-Moderate Consequences:* The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 2.2×10^{-6} and 3.0×10^{-6} for the Large and Small ALWRs, respectively. The associated risk of cancer fatality would be 2.2×10^{-11} and 3.0×10^{-11} per year. The estimated cancer fatalities for the population within 50 miles of the accidents would be 7.3×10^{-4} and 1.0×10^{-3} and the associated risk of cancer fatalities would be 7.3×10^{-9} and 1.0×10^{-8} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 3.1×10^{-5} and 3.9×10^{-5} for the Large and Small ALWRs, respectively. The associated risk of cancer fatality to the worker would be 3.1×10^{-10} and 3.9×10^{-10} per year. • *High Consequences/Low Probability*–The accident impacts from the recycling and extraction facilities are negligible compared to those from the supply technologies. Therefore, the impacts from supply technologies alone are identical to those listed above.

Radiological and Hazardous Chemical Impacts — Accidents

ORR	Pantex	SRS
• **Tritium Supply Alone**—*Low-to-Moderate Consequences:* The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 4.3×10^{-5} and 5.8×10^{-5} for the Large and Small ALWRs, respectively. The associated risk of cancer fatality would be 4.3×10^{-10} and 5.8×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents would be 0.46 and 0.64 and the associated risk of cancer fatalities would be 4.6×10^{-6} and 6.4×10^{-6} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 1.6×10^{-4} and 2.1×10^{-4} for the Large and Small ALWRs, respectively. The associated risk of cancer fatality to the worker would be 1.6×10^{-9} and 2.1×10^{-9} per year. • *High Consequences/Low Probability*—The accident impacts from the recycling and extraction facilities are negligible compared to those from the supply technologies. Therefore, the impacts from supply technologies alone are identical to those listed above.	• **Tritium Supply Alone**—*Low-to-Moderate Consequences:* The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 3.9×10^{-6} and 5.2×10^{-6} for the Large and Small ALWRs, respectively. The associated risk of cancer fatality would be 3.9×10^{-11} and 5.2×10^{-11} per year. The estimated cancer fatalities for the population within 50 miles of the accidents would be 0.015 and 0.021 and the associated risk of cancer fatalities would be 1.5×10^{-7} and 2.1×10^{-7} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 1.2×10^{-5} and 1.6×10^{-5} for the Large and Small ALWRs, respectively. The associated risk of cancer fatality to the worker would be 1.2×10^{-10} and 1.6×10^{-10} per year. • *High Consequences/Low Probability*—The accident impacts from the recycling and extraction facilities are negligible compared to those from the supply technologies. Therefore, the impacts from supply technologies alone are identical to those listed above.	• **No Tritium Supply Alone.**

Radiological and Hazardous Chemical Impacts — Accidents

Technology	INEL	NTS
Accelerator Production of Tritium	- **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences (Helium-3 Target)*: The consequences of an APT accident are negligible. The radiological impacts from the extraction and recycling facilities are more severe for the population within 50 miles of the accident than those of the APT supply technology. The APT with a helium-3 target system has a continuous extraction process and a separate extraction facility is not required. The recycling facility would be collocated with the APT. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $2.1x10^{-7}$. The associated risk of cancer fatality is $4.2x10^{-11}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $2.1x10^{-3}$ with an associated risk of cancer fatalities of $4.2x10^{-7}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $7.2x10^{-10}$. The associated risk of cancer fatality to the worker is $1.4x10^{-13}$ per year. - *Low-to-Moderate Consequences* (Spallation-induced lithium conversion Target)—The consequences of an APT accident are negligible. The radiological impacts from the extraction and recycling facilities are both more severe for the population within 50 miles of the accident than those of the APT supply technology. The extraction facility impacts are more severe. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $5.0x10^{-5}$. The associated risk of cancer fatality is $1.0x10^{-9}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.45 with an associated risk of cancer fatalities of $9.0x10^{-6}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $1.7x10^{-3}$. The associated risk of cancer fatality to the worker is $3.4x10^{-8}$ per year.	- **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences (Helium-3 Target)*: The consequences of an APT accident are negligible. The radiological impacts from the extraction and recycling facilities are more severe for the population within 50 miles of the accident than those of the APT supply technology. The APT with a helium-3 target system has a continuous extraction process and a separate extraction facility is not required. The recycling facility would be collocated with the APT. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $9.5x10^{-8}$. The associated risk of cancer fatality is $1.9x10^{-11}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $3.2x10^{-5}$ with an associated risk of cancer fatalities of $6.4x10^{-9}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $2.2x10^{-6}$. The associated risk of cancer fatality to the worker is $4.4x10^{-10}$ per year. - *Low-to-Moderate Consequences* (Spallation-induced lithium conversion Target)—The consequences of an APT accident are negligible. The radiological impacts from the extraction and recycling facilities are both more severe for the population within 50 miles of the accident than those of the APT supply technology. The extraction facility impacts are more severe. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $2.2x10^{-5}$. The associated risk of cancer fatality is $4.4x10^{-10}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $7.5x10^{-3}$ with an associated risk of cancer fatalities of $1.5x10^{-7}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $5.2x10^{-8}$. The associated risk of cancer fatality to the worker is $1.0x10^{-12}$ per year.

Radiological and Hazardous Chemical Impacts — Accidents

ORR	Pantex	SRS
• **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences (Helium-3 Target)*: The consequences of an APT accident are negligible. The radiological impacts from the extraction and recycling facilities are more severe for the population within 50 miles of the accident than those of the APT supply technology. The APT with a helium-3 target system has a continuous extraction process and a separate extraction facility is not required. The recycling facility would be collocated with the APT. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $1.8\mathrm{x}10^{-6}$. The associated risk of cancer fatality is $3.6\mathrm{x}10^{-10}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.021 with an associated risk of cancer fatalities of $4.2\mathrm{x}10^{-6}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $1.1\mathrm{x}10^{-5}$. The associated risk of cancer fatality to the worker is $2.2\mathrm{x}10^{-9}$ per year.	• **Collocated Tritium Supply and Recycling**—*Low-to-Moderate Consequences (Helium-3 Target)*: The consequences of an APT accident are negligible. The radiological impacts from the extraction and recycling facilities are more severe for the population within 50 miles of the accident than those of the APT supply technology. The APT with a helium-3 target system has a continuous extraction process and a separate extraction facility is not required. The recycling facility would be collocated with the APT. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $1.7\mathrm{x}10^{-7}$. The associated risk of cancer fatality is $3.4\mathrm{x}10^{-11}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $7.0\mathrm{x}10^{-4}$ with an associated risk of cancer fatalities of $1.4\mathrm{x}10^{-7}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $8.8\mathrm{x}10^{-7}$. The associated risk of cancer fatality to the worker is $1.8\mathrm{x}10^{-10}$ per year.	• **Tritium Supply and Upgraded Recycling**—*Low-to-Moderate Consequences (Helium-3 Target)*: The consequences of an APT accident are negligible. The radiological impacts from the extraction and recycling facilities are more severe for the population within 50 miles of the accident than those of the APT supply technology. The APT with a helium-3 target system has a continuous extraction process and a separate extraction facility is not required. The recycling facility would be collocated with the APT. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $4.9\mathrm{x}10^{-7}$. The associated risk of cancer fatality is $9.8\mathrm{x}10^{-11}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.025 with an associated risk of cancer fatalities of $5.0\mathrm{x}10^{-6}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $2.0\mathrm{x}10^{-5}$. The associated risk of cancer fatality to the worker is $4.0\mathrm{x}10^{-9}$ per year.
• *Low-to-Moderate Consequences* (Spallation-induced lithium conversion Target)—The consequences of an APT accident are negligible. The radiological impacts from the extraction and recycling facilities are both more severe for the population within 50 miles of the accident than those of the APT supply technology. The extraction facility impacts are more severe. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $4.2\mathrm{x}10^{-4}$. The associated risk of cancer fatality is $8.4\mathrm{x}10^{-9}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 4.5 with an associated risk of cancer fatalities of $9.0\mathrm{x}10^{-5}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $2.6\mathrm{x}10^{-3}$. The associated risk of cancer fatality to the worker is $5.2\mathrm{x}10^{-8}$ per year.	• *Low-to-Moderate Consequences* (Spallation-induced lithium conversion Target)—The consequences of an APT accident are negligible. The radiological impacts from the extraction and recycling facilities are both more severe for the population within 50 miles of the accident than those of the APT supply technology. The extraction facility impacts are more severe. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $3.9\mathrm{x}10^{-5}$. The associated risk of cancer fatality is $7.8\mathrm{x}10^{-10}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.16 with an associated risk of cancer fatalities of $3.2\mathrm{x}10^{-6}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $2.4\mathrm{x}10^{-4}$. The associated risk of cancer fatality to the worker is $4.8\mathrm{x}10^{-9}$ per year.	• *Low-to-Moderate Consequences* (Spallation-induced lithium conversion Target)—The consequences of an APT accident are negligible. The radiological impacts from the extraction and recycling facilities are both more severe for the population within 50 miles of the accident than those of the APT supply technology. The extraction facility impacts are more severe. For the extraction facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $1.2\mathrm{x}10^{-4}$. The associated risk of cancer fatality is $2.4\mathrm{x}10^{-10}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 6 with an associated risk of cancer fatalities of $1.2\mathrm{x}10^{-4}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $4.8\mathrm{x}10^{-3}$. The associated risk of cancer fatality to the worker is $9.6\mathrm{x}10^{-8}$ per year.

Radiological and Hazardous Chemical Impacts — Accidents

Technology	INEL	NTS
Accelerator Production of Tritium (Continued)	• *High Consequence/Low Probability (Helium-3 Target)*—The radiological impacts from the extraction and recycling facilities are more severe for the population within 50 miles of the accident than those of the APT supply technology. The APT with a helium-3 target system has a continuous extraction process and a separate extraction facility is not required. The recycling facility would be collocated with the APT. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $2.4\mathrm{x}10^{-5}$. The associated risk of cancer fatality is $2.4\mathrm{x}10^{-11}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.040 with an associated risk of cancer fatalities of $4.0\mathrm{x}10^{-8}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $2.4\mathrm{x}10^{-3}$. The associated risk of cancer fatality to the worker is $2.4\mathrm{x}10^{-9}$ per year.	• *High Consequence/Low Probability (Helium-3 Target)*—The radiological impacts from the extraction and recycling facilities are more severe for the population within 50 miles of the accident than those of the APT supply technology. The APT with a helium-3 target system has a continuous extraction process and a separate extraction facility is not required. The recycling facility would be collocated with the APT. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $6.6\mathrm{x}10^{-5}$. The associated risk of cancer fatality is $6.6\mathrm{x}10^{-11}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $3.9\mathrm{x}10^{-3}$ with an associated risk of cancer fatalities of $3.9\mathrm{x}10^{-9}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $1.7\mathrm{x}10^{-3}$. The associated risk of cancer fatality to the worker is $1.7\mathrm{x}10^{-9}$ per year.
	• *High Consequence/Low Probability* (Spallation-induced lithium conversion Target)—The radiological impacts from the extraction and recycling facilities are both more severe for the population within 50 miles of the accident than those of the APT supply technology. The recycling facility impacts are more severe. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $2.4\mathrm{x}10^{-5}$. The associated risk of cancer fatality is $2.4\mathrm{x}10^{-11}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.040 with an associated risk of cancer fatalities of $4.0\mathrm{x}10^{-8}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $2.4\mathrm{x}10^{-3}$. The associated risk of cancer fatality to the worker is $2.4\mathrm{x}10^{-9}$ per year.	• *High Consequence/Low Probability* (Spallation-induced lithium conversion Target)—The radiological impacts from the extraction and recycling facilities are both more severe for the population within 50 miles of the accident than those of the APT supply technology. The recycling facility impacts are more severe. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $2.4\mathrm{x}10^{-5}$. The associated risk of cancer fatality is $2.4\mathrm{x}10^{-11}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.40 with an associated risk of cancer fatalities of $4.0\mathrm{x}10^{-8}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $2.4\mathrm{x}10^{-3}$. The associated risk of cancer fatality to the worker is $2.4\mathrm{x}10^{-9}$ per year.

Radiological and Hazardous Chemical Impacts — Accidents

ORR	Pantex	SRS
• *High Consequence/Low Probability (Helium-3 Target)*–The radiological impacts from the extraction and recycling facilities are more severe for the population within 50 miles of the accident than those of the APT supply technology. The APT with a helium-3 target system has a continuous extraction process and a separate extraction facility is not required. The recycling facility would be collocated with the APT. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 5.2×10^{-4}. The associated risk of cancer fatality is 5.2×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.38 with an associated risk of cancer fatalities of 3.8×10^{-7} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 2.3×10^{-3}. The associated risk of cancer fatality to the worker is 2.3×10^{-9} per year.	• *High Consequence/Low Probability (Helium-3 Target)*–The radiological impacts from the extraction and recycling facilities are more severe for the population within 50 miles of the accident than those of the APT supply technology. The APT with a helium-3 target system has a continuous extraction process and a separate extraction facility is not required. The recycling facility would be collocated with the APT. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 3.5×10^{-4}. The associated risk of cancer fatality is 3.5×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.049 with an associated risk of cancer fatalities of 4.9×10^{-8} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 1.0×10^{-3}. The associated risk of cancer fatality to the worker is 1.0×10^{-9} per year.	• *High Consequence/Low Probability (Helium-3 Target)*–The radiological impacts from the extraction and recycling facilities are more severe for the population within 50 miles of the accident than those of the APT supply technology. The APT with a helium-3 target system has a continuous extraction process and a separate extraction facility is not required. The recycling facility would be collocated with the APT. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 2.2×10^{-5}. The associated risk of cancer fatality is 4.4×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.15 with an associated risk of cancer fatalities of 3.0×10^{-6} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 1.0×10^{-3}. The associated risk of cancer fatality to the worker is 2.0×10^{-8} per year.
• *High Consequence/Low Probability* (Spallation-induced lithium conversion Target)—The radiological impacts from the extraction and recycling facilities are both more severe for the population within 50 miles of the accident than those of the APT supply technology. The recycling facility impacts are more severe. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 5.2×10^{-4}. The associated risk of cancer fatality is 5.2×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.38 with an associated risk of cancer fatalities of 3.8×10^{-7} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 2.3×10^{-3}. The associated risk of cancer fatality to the worker is 2.3×10^{-9} per year.	• *High Consequence/Low Probability* (Spallation-induced lithium conversion Target)—The radiological impacts from the extraction and recycling facilities are both more severe for the population within 50 miles of the accident than those of the APT supply technology. The recycling facility impacts are more severe. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 3.5×10^{-4}. The associated risk of cancer fatality is 3.5×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.049 with an associated risk of cancer fatalities of 4.9×10^{-8} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 1.0×10^{-3}. The associated risk of cancer fatality to the worker is 1.0×10^{-9} per year.	• *High Consequence/Low Probability* (Spallation-induced lithium conversion Target)–The radiological impacts from the extraction and recycling facilities are both more severe for the population within 50 miles of the accident than those of the APT supply technology. The recycling facility impacts are more severe. For the recycling facility, the increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 2.2×10^{-5}. The associated risk of cancer fatality is 4.4×10^{-10} per year. The estimated cancer fatalities for the population within 50 miles of the accidents is 0.15 with an associated risk of cancer fatalities of 3.0×10^{-6} per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be 1.0×10^{-3}. The associated risk of cancer fatality to the worker is 2.0×10^{-8} per year.

Radiological and Hazardous Chemical Impacts — Accidents

Technology	INEL	NTS
Accelerator Production of Tritium (Continued)	• **Tritium Supply Alone**—*Low-to-Moderate Consequences: (Helium-3 Target)* - The consequences of an APT accident are negligible. • *Low-to-Moderate Consequences* (Spallation-induced lithium conversion Target) - The consequences of an APT accident are negligible. • *High Consequences/Low Probability: (Helium-3 Target)* - The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $6.2x10^{-9}$. The associated risk of cancer fatality is $4.4x10^{-15}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $1.0x10^{-5}$ with an associated risk of cancer fatalities of $7.4x10^{-12}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $6.1x10^{-7}$. The associated risk of cancer fatality to the worker is $4.4x10^{-13}$ per year. • *High Consequences/Low Probability* (Spallation-induced lithium conversion Target) - The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $1.3x10^{-7}$. The associated risk of cancer fatality is $9.2x10^{-14}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $9.4x10^{-5}$ with an associated risk of cancer fatalities of $6.7x10^{-11}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $9.4x10^{-6}$. The associated risk of cancer fatality to the worker is $6.7x10^{-12}$ per year.	• **Tritium Supply Alone**—*Low-to-Moderate Consequences: (Helium-3 Target)* - The consequences of an APT accident are negligible. • *Low-to-Moderate Consequences* (Spallation-induced lithium conversion Target) - The consequences of an APT accident are negligible. • *High Consequences/Low Probability: (Helium-3 Target)* - The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $1.7x10^{-8}$. The associated risk of cancer fatality is $1.2x10^{-14}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $9.9x10^{-7}$ with an associated risk of cancer fatalities of $7.0x10^{-13}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $4.5x10^{-7}$. The associated risk of cancer fatality to the worker is $3.2x10^{-13}$ per year. • *High Consequences/Low Probability* (Spallation-induced lithium conversion Target) - The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $3.3x10^{-7}$. The associated risk of cancer fatality is $2.3x10^{-13}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $9.0x10^{-6}$ with an associated risk of cancer fatalities of $6.4x10^{-12}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $6.7x10^{-6}$. The associated risk of cancer fatality to the worker is $4.8x10^{-12}$ per year.

Radiological and Hazardous Chemical Impacts — Accidents

ORR	Pantex	SRS
• **Tritium Supply Alone**—*Low-to-Moderate Consequences. (Helium-3 Target)*–The consequences of an APT accident are negligible.	• **Tritium Supply Alone**—*Low-to-Moderate Consequences. (Helium-3 Target)* - The consequences of an APT accident are negligible.	• **No tritium Supply Alone.**
• *Low-to-Moderate Consequences* (Spallation-induced lithium conversion Target) - The consequences of an APT accident are negligible.	• *Low-to-Moderate Consequences* (Spallation-induced lithium conversion Target) - The consequences of an APT accident are negligible.	
• *High Consequences/Low Probability–(Helium-3 Target)* - The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $1.3\text{x}10^{-7}$. The associated risk of cancer fatality is $9.5\text{x}10^{-14}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $9.6\text{x}10^{-5}$ with an associated risk of cancer fatalities of $6.8\text{x}10^{-11}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $6.0\text{x}10^{-7}$. The associated risk of cancer fatality to the worker is $4.3\text{x}10^{-13}$ per year.	• *High Consequences/Low Probability–(Helium-3 Target)* - The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $9.0\text{x}10^{-8}$. The associated risk of cancer fatality is $6.4\text{x}10^{-14}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $1.3\text{x}10^{-5}$ with an associated risk of cancer fatalities of $8.9\text{x}10^{-12}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $2.6\text{x}10^{-7}$. The associated risk of cancer fatality to the worker is $1.9\text{x}10^{-13}$ per year.	
• *High Consequences/Low Probability* (Spallation-induced lithium conversion Target) - The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $2.2\text{x}10^{-6}$. The associated risk of cancer fatality is $1.6\text{x}10^{-12}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $1.0\text{x}10^{-3}$ with an associated risk of cancer fatalities of $7.4\text{x}10^{-10}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $8.7\text{x}10^{-6}$. The associated risk of cancer fatality to the worker is $6.2\text{x}10^{-12}$ per year.	• *High Consequences/Low Probability* (Spallation-induced lithium conversion Target) - The increase in the likelihood of cancer fatality to a maximally exposed individual at the site boundary would be $1.4\text{x}10^{-6}$. The associated risk of cancer fatality is $1.0\text{x}10^{-12}$ per year. The estimated cancer fatalities for the population within 50 miles of the accidents is $1.3\text{x}10^{-4}$ with an associated risk of cancer fatalities of $9.6\text{x}10^{-11}$ per year. The increase in the likelihood of cancer fatality to a worker 1,000 meters from the accidents would be $3.8\text{x}10^{-6}$. The associated risk of cancer fatality to the worker is $2.7\text{x}10^{-12}$ per year.	

Radiological and Hazardous Chemical Impacts — Accidents

Technology	INEL	NTS
All Supply Technologies	• **Less Than Baseline**—The accident impacts for any of the supply technologies operating at reduced production capacity would not differ from the impacts associated with technologies operating at full capacity.	• **Less Than Baseline**—The accident impacts for any of the supply technologies operating at reduced production capacity would not differ from the impacts associated with technologies operating at full capacity
	• **Tritium Extraction and Recycling Phaseout**—The phaseout of recycling at SRS would eliminate any accident impacts associated with that facility. This action applies to any collocated tritium and new recycling facility at INEL.	• **Tritium Extraction and Recycling Phaseout**—The phaseout of recycling at SRS would eliminate any accident impacts associated with that facility. This action applies to any collocated tritium and new recycling facility at NTS.
	Waste Management	
No Action (2010)	• INEL would continue to manage spent nuclear fuel and the following waste types: high-level; TRU; low-level; mixed TRU and low-level; hazardous; and nonhazardous.	• NTS would continue to manage the following waste types: TRU; low-level; mixed TRU and low-level; hazardous; and nonhazardous.
Heavy Water Reactor	• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would be generated and require a new storage facility.	• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would be generated and require a new storage facility.
	• Liquid LLW would be generated. The existing treatment facility may be adequate. Solid LLW generation would increase by 109 percent requiring 0.6 acres per year of onsite LLW disposal area.	• Liquid LLW would be generated. A new treatment facility would be required. Solid LLW generation would increase by 0.6 percent requiring 13.5 acres per year of onsite LLW disposal area.
	• Liquid mixed LLW would be generated at such a small quantity that no impact would occur. Solid mixed LLW generation would increase by 19 percent. New or expanded treatment and storage facilities may be required.	• Liquid mixed LLW would be generated and require additional treatment capability for organic mixed waste. Solid mixed LLW generation would increase by 2 percent. Additional treatment capability for organic mixed waste may be required.
	• Hazardous waste generation would increase by 13 percent. Use of existing facilities is feasible.	• Solid Hazardous waste generation would increase by 205 percent and require an additional storage facility.
	• Liquid nonhazardous sanitary waste would be generated and require new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 22 percent. Landfill life reduced or expansion required.	• Liquid nonhazardous sanitary waste would be generated and require new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 214 percent. Landfill life reduced or expansion required.
	• Other solid nonhazardous wastes are recycled. No impacts would occur.	• Other solid nonhazardous wastes are recycled. No impacts would occur.

Radiological and Hazardous Chemical Impacts — Accidents

ORR	Pantex	SRS
• **Less Than Baseline**—The accident impacts for any of the supply technologies operating at reduced production capacity would not differ from the impacts associated with technologies operating at full capacity.	• **Less Than Baseline**—The accident impacts for any of the supply technologies operating at reduced production capacity would not differ from the impacts associated with technologies operating at full capacity.	• **Less Than Baseline**—The accident impacts for any of the supply technologies operating at reduced production capacity would not differ from the impacts associated with technologies operating at full capacity.
• **Tritium Extraction and Recycling Phaseout**—The phaseout of recycling at SRS would eliminate any accident impacts associated with that facility. This action applies to any collocated tritium and new recycling facility at ORR.	• **Tritium Extraction and Recycling Phaseout**—The phaseout of recycling at SRS would eliminate any accident impacts associated with that facility. This action applies to any collocated tritium and new recycling facility at Pantex.	• **No Tritium Extraction and Recycling Phaseout With SRS Alternatives.**
	Waste Management	
• ORR would continue to manage spent nuclear fuel and the following waste types: TRU; low-level; mixed TRU and low-level; hazardous; and nonhazardous.	• Pantex would continue to manage the following waste types: low-level; mixed low-level; hazardous; and nonhazardous.	• SRS would continue to manage spent nuclear fuel and the following waste types: high-level; TRU; low-level; mixed TRU and low-level; hazardous; and nonhazardous.
• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would be generated and require a new storage facility.	• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would be generated and require a new storage facility.	• **Tritium Supply and Upgraded Recycling**—Spent nuclear fuel would be generated and require a new storage facility.
• Liquid LLW generation would increase by 358 percent and require a new treatment facility. Solid LLW generation would increase by 60 percent requiring 1.2 acres per year of onsite LLW disposal area.	• Liquid LLW generation would increase by 521,000 percent and require a new treatment facility. Solid LLW generation would increase by 22,200 percent requiring a new staging facility and 92 LLW shipment to NTS.	• Liquid LLW would be generated and require a new treatment facility. Solid LLW generation would increase by 102 percent and require 0.4 acres per year of onsite LLW disposal area.
• Liquid mixed LLW generation would increase less than 1 percent. Solid mixed LLW would increase less than 1 percent. No impacts would occur.	• Liquid mixed LLW generation would increase 1 percent. Solid mixed LLW generation would increase by 2,440 percent and require the expansion of the existing and planned treatment and storage facilities.	• No increase in liquid mixed LLW generation. Solid mixed LLW generation would increase by 79 percent and require additional facilities.
• Solid hazardous waste generation would increase by 4 percent. Negligible impacts to existing facilities.	• Solid hazardous waste generation would increase by 65 percent. Existing/planned facilities are adequate.	• Solid hazardous waste generation would increase by 308 percent and require additional storage facilities.
• Liquid nonhazardous sanitary waste generation would increase by 491 percent and require new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 19 percent. Landfill life reduced or expansion required.	• Liquid nonhazardous sanitary waste generation would increase by 156 percent and require expansion of or new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 2,040 percent. Landfill life reduced or expansion required.	• Liquid nonhazardous sanitary waste generation would increase by 1,260 percent and require additional treatment facilities. Solid nonhazardous sanitary waste generation would increase by 10 percent. Landfill life reduced or expansion required.
• Other solid nonhazardous wastes are recycled. No impacts would occur.	• Other solid nonhazardous waste are recycled. No impacts would occur.	• Other solid nonhazardous waste are recycled. No impacts would occur.

Waste Management

Technology	INEL	NTS
Heavy Water Reactor (Continued)	• **Tritium Supply Alone**—No change for spent nuclear fuel or liquid LLW. Liquid mixed LLW no longer generated. Generation decreases however impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous waste. Required LLW disposal area decreases to 0.6 acres per year. Solid sanitary generation decreases from a 22 percent increase over No Action to 11 percent increase; thus, proportionately decreasing impact to landfill.	• **Tritium Supply Alone**—No change for spent nuclear fuel or liquid LLW. Liquid mixed LLW no longer generated. Generation decreases, however, impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other nonhazardous solid waste. Required LLW disposal area decreases 0.6 acres per year. The increase over No Action of the solid sanitary generation rate decreases from a factor of 3 to a factor of 2; thus, proportionately decreasing impact landfill.
	• **Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.	• **Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.
Modular High Temperature Gas-Cooled Reactor	• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would be generated and require a new storage facility.	• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would be generated and require a new storage facility.
	• Liquid LLW would be generated. Existing treatment facility may be adequate. Solid LLW generation would increase by 32 percent and require 0.2 acres per year of onsite LLW disposal area.	• Liquid LLW would be generated and require a new treatment facility. Solid LLW generation would increase by 4 percent require 0.2 acres per year of onsite LLW disposal area.
	• Liquid mixed LLW would be generated at such a small quantity that no impact would occur. Solid mixed LLW generation would increase by less than 1 percent. Negligible impacts to existing facilities.	• Liquid mixed LLW would be generated and require additional treatment capability for organic mixed waste. Solid mixed LLW generation would increase by less than 1 percent. Additional treatment capacity for organic mixed waste may be required.
	• Hazardous waste generation would increase by 33 percent and use of existing facilities is feasible.	• Solid Hazardous waste generation would increase by 505 percent and require an additional storage facility.
	• Liquid nonhazardous sanitary waste would be generated and require new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 22 percent. Landfill life reduced or expansion required.	• Liquid nonhazardous sanitary waste would be generated and require new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 211 percent. Landfill life reduced or expansion required.
	• Other solid nonhazardous waste are recycled. No impacts would occur.	• Other solid nonhazardous waste are recycled. No impacts would occur.

Waste Management

ORR	Pantex	SRS
• **Tritium Supply Alone**—No change for spent nuclear fuel or liquid LLW. Liquid mixed LLW no longer generated. Generation decreases, however, impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous waste. Required LLW disposal area decreased to 1.1 acres per year. Solid sanitary generation decreases from a 19 percent to a 10 percent increase over No Action; thus, proportionately decreasing impact to landfill.	• **Tritium Supply Alone**—No change for spent nuclear fuel or liquid LLW. Liquid mixed LLW no longer generated. Generation decreases, however, impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous waste. LLW shipments to NTS decrease to 86. Solid sanitary generation decreases from factor of 21 to a factor of 11 over No Action; thus, proportionately decreasing impact to landfill.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—No appreciable change from collocated supply and recycling.	• **Less Than Baseline Operations**—No appreciable change from collocated supply and recycling.	• **Less Than Baseline Operations**—No appreciable change from collocated supply and recycling.
• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would be generated and require a new storage facility.	• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would be generated and require a new storage facility.	• **Tritium Supply and Upgraded Recycling**—Spent nuclear fuel would be generated require and a new storage facility.
• Liquid LLW generation would increase by 89 percent and require a new treatment facility. Solid LLW generation would increase by 18 percent requiring 0.35 acre per year of onsite LLW disposal area.	• Liquid LLW generation would increase by 130,000 percent and require a new treatment facility. Solid LLW generation would increase by 6,600 percent, require a new staging facility, and 27 LLW shipment to NTS.	• Liquid LLW would be generated and require a new treatment facility. Solid LLW generation would increase by 25 percent requiring 0.1 acres per year of onsite LLW disposal area.
• Liquid and solid mixed LLW waste generation would increase by less than 1 percent. No impacts would occur.	• Liquid mixed LLW would be generated in such small quantities that only minor impacts would occur. Solid mixed LLW generation would increase by 60 percent. Existing/planned facilities would be adequate.	• No increase in liquid mixed LLW generation. Solid mixed LLW generation would increase by less than 1 percent. No impacts would occur.
• Solid Hazardous waste generation would increase by 9 percent. Negligible impacts to existing facilities.	• Solid Hazardous waste generation would increase by 160 percent. Negligible impacts to existing facilities.	• Solid Hazardous waste generation would increase by 769 percent and require additional storage facilities.
• Liquid nonhazardous sanitary waste generation would increase by 342 percent and require new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 19 percent. Landfill life reduced or expansion required.	• Liquid nonhazardous sanitary waste generation would increase by 111 percent and require expansion of or new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 2,020 percent. Landfill life reduced or expansion required.	• Liquid nonhazardous sanitary waste generation would increase by 877 percent and require additional treatment facilities. Solid nonhazardous sanitary waste generation would increase by 9 percent. Landfill life reduced or expansion required.
• Other solid nonhazardous wastes are recycled. No impacts would occur.	• Other solid nonhazardous wastes are recycled. No impacts would occur.	• Other solid nonhazardous wastes are recycled. No impacts would occur.

Waste Management

Technology	INEL	NTS
Modular High Temperature Gas-Cooled Reactor (Continued)	• **Tritium Supply Alone**—No change for spent nuclear fuel or liquid LLW. Liquid mixed LLW no longer generated. Generation decreases however impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous wastes. Required LLW disposal area decreases to 0.2 acres per year. Solid sanitary generation decreases from a 22 percent to an 11 percent increase over No Action; thus, proportionately decreasing impact to landfill.	• **Tritium Supply Alone**—No change for spent nuclear fuel or liquid LLW. Liquid mixed LLW no longer generated. Generation decreases however impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous wastes. Required LLW disposal area decreases to 0.15 acres per year. The increase in generation rate over No Action for solid sanitary wastes decreases from a factory of 3 to a factor of 2; thus, proportionately decreasing impact to landfill.
	• **Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.	• **Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.
Advanced Light Water Reactor	• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would be generated by both the Large and Small ALWRs and require a new storage facility.	• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would be generated by both the Large and Small ALWRs and require a new storage facility.
	• Liquid LLW would be generated. The large ALWR would require a new treatment facility while the existing treatment facility may be adequate for the small. Solid LLW generation would increase by 21 and 20 percent for the Large and Small ALWR, and requiring 0.2 and 0.1 acres per year of onsite LLW disposal area, respectively.	• Liquid LLW would be generated and both the Large and Small ALWRs would require a separate treatment facility. Solid LLW generation would increase by 3 and 2 percent for the Large and Small ALWR, and requiring 0.2 and 0.1 acres per year of onsite LLW disposal area, respectively.
	• Liquid mixed LLW would be generated at such a small quantity that negligible impacts would occur for either ALWR. Solid mixed LLW generation would increase by 1 percent for either.	• Liquid mixed LLW would be generated and both the Large and Small ALWRs would require an additional treatment capability for organic mixed waste. Solid mixed LLW generation would increase by less than 1 percent for either. Additional treatment capability for organic mixed waste may be required.
	• Hazardous waste generation would increase by 12 percent for the Large and Small ALWR. Use of existing facilities is feasible.	• Solid hazardous waste generation would increase by 180 percent for either the Large or Small ALWR. An additional storage facility would be required for either.

Waste Management

ORR	Pantex	SRS
• **Tritium Supply Alone**—No change for spent nuclear fuel or liquid LLW. Liquid mixed LLW no longer generated. Generation decreases however impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous wastes. Required LLW disposal area decreases to 0.3 acres per year. Solid sanitary generation decreases from a 19 percent to a 10 percent increase over No Action; thus, proportionately decreasing impact to landfill.	• **Tritium Supply Alone**—No change for spent nuclear fuel or liquid LLW. Liquid mixed LLW no longer generated. Generation decreases however impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous wastes. LLW shipments to NTS decrease to 22. Solid sanitary generation decreases from a factor of 21 to a factor of 11 over No Action; thus proportionately decreasing impact to landfill.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.	• **Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.	• **Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.
• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would be generated by both the Large and Small ALWRs and require a new storage facility.	• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would be generated by both the Large and Small ALWRs and require a new storage facility.	• **Tritium Supply and Upgraded Recycling**—Spent nuclear fuel would be generated by both the Large and Small ALWRs and require a new storage facility.
• Liquid LLW generation would increase by 852 and 135 percent for the Large and Small ALWR, and a new treatment facility would be required for either. Solid LLW generation would increase by approximately 11 percent, requiring 0.4 and 0.2 acres per year of onsite LLW disposal area, respectively.	• Liquid LLW generation would increase by 1,240,000 and 196,000 percent for the Large and Small ALWR, and a new treatment facility would be required for either. Solid LLW generation would increase by 4,240 and 4,040 percent for the Large and Small ALWRs, respectively, a new staging facility would be required for either, and 32 and 18 LLW shipments to NTS, respectively.	• Liquid LLW would be generated for the Large and Small ALWR, and a separate treatment facility would be required for either. Solid LLW generation would increase by 14 and 13 percent respectively, and require 0.06 and 0.05 acres per year of onsite LLW disposal area.
• Liquid and solid mixed LLW generation would increase by less than 1 percent. No impacts would occur for either ALWR.	• Liquid mixed LLW would be generated at such a small quantity that negligible impacts would occur for either ALWR. Solid mixed LLW generation would increase 160 percent. Existing/planned facilities would be adequate.	• No increase in liquid mixed LLW generation for either the Large or Small ALWR. Solid mixed LLW generation would increase by 4 percent for either. Expansion of existing/planned treatment capacity may be required.
• Solid hazardous waste generation would increase by 3 percent for the Large and Small ALWR. Negligible impacts to existing facilities.	• Solid hazardous waste generation would increase by 57 percent for the Large and Small ALWR. Negligible impacts to existing facilities.	• Solid hazardous waste generation would increase by 269 percent for the Large and Small ALWRs. Additional storage facilities would be required.

Waste Management

Technology	INEL	NTS
Advanced Light Water Reactor (Continued)	• Liquid nonhazardous sanitary waste would be generated and require new treatment facilities for either ALWR. Solid nonhazardous sanitary waste generation would increase by 21 and 17 percent for the Large and Small ALWRs. Landfill life reduced or expansion required by either.	• Liquid nonhazardous sanitary waste would be generated and require new treatment facilities for either ALWR. Solid nonhazardous sanitary waste generation would increase by 204 and 166 percent for the Large and Small ALWRs. Landfill life reduced or expansion required by either.
	• Other solid nonhazardous wastes would be recycled. No impacts would occur.	• Other solid nonhazardous wastes would be recycled. No impacts would occur.
	• **Tritium Supply Alone**—No change for spent nuclear fuel or liquid LLW. Liquid mixed LLW no longer generated. Generation decreases however impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous wastes. Required LLW disposal area decreases to 0.2 and 0.08 acres per year, respectively. Solid sanitary generation decreases to a 10 and 6 percent increase, respectively; thus, proportionately decreasing impact to landfill.	• **Tritium Supply Alone**—No change for spent nuclear fuel or liquid LLW. Liquid mixed LLW no longer generated. Generation decreases however impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous wastes. Required LLW disposal area decreases to 0.2 and 0.09 acres per year, respectively. Solid sanitary generation decreases to a 99 and 60 percent increase, respectively; thus, proportionately decreasing impact to landfill.
	• **Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.	• **Less Than Baseline Operations**—No appreciable change from the collocated supply and upgraded recycling.

Waste Management

	Pantex	SRS
Liquid nonhazardous sanitary waste generation would increase by 1,310 and 595 percent for the Large and Small ALWRs and require new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 19 and 15 percent for the Large and Small ALWRs. Landfill life reduced or expansion by either.	Liquid nonhazardous sanitary waste generation would increase by 261 and 161 percent for the Large and Small ALWRs, and either would require expansion of or new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 1,950 and 1,580 percent for the Large and Small ALWRs. Landfill life by either reduced or expansion required by either.	Liquid nonhazardous sanitary waste generation would increase by 3,380 and 1,530 percent for the Large and Small ALWRs, and either would require new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 9 and 5 percent for the Large and Small ALWRs. Landfill life reduced or expansion required by either.
Other solid nonhazardous wastes would by recycled. No impacts would occur.	Other solid nonhazardous wastes would by recycled. No impacts would occur.	Other solid nonhazardous wastes would by recycled. No impacts would occur.
Tritium Supply Alone—No change for spent nuclear fuel or liquid LLW. Liquid mixed LLW no longer generated. Generation decreases however impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous wastes. Required LLW disposal area decreases to 0.3 and 0.2 acres per year, respectively. Solid sanitary generation decreases to a 9 and 5 percent increase over No Action, respectively; thus, proportionately decreasing impact to landfill.	**Tritium Supply Alone**—No change for spent nuclear fuel or liquid LLW. Liquid mixed LLW no longer generated. Generation decreases however impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous wastes. LLW shipments would decrease to 26 and 13, respectively. Solid sanitary generation decreases to a factor of 9 and 7 respectively over No Action; thus, proportionately decreasing impact to the landfill.	No **Tritium Supply Alone.**
Less Than Baseline Operations—No appreciable change from the collocated supply and recycling.	**Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.	**Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.

Waste Management

Technology	INEL	NTS
Accelerator Production of Tritium	• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would not be generated	• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would not be generated.
	• No increase in liquid LLW is expected. Solid LLW generation would increase by 18 percent requiring 0.1 acres per year of onsite LLW disposal area.	• No increase in liquid LLW is expected. Solid LLW generation would increase by 2 percent requiring 0.1 acres per year of onsite LLW disposal area.
	• Liquid mixed LLW would be generated. Solid mixed LLW generation would increase by 1 percent. Minor impacts would occur.	• Liquid mixed LLW would be generated and require an additional treatment capability for organic mixed waste. Solid mixed LLW generation would increase by less than 1 percent. Additional treatment capability for organic mixed waste may be required.
	• Solid hazardous waste generation would increase by 1 percent. Use of existing facilities is feasible.	• Solid hazardous waste generation would increase by 18 percent and the existing storage facilities would require expansion.
	• Liquid nonhazardous sanitary waste would be generated and require new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 13 percent. Landfill life reduced or expansion required.	• Liquid nonhazardous sanitary waste would be generated and require new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 123 percent. Landfill life reduced or expansion required.
	• Other solid nonhazardous wastes would be recycled. No impacts would occur.	• Other solid nonhazardous wastes would be recycled. No impacts would occur.

Waste Management

ORR	Pantex	SRS
• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would not be generated.	• **Collocated Tritium Supply and Recycling**—Spent nuclear fuel would not be generated.	• **Tritium Supply and Upgraded Recycling**—Spent nuclear fuel would not be generated.
• No increase in liquid LLW is expected. Solid LLW generation would increase by 10 percent requiring 0.2 acres per year of onsite LLW disposal area.	• No increase in liquid LLW is expected. Solid LLW generation would increase by 3,580 percent require a new staging facility, and 16 LLW shipments to NTS.	• No increases in liquid LLW is expected. Solid LLW generation would increase by 11 percent requiring 0.05 acres per year of onsite LLW disposal area.
• Liquid and solid mixed LLW generation would increase by less than 1 percent. Negligible impacts to existing facilities.	• Liquid mixed LLW would be generated in such small quantities that no impacts would occur. Solid mixed LLW generation would increase by 176 percent. Existing/planned facilities would be adequate.	• No increase in liquid mixed LLW generation. Solid mixed LLW generation would increase by 5 percent requiring expansion of treatment facilities.
• Solid hazardous waste generation would increase by less than 1 percent but only minor impacts would occur.	• Solid hazardous waste generation would increase by 6 percent. Negligible impacts to existing facilities.	• Hazardous waste generation would increase by 19 percent and require expansion of storage facilities.
• Liquid nonhazardous sanitary waste generation would increase by 67 percent and require new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 11 percent. Landfill life reduced or expansion required.	• Liquid nonhazardous sanitary waste generation would increase by 791 percent and require new treatment facilities. Solid nonhazardous sanitary waste generation would increase by 1,180 percent. Landfill life reduced or expansion required.	• Liquid nonhazardous sanitary waste generation would increase by 162 percent and require new treatment facilities. Solid nonhazardous sanitary waste generation would increase by less than 2 percent. Negligible impact to landfill life.
• Other solid nonhazardous wastes would be recycled. No impacts would occur.	• Other solid nonhazardous wastes would be recycled. No impacts would occur.	• Other solid nonhazardous wastes would be recycled. No impacts would occur.

Waste Management

Technology	INEL	NTS
Accelerator Production of Tritium	- **Tritium Supply Alone**—Liquid mixed LLW no longer generated. Generation decreases however impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous wastes. Required LLW disposal area decreases to 0.07 acres per year. Solid sanitary generation decreases from 13 percent to a less than 2 percent increase over No Action; thus, only a small impact to the landfill. - **Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.	- **Tritium Supply Alone**—Liquid mixed LLW no longer generated. Generation decreases however impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous wastes. Required LLW disposal area decreases to 0.07 acres per year. Solid sanitary generation decreases from 123 percent to 18 percent increase; thus, proportionately decreasing impact to landfill. - **Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.
All Supply Technologies	- **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at INEL. Decrease the generation of solid low-level, mixed low-level, hazardous, and sanitary wastes. The 7 percent decrease in solid LLW generation would extend life of LLW disposal facility. Offsite hazardous wastes shipments to offsite RCRA facilities would decrease. Decrease in sanitary wastes would occur over time as recycling facilities are transitioned.	- **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at NTS. Decrease the generation of solid low-level, mixed low-level, hazardous, and sanitary wastes. The 7 percent decrease in solid LLW generation would extend life of LLW disposal facility. Offsite hazardous wastes shipments to offsite RCRA facilities would decrease. Decrease in sanitary wastes would occur over time as recycling facilities are transitioned.

Waste Management

ORR	Pantex	SRS
• **Tritium Supply Alone**—Liquid mixed LLW no longer generated. Generation decreases however impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous waste. Required LLW disposal area decreases to 0.1 acres per year. Solid sanitary generation decreases from 11 percent to a less than 2 percent increase over No Action; thus, proportionately decreasing impact to landfill.	• **Tritium Supply Alone**—Liquid mixed LLW no longer generated. Generation decreases however impacts do not change for solid mixed low-level, hazardous, liquid sanitary, and other solid nonhazardous waste. LLW shipment would decrease to 10. Solid sanitary generation decreases from a factor of 13 to 3 over No Action; thus, proportionately decreasing impact to the landfill.	• **No Tritium Supply Alone.**
• **Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.	• **Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.	• **Less Than Baseline Operations**—No appreciable change from the collocated supply and recycling.
• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at ORR. Decrease the generation of solid low-level, mixed low-level, hazardous, and sanitary wastes. The 7 percent decrease in solid LLW generation would extend life of LLW disposal facility. Offsite hazardous wastes shipments to offsite RCRA facilities would decrease. Decrease in sanitary wastes would occur over time as recycling facilities are transitioned.	• **Tritium Recycling Phaseout**—This action applies to any collocated tritium supply and new recycling facility at Pantex. Decrease the generation of solid low-level, mixed low-level, hazardous, and sanitary wastes. The 7 percent decrease in solid LLW generation would extend life of LLW disposal facility. Offsite hazardous wastes shipments to offsite RCRA facilities would decrease. Decrease in sanitary wastes would occur over time as recycling facilities are transitioned.	• **No Tritium Recycling Phaseout With SRS Alternatives.**

Intersite Transport of Weapons Complex Materials

Technology	INEL	NTS
No Action (2010)	• Negligible tritium transport.	• Negligible tritium transport.
Heavy Water Reactor	• **Collocated Tritium Supply and Recycling**— The relative transportation risk of tritium for this alternative is 0.71 compared to No Action. • The potential risk for transporting heavy water is 3.57×10^{-5} cancer fatalities. • The annual risk from transporting highly enriched uranium fuel feed material from ORR to INEL is 5.1×10^{-4} fatalities. • No intersite transport of LLW.	• **Collocated Tritium Supply and Recycling**—The relative transportation risk of tritium for this alternative is 0.7 compared to No Action. • The potential risk for transporting heavy water is 3.57×10^{-5} cancer fatalities. • The annual risk from transporting highly enriched uranium fuel feed material from ORR to NTS is 5.1×10^{-4} fatalities. • No intersite transport of LLW.

Intersite Transport of Weapons Complex Materials

ORR	Pantex	SRS
- Negligible tritium transport.	- The risk of transporting limited-life components to and from Pantex is negligible under normal operations. Under accident conditions, the risk of transporting limited-life components to and from Pantex would be 1.0×10^{-8} cancer fatalities per year from radiological affects.	- The risk of transporting limited-life components to and from SRS is negligible under normal operation. Under accident conditions, the risk of transporting limited-life components to and from SRS would be 1.0×10^{-8} cancer facilities per year from radiological affects.
- **Collocated Tritium Supply and Recycling**—The relative transportation risk of tritium for this alternative is 0.87 compared to No Action.	- **Collocated Tritium Supply and Recycling**—The risk is zero because there is no intersite transportation of tritium when tritium supply and recycling are collocated with the assembly and disassembly function.	- **Tritium Supply and Upgraded Recycling**—The transportation risk of tritium for this alternative is the same as No Action.
- The potential risk for transporting heavy water is 3.57×10^{-5} cancer fatalities.	- The potential risk for transporting heavy water is 3.57×10^{-5} cancer fatalities.	- No transport of heavy water, thus no risk.
- No intersite transport of highly enriched uranium fuel feed material.	- The annual risk from transporting highly enriched uranium fuel feed material from ORR to Pantex is 5.1×10^{-4} fatalities.	- The annual risk from transporting highly enriched uranium fuel feed material from ORR to SRS is 5.1×10^{-4} fatalities.
- No intersite transport of LLW.	- For intersite transportation of LLW, credible accidents associated with locating an HWR at Pantex would result in risks of 3.0×10^{-8} fatal cancers per year from radiological releases and 4.0×10^{-4} fatalities per year from nonradiological causes.	- No intersite transport of LLW.

Intersite Transport of Weapons Complex Materials

Technology	INEL	NTS
Heavy Water Reactor (Continued)	- **Tritium Supply Alone**—The risk for transporting new tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	- **Tritium Supply Alone**—The risk for transporting new tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS.
	- The potential risk for transporting heavy water is 1.4x10^{-5} cancer fatalities.	- The potential risk for transporting heavy water is 1.4x10^{-5} cancer fatalities.
	- The annual risk from transporting highly enriched uranium fuel feed material from ORR to INEL is 5.1x10^{-4} fatalities.	- The annual risk from transporting highly enriched uranium fuel feed material from ORR to NTS is 5.1x10^{-4} fatalities.
	- No intersite transport of LLW.	- No intersite transport of LLW.
	- **Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.	- **Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.
Modular High Temperature Gas-Cooled Reactor	- **Collocated Supply and Recycling**—The relative transportation risk of tritium for this alternative is 0.71 compared to No Action.	- **Collocated Supply and Recycling**—The relative transportation risk of tritium for this alternative is 0.7 compared to No Action.
	- The annual risk from transporting highly enriched uranium fuel feed material from ORR to INEL is 5.1x10^{-4} fatalities.	- The annual risk from transporting highly enriched uranium fuel feed material from ORR to NTS is 5.1x10^{-4} fatalities.
	- No intersite transport of LLW.	- No intersite transport of LLW.

Intersite Transport of Weapons Complex Materials

ORR	Pantex	SRS
Tritium Supply Alone—The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	**Tritium Supply Alone**—The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	**No Tritium Supply Alone.**
The potential risk for transporting heavy water is $1.4\text{x}10^{-5}$ cancer fatalities.	The potential risk for transporting heavy water is $1.4\text{x}10^{-5}$ cancer fatalities.	
No intersite transport of highly enriched uranium fuel feed material.	The annual risk from transporting highly enriched uranium fuel feed material from ORR to Pantex is $5.1\text{x}10^{-4}$ fatalities.	The annual risk from transporting highly enriched uranium fuel feed material from ORR to SRS is $5.1\text{x}10^{-4}$ fatalities.
No intersite transport of LLW.	For intersite transportation of low-level waste, credible accidents associated with locating a HWR would result in risks of $2.8\text{x}10^{-8}$ fatal cancers per year from radiological releases and $3.7\text{x}10^{-4}$ from nonradiological releases.	
Less Than Baseline Operations—Transportation risk is approximately 50 percent of baseline tritium requirement operations.	**Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.	**Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.
Collocated Supply and Recycling—The relative transportation risk of tritium for this alternative is 0.87 compared to No Action.	**Collocated Supply and Recycling**—The risk is zero because there is no intersite transportation of tritium when tritium supply and recycling are collocated with the assembly and disassembly function.	**Tritium Supply and Upgraded Recycling**—The transportation risk of tritium for this alternative the same as No Action.
No intersite transport of highly enriched uranium fuel feed material.	The annual risk from transporting highly enriched uranium fuel feed material from ORR to Pantex is $5.1\text{x}10^{-4}$ fatalities.	The annual risk from transporting highly enriched uranium fuel feed material from ORR to SRS is $5.1\text{x}10^{-4}$ fatalities.
No intersite transport of LLW.	For intersite transportation, credible accidents associated with locating an MHTGR at Pantex would result in risks of $8.8\text{x}10^{-9}$ fatal cancers per year from radiological releases and $1.2\text{x}10^{-4}$ fatalities per year from nonradiological causes.	No intersite transport of LLW.

Intersite Transport of Weapons Complex Materials

Technology	INEL	NTS
Modular High Temperature Gas-Cooled Reactor (Continued)	• **Tritium Supply Alone**—The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS. • The annual risk from transporting highly enriched uranium fuel feed material from ORR to INEL is 5.1×10^{-4} fatalities. • No intersite transport of LLW.	• **Tritium Supply Alone**—The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS. • The annual risk from transporting highly enriched uranium fuel feed material from ORR to NTS is 5.1×10^{-4} fatalities. • No intersite transport of LLW.
	• **Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.	• **Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.
Advanced Light Water Reactor	• **Collocated Supply and Recycling**—The relative transportation risk of tritium for this alternative is 0.71 compared to No Action. • No intersite transport of LLW.	• **Collocated Supply and Recycling**—The relative transportation risk of tritium for this alternative is 0.7 compared to No Action. • No intersite transport of LLW.
	• **Tritium Supply Alone**—The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS. • No intersite transport of LLW.	• **Tritium Supply Alone**—The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS. • No intersite transport of LLW.

Intersite Transport of Weapons Complex Materials

ORR	Pantex	SRS
• **Tritium Supply Alone**—The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	• **Tritium Supply Alone**—The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	• **No Tritium Supply Alone.**
• No intersite transport of highly enriched uranium fuel feed material.	• The annual risk from transporting highly enriched uranium fuel feed material from ORR to Pantex is $5.1\text{x}10^{-4}$ fatalities.	• The annual risk from transporting highly enriched uranium fuel feed material from ORR to SRS is $5.1\text{x}10^{-4}$ fatalities.
• No intersite transport of LLW.	• For intersite transportation of LLW, credible accidents associated with locating a MHTGR would result in risks of $7.15\text{x}10^{-9}$ fatal cancers per year from radiological releases and $9.46\text{x}10^{-5}$ from nonradiological releases.	
• **Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.	• **Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.	• **Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.
• **Collocated Supply and Recycling**—The relative transportation risk of tritium for this alternative is 0.87 compared to No Action.	• **Collocated Supply and Recycling**—The risk is zero because there is no intersite transportation of tritium when tritium supply and recycling are collocated with the assembly and disassembly function.	• **Tritium Supply and Upgraded Recycling**—The relative transportation risk of tritium for this alternative is the same as No Action.
• No intersite transport of LLW.	• For intersite transportation of low-level waste, credible accidents associated with locating a Large or Small ALWR at Pantex would result in risks of $1.0\text{x}10^{-8}$ for the large and $5.9\text{x}10^{-9}$ fatal cancers per year, respectively, from radiological releases and $1.4\text{x}10^{-4}$ and $7.7\text{x}10^{-5}$ fatalities per year from nonradiological causes.	• No intersite transport of low-level waste.
• **Tritium Supply Alone**—The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	• **Tritium Supply Alone**—The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	• **No Tritium Supply Alone.**
• No intersite transport of LLW.	• For intersite transportation of LLW, credible accidents associated with locating a Large or Small ALWR at Pantex would result in risks of $8.5\text{x}10^{-9}$ or $4.2\text{x}10^{-9}$ fatal cancers per year from radiological releases and $1.1\text{x}10^{-4}$ or $5.6\text{x}10^{-5}$ fatalities per year from nonradiological causes.	

Intersite Transport of Weapons Complex Materials

Technology	INEL	NTS
Advanced Light Water Reactor (Continued)	• **Less Than Baseline Operations—** Transportation risk is approximately 50 percent of baseline tritium requirement operations.	• **Less Than Baseline Operations—** Transportation risk is approximately 50 percent of baseline tritium requirement operations.
Accelerator Production of Tritium	• **Collocated Supply and Recycling—** The relative transportation risk of tritium for this alternative is 0.71 compared to No Action.	• **Collocated Supply and Recycling—** The relative transportation risk of tritium for this alternative is 0.70 compared to No Action.
	• The potential risk for transporting heavy water is 6.63×10^{-6}. • No intersite transport of LLW.	• The potential risk for transporting heavy water is 6.63×10^{-6}. • No intersite transport of LLW.
	• **Tritium Supply Alone—**The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS. • The potential risk for transporting heavy water is 6.63×10^{-6}.	• **Tritium Supply Alone—**The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS. • The potential risk for transporting heavy water is 6.63×10^{-6}.

Intersite Transport of Weapons Complex Materials

ORR	Pantex	SRS
Less Than Baseline Operations—Transportation risk is approximately 50 percent of baseline tritium requirement operations.	**Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.	**Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.
Collocated Supply and Recycling—The relative transportation risk of tritium for this alternative is 0.87 compared to No Action.	**Collocated Supply and Recycling**—The risk is zero because there is no intersite transportation of tritium when tritium supply and recycling are collocated with the assembly and disassembly function.	**Tritium Supply and Upgraded Recycling**—The transportation risk of tritium for this alternative is the same as No Action.
The potential risk for transporting heavy water is 6.63×10^{-6}.	The potential risk for transporting heavy water is 6.63×10^{-6}.	No transport of heavy water, thus no risk.
No intersite transport of LLW.	For intersite transportation, credible accidents associated with locating an APT at Pantex would result in risks of 5.2×10^{-9} fatal cancers per year from radiological releases and 6.9×10^{-5} for nonradiological releases.	No intersite transport of LLW.
Tritium Supply Alone—The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	**Tritium Supply Alone**—The risk for transporting tritium for this alternative is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	**No Tritium Supply Alone.**
The potential risk for transporting heavy water is 6.63×10^{-6}.		

Intersite Transport of Weapons Complex Materials

Technology	INEL	NTS
Accelerator Production of Tritium (Continued)	• No intersite transport of LLW.	• No intersite transport of LLW.
	• **Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.	• **Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.

Intersite Transport of Weapons Complex Materials

ORR	Pantex	SRS
- No intersite transport of LLW.	- For intersite transportation of LLW, credible accidents associated with locating an APT would result in risks of 3.3×10^{-9} fatal cancers per year from radiological releases and 4.3×10^{-5} from nonradiological releases. - The potential risk for transporting heavy water is 6.63×10^{-6}.	
- **Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.	- **Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.	- **Less Than Baseline Operations**—Transportation risk is approximately 50 percent of baseline tritium requirement operations.

TABLE I.1–2.—*Summary Comparison of Environmental Impacts of the Commercial Light Water Reactor Alternative* [Page 1 of 2]

Advanced Light Water Reactor[a]	Complete Construction of a Commercial Reactor	Purchase Existing Reactor or Single Reactor Irradiation Services	Purchase Irradiation Services – Multiple (2) Reactors
Construction			
• Construction would result in short-term exceedance of 24-hour PM_{10} and TSP standards.	• Construction related air emissions would increase but would be smaller than ALWR and of shorter duration. Emissions would be temporary and would not be expected to significantly affect air quality in the project site area.	• There would be no impacts related to construction from this alternative at the plant site. A new extraction and target fabrication facility would be constructed at SRS. Emissions would be temporary and would not be expected to significantly affect air quality in the project site area.	• There would be no impacts related to construction from this alternative at the plant site. A new extraction and target fabrication facility would be constructed at SRS. Emissions would be temporary and would not be expected to significantly affect air quality in the project site area.
• Total employment would be 12,600 worker-years over a 6-year period.	• Employment would require 3,530 to 5,730 worker-years over 5 years of construction for a 45 percent or 85 percent complete reactor, respectively.	• Construction of the extraction facility and target fabrication facility would require 326 worker-years over a 3 year period.	• Construction of the extraction facility and target fabrication facility would require 326 worker-years over a 3 year period.
• Hazardous waste generated from construction activities would be approximately 930 yd^3.	• Hazardous waste generated from construction activities would be substantially less than an ALWR.	• The annual average volume of hazardous waste generated from construction of the extraction and target fabrication facilities would be approximately 6 yd^3.	• The annual average volume of hazardous waste generated from construction of the extraction and target fabrication facilities would be approximately 6 yd^3.

TABLE I.1–2.—*Summary Comparison of Environmental Impacts of the Commercial Light Water Reactor Alternative* [Page 2 of 2]

Advanced Light Water Reactor[a]	Complete Construction of a Commercial Reactor	Purchase Existing Reactor or Single Reactor Irradiation Services	Purchase Radiation Services – Multiple (2) Reactors
Operation			
• Operation would require approximately 16 billion gallons of water per year. No substantial impacts to surface water are expected.	• Operation would require approximately the same amount of water as the ALWR.	• Adding the tritium production mission to an operating commercial reactor would require no additional water consumption.	• Adding the tritium production mission to an operating commercial reactor would require no additional water consumption.
• Operation would require approximately 830 workers.	• Operation would require approximately 830 workers.	• Operation would require 72 additional workers over the existing plant workforce.	• Operation would require a total of 127 additional workers over the existing plant workforce.
• Approximately 193 dry storage assemblies of spent fuel would be generated and: – 710 yd^3 of LLW – 6 yd^3 of mixed waste.	• Approximately 193 dry storage assemblies of spent fuel would be generated and: – 490 yd^3 of LLW –the amount of mixed waste would be similar to the ALWR.	• Approximately 137 dry storage assemblies of spent fuel would be generated and: – 160 yd^3 of LLW – no additional mixed waste would be generated.	• Approximately 137 dry storage assemblies of spent fuel would be generated and: – 160 yd^3 of LLW – no additional mixed waste would be generated.
• Worker exposure for all personnel would be approximately 170 person-rem per year.	• Worker exposure for all personnel would be approximately 240 person-rem.	• Worker exposure would increase for all personnel by 48 person-rem.	• Worker exposure would increase for all personnel by 48 person-rem.
• Tritium production would result in the emission of approximately 6,840 curies per year of gaseous tritium and 1,740 curies per year of liquid tritium.	• Gaseous and liquid tritium emissions would be similar to ALWR.	• Tritium production would result in the emission of 5,740 curies per year of gaseous tritium and 1,460 curies per year of liquid tritium over the existing plant emissions.	• Tritium production would result in the emission of 3,680 curies per year per reactor of gaseous tritium and 935 curies per year per reactor of liquid tritium over the existing plant emissions.
• Radiological releases associated with production of tritium would result in an annual dose of 90 person-rem to the 50-mile population.	• Radioactive releases associated with production of tritium would be similar to the ALWR.	• Radioactive releases associated with production of tritium would result in an annual dose increase of 0.5 person-rem to the 50-mile population.	• Radioactive releases associated with production of tritium would result in an annual dose increase of 0.5 person-rem to the 50-mile population.
• For a high consequence/low probability accident, approximately 1.7 cancer fatalities and a risk of 2.6×10^{-7} cancer fatalities per year could result.	• Similar to ALWR.	• No substantial increase in consequences or risk from accidents is expected.	• No substantial increase in consequences or risk from accidents is expected.

[a] For comparative purposes only, Large ALWR at SRS is presented.

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