



# APPENDIX B Idaho National Engineering Laboratory Spent Nuclear Fuel Management Program

Department of Energy Programmatic  
Spent Nuclear Fuel Management  
and  
Idaho National Engineering Laboratory  
Environmental Restoration and  
Waste Management Programs  
Final Environmental Impact Statement  
Volume I  
Appendix B  
Idaho National Engineering Laboratory  
Spent Nuclear Fuel Management Program  
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## 1. INTRODUCTION

The U.S. Department of Energy (DOE) has prepared the Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environment Restoration and Waste Management Programs Environmental Impact Statement (SNF and I

to assist its management in making two decisions. The first decision, which is to determine the management program for DOE spent nuclear fuel. The second decision is the direction of environmental restoration, waste management, and spent nuclear fuel management activities at the Idaho National Engineering Laboratory.

Volume 1 of the EIS, which supports the programmatic decision, considers the effect of nuclear fuel management on the quality of the human and natural environment for planning through 2035. DOE has derived the information and analysis results in Volume 1 from specific appendices. Volume 2 of the EIS, which supports the INEL-specific decision, considers environmental impacts for various environmental restoration, waste management, and fuel management alternatives for planning years 1995 through 2005.

This Appendix B to Volume 1 considers the impacts on the INEL environment of the implementation of various DOE-wide spent nuclear fuel management alternatives. The Propulsion Program, which is a joint Navy/DOE program, is responsible for spent naval fuel examination at the INEL. For this appendix, naval fuel that has been examined at the INEL and turned over to DOE for storage is termed naval-type fuel. This appendix examines management of DOE spent nuclear fuel including naval-type fuel. Naval spent nuclear fuel examination is addressed in Appendix D; Section 5.16 of this appendix includes relevant environmental consequences from Appendix D.

In addition to this introduction, Appendix B contains the following chapters:

- Chapter 2 - Background: Describes INEL spent nuclear fuel facilities, the framework for spent nuclear fuel management at the INEL, and the INEL spent nuclear fuel management program.
- Chapter 3 - Spent Nuclear Fuel Management Alternatives: Describes the DOE nuclear fuel management alternatives as the INEL would implement them, and provides a summary comparison of potential environmental consequences for each alternative described in Chapter 5.
- Chapter 4 - Affected Environment: Describes the INEL site and the surrounding environment that DOE spent nuclear fuel management actions could affect.
- Chapter 5 - Environmental Consequences: Provides the results of environmental consequence analyses for each spent nuclear fuel management alternative.
- Chapter 6 - References

Volume 1 contains a list of acronyms and abbreviations and a glossary that is an appendix.

## 2. BACKGROUND

This chapter contains an overview of the Idaho National Engineering Laboratory and historic events related to spent nuclear fuel, a description of the regulatory actions evaluated in this document, and an overview of the current spent nuclear fuel management program at the INEL.

### 2.1 Overview

The following sections provide a general overview of the INEL including its history, activities, and mission as they relate to spent nuclear fuel management and future

#### 2.1.1 History of Spent Nuclear Fuel Activities

The U.S. Atomic Energy Commission, a predecessor of the U.S. Department of Energy, established the INEL, formerly the National Reactor Testing Station, to build, test, and operate types of nuclear reactors, support plants, and associated equipment. Since its establishment (see Table 2-1), DOE and its predecessor agencies have built 52 reactors at the INEL. DOE programs at the site have included test irradiation services, uranium recovery from enriched spent fuels, calcination of liquid radioactive waste, light-water-cooled reactor development and research, operation of research reactors, environmental restoration, and storage of solid transuranic wastes. In support of the DOE reactor research program and as part of a nuclear fuel reprocessing program, the INEL has received spent nuclear fuel from many sources, including naval reactors, university reactors, commercial reactors, and DOE reactors as well as fuels fabricated in the United States and irradiated in foreign reactors.

The Experimental Breeder Reactor-I, now a National Historic Landmark, maintains

in the history of nuclear power in the United States. In December 1951, this reactor produced the first usable electricity from a nuclear reactor. The Experimental Breeder Reactor-I also nuclear reactor could actually produce more fuel than it consumes.

Of special significance to spent nuclear fuel is the history of the Idaho Chemical Processing Plant. From 1953 to 1992, this plant recovered usable uranium from spent nuclear fuel from States government reactors. The plant operated for 39 years as a full-scale producer of nuclear fuel. Table 2-1. INEL spent nuclear fuel history.

Year	Event
1949	National Reactor Testing Station established
1951	Site reactor first to generate electricity from nuclear fission
1953	ICPPa began operation
1953	Test of first submarine nuclear reactor
1957	Expended Core Facility constructed
1965	DOE contract with Public Service Company of Colorado (Fort St. Vrain)
1974	Site became Idaho National Engineering Laboratory
1980	DOE contracted to receive Public Service Company of Colorado (Fort St. Vrain) spent nuclear fuel
1992	Decision to discontinue reprocessing of spent nuclear fuel at ICPPa announced
1992	DOE creates Office of Spent Fuel Management
1993	Court order of June 28, 1993 issued
a.	ICPP = Idaho Chemical Processing Plant.
April 1992,	DOE decided to phase out reprocessing for material recovery, resulting in the reprocessing operation.

Spent naval nuclear fuel handling at the Naval Reactors Facility originated in construction of the Expended Core Facility. The original building contained a waste cells, which are connected to the water pit by transfer tunnels. The Expended Core Facility spent nuclear fuel from operating naval ships and from prototype naval reactors. The support research and development for naval fuel quality improvement. Over the years, additions and improvements at the Naval Reactors Facility site, including the construction and operation of three prototype reactors and facilities for training naval nuclear power. The Naval Nuclear Propulsion Program is placing the prototype reactors, which have the useful lives, in layup. All training is expected to end before DOE issues Decision for this Environmental Impact Statement (EIS). Expended Core Facility act continuing. Appendix D describes the Naval Reactors Facility in more detail.

In 1965 the United States entered into a contract with Public Service Company of Colorado for fuel at the Fort St. Vrain Nuclear Power Plant. In 1980, the United States Service Company of Colorado modified the 1965 contract, requiring DOE to accept reprocessed Vrain spent nuclear fuel at the INEL. From 1980 to 1986, Public Service Company of Colorado shipped approximately 120 shipments of Fort St. Vrain spent nuclear fuel to the INEL.

In 1974 the National Reactor Testing Station became the Idaho National Engineering Laboratory. The INEL mission broadened to include research and engineering for nonnuclear programs, environmental restoration and waste management activities.

In the early 1980s, pursuant to the West Valley Demonstration Project Act (42 U.S.C. 10101), a court order, DOE agreed to accept 125 special case commercial reactor spent nuclear fuel located at the state-owned Western New York Nuclear Service Center. DOE began a program to demonstrate the viability of a transportable spent nuclear fuel storage cask, with shipping the fuel to the INEL. Based on this, New York State Energy Research and Development Authority, which has jurisdiction over the center, has allowed continued storage under U.S. Nuclear Regulatory Commission Certificates of Compliance, which have been issued. The remains at West Valley awaiting the Record of Decision for this EIS.

In addition to the naval and INEL-generated fuel on the site, some special-case fuel, such as fuel from university reactors, has been shipped directly to the Idaho Chemical Processing Plant for storage. Damaged fuel from the 1979 Three Mile Island accident was shipped to the Test Area North for examination and storage as part of a research mission.

In 1990, DOE issued an Environmental Assessment and Finding of No Significant Impact. The Public Service Company of Colorado shipments of Fort St. Vrain spent nuclear fuel to the INEL. The State of Idaho challenged the adequacy of the Environmental Assessment and, in June 1993, the United States District Court for the District of Idaho found for the State and ordered DOE to prepare this EIS. A DOE appeal of the order resulted in a December 1993 amendment that governs the schedule and obligation for preparing the EIS.

### 2.1.2 Current Activities at Spent Nuclear Fuel-Related Facilities

Six major facility areas at the INEL (Figure 2-1) store spent nuclear fuel: Ar Laboratory - West, Idaho Chemical Processing Plant, Naval Reactors Facility, Power Figure 2-1. Major facility areas located at the Idaho National Engineering Labor configurations. The total amount of spent nuclear fuel at the INEL accounts for ab weight of heavy metal) of the spent nuclear fuel in the DOE complex (DOE 1993).

weight of heavy metal) of the spent nuclear fuel in the DOE complex (DOE 1995). Table 2-2 lists the primary INEL spent nuclear fuel storage facilities, the type and the storage configurations. Figure 2-2 indicates the relative proportion of fuel. The number and variety of wet and dry storage configurations currently in use at the result of the different purposes for the facilities (e.g., at-reactor storage, development, reprocessing, and fuel research and development). The condition of the fuel in storage is generally good with the notable exception of the fuel in the Und Facility (CPP-603). The following paragraphs briefly describe each primary facility spent nuclear fuel.

The Argonne National Laboratory - West generates spent nuclear fuel as a result of development activities related to advanced reactor design. DOE has brought small quantities of spent nuclear fuel from other reactors to this facility to support these activities. Reactors at the Argonne National Laboratory - West are the Experimental Breeder Reactor II, the Transient Reactor Test Facility, the Zero Power Physics Reactor, and the Neutron Radiography Reactor. Spent nuclear fuel includes both wet (including molten sodium) and dry configurations. Historically, the Argonne National Laboratory - West has received spent nuclear fuel from other reactors for testing and research purposes.

The Idaho Chemical Processing Plant historically received spent nuclear fuel from and offsite reactors for reprocessing (i.e., the recovery of uranium for reuse). It is to phase out reprocessing activities in 1992. The new mission for this facility is spent fuel storage, plus research and development of technologies in support of the disposition of spent nuclear fuel. The Idaho Chemical Processing Plant stores virtually all types of spent nuclear fuel, including production reactor fuel [i.e., fuel from Hanford Site and Savannah River Site (SRS) reactors]. It stores nonproduction aluminum-based spent nuclear fuel. This facility also stores spent nuclear fuel in dry storage configurations.

The Naval Reactors Facility includes the Expanded Core Facility, which receives naval spent nuclear fuel to support fuel development and performance analyses. In the Expanded Core Facility removes structural support material from fuel assemblies before the fuel portion to the Idaho Chemical Processing Plant for interim storage.

**Table 2-2.** Major INEL spent nuclear fuel storage facilities.

Facility(a)	Storage Type(b)	Fuel Type(c)					6a
		1	2	3	4	5	
Argonne National Laboratory - West							-
Experimental Breeder Reactor II	Liquid sodium						-
Hot Fuel Examination Facility	Dry						-
Neutron Radiography Reactor	Wet						-
Radioactive Scrap and Waste Facility	Dry						
Transient Reactor Test Facility	Dry						
Idaho Chemical Processing Plant							-
Underwater Fuel Storage Facility <sup>d</sup>	Wet	-	-				
Irradiated Fuel Storage Facility	Dry				-		
Fuel Storage Area/Fluorinel Dissolution	Wet	-	-				-
Process Cell							
Underground Storage Facility	Dry				-		
Naval Reactors Facility						-	
Expended Core Facility	Wet	-					
Expended Core Facility Rail Siding	Dry	-					
Power Burst Facility							-
Power Burst Facility Storage Canal	Wet						
Test Reactor Area						-	
Materials Test Reactor Canal	Wet						
Advanced Reactivity Measurement Facility	Wet		-				
Coupled Fast Reactivity Measurement Facility	Wet		-				
Advanced Test Reactor Canal	Wet		-				

## Test Area North

Test Area North Pool

Wet

-

Test Area North Pad

Dry

-

- a. This table lists the major spent fuel storage facilities. Other facilities (e.g. contain small quantities of spent nuclear fuel.
- b. Wet storage involves water-filled pools. Dry storage involves a variety of configurations (e.g. buildings).
- c. The spent fuel types are as follows:
1. Naval-type fuel
  2. Savannah River Site production fuels and other aluminum-clad fuels
  3. Hanford Site production fuels
  4. Graphite fuels
  5. Special case commercial fuels
  - 6a. Experimental reactors - stainless steel-clad fuels
  - 6b. Experimental reactors - zirconium-clad fuels
  - 6c. Experimental reactors - other fuel configurations
- d. Spent nuclear fuel storage at this facility will cease by December 31, 2000, as DOE and the State of Idaho.

Figure 2-2. Distribution of INEL SNF. The Power Burst Facility reactor was placed in wet storage, in a storage pool condition, but it is small and uneconomical to use. DOE plans to remove the fuel from the pool by 1996.

DOE has used Test Area North for commercial reactor fuel research. The large T Hot Shop and Hot Cells have supported the Loss of Fluid Test and commercial nuclear fuel research. Test Area North stores special case commercial fuel (including Three Mile Island Unit 2 core debris) and DOE experimental fuel similar to commercial fuel.

Test Reactor Area has historically operated a number of test reactors, but the Test Reactor and its associated Critical Facility are the only reactors now operating. Fuel at this area is associated with the Test Reactor Area reactors, which utilized special case commercial, foreign, and DOE experimental fuel. In addition, DOE stores small amounts of special case commercial, foreign, and DOE experimental fuel at Test Reactor Area in the Materials Test Reactor building. Fuel in storage at the Test Reactor Area is in water-filled pools (DOE 1993).

### 2.1.3 Spent Nuclear Fuel Mission

The INEL spent nuclear fuel mission is to manage DOE-owned spent nuclear fuel in a way that protects the safety of INEL workers, the public, and the environment. A laboratory for the DOE Spent Nuclear Fuel Program, the INEL provides support to the Fuel Management and coordinates the development of an integrated program for DOE.

The main focus of near-term activities is the accurate quantification and characterization of DOE-owned spent nuclear fuel, identification of spent nuclear fuel management facility conditions, identification of safe interim storage for existing and new spent nuclear fuel, identification of technologies and requirements to place DOE spent nuclear fuel in long-term storage. Long-term activities include the development of final waste acceptance criteria required for stabilization technologies for alternate fuel disposition, construction of facilities to meet waste disposal requirements, processing of the fuel to a final waste form, and the waste form for disposition.

## 2.2 Regulatory Framework for Spent Nuclear Fuel Management

This section summarizes State of Idaho laws and regulations that apply to spent nuclear fuel management at the INEL. Volume 1, Section 7.2, provides summary information for Federal regulations, Executive Orders, and DOE Orders. Volume 2, Chapter 2, provides information on National Environmental Policy Act reviews related to site-specific decisions that have environmental impacts. Volume 2, Chapter 7, provides information on regulatory requirements that INEL holds or for which it has applied.

The Idaho Environmental Protection and Health Act (Idaho Code, Title 39, Chapter 2) establishes general provisions for the protection of the environment and public health. The Idaho Department of Health and Welfare and its Division of Environmental Quality are consolidating all state public health and environmental protection activities in one division. The Act authorizes the Department to promulgate standards, rules, and regulations relating to the protection of the environment and public health.

quality, noise reduction, and solid waste disposal; and grants authority to issue r collect fees, establish compliance schedules, and review plans for the construction public water treatment and disposal facilities.

The Idaho Water Pollution Control Act (Idaho Code, Title 39, Chapter 36) author Department of Health and Welfare to protect the waters of Idaho. This law contains on the prevention of water pollution and the provision of financial assistance to m

The Idaho Department of Health and Welfare is also responsible for the enforcem implementation of the Hazardous Waste Management Act of 1983, as amended (Idaho Cod Chapter 44), which provides for the protection of health and the environment from t improper or unsafe management of hazardous wastes and for the establishment of a tr manifesting system for these wastes. This program is intended to be consistent wit stringent than, the Federal regulations established under the Resource Conservation (RCRA). At this time, Idaho has primacy over hazardous and mixed waste regulations through July 1, 1990, by the U.S. Environmental Protection Agency. The Hazardous W Management Act sets forth requirements for the development of plans that address th hazardous wastes; unauthorized treatment, storage, release, use, or disposal of the requirements for hazardous waste facilities. Under the authority of this Act, the Health and Welfare has promulgated rules and regulations on the transportation, mon and record keeping of hazardous wastes.

Several INEL facilities have air quality permits from the State, and operate in permit conditions. Permit applications are currently pending with the State for pr modified emission sources. In April 1991 DOE submitted an inventory of all potenti radioactive and criteria pollutant emission sources to the State. The inventory co necessary for the State to issue the INEL a Permit to Operate.

The Idaho Department of Health and Welfare, Division of Environmental Quality, Bureau, conducts annual inspections of the INEL to determine if the operating porti in compliance with the Rules for the Control of Air Pollution in Idaho. The most r were in January 1994. In addition, pursuant to 40 CFR Part 61.94(H), DOE submits t annual report documenting compliance with National Emission Standards for Hazardous at the INEL.

## 2.3 Spent Nuclear Fuel Management Program at the INEL

In 1992 the Secretary of Energy directed the Assistant Secretary for Environmen and Waste Management to develop an integrated, long-term spent nuclear fuel managem In response to this request, DOE created the Office of Spent Fuel Management (EM-37 which has strategic programmatic responsibilities, has designated the INEL as the p organization for the DOE Spent Nuclear Fuel Program. In this role, the INEL provid support to the Office of Spent Fuel Management and develops site communication and the national program.

As identified in the Spent Fuel Working Group Report on Storage of the Departme Nuclear Fuel and Other Reactor Irradiated Nuclear Materials and Their Environmental Health Vulnerabilities, Volume I (DOE 1993), some of the current storage facilities inadequate for extended interim storage, and additional storage facilities or modif necessary. In February 1994, DOE issued, Plan of Action to Resolve Spent Nuclear F Vulnerabilities, Phase I (DOE 1994a), followed by a Phase II Plan in April 1994 (DO Phase III Plan in October 1994 (DOE 1994c), which identified specific corrective ac the spent nuclear fuel vulnerabilities. At the INEL, many of the corrective action completed or are currently underway. The spent nuclear fuel storage pools at Test Burst Facility, and the Underwater Fuel Storage Facility do not comply with new fa requirements. The INEL plans to move spent nuclear fuel from the CPP-603 Underwate Facility by December 31, 2000. To stabilize this fuel for storage, the INEL also p canning equipment in the Irradiated Fuel Storage Facility hot cell. This equipment operation by late 1995. To the extent of its existing capability, DOE could consol fuel at the Power Burst Facility, the Idaho Chemical Processing Plant, and the Test Idaho Chemical Processing Plant as a result of implementing the management alternat Chapter 3. These activities and other planned actions for which National Environme review will be completed before the Record of Decision of this EIS were analyzed un Action Alternative (see Chapter 3).

Each of the specific INEL spent nuclear fuel Plan of Action projects could resu worker exposures, and other potential environmental impacts. The potential environ that could result from each project or corrective action item were not analyzed ind collectively enveloped by the spent nuclear fuel management activities reported and

alternative. Successful completion of the corrective actions would significantly reduce environmental, safety, and health risks associated with spent fuel storage at INEL.

The INEL has provided support in the development of dry at-reactor storage of spent commercial spent nuclear fuel in accordance with the requirements of the Nuclear Waste 1982 and its 1987 amendments. Dry-storage demonstrations and research at the INEL are the granting of NRC licenses to several utilities for the construction and operation of facilities at reactor sites. Research at these facilities is demonstrating the technical economics of adding dry storage capacity in metal or concrete spent fuel storage canisters.

## 3. SPENT NUCLEAR FUEL MANAGEMENT ALTERNATIVES

Chapter 3 describes the alternatives for spent nuclear fuel management as they are being developed at the National Engineering Laboratory (INEL) and summarizes and compares potential environmental consequences for each alternative. Chapter 5 contains full descriptions of the consequences of implementing the alternatives.

### 3.1 Description of Alternatives

DOE has identified five spent nuclear fuel management alternatives:

- Alternative 1 - No Action
- Alternative 2 - Decentralization (2a, 2b, and 2c)
- Alternative 3 - 1992/1993 Planning Basis
- Alternative 4 - Regionalization (4a and 4b)
- Alternative 5 - Centralization (5a and 5b)

Table 3-1 summarizes the actions that would result from the implementation of each alternative at the INEL. For each alternative, this table summarizes the proposed transportation, storage, research and development, and naval-type fuel examination activities. For Alternatives 2, 3, 4, and 5, it identifies a number of options.

The analysis of each alternative considers, as appropriate, existing and projected spent nuclear fuel inventories, existing spent nuclear fuel wet and dry storage facilities, the construction of new facilities and associated stabilization facilities to achieve interim management objectives, and the relocation of the spent nuclear fuel as appropriate to proposed interim storage facilities.

Table 2-2 lists existing spent nuclear fuel storage facilities with associated spent nuclear fuel. Table 3-2 lists the potential facilities and projects required for specific alternatives. Table 3-3 lists the potential environmental consequences for each alternative on the existing facilities and projects listed in Tables 2-2 and 3-2, respectively.

Table 3-1. Summary of spent nuclear fuel management alternatives at the Idaho National Engineering Laboratory.

The alternatives involving the interim storage of naval spent nuclear fuel at the INEL include a transition period, which would start on June 1, 1995, and continue for 3 years. During this period, approximately 80 shipments of naval spent nuclear fuel would be received at the INEL. The Expanded Core Facility for examination and subsequent shipment to the Idaho Chemical Processing Plant for storage. After this transition period, DOE would phase out the Expanded Core Facility. The worker total at the facility would decline to about 10 by 2001. Appendix A describes the transition period.

#### 3.1.1 Alternative 1: No Action

Table 3-1 lists the basic actions expected under this alternative. This alternative is restricted to the minimum actions necessary for the continued safe and secure management of spent nuclear fuel. Table 3-3 lists the existing inventory of spent nuclear fuel at the INEL. This is not a status quo condition in terms of spent nuclear fuel receipts (unlike Alternative 1 operations would continue in accordance with the 1992/1993 planning basis). Rather, the INEL would maintain spent nuclear fuel close to defueling or current storage locations with minor upgrades or replacements.

DOE would continue the operation of the following existing spent nuclear fuel management facilities: the Fuel Storage Area/Fluorine Dissolution Process Cell; CPP-603 Underwater Fuel Storage Facility (until 2000); Irradiated Fuel Storage Facility; Underground Storage Facility; Power Reactor Fuel Storage Canal; Advanced Test Reactor Canal; Advanced Reactivity Measurement Facility.

Reactivity Measurement Facility; Materials Test Reactor canal; Test Area North Pool Argonne National Laboratory - West Hot Fuel Examination Facility, Radioactive Scrap Facility, Transient Reactor Test Facility, Zero Power Physics Reactor, and Neutron Reactor pool. Table 2-2 lists the type(s) of storage and spent nuclear fuels assoc

### 3.1.1.1 Transportation. Under this alternative, the INEL would neither receive nor ship spent

nuclear fuel except for naval spent fuel during a transition period. DOE would con Advanced Test Reactor canal spent nuclear fuel to the Idaho Chemical Processing Pla DOE could transfer other spent nuclear fuel at the INEL site (e.g., Test Reactor Ar Pad, Power Burst Facility storage canal, Experimental Breeder Reactor-II, and Naval **Table 3-3. Spent nuclear fuel inventory for each alternative by 2035 (metric tons**

Fuel Type	1. No Action(d)	2. Decentralization	3. 1992/1993 Planning Basis	4a. Regionalization by Fuel Type	4 R b (
Naval-type	10.23	N/Cf	+55.00	+55.00	+
Aluminum-clad	2.91	11.02	+12.09	-2.91	+
Hanford	None	None	None	None	+
Graphite	11.60	N/C	+16.00	+16.01	+
Special case	122.88	+0.03	+26.69	+33.63	+
commercial					
Stainless-steel-clad	77.43	+1.08	+1.19	+19.08	+
Zircaloy-clad	49.09	+0.67	+0.670	+28.90	+
Other	0.01	+0.82	+0.82	+1.69	+
Net increase (+)/ decrease (-)	-	+13.62	+112.47	+151.41	+
TOTAL	274.14	287.76	386.61	425.55	2

a. Source: Wichmann (1995).

b. To convert metric tons to tons, multiply by 1.10. Heavy metals are uranium, plu

c. The values may not sum exactly due to rounding.

d. The No-Action Alternative represents the present inventory and projections and s determining the net increase or decrease for each type of spent nuclear fuel for

e. Regionalization 4b(2), Regionalization by Geography (Elsewhere), assumes all spe the INEL go to the Nevada Test Site or Hanford Site. Inventories for 4b(2) woul Alternative 5a.

f. N/C = No change from the No-Action Alternative.

Propulsion Program prototype reactors at the Naval Reactors Facility) to the Idaho Processing Plant to the extent of its storage capability.

### 3.1.1.2 Stabilization. Due to the deteriorated condition of some of the fuel in the CPP-603

Underwater Fuel Storage Facility, additional canning and characterization capabilit necessary to stabilize this fuel for safe transport and subsequent storage. DOE ha installation and operation of new fuel canning and characterization equipment in th Storage Facility, which could provide these capabilities, by late 1995. (The insta equipment would be a minor upgrade and would have a smaller extent than similar act under Alternatives 3, 4, and 5.) DOE could perform other required stabilization of at the INEL in either the Remote Analytical Laboratory or the Fluorinel Dissolution

### 3.1.1.3 Storage. DOE has identified the CPP-603 Underwater Fuel Storage Facility as one of

five complex-wide spent nuclear fuel storage facilities that exhibit the greatest v to selected criteria and, therefore, has selected this facility for priority attent of the August 9, 1993, agreement between the Secretaries of the Department of Energ Department of the Navy and the Governor of Idaho to phase out storage operations in



CPP-603 facility, one goal of this and the other alternatives would be to remove spent nuclear fuel from the North and Middle Basins of the CPP-603 facility by the end of 2000 (DOE 1993a). DOE would remove material to the Fuel Storage Area at the Idaho Chemical Processing Plant.

At the Argonne National Laboratory-West, the spent nuclear fuel stored at the High Temperature Engineering Examination Facility and the Radioactive Scrap and Waste Facility, primarily Experimental Breeder Reactor-II fuel and blanket elements, would remain in dry storage until its potential use at the Fuel Cycle Facility. At the Experimental Breeder Reactor-II site, DOE would use dry storage except for the Neutron Radiography Reactor pool fuel. The Test Area North Pool Fuel Storage project would continue, resulting in the relocation of Test Area North spent pool fuel storage at the Idaho Chemical Processing Plant by 1998. The dry cask storage required for the pool fuel is not related to the Dry Fuels Storage Facility.

DOE would start no new projects to increase spent nuclear fuel storage capacity sufficient storage capacity to meet No-Action storage needs. The planning of spent nuclear fuel projects such as the Dry Fuels Storage Facility and Additional Increased Rack Capacity Storage Area would stop.

#### **3.1.1.4 Research and Development. There would be only limited spent nuclear fuel**

research and development. Existing spent nuclear fuel management research and development would continue. Existing facilities such as the Process Improvement Facility, the High Temperature Engineering Examination Laboratory, and the Pilot Plant Facility would support continuing research and development.

#### **3.1.1.5 Naval-Type Fuel Examination. After a transition period, DOE would cease**

shipments of naval spent nuclear fuel to the INEL and would phase out the Expanded Fuel Examination. DOE would make onsite shipments of the "library fuel" (a representative sampling of fuel types maintained for reference purposes) and the spent nuclear fuel that originated at the Naval Reactors Facility to the Idaho Chemical Processing Plant.

### **3.1.2 Alternative 2: Decentralization**

Under this alternative, DOE could transport fuel for safety or research and development activities. In addition, DOE could undertake actions for safety it deemed desirable, and could perform spent nuclear fuel treatment and research and development. Table 3-3, the anticipated spent nuclear fuel inventory for this alternative would be the inventory for Alternative 1, with the increase consisting primarily of aluminum-clad spent nuclear fuel from university and foreign research and experimental facilities.

#### **3.1.2.1 Transportation. This alternative assumes that the INEL would accept primarily**

limited shipments of spent nuclear fuel from offsite sources into the Fuel Storage Area (from university reactors) after the Record of Decision for this EIS (1995). Onsite transfer of fuel from the Fuel Storage Area to the Storage Facility or the Irradiated Fuel Storage Facility would consolidate the spent nuclear fuel in the Advanced Test Reactor and in the Material Test Reactor. Power Burst Facility canals at the Idaho Chemical Processing Plant for canning, characterization, and storage.

As in the No-Action Alternative, there would be a transition period during which the Naval Reactors Program would ship naval spent nuclear fuels to the Expanded Fuel Examination and subsequent shipment to the Idaho Chemical Processing Plant for storage. Section 3.1.2.5 describes the transportation of naval spent fuels that would occur during the transition period.

#### **3.1.2.2 Stabilization. DOE would use the canning and characterization equipment identified in**

Section 3.1.1.2 to stabilize spent nuclear fuel removed from the CPP-603 Underwater Storage Facility for interim underwater storage.

#### **3.1.2.3 Storage. As in Alternative 1, DOE would transfer the spent nuclear fuel in the**

CPP-603 Underwater Fuel Storage Facility to the Fuel Storage Area by 2000. DOE would use the Underground Storage Facility and the Irradiated Fuel Storage Facility for the fuel inventory and transfers of other spent nuclear fuel based on safety analyses. or increase fuel storage capacity at the INEL as required.

The Test Area North Pool Fuel Transfer project would result in the relocation of Test Area North spent nuclear fuel into dry storage at a pad at the Idaho Chemical

#### **3.1.2.4 Research and Development. The development of technology for the disposition of**

spent nuclear fuel would continue. Research and development activities would include pilot plant testing, continued repository performance assessments and waste acceptance development, and the characterization of spent nuclear fuel. Shipments of samples of nuclear fuel assemblies to offsite DOE facilities would be necessary.

#### **3.1.2.5 Naval-Type Fuel Examination. DOE would consider three options for naval reactor**

spent nuclear fuel receipt and shipment. Under options 2a and 2b, DOE would stop sending spent nuclear fuel to the INEL and would shut down the Expanded Core Facility. Option 2c would enable the continued receipt of naval-type fuel for examination at the Expanded Core Facility and return to the originating shipyards for storage in transport casks. Chapter 3 of A describes these options. As with Alternative 1, each option would require approximately a 10-year transition period. During this period, DOE would transport spent nuclear fuel in casks to the Expanded Core Facility, unload the containers, and use them to support additional defueling.

### **3.1.3 Alternative 3: 1992/1993 Planning Basis**

This alternative is consistent with DOE plans at the INEL before the injunction against nuclear fuel shipment to the INEL; it assumes a 40-year planning horizon for the collection, transportation, receipt, stabilization, and storage of spent nuclear fuel. As with Alternative 1, DOE would continue the maintenance and operation of existing spent nuclear fuel-related facilities. Some consolidation of INEL facilities could occur. DOE would send newly generated spent nuclear fuel to either the INEL or the Savannah River Site. DOE would assess the construction of new facilities to accommodate current and projected spent nuclear fuel management requirements.

The amount of spent nuclear fuel at the INEL under this alternative would be greater than under either Alternative 1 or 2 (see Table 3-3) because this alternative assumes that the INEL would manage, before stabilization and disposal, its present inventory (see Alternative 1) and receipts of DOE spent nuclear fuel, including the following:

- Naval-type spent nuclear fuel
- Approximately half of the aluminum-clad spent nuclear fuel from university research and experimental reactors
- All Training Reactor Isotopics General Atomics (TRIGA) spent nuclear fuels from the Hanford Site and approximately half of that from foreign, DOE, and university reactors
- Fort St. Vrain spent nuclear fuel from Public Service of Colorado
- Special case commercial pressurized water reactor and boiling water reactor fuel from the DOE facility in West Valley, New York
- Miscellaneous spent nuclear fuel types from such DOE sites as Los Alamos, N. M., and Oak Ridge, Tennessee, and from university reactors and other locations

#### **3.1.3.1 Transportation. DOE would consolidate the spent nuclear fuel in the Test Reactor**

Area (Advanced Test Reactor canal, Materials Test Reactor canal, and Coupled Fast Reactor Measurements Facility and Advanced Reactivity Measurement Facility canal) and the PWR Fuel Facility at the Idaho Chemical Processing Plant for canning and dry storage.

The INEL would receive and temporarily store new spent nuclear fuels in the Fuel Transfers could occur from the Fuel Storage Area to the Underground Storage Facility Fuel Storage Facility or, when available, the dry storage vaults at the proposed Dry Facility.

At present, DOE is transferring spent nuclear fuel from the Advanced Test Reactor Idaho Chemical Processing Plant. DOE would maintain this canal for the storage and its recyclable fuel assemblies until the reactor no longer had a mission. The Expanded Reactor-II spent nuclear fuel in storage would remain at Argonne National Laboratory Alternative 2, the Test Area North Pool Fuel Transfer project would result in the removal of the contents of the Test Area North spent nuclear fuel pool to dry storage at a pad at the Idaho Chemical Processing Plant.

### **3.1.3.2 Stabilization. DOE would complete a new Canning and Characterization Facility with**

appropriate inspection, stabilization, and packaging equipment to stabilize new received fuel and to prepare fuel currently in underwater storage for dry storage. This facility is an integral part of the Dry Fuels Storage Facility that DOE would complete under this alternative. If the Dry Fuels Storage Facility is in service, DOE would use the canning and characterization equipment described under Alternative 1 to stabilize spent nuclear fuel removed from the Underwater Fuel Storage Facility for interim underwater storage.

### **3.1.3.3 Storage. As with Alternative 2, DOE would upgrade or increase dry fuel storage**

capacity at the INEL as required. DOE would complete the Fuel Storage Area Increased Capacity project in 1997. Coupled with stringent fuel management and, if necessary, the storage of some aluminum fuel in stainless steel racks, this project would allow the INEL to accept all of the project spent nuclear fuel receipts until the Additional Increased Capacity project would be completed in 2001. The Additional Increased Rack Capacity project at the Fuel Storage Area to accept the projected spent nuclear fuel receipts until the Dry Fuels Storage Facility project would become available in 2005. The INEL would receive the Fort St. Vrain nuclear fuel in the Irradiated Fuel Storage Facility on a space-available basis or in the Dry Fuels Storage Facility. Modifications to the Irradiated Fuel Storage Facility equipment would be necessary to accept the new Fort St. Vrain shipping casks.

DOE would continue to use the Underground Storage Facility and the Irradiated Fuel Storage Facility for current inventory and for transfers of other fuel inventories based on the results of these safety analyses, upgrades would be limited to those required for facility improvements and for making transfers safely.

### **3.1.3.4 Research and Development. Spent nuclear fuel research and development would**

continue as planned, with the construction of a Technology Development Facility. The Electrometallurgical Process Demonstration Project at Argonne National Laboratory - Idaho Facility would continue. In addition, Argonne National Laboratory would implement the Blanket Processing project under this alternative. The Dry Fuels Storage Facility would demonstrate technology for the dry storage of selected DOE highly enriched uranium.

### **3.1.3.5 Naval-Type Fuel Examination. The practice of transporting spent nuclear fuel from**

naval reactors to the Expanded Core Facility at the INEL would resume. After an examination, DOE would transfer such fuel to the Idaho Chemical Processing Plant for interim storage disposition. Under this alternative, the Naval Nuclear Propulsion Program would continue the Expanded Core Facility Dry Cell Construction project.

## **3.1.4 Alternative 4: Regionalization**

This alternative assumes that DOE would base the spent nuclear fuels shipped between the receipt of fuels from other locations primarily on either geography or fuel type. DOE offers two options for the redistribution of existing and new spent nuclear fuel:

- Option 4a assumes that DOE would base the spent nuclear fuels shipped between the receipt of fuels from other locations at the INEL, Hanford Site, or

River Site primarily on fuel type.

- Option 4b assumes that DOE would base the spent nuclear fuels shipped between the receipt of fuels on geography. There would be a single western site Hanford Site, INEL or Nevada Test Site. Option 4b(1) in which the INEL is regional site is essentially the same as Alternative 5b. Option 4b(2) in which SNF to another western regional site is the same as Alternative 5a.

#### **3.1.4.1 Transportation. Under option 4a, the INEL would receive all Zircaloy- and**

stainless-steel-clad spent nuclear fuel. This redistribution would optimize DOE spent nuclear fuel management.

The spent nuclear fuel inventory involved under option 4a would be greater than Alternative 1, 2, or 3 because this alternative assumes that the INEL would manage inventory plus the following additional spent nuclear fuels (see Table 3-3) prior to disposal:

- Naval-type spent nuclear fuel
- All spent nuclear fuel except aluminum-clad fuel and Hanford spent nuclear
- All Training Reactor Isotopics General Atomics spent nuclear fuels from the
- Fort St. Vrain spent nuclear fuel from Public Service of Colorado
- Special case commercial pressurized water reactor and boiling water reactor fuel from the DOE facility in West Valley, New York

Under option 4b(1), DOE would regionalize all western DOE SNF at the INEL. DOE would transport all spent nuclear fuel at other western sites to the INEL. Because the fuel alternative would be within 15 percent of that for Alternative 5b, analyses for this alternative assume that environmental impacts would be the same as those for Alternative 5b at the INEL.

Under option 4b(2), DOE would regionalize all western DOE SNF at either the Nevada or Hanford Site. DOE would transport spent nuclear fuel at the INEL to the selected site; thus, this option would be the same as Alternative 5a - Centralization at Other DOE

#### **3.1.4.2 Stabilization. DOE would stabilize the spent nuclear fuels it would retain at the INEL**

as planned for Alternative 3, with the construction of such new facilities as a characterization facility and the Dry Fuels Storage Facility. Options 4a and 4b(1) would require the receipt and storage of spent nuclear fuel, while option 4b(2) would require capabilities for shipping spent nuclear fuel. For spent nuclear fuel at the INEL regional sites, the receiving site would perform any stabilization beyond that required for transportation.

#### **3.1.4.3 Storage. Under option 4a, DOE would increase dry storage capacity and undertake**

facility upgrades similar to those described for Alternative 3, with replacements as appropriate. Under option 4b(1), DOE would increase dry storage capacity and undertake facility upgrades similar to those described for Alternative 5b, with replacements and additions. Option 4b(2) would not require increased storage capacity and, therefore, there would be no facility upgrades.

#### **3.1.4.4 Research and Development. As with Alternative 3, this alternative would include**

the continuation of activities related to the treatment of spent nuclear fuel, including development (e.g., Electrometallurgical Process Demonstration Project), and the construction of the Dry Fuels Storage Facility. DOE would initiate pilot programs as needed to support research on spent nuclear fuel management and disposition. DOE would use historic data on spent nuclear fuel to provide the bounding case for a determination of the impacts associated with potential

activities.

#### **3.1.4.5 Naval-Type Fuel Examination. Under options 4a and 4b(1), the transportation of**

spent nuclear fuel from naval reactors to the Expanded Core Facility at the INEL with Alternative 1, under option 4b(2) DOE would phase out shipments of naval-type to the INEL and would phase out the Expanded Core Facility.

### **3.1.5 Alternative 5: Centralization**

Under this alternative, DOE would send all current and future spent nuclear fuel both DOE and the Naval Nuclear Propulsion Program to one DOE site for interim storage disposition.

The two options under Alternative 5 encompass the extreme ranges of spent nuclear inventories that DOE could store at the INEL (i.e., all or none of the inventory). DOE would ship the INEL spent nuclear fuel inventory off the site to the Hanford Site, the Nevada Test Site, or the Oak Ridge Reservation. Under option 5b, DOE would ship spent nuclear fuel to the INEL.

This alternative would bound the maximum number of spent nuclear fuel-related activities that could reasonably undertake at any site. DOE would have to build new facilities at the centralized destination would continue as an interim action pending the construction and examination facilities at the selected site. DOE would then transfer activities to the selected site, and the other sites would close their spent nuclear fuel facilities. To ship spent nuclear fuel from the originating site, it would characterize and analyze as necessary.

The locations from which spent nuclear fuel would originate, in addition to the Savannah River Site, would include Argonne National Laboratory - East, Babcock and Brookhaven National Laboratory, General Atomics, Los Alamos National Laboratory, Oak Ridge National Laboratory, Sandia National Laboratories, West Valley, and Fort St. Vrain. It would also include fuel that might be returned to the United States following irradiation.

This alternative would include activities related to the treatment of spent nuclear fuel for research and development and pilot programs to support future decisions on its disposition. DOE would use historic data on spent nuclear fuel to provide a foundation case for decisions associated with potential pilot program activities.

#### **3.1.5.1 Alternative 5a - Centralization at Other DOE Sites.**

##### **3.1.5.1.1 Transportation - This option assumes that the INEL would consolidate and**

prepare all existing and projected onsite spent nuclear fuel for shipment to another DOE site, the Savannah River Site, the Nevada Test Site, or Oak Ridge.

##### **3.1.5.1.2 Stabilization - The DOE would construct a canning and characterization facility**

at the Idaho Chemical Processing Plant to accept the different types of INEL spent nuclear fuel, various shipping casks and storage containers, and to stabilize these fuel types before they are sent to the selected DOE facility.

##### **3.1.5.1.3 Storage - As in Alternative 1, DOE would complete the CPP-603 Underwater**

Fuel Storage Facility pool inventory transfer to existing dry storage facilities by DOE would not

build the Dry Fuels Storage Facility. DOE would then close all spent nuclear fuel facilities at the INEL with the exception of those in direct support of operating reactors, such as the Reactor canal or the Argonne National Laboratory-West Hot Fuel Examination Facility. This closure would require the establishment of a major surveillance and operation until DOE determined the disposition of these facilities. The timeframe depends on the following factors:

- The time necessary to stabilize the spent nuclear fuel in the CPP-603 Underwater

#### Storage Facility

- The time necessary for the selected DOE site to prepare facilities qualifie nuclear fuel
- The time necessary for the procurement and licensing of shipping containers compatible with the selected receiving DOE site

The spent nuclear fuel inventory that DOE would export off the INEL site for Al the same quantity listed for Alternative 1 (see Table 3-3).

#### **3.1.5.1.4 Research and Development - Under this option there would be a phaseout of**

all research and development activities, although the Electrometallurgical Process Project would continue at the Argonne National Laboratory - West Fuel Cycle Facilit stabilize only spent nuclear fuel currently on the site).

#### **3.1.5.1.5 Naval-Type Fuel Examination - As with Alternative 1, DOE would phase out**

shipments of naval-type spent nuclear fuel to the INEL and would phase out the Expe Facility.

#### **3.1.5.2 Alternative 5b - Centralization at the INEL.**

##### **3.1.5.2.1 Transportation - This option assumes that the INEL would receive all DOE and**

naval-type spent nuclear fuel (see Table 3-3).

##### **3.1.5.2.2 Stabilization - The Hanford Site, the Savannah River Site, and other DOE**

facilities would stabilize as necessary, spent nuclear fuel for safe transportation Processing Plant.

The Hanford Site, the Savannah River Site, and other DOE facilities would procure an undetermined number of additional casks and install cask handling equipment as n would complete an expanded Dry Fuels Storage Facility at the INEL, which would incl Canning and Characterization Facility similar to that described for Alternative 3. if needed, repackage the spent nuclear fuel into compatible canisters for dry stora facility projects would be the same as those described for Alternative 3. In addit stabilizing for safe storage all complex-wide spent nuclear fuel, as necessary, in Idaho Chemical Processing Plant. Upgrades and new facilities would be necessary to term fuel stabilization for ultimate disposition; this would address criticality (u uncontrolled nuclear fission) concerns about the disposal of spent nuclear fuel in repository.

##### **3.1.5.2.3 Storage - Projects and activities for storage of spent nuclear fuel would be similar**

to those described for Alternative 3, except that accelerated schedules for the Inc and Additional Increased Rack Capacity projects would be necessary to accommodate t fuel receipts.

In addition, the schedule for the Dry Fuel Storage Facility project would have to b accelerated and its scope expanded. For example, the Increased Rack Capacity proje completed in late 1996, the Additional Increased Rack Capacity project may have to late 1998, and the Expanded Dry Fuels Storage Facility project may have to be compl the Expanded Dry Fuels Storage Facility would become available even earlier, it cou need for the Additional Increased Rack Capacity project.

##### **3.1.5.2.4 Research and Development - DOE would conduct maximum spent nuclear**

fuel research and development under this option.

As with Alternative 4, the Electrometallurgical Process Demonstration Project would continue at the Argonne National Laboratory - W

#### 3.1.5.2.5 Naval-Type Fuel Examination - Similar to Alternative 3, the practice of

transporting spent nuclear fuel from naval reactors to the Expanded Core Facility a resume.

## 3.2 Comparison of Alternatives

Chapter 5 analyzes the environmental consequences of the alternatives. Tables summarize and compare the potential impacts associated with each alternative from t Chapter 5 for construction, normal operations, and accidents, respectively.

A review of the impacts of the alternatives, as presented in Chapter 5, indicat would be minimal or negligible in most areas. Further, most areas with measurable have no appreciable differences among alternatives.

In general, the levels of potential impacts associated with Alternatives 1 thro would be similar because the amounts of spent nuclear fuel that DOE would manage at these alternatives would be on the same order of magnitude (e.g., 300 to 450 MTHM) would extend throughout the full 40-year management period. The lowest level of ov impact at the INEL would occur under Alternative 4b(2) - Regionalization by Geograp and Alternative 5a - Centralization at Other DOE Sites because DOE would ship INEL fuel off the site well before the management period ended in 2035. Alternative 5b 4b(1), under which DOE would ship all or nearly all spent nuclear fuel to the INEL, greatest potential onsite impacts.

## 4. AFFECTED ENVIRONMENT

Table 3-4. Comparison of impacts from construction. (Page 1)

Table 3-4. (Page 2)

Table 3-4. (Page 3)

Table 3-5. Comparison of impacts from normal operations. (Page 1)

Table 3-5. (Page 2)

Table 3-5. (Page 3)

Table 3-6. Comparison of impacts from accidents.

### 4.1 Overview

Chapter 4 describes the existing environment at the Idaho National Engineering (INEL) site and the surrounding region. It emphasizes areas that the proposed spen management alternatives could affect. The information in this chapter provides the environmental conditions against which the Department of Energy (DOE) can measure t environmental effects of the alternatives. It supports the assessment of the poten consequences that Chapter 5 discusses. DOE used the discussion of the Affected Env Volume 2 of this EIS as input for this chapter.

### 4.2 Land Use

The INEL site encompasses 570,914 acres (2,310.4 square kilometers) in Butte, B Jefferson, Bonneville, and Clark Counties, Idaho. This section describes existing and in the surrounding region, and land use plans and policies applicable to the su

#### 4.2.1 Existing and Planned Land Uses at the INEL

Categories of land use at the INEL include facility operations, grazing, genera infrastructure such as roads. Facility operations include industrial and support o

with energy research and waste management activities (DOE also conducts such activities at the Three Falls facilities). In addition, DOE uses INEL land for recreation and environmental purposes with the designation of the INEL as a National Environmental Research Park.

Much of the INEL is open space that DOE has not designated for specific uses. Open space serves as a buffer zone between INEL facilities and other land uses. Forest operations use about 2 percent of the total INEL site area (11,400 acres or 46 square kilometers). Public access to most facility areas is restricted. Approximately 6 percent of the 32,985 acres (133.5 square kilometers), is devoted to public roads and utility rights-of-way on the site. Recreational uses include public tours of general facility areas and the Reactor-I (a National Historic Landmark), and controlled hunting, which is generally 0.5 mile (0.8 kilometer) inside the INEL boundary.

Cattle and sheep grazing occupies between 300,000 and 350,000 acres (1,200 and 1,400 square kilometers). The U.S. Sheep Experiment Station uses a 900-acre (3.6-square-kilometer) land, at the junction of Idaho State Highways 28 and 33, for a winter feed lot for sheep. Grazing is not allowed within 2 miles (3.2 kilometers) of any nuclear facility because of the possibility of milk contamination by long-lived radionuclides, dairy cattle are not permitted. The Department of the Interior's Bureau of Land Management grants and administers grazing permits. Figure 4.2-1 shows selected land uses at the INEL and in the surrounding region.

Figure 4.2-1 Selected land uses at the INEL and in the surrounding region. The INEL site is 568.3 square kilometers in the eastern and southern portions of the INEL site) and the Resource Area (430,499 acres or 1,742 square kilometers in the central and western portions). The Bureau of Land Management administers both of these areas. Under Resource Management, the Bureau manages portions of these Resource Areas for grazing and wildlife habitat. Exploration or development is allowed on INEL land.

DOE land use plans and policies applicable to the INEL include the INEL Institutional Plan (Fiscal Year 1994 - 1999 (DOE-ID 1993c) and the INEL Technical Site Information Report (DOE 1993a). The Institutional Plan provides a general overview of INEL facilities, outlines program directions and major construction projects, and identifies specific technical equipment needs. The Technical Site Information Report presents a 20-year development plan for activities at the site. Under the scope of these planning documents, energy and waste management activities would continue in existing facility areas and, in some cases, expand into currently undeveloped site areas. These documents also describe environmental management, and spent nuclear fuel activities. Projected land use scenarios for the future include the outgrowth of current functional areas and the possible development of wetlands in existing grazing areas.

No on-site land use restrictions due to Native American treaty rights would exist for the alternatives described in this EIS. The INEL does not lie within any of the lands covered by the Fort Bridger Treaty, and the entire INEL site is land occupied by the U.S. Department of Energy. Therefore, the provisions in the Fort Bridger Treaty that allows the Shoshone Indians to hunt on unoccupied lands of the United States do not apply to the INEL site.

#### 4.2.2 Existing and Planned Land Use in Surrounding Areas

The Federal government, the State of Idaho, and private parties own the lands surrounding the INEL site. Land uses on Federally owned land consist of grazing, wildlife management, energy and energy production, and recreational uses. State-owned lands are used for grazing, wildlife management, and recreational purposes. Privately owned lands are used primarily for agriculture, production, and range land.

Small communities and towns near the INEL boundaries include Mud Lake to the east, Butte City, and Howe to the west; and Atomic City to the south. The larger communities of Rexburg, Blackfoot, and Pocatello and Chubbuck are to the east and southeast. The Fort Hall Indian Reservation is to the southeast of the INEL. Recreation and tourism in the region around the INEL include the Craters of the Moon National Monument, Hell's Canyon National Monument, Black Canyon Wilderness Study Area, Camas National Wildlife Refuge, Market Lake State Wildlife Management Area, North Lake State Wildlife Management Area, Yellowstone National Park, Grand Teton National Park, Jackson Hole Recreation Complex, and Challis National Forests, and the Snake River.

Lands surrounding the INEL site are subject to Federal and state planning laws and regulations that require public involvement in their implementation for and use of Federal lands and their resources. Land use planning in the State of Idaho is governed by the Local Planning Act of 1975 (State of Idaho Code 1975). Because the State of Idaho is the land use planning agency, the Idaho legislature requires each county to adopt its own land use planning guidelines. County plans that are applicable to lands bordering the INEL site are subject to review and approval by the Idaho Department of Lands.



Clark County Planning and Zoning Ordinance and Interim Land Use Plan (Clark County Bonneville County Comprehensive Plan (Bonneville County 1976); Bingham County Zoning and Planning Handbook (Bingham County 1986); Jefferson County Comprehensive Plan (Jefferson County 1988); and Butte County Comprehensive Plan (Butte County 1992). Land use plan INEL facilities within the Idaho Falls city limits is subject to Idaho Falls planning restrictions (City of Idaho Falls 1989, 1992).

All county plans and policies accept development adjacent to previously developed minimize the need to extend infrastructure improvements and to avoid urban sprawl. INEL is remote from most developed areas, INEL lands and adjacent areas are not likely residential and commercial development; no new development is planned near the INEL. However, DOE expects recreational and agricultural uses to increase in the surrounding response to greater demand for recreational areas and the conversion of range land.

## 4.3 Socioeconomics

This section presents a brief overview of current socioeconomic conditions with influence where approximately 97 percent of the INEL workforce lived in 1991 (DOE-I). INEL region of influence is a seven-county area comprised of Bingham, Bonneville, Butte, Jefferson, Bannock, and Madison Counties. The region of influence also includes the Shoshone Reservation and Trust Lands (home of the Shoshone-Bannock Tribes) in Bannock, Bingham, and Power Counties.

### 4.3.1 Employment

Historically, the regional economy has relied predominantly on natural resource extraction. Today, farming, ranching, and mining remain important components of the economy. Idaho Falls is the retail and service center for the region of influence, evolved into an important processing and distribution center and site of higher education.

#### 4.3.1.1 Region. The labor force in the region of influence increased from 92,159 in 1980 to

104,654 in 1991, an average annual growth rate of approximately 1.2 percent. In 1991, the region of influence accounted for approximately 18 percent of the total state labor force of 580,000 (ISDE 1992). As listed in Table 4.3-1, the projected labor force in the region of influence will increase to 108,667 by 1995.

Unemployment rates varied considerably among the counties of the region of influence, ranging from 2.6 percent in Clark County to 6.3 percent in Bannock and Bingham Counties. In 1980 the average annual unemployment rate for the region has ranged from 5.3 percent to 8.3 percent in 1983. In 1991 the average annual unemployment rate for the region of influence was 5.5 percent compared to the statewide average of 6.2 percent (ISDE 1992).

Employment in the region of influence increased from 86,261 in 1980 to 98,898 in 1991, an average annual growth rate of approximately 1.3 percent. As listed in Table 4.3-1, employment is projected to increase to 101,450 by 1995.

**Table 4.3-1.** Projected labor force, employment, and population for the INEL region 1995-2004.

	1995	1996	1997	1998	1999	2000	2001
Labor Force	108,667	109,607	110,547	111,487	112,427	113,367	114,308
Employment	101,450	102,328	103,205	104,083	104,960	105,838	106,716
Population	247,990	251,518	255,096	258,726	262,406	266,140	268,667

Source: ISDE (1992); SAIC (1994); ISDE (1991); ISDE (1986).

#### 4.3.1.2 Idaho National Engineering Laboratory. INEL plays a substantial role in the

regional economy. During Fiscal Year 1990, INEL directly employed approximately 11,100 personnel, accounting for almost 12 percent of total regional employment. The population directly supported by INEL employment was approximately 38,000 persons, or 15 percent of the total regional population. The major employers at INEL are DOE-ID, DOE-ID c Argonne National Laboratory-West, and the Naval Reactors Facility (see Figure 4.3-1). Total direct INEL employment was approximately 11,600 jobs (DOE-ID 1994). Projections for January 1995 indicate that the total number of jobs at INEL will decrease to approximately 7,250 in Fiscal Year 1995 and to approximately 7,250 in Fiscal Year 2004 (Tellez 1995). Projections for 2001 indicate that the total number of jobs at INEL will decrease to approximately 7,250 in Fiscal Year 2001 and to approximately 7,250 in Fiscal Year 2004 (Tellez 1995).

in INEL employment are primarily related to contractor consolidation, which account of the projected losses between Fiscal Year 1994 and Fiscal Year 2004, and to reduce Naval Reactors Facility, which accounts for 33 percent of the projected job losses. at DOE-ID resulted in the consolidation of several contracts under one contract. T eliminated redundant administrative activities previously performed by each individual offered early retirement or other options to impacted INEL contractor employees.

### 4.3.2 Population and Housing

#### 4.3.2.1 Population. From 1960 to 1990, population growth in the region of influence

mirrored statewide growth. During this period, the region's population increased a rate of approximately 1.3 percent, while the growth rate for the State was 1.4 percent and 1990, population growth in the region of influence approximately equaled that of average growth rate of 0.6 percent per year. The region of influence had a 1990 population of 219,713, which comprised 22 percent of the total State population of 1,006,749. Based on employment trends, the population in the region of influence will reach approximately 248,000 persons by 1995 (Table 4.3-1).

Figure 4.3-1. Historic and projected employment at the Idaho National Engineering

In 1990, the most populous counties were Bannock and Bonneville, which together over 60 percent of the seven-county total (Figure 4.3-2). Butte and Clark were the the counties in the region of influence. The largest cities in the region of influence Idaho Falls, with 1990 populations of approximately 46,000 and 44,000, respectively Fort Hall Indian Reservation and Trust Lands contained 5,113 residents, most of who resided in Bingham County.

#### 4.3.2.2 Housing. Bonneville and Bannock Counties (which respectively include the cities of

Idaho Falls and Pocatello) provided 67 percent of the 73,230 year-round housing units in the region of influence in 1990 (see Table 4.3-2). Of this number, approximately 70 percent were owner units, 17 percent were multifamily units, and 13 percent were mobile homes. Most of the units (75 percent) were in Bonneville and Bannock Counties. About 29 percent of the housing units in the region were rental units and 71 percent were homeowner units.

The median value of owner-occupied housing units ranged from \$37,300 in Clark County to \$68,700 in Madison County, and median monthly rents ranged from \$243 in Butte County to \$310 in Bonneville County. In 1990, there were 1,510 occupied housing units on the Fort Hall Indian Reservation and Trust Lands (USBC 1992) and a vacancy rate of 14 percent.

### 4.3.3 Community Services

This assessment considers the following selected community services in the region of influence: public schools, law enforcement, fire protection, hospital services, and solid waste management. Table 4.3-3 summarizes pertinent characteristics of these services for the region of influence.

Seventeen public school districts and three nonpublic schools provide education to about 58,000 children in the region of influence. Of these students, about 6,500 were INEL-related employees. During the 1990-1991 academic year, most public school districts received an average of \$3,000 to \$4,000 per student annually. Higher education in the region is provided by the University of Idaho, Idaho State University, Brigham Young University, Ricks College, and Eastern Idaho Technical College.

Seven county sheriff's offices, 12 city police departments, and the Idaho State Police provide law enforcement services in the region. There was a total of 479 sworn officers and 10 civilian employees.

Figure 4.3-2. Historic and projected total population for the counties of the region of influence.

**Table 4.3-2.** Number of housing units, vacancy rates, median house value, and median monthly rent by county and region of influence.

County	Homeowner housing units Number of units	Vacancy rates	Median value (\$)	Rental units Number of units	Vacancy rates
Bannock	16,447	2.4	53,300	7,467	10
Bingham	9,010	2.0	50,700	2,955	9.
Bonneville	17,707	1.9	63,700	7,375	6.

Butte	780	4.6	41,400	302	16
Clark	177	1.7	37,300	114	9.
Jefferson	4,000	2.0	54,300	992	4.
Madison	3,522	1.3	68,700	2,392	2.
Region of influence	51,674	2.1	-	21,556	4.

a. Source: USBC (1992).

enforcement personnel in 1991, more than 59 percent of whom served Bannock and Bonn Counties.

Eighteen fire districts in the region of influence operate 30 fire stations sta approximately 300 volunteer firefighters. Bingham, Bonneville, Butte, Clark, and J which surround the INEL, have developed emergency plans to be implemented in the ev radiological or hazardous materials emergency. Each emergency plan identifies faci extremely hazardous substances and defines transportation routes for these substanc plans also include procedures for notification and response, listings of emergency facilities, evacuation routes, and training programs.

Eight hospitals serve the region of influence with more than 900 licensed beds nearly 128,000 patient-days per year. Occupancy rates range from 22.0 to 61.7 perc (IDHW 1990). County governments and the Blackfoot, Dubois, Idaho Falls, and Pocate departments provide regional ambulance services. A private ambulance company serve Butte County. Four quick-response units, two medical helicopters, and two clinics emergency medical services also serve the region of influence (Hardinger 1990; U.S. 1992).

**Table 4.3-3.** Summary of public services available in the region of influence.

Public Service	County			
Schools	Bannock	Bingham	Bonneville	But
Number of public school districts	2	5	3	1
Total enrollment	15,455	11,311	17,896	765
Number of INEL-related students (excluding military)	485	1,532	4,040	301
Health Care Delivery				
Number of hospitals	3	2	1	1
Number of licensed beds	309	238	311	4
Law Enforcement				
Number of sworn law enforcement officers	151	65	143	4
Total personnel per 1000 population	2.5	2.0	2.2	1.3
Fire Protection				
Number of fire stations	9	7	6	2
Number of firefighters	166	96	121	15
Number of firefighting vehicles	37	25	24	3
Municipal Solid Waste Disposal				
Number of landfills meeting EPAb regulations1c		3d	1e	2
Expected lifespan in years	30	3-6	50	30

a. Source: IDE (1991); IDHW (1990); IDLE (1991); Kouris (1992a); and Kouris (1992

b. EPA = U.S. Environmental Protection Agency.

c. Fort Hall Mine Landfill is being redesigned to meet EPA standards.

d. Aberdeen Landfill may close due to noncompliance with EPA standards.

e. A new landfill is replacing Bonneville County Landfill.

f. Madison and Clark Counties are evaluating a regional landfill for use after 199

Municipal solid waste generated in the region of influence is transported to co 1992, twelve landfills served the region of influence. Four landfills (one each in Jefferson, and Madison Counties) will close without replacement before reaching the capacity due to noncompliance with new Environmental Protection Agency standards (C

#### 4.3.4 Public Finance

In Fiscal Year 1991, total county revenues for the region of influence amounted \$90 million (see Table 4.3-4). County governments receive most of their revenues f intergovernmental transfers. In 1991 the total assessed value of taxable property influence was about \$4.5 billion. In addition to property tax revenues, local gove counties) also receive revenue from sales tax disbursements and revenue-sharing pro sources provide approximately 60 to 85 percent of the total revenues received by ea

**Table 4.3-4.** Total revenues and expenditures by county, Fiscal Year 1991.

County	Total revenues (\$)	Total expenditures (\$)
Bannock	16,232,274	14,216,708
Bingham	11,434,200	10,708,011
Bonnevilleb	50,186,650	51,850,100
Butte	1,417,684	1,397,012
Clark	1,236,849	1,086,379
Jefferson	4,408,236	4,566,074
Madison	5,249,432	5,662,080
Seven-county region	90,165,325	89,486,364

a. Sources: Ghan (1992); Bingham County (circa 1992); McFadden (circa 1992); Swage (1992a); Swager & Swager (1992b); Draney, Searle, and Associates (1992); Schwend Sutton (1992).

b. Bonneville County's financial statements and total revenue data include special schools, cities, cemeteries, fire districts, ambulance districts, and other special other county budgets. The majority of intergovernmental revenue is used to fund Although DOE as a Federal agency is exempt from paying state or local taxes, IN and contractors are not. In 1992, INEL employees paid an estimated \$60 million in withholding tax and \$24 million in state withholding tax.

In 1991 the major categories of county government expenditures were general gov services, 27 percent; road maintenance, 18 percent; public safety, 16 percent; health programs, 16 percent; sanitation and public works, 9 percent; debt service, 3 percent; 2 percent; and other expenditures, 9 percent.

## 4.4 Cultural Resources

This section discusses cultural resources at the INEL, including prehistoric and archeological sites and historic sites and structures, and traditional resources that have religious importance to local Native Americans. It also discusses paleontological resources at the INEL site.

### 4.4.1 Archeological Sites and Historic Structures

As summarized in the INEL Draft Management Plan for Cultural Resources (Miller 1992), the INEL contains a rich and varied inventory of cultural resources. This inventory provides an important paleontological context for the region and the many prehistoric sites that are preserved within it. These latter sites, including campsites, lithic hunting blinds, among others, are also an important part of the INEL inventory because they provide information about the activities of aboriginal hunting and gathering groups who inhabited the area approximately 12,000 years. In addition, archeological sites, pictographs, caves, and other features of the INEL landscape are also important to contemporary Native Americans for historic, religious, and traditional reasons. Historic sites, including the abandoned Powell/Pioneer, a northern spur of the Oregon Trail known as Goodale's Cutoff, many homesteads, irrigation canals, sheep and cattle camps, and stage and wagon trails, the area during the late 1800s and early 1900s. Finally, the many scientific and historic sites inside the INEL boundaries have preserved important information on the history of nuclear science in America.

To date, more than 100 cultural resource surveys have been conducted over approximately 4 percent of the area on the INEL site. These surveys, most of which have occurred in facility areas, have identified 1,506 archeological resources, including 688 prehistoric sites, 753 prehistoric isolates, and 27 historic isolates (Miller 1992; Gilbert and Miller 1993). Until formal significance evaluations (archeological testing and historic records studies) are completed, all cultural sites in this inventory are considered to be potentially eligible for listing in the National Register of Historic Places. However, all the isolates have been categorized as ineligible to meet eligibility requirements (Yohe 1993).

Due to the relatively high density of prehistoric sites on the INEL and the need to protect these resources during Federal undertakings, DOE has sponsored a preliminary study, which includes the development of a predictive model, to identify areas where densities of sites are high and where potential impacts to significant archeological resources, as well as costs of compliance, are correspondingly high (Ringe 1993). This information provides guidance for INEL project planning and implementation.

selection of appropriate areas for new construction. However, it does not take the that are required by the National Historic Preservation Act before ground-disturbin (NHPA 1966 as amended).

The predictive model, constructed using a multivariate statistical technique on variables associated with areas with and without sites, indicates that prehistoric appear to be concentrated in association with certain definable physical features o context, very high densities of resources are likely to occur along the Big Lost Ri atop buttes, and within craters and caves. The Lemhi Mountains, the Lake Terreton mile- (2,800-meter-) wide zone along the edge of local lava fields probably contain density of sites. Within the extensive flows of basaltic lava and along the low fo Mountains, site density is classified as moderate, and the lowest density of prehis probably occurs in the floodplain of the Big Lost River and the alluvial fans emerg Creek Valley, in the sinks, and in the recent Cerro Grande lava flow. However, a c or medium density does not eliminate the possibility that significant resources exi Although the predictive model has not been tested, it is useful as a planning guide most likely to contain archeological resources based on past surveys.

Although there has been no systematic inventory of historically significant fac with the creation and operation of the INEL, a preliminary study indicated that all require evaluation (Braun et al. 1993). The Experimental Breeder Reactor-I is a Na Landmark listed in the National Register of Historic Places. To date, however, few properties have been formally evaluated for eligibility to the National Register. Agreement between DOE, the Idaho State Historic Preservation Office, and the Nation Council on Historic Preservation establish that certain structures at Test Area Nor Auxiliary Reactor Area (DOE 1993a) are eligible for nomination, and outline specifi preserving the historic value of the areas in conformance with the requirements of American Building Survey and the Historic American Engineering Record. Other facil INEL site are likely to require similar efforts if DOE schedules them for major mod demolition, or abandonment.

#### 4.4.2 Native American Cultural Resources

Because Native American people believe the land is sacred, the entire INEL rese important to them. Cultural resources, to the Shoshone-Bannock peoples, include al traditional lifeways and usage of all natural resources. This includes not only pr sites, which are important in a religious or cultural heritage context, but also fe landscape, air, plant, water, or animal resources that might have special significa may be affected by changes in the visual environment (construction, ground disturba introduction of a foreign element into the setting), dust particles, or by contamin the INEL is included within a large territory once inhabited by and still of import Shoshone-Bannock Tribes. Plant resources used by the Shoshone-Bannock Tribes that or near the INEL site are listed in Table 4.4-1. Areas significant to the tribes w buttes, wetlands, sinks, grasslands, juniper woodlands, Birch Creek, and the Big Lo

Five Federal laws prompt consultation between Federal agencies and Indian Tribe Environmental Policy Act (NEPA 1969), the National Historic Preservation Act (NHPA amended), the American Indian Religious Freedom Act (AIRFA 1978), the Archeological Protection Act (ARPA 1979), and the Native American Graves Protection and Repatriat (NAGPRA 1990). In accordance with these directives and in consideration of its Nat Policy (DOE 1990a and DOE 1992a), DOE is developing procedures at the INEL for cons coordination with the Shoshone-Bannock Tribes of the Fort Hall Reservation. DOE ha additional interaction and exchange of information with the Shoshone-Bannock Tribes outlined this relationship in a formal Working Agreement with these tribes (DOE 199 the Cultural Resources Management Plan for the INEL (Miller 1992) and the curation permanent storage of archaeological materials will be completed by June 1996. The Resources Management Plan will define procedures for involving the tribes during th of project development and the curation agreement will provide for the repatriation accordance with NAGPRA.

#### 4.4.3 Paleontological Resources

There are 31 known fossil localities at the INEL site. Available information s region has relatively abundant and varied paleontological resources. Preliminary a **Table 4.4-1.** Plants used by the Shoshone-Bannock tribes that are located on or nea

Plant Family	Type of Use	Location
Desert Parsley	medicine, food	scattered over site
Milkweed	food, tools	roadsides
Sagebrush	medicine, tools	throughout the site
Balsamroot	food, medicine	around buttes
Thistle	food	scattered throughout site
Gumweed	medicine	disturbed areas
Sunflower	medicine, food	roadside
Dandelion	food, medicine	throughout site
Beggar's Ticks	food	disturbed areas throughout site
Tansymustard	food, medicine	disturbed areas
Cactus	food	throughout the site
Honeysuckle	food, tools	Big Southern Butte
Goosefoot	food	throughout site
Russian Thistle	food	disturbed areas throughout site
Dogwood	food, medicine, tools	Webb Springs, Birch Creek
Juniper	medicine, food, tools	throughout site
Gooseberry	food	scattered throughout site
Mentha arvensis	medicine	Big Lost River
Wild onion	food, medicine, dye	throughout site
Caloehortus spp.	food	buttes
Fireweed	food	throughout site
Pine	food, tools, medicine	Big Southern Butte
Douglas Fir	medicine	Big Southern Butte
Plantain	medicine, food	throughout site
Wildrye	food, tools	throughout site
Indian Ricegrass	food	throughout site
Bluegrass	food, medicine	throughout site
Serviceberry	food, tools, medicine	buttes
Chokeberry	food, medicine, tools, fuel	buttes
Wood's Rose	food, smoking, medicine, ritual	Big Lost River, Big Southern Butte
Red Raspberry	food, medicine	Big Southern Butte
Willow	medicine	throughout site in moist areas
Coyote Tobacco	smoking, medicine	Big Lost River, Webb Springs
Cattail	food, tools	sinks, outflow from facilities

Source: Andersen et al. (1995).

these materials are most likely to occur in association with archeological sites; in deposits of the Big Lost River, Little Lost River, and Birch Creek; in deposits playas; in some wind and sand deposits; and in sedimentary interbeds or lava tubes flows (Miller 1992).

## 4.5 Aesthetic and Scenic Resources

### 4.5.1 Visual Character of the INEL Site

The Bitterroot, Lemhi, and Lost River mountain ranges border the INEL site on the west. Persons can see volcanic buttes near the southern boundary of the INEL from the site and from the Fort Hall Reservation. Most of the INEL site consists of open covered predominantly by large sagebrush and grasslands (see Section 4.9). Pasture farmland border much of the INEL site (see Section 4.2).

Although the INEL has a master plan, it has not established specific visual resources. The nine facility areas on the INEL site are generally of low density, look like commercial complexes, and are spread across the site. Structures in the facility areas from 10 feet to approximately 100 feet (3 to 30 meters). About 90 miles (145 kilometers) of public highway run through the INEL site (see Section 4.11). Although many INEL facilities are visible from these highways, most facilities are located more than 0.5 mile (0.8 kilometers) from roads.

### 4.5.2 Scenic Areas

The Craters of the Moon National Monument is about 15 miles (24 kilometers) south of the INEL site's western boundary. The Monument is located in a designated Wilderness Area and must maintain Class I (very high) air quality standards or minimal degradation, as required by the Clean Air Act (CAA 1990; CFR 1990; CFR 1991b). Under Section 169a of the Clean Air Act, air quality includes visibility and scenic view considerations.

Lands adjacent to the INEL under Bureau of Land Management jurisdiction are Visual Resource Management Class II areas (BLM 1984; BLM 1986), which urge preservation and retention of the existing character of the landscape. Lands inside the INEL boundaries are Class II, the most lenient classes in terms of modification. The Bureau of Land Management is considering a Black Canyon Wilderness Study Area, which is adjacent to the INEL, for a Wilderness designation (BLM 1986); if approved, this would result in an upgrade from Visual Resource Management Class II to a Class I.

Features of the natural landscape have special significance to the Shoshone-Banwick visual environment of the INEL site is within the visual range of Fort Hall Reservation.

## 4.6 Geology

This section describes the geology of the INEL and the surrounding area. Section 4.6.1 characterizes the general geology, while section 4.6.2 describes the natural resources. Sections 4.6.3 and 4.6.4 describe seismic and volcanic hazards, respectively.

### 4.6.1 General Geology

The site is on the Eastern Snake River Plain (Figure 4.6-1). The Plain forms a broad, crescent-shaped trough with low relief composed primarily of surface basaltic flows formed 1.2 million to 2,100 years ago. The Plain features thin, discontinuous, and deposits of wind-blown loess and sand; water-borne alluvial fan, lacustrine, and fluvial sediments; and rhyolitic domes formed 1,200,000 to 300,000 years ago (Kuntz et al. 1992; Figure 4.6-2). Mountains and valleys of the Basin and Range Province, which trend northwest and consist of folded and faulted rocks that are more than 70 million years old, bound the Plain on the north and south. The Yellowstone Plateau bounds the Plain on the east. The episode of Basin and Range faulting began 20 to 30 million years ago and continues recently associated with the October 28, 1983, Borah Peak earthquake [moment magnitude 7.3 on the Richter scale with a resulting peak ground acceleration of 0.05 g (INEL (Jackson 1985))], which occurred along the Lost River fault, approximately 100 miles (62 miles) from site facilities and the 1959 Hebgen Lake Earthquake, moment magnitude 7.5, approximately 150 kilometers (93 miles) from the INEL (Figure 4.6-1).

The northeast-trending volcanic terrain of the Plain has a markedly different tectonic pattern than the folded and faulted terrain of the northwest-trending Basin and Range faults have not been observed on or across the Plain. Four northwest-trending volcanic rift zones, attributed to basaltic eruptions that occurred 4 million to 2,000 years ago, cross the Plain at the INEL (Bowman 1995; Hackett and Smith 1992; Kuntz et al. 1992).

The seismic characteristics of the Eastern Snake River Plain and the adjacent Basin and Range Province are also different. Earthquakes and active faulting are associated with tectonic activity. The Plain has historically experienced few and small earthquakes (Pelton et al. 1990; WCC 1992; Jackson et al. 1993).

### Figure 4.6-1. Location of INEL in context of regional geologic features. Figure 4.6-2. Lithologic logs of deep drill holes in the INEL area. 4.6.2 Natural Resources

In 1979 the INEL drilled a geothermal exploration well to 3,159 meters (10,365 feet). Researchers measured a temperature of 142°C (288°F) but identified no commercial quality geothermal fluids (IDWR 1980). Mineral resources include several quarries or pits within the site boundary that supply sand, gravel, pumice, silt, clay, and aggregate for road construction and maintenance, new facility construction and maintenance, waste burial activities, and landscaping cinders. During excavations, DOE might study the gravel pits to characterize the surficial geology of the site. Outside the site boundary, mineral resources include pumice, phosphate, and base and precious metals (Strowd et al. 1981; Mitchell et al. 1981). The geologic history of the Plain makes the potential for petroleum production at the INEL

### 4.6.3 Seismic Hazards

The distribution of earthquakes at and near the INEL from 1884 to 1989 clearly shows the Plain has a remarkably low rate of seismicity, whereas the surrounding Basin and Range has a high rate (Figure 4.6-3, WCC 1992). The mechanism for faulting and generation of earthquakes in the Basin and Range is attributed to northeast-southwest directed crustal extension.

Several investigators have suggested hypotheses for the low rate of seismic activity in the Plain compared to the activity in both the Centennial Tectonic Belt and the Intermountain Belt:

- Smith and Sbar (1974) and Brott et al. (1981) suggest that high crustal temperatures in the Plain and adjacent region inside the seismic parabola (Figure 4.6-1) reduce deformation (aseismic creep), in contrast to the brittle deformation (rock fracturing) in the Basin and Range.
- Anders et al. (1989) suggest that the Plain and the adjacent region inside the seismic parabola (Figure 4.6-1) have increased integrated lithospheric strength. The presence of mid-crustal basic intrusive rock strengthens the crust so that it is less likely to fracture (see also Smith and Arabasz 1991).

Figure 4.6-3. Earthquakes with magnitudes greater than 2.5 from 1884 to 1989. -

and associated seismicity by altering the local tectonic stress field. As volcanic rift zones, they push apart the surrounding rocks and decrease deformation thereby preventing earthquakes from occurring.

- Anders and Sleep (1992) propose that the introduction of mantle-derived magmas into the midcrust beneath the Plain has decreased faulting and earthquakes by lowering crustal temperatures.

The markedly different tectonic and seismic histories of the Plain and Basin and Range reflect the dissimilar deformational processes acting in each region. Both regions are under the same extensional stress field (Weaver et al. 1979; Zoback and Zoback 1989; Pierce and Jackson et al. 1993); however, crustal deformation occurs through dike injection in the Basin and Range (Rodgers et al. 1990; Patton et al. 1991; Hackett and Smith 1992).

Major seismic hazards include the effects from ground shaking and surface deformation (e.g., tilting). Other potential seismic hazards (e.g., avalanches, landslides, mudslides and soil liquefaction) are not likely to occur at the INEL because the local geologic conditions are not conducive to them. Based on the seismic history and the geologic conditions, an earthquake of moment magnitude 5.5 (and associated strong ground shaking and surface fault rupture) to occur in the Plain. However, moderate to strong ground shaking from earthquakes in the Basin and Range can affect the INEL. Researchers use patterns of seismicity and locations of faults to assess potential sources of future earthquakes and to estimate levels of ground motion. The sources and maximum magnitudes of earthquakes that could produce the maximum level of ground motions at all INEL facilities include the following (WCC 1990; WCC 1992):

- A moment magnitude 7.0 earthquake at the southern end of the Lemhi fault and Fallert Springs segments
- A moment magnitude 7.0 earthquake at the southern end of the Lost River fault and Arco segment
- A moment magnitude 5.5 earthquake associated with dike injection in either the Lava Ridge-Hell's Half Acre Volcanic Rift Zone and the Axial Volcanic Zone
- A "random" moment magnitude 5.5 earthquake occurring in the Eastern Snake River Plain

Figure 4.6-4 shows a facility-specific example of the relationship of the peak ground motion on the INEL to the annual frequency of occurrence of seismic events in the region, including the four events described above (WCFS 1993). The curves refer to the site of the Idaho Chemical Processing Plant in the south-central INEL and might not be applicable to other INEL areas. Ground motion contributions from seismic sources not shown on Figure 4.6-4 (i.e., Intermountain seismic belt and Yellowstone Region) are significantly smaller than those from the sources shown. The INEL Natural Phenomena Analysis determines INEL seismic design-basis events based on studies such as those performed by Clyde Consultants (1990) and Woodward Clyde Federal Services (1993).

A maximum horizontal ground surface acceleration of 0.24g at the Idaho National Laboratory is estimated to result from an earthquake that could occur once every 2,000 years (1994). The seismic hazard information presented in this EIS is for general seismicity comparisons across DOE sites. Potential seismic hazards for existing and new facilities are evaluated on a facility-specific basis, consistent with DOE orders, standards, and procedures. Section 5.15 describes the potential impacts of postulated seismic events.



#### 4.6.4 Volcanic Hazards

Volcanic hazards at the INEL can come from sources inside or outside Plain boun hazards include the effects of lava flows, ground deformation (fissures, uplift, su earthquakes (associated with magmatic processes as distinct from earthquakes associ tectonics), and ash flows or airborne ash deposits (Bowman 1995). Most of the basa activity occurred from 4 million to 2,100 years ago in the INEL area. The most rec volcanic eruption occurred 2,100 years ago at the Craters of the Moon, 25 kilometer southwest of the INEL (Kuntz et al. 1992). The rhyolite domes along the Axial Volc between 1.2 million and 300,000 years ago and have a recurrence interval of about 2 Therefore, the probability of future dome formation affecting INEL facilities is ve

Figure 4.6-4. Contribution of the seismic sources to the mean peak acceleration

Catastrophic Yellowstone eruptions have occurred three times in the past 2 mill INEL is more than 160 kilometers (70 miles) from the Yellowstone Caldera rim and hi winds would not disperse Yellowstone ash in the direction of INEL. Due to the infr distance, and unfavorable dispersal, pyroclastic flows or ash fallout from future Y should not impact the INEL.

Basaltic lava flows and eruptions from fissures or vents might occur. Based on analysis of the volcanic history in the Big Southern Butte area (Volcanism Working conditional probability that basaltic volcanism would affect a south-central INEL 1 2.5 y  $10^{-5}$  per year (once per 40,000 years or longer), where the risk associated wi Zone volcanism is greatest. The estimated probability of volcanic impact on INEL f north, where both silicic and basaltic volcanism have been older and less frequent, year (once every million years or longer). The statistics of 116 measured INEL-are and areas were used to define the two lava flow hazard zones (Figure 4.6-5). The h particular site within or near a volcanic zone is much lower, typically by an order more, and must be assessed on a site-specific basis (Bowman 1995).

#### Figure 4.6-5. Map of the INEL showing locations of volcanic rift zones and lava flow hazard zones. 4.7 Air Quality

This section describes the air resources of the INEL site and the surrounding a discussion includes the climatology and meteorology of the region, descriptions of radiological air contaminant emissions, and a characterization of existing and proj pollutants. The analysis includes both existing facilities and those that were exp analysis was performed) to be operational before June 1, 1995. Additional detail a information on the material presented in this section is presented in Appendix F, S Volume 2.

#### 4.7.1 Climatology and Meteorology

The Eastern Snake River Plain climate exhibits low relative humidity, wide dail swings, and large variations in annual precipitation. Average seasonal temperature INEL site range from -7.3yC (18.8yF) in winter to 18.2yC (64.8yF) in summer, with a temperature of about 5.6yC (42yF). Temperature extremes range from a summertime ma 39.4yC (103yF) to a wintertime minimum of -45yC (-49yF). The annual average relati 50 percent, with monthly average maximum values ranging from 59 percent in July to February and December, and with monthly average minimum values ranging from 16 perc and July to 47 percent in January (Clawson et al. 1989).

Annual precipitation is light, averaging 221.2 millimeters (8.71 inches), with of zero to 127 millimeters (5 inches). The maximum 24-hour precipitation rate is 4 (1.8 inches). The greatest short-term precipitation rates are attributable primari which occur approximately two or three days per month during the summer. The avera snowfall is 701 millimeters (27.6 inches), with a maximum of 1,516 millimeters (59. minimum of 173 millimeters (6.8 inches) (Clawson et al. 1989).

The INEL site is in the belt of prevailing westerlies; however, the mountain ra Eastern Snake River Plain normally channel these winds into a southwest wind. Most experience the predominant southwest-northeast wind flow of the Eastern Snake River subtle terrain features near some locations cause considerable variations from this annual average wind speed measured at the 6.1-meter (20-foot) level at the Central

Weather Station is 3.4 meters per second (7.5 miles per hour). Monthly average val 2.3 meters per second (5.1 miles per hour) in December to 4.2 meters per second (9. in April and May (Clawson et al. 1989). The highest hourly average near-ground win measured onsite is 22.8 meters per second (51 miles per hour) from the west-southwe maximum instantaneous gust of 34.9 meters per second (78 miles per hour) (Clawson e Figure 4.7-1 presents the frequency of wind speed and wind direction at three meteo monitoring sites on the INEL site from 1988 to 1992. The wind directions presented the direction from which the wind blows. The three wind-roses demonstrate the effe predominant wind directions and wind speed. The winds at the Test Area North monit predominantly from the north-northwest, whereas the winds from the other stations a from the southwest.

Air pollutant dispersion is a result of the processes of transport and diffusio contaminants in the atmosphere. Transport is the movement of a pollutant in the wi diffusion refers to the process whereby turbulent eddies dilute a pollutant plume. gradient of the atmosphere (i.e., the change in temperature with altitude) can rest vertical diffusion of pollutants. Lapse rate conditions, which tend to enhance ver slightly less than 50 percent of the time. Conversely, thermal stratification or i which inhibit vertical diffusion, occur slightly more than 50 percent of the time. the pollutants can freely diffuse is the mixing depth, while the layer of air from mixing depth is the mixed layer. Estimates of the monthly average depth of the mix from 400 meters (1,312 feet) in December to 3,000 meters (9,843 feet) in July. Wit mostly clear skies, nocturnal inversions begin forming after sunset and dissipate a after sunrise. These inversions are often ground-based, meaning the atmospheric te with height from the ground (Clawson et al. 1989).

Other than thunderstorms, severe weather is uncommon. Five funnel clouds (torn touching the ground) and no tornadoes were reported on the site between 1950 and 19 the region is good because of the low moisture content of the air and minimal sourc reducing pollutants. From Craters of the Moon National Monument, the seasonal visu 130 to 155 kilometers (81 to 97 miles) (Notar 1993).

## 4.7.2 Air Quality

### 4.7.2.1 Nonradiological Air Quality. The INEL is in the Eastern Idaho Intrastate Air

Quality Control Region (AQCR 61). Neither the INEL nor any of the surrounding coun Figure 4.7-1. Depiction of annual average wind direction and speed at INEL meteor designated as a nonattainment area (CFR 1992b) for the National Ambient Air Quality (CFR 1991b). Ambient air quality data monitored in the vicinity of the INEL indica in compliance with applicable air quality standards (DOE 1991a).

The Clean Air Act (CAA 1990) contains requirements to prevent the deterioration in areas designated to be in attainment with the ambient air quality standards. Th administered through a program that limits the increase in specific air pollutants existed in what has been termed a baseline (or starting) year, which is 1977. The maximum allowable ambient pollutant concentration increases or increments. They sp limits for pollutant level increases for the nation as a whole (Class II areas) and stringent increment limits (as well as ceilings) for designated national resources, forests, parks, and monuments (Class I areas). Three areas in the INEL vicinity ar Significant Deterioration Class I ambient air quality areas: Craters of the Moon W approximately 53 kilometers (33 miles) to the west-southwest; Yellowstone National approximately 143 kilometers (89 miles) to the northeast; and Grand Teton National approximately 145 kilometers (90 miles) to the east-northeast.

DOE evaluates proposed new and modified sources of emissions at INEL to determi emissions increase of all pollutants. The INEL is considered a major source, becau emissions of specific regulated air contaminants exceed 227 metric tons (250 tons) Therefore, a Prevention of Significant Deterioration analysis must be performed for emission increases of specified regulated pollutants. Levels of significance for n range from very small quantities (less than 1 pound) for beryllium up to 91 metric year for carbon monoxide. Their significance is dependent on the toxicity of the s radionuclides, significance means any increase in emissions that would result in an millirem per year or greater.

Ambient air quality standards for Idaho are the same as the National Ambient Ai Standards but include total suspended particulates and fluorides. The Idaho Depart Welfare (IDHW) also has ambient concentration limits for hazardous and toxic air po

Table 4.7-1 lists emission rates of criteria and hazardous and toxic air pollutants

The types and amounts of nonradiological emissions from INEL facilities and act **similar to those from other industrial complexes that are the same sizes as the INE** sources such as boilers and emergency generators emit both criteria and toxic pollu **Table 4.7-1. Baseline annual average and maximum hourly emission rates of nonradio** pollutants at the INEL.

Pollutant	Annual average (kg/yr) <sup>b,c</sup>	Maximum hourly (kg/hr)
Criteria pollutants		
Carbon monoxide (CO)	301,000	177
Lead (Pb)	11	0.085
Nitrogen dioxide (NO <sub>2</sub> )	744,000	545
Particulate matter (PM <sub>10</sub> ) <sup>d</sup>	302,000	230
Sulfur dioxide (SO <sub>2</sub> )	202,000	136
Hazardous/toxic air pollutant <sup>e</sup>		
Acetaldehyde	31	0.39
Ammonia	1,600	3.4
Arsenic	4.2	9.0 y 10 <sup>-4</sup>
Benzene	370	16
1,3-Butadiene	220	0.8
Carbon tetrachloride	28	0.08
Chloroform	1.9	5.5 y 10 <sup>-3</sup>
Chromium - trivalent	3.1	2.5 y 10 <sup>-3</sup>
Chromium - hexavalent	0.4	6.2 y 10 <sup>-4</sup>
Cyclopentane	350	0.58
Dichloromethane	620	0.29
Formaldehyde	960	8.9
Hydrazine	8.3	9.5 y 10 <sup>-4</sup>
Hydrochloric acid	1,500	0.34
Mercury	200	0.023
Napthalene	16	2.2
Nickel	270	0.057
Nitric acid	1,500	1.7
Phosphorous	56	0.024
Potassium hydroxide	990	0.24
Propionaldehyde	62	0.24
Styrene	4.7	0.74
Tetrachlorethylene	980	0.11
Toluene	580	56
Trichloroethylene	4.7	0.013
Trimethylbenzene	87	12

a. Source: Volume 2, Table 4.7-2.

b. To convert kilograms to pounds, multiply by 2.2.

c. Annual average values include actual emissions plus projected increases from fac become opertional after the baseline year.

d. It is conservatively assumed that all particulate matter is PM<sub>10</sub> (less than 10 m

e. Hazardous/toxic air pollutants that are listed in State of Idaho regulations and that exceed screening criteria.

sources include chemical processing operations, transportation, waste management ac research laboratories.

Table 4.7-2 compares the INEL contribution to air quality to applicable standar This assessment modelled the INEL air emissions inventory for 1990 using the method by the U.S. Environmental Protection Agency to predict the maximum ground-level con would occur at or beyond the site boundary for each regulated pollutant (EPA 1993b) Source Complex-2 model primarily assessed criteria pollutants, and the SCREEN model air pollutants. The SCREEN model incorporates meteorological data that tend to ove and is useful for identifying cases that require additional, more refined assessmen concentrations listed in Table 4.7-2 are the sums of the following factors: the co from potential impacts from current operations and the concentrations resulting fro or operation of planned upgrades or modifications before the implementation of the described in Section 5.7. Background concentrations have not been included because on background levels in the INEL environs are not available for most pollutants and levels are low and are more than offset by the use of the maximum (as opposed to ac The baseline concentrations represent the maximum calculated concentration occurrin locations (site boundary, public roads, and Craters of the Moon Wilderness Area).

the baseline concentrations to applicable Federal and state criteria pollutant and pollutant guidelines and regulations shows that air quality at INEL is in compliance with applicable guidelines and regulations. The 24-hour total suspended particulate background concentration is 40 micrograms per cubic meter, which is the same as the annual geometric mean value. Sources include chemical processing operations, transportation, waste management at research laboratories.

#### 4.7.2.2 Radiological Air Quality. The major source of radiation exposure in the Eastern

Snake River Plain is from natural background radiation sources such as cosmic rays; naturally present in soil, rocks, and the human body; and airborne radionuclides of radon. Sources of radioactivity related to INEL operations include research and spent nuclear fuel testing and stabilization, irradiated material and fuel examination treatment and storage, and depleted uranium armor production.

Radioactive emissions from INEL facilities include the noble gases (argon, krypton and iodine; particulate fission products such as rubidium, strontium, and cesium; and **Table 4.7-2.** Comparison of baseline ambient air concentrations with most stringent regulations and guidelines at the INEL.

Pollutant	Averaging time	Most stringent regulation or guideline (-g/m <sup>3</sup> ) a,b,c	Maximum baseline concentration (-g/m <sup>3</sup> )
<b>Criteria pollutants</b>			
Carbon monoxide (CO)	8-hour	10,000	280
	1-hour	40,000	610
Lead (Pb)	Calendar Quarter	1.5	0.001
Nitrogen dioxide (NO <sub>2</sub> )	Annual	100	4
Particulate matter (PM <sub>10</sub> )	Annual	50	5
	24-hour	150	80
Sulfur dioxide (SO <sub>2</sub> )	Annual	80	6
	24-hour	365	140
	3-hour	1,300	580
<b>Hazardous/toxic air pollutants</b>			
Acetaldehyde	Annual	4.5 y 10 <sup>-1</sup>	1.1 y 10 <sup>-2</sup>
Ammonia	Annual	1.8 y 10 <sup>2</sup>	6.0 y 10 <sup>0</sup>
Arsenic	Annual	2.3 y 10 <sup>-4</sup>	9.0 y 10 <sup>-5</sup>
Benzene	Annual	1.2 y 10 <sup>-1</sup>	2.9 y 10 <sup>-2</sup>
Butadiene	Annual	3.6 y 10 <sup>-3</sup>	1.0 y 10 <sup>-3</sup>
Carbon Tetrachloride	Annual	6.7 y 10 <sup>-2</sup>	6.0 y 10 <sup>-3</sup>
Chloroform	Annual	4.3 y 10 <sup>-2</sup>	4.0 y 10 <sup>-4</sup>
Chromium - hexavalent	Annual	8.3 y 10 <sup>-5</sup>	6.0 y 10 <sup>-5</sup>
Chromium - trivalent	Annual	5.0 y 10 <sup>0</sup>	3.6 y 10 <sup>-2</sup>
Cyclopentane	Annual	1.7 y 10 <sup>4</sup>	2.7 y 10 <sup>-0</sup>
Formaldehyde	Annual	7.7 y 10 <sup>-2</sup>	1.2 y 10 <sup>-2</sup>
Hydrazine	Annual	3.4 y 10 <sup>-4</sup>	1.0 y 10 <sup>-6</sup>
Hydrochloric acid	Annual	7.5 y 10 <sup>0</sup>	9.8 y 10 <sup>-1</sup>
Mercury	Annual	1.0 y 10 <sup>0</sup>	4.2 y 10 <sup>-2</sup>
Methylene Chloride	Annual	2.4 y 10 <sup>-1</sup>	6.0 y 10 <sup>-3</sup>
Napthalene	Annual	5.0 y 10 <sup>2</sup>	1.8 y 10 <sup>1</sup>
Nickel	Annual	4.2 y 10 <sup>-3</sup>	2.7 y 10 <sup>-3</sup>
Nitric Acid	Annual	5.0 y 10 <sup>1</sup>	6.4 y 10 <sup>-1</sup>
<b>Table 4.7-2. (continued).</b>			
Pollutant	Averaging time	Most stringent regulation or guideline (-g/m <sup>3</sup> ) a,b,c	Maximum baseline concentration (-g/m <sup>3</sup> )
Perchloroethylene	Annual	2.1 y 10 <sup>0</sup>	1.1 y 10 <sup>-1</sup>
Phosphorous	Annual	1.0 y 10 <sup>0</sup>	3.0 y 10 <sup>-1</sup>
Potassium hydroxide	Annual	2.0 y 10 <sup>1</sup>	2.0 y 10 <sup>-1</sup>
Propionaldehyde	Annual	4.3 y 10 <sup>0</sup>	3.0 y 10 <sup>-1</sup>
Styrene	Annual	1.0 y 10 <sup>3</sup>	1.3 y 10 <sup>0</sup>
Toluene	Annual	3.8 y 10 <sup>3</sup>	3.7 y 10 <sup>2</sup>

Trichloroethylene	Annual	7.7 y 10 <sup>-2</sup>	9.7 y 10 <sup>-4</sup>
Trimethylbenzene	Annual	1.2 y 10 <sup>3</sup>	1.0 y 10 <sup>2</sup>

a. CFR (1991b).

b. IDHW (1994); the ambient standards for the criteria pollutants are the same as t

c. Standards cited for hazardous/toxic air pollutants are for all new sources const since May 1, 1994, under State of Idaho Regulations for the Control of Air Pollu Idaho (IDHW 1994).

Source: Volume 2, Section 4.7.

by neutron activation such as tritium (hydrogen-3), carbon-14, and cobalt-60; and v (less than 6 y 10<sup>-4</sup> curies per year) of heavy elements such as uranium, thorium, pl decay products. Historically, the radionuclide with the highest emission rate is t krypton-85, which is released primarily by the chemical reprocessing of spent nucle Chemical Processing Plant. Fuel reprocessing also releases small amounts (less tha year) of iodine-129, which is of concern because of its long half-life (16 million properties (iodine isotopes tend to accumulate in the human thyroid). Reactor oper gas isotopes with short half-lives, including argon-41 and isotopes of xenon (prima -135, and -138). Other activities at the INEL, including waste management operatio low levels of airborne radionuclide emissions (less than 1 y 10<sup>-4</sup> curie per year). summarizes airborne radionuclide emissions from INEL facility areas, plus estimated projects expected, at the time of the analysis was performed, to become operational 1995.

Radioactivity released to the atmosphere can result in human exposure through a pathways, including inhalation, external exposure, and ingestion. DOE conducts phy **Table 4.7-3. Summary of airborne radionuclide emissions from INEL facility areas (**

Facility	Tritium/ carbon-14	Iodines	Noble gases	Mixed fission an activation productsb
Argonne National Laboratory-West	1.0 y 10 <sup>2</sup>	-d	1.3 y 10 <sup>4</sup>	8.1 y 10 <sup>-4</sup>
Central Facilities Area	2.6 y 10 <sup>0</sup>	5.0 y 10 <sup>-7</sup>	-	1.9 y 10 <sup>-5</sup>
Idaho Chemical Processing Plant	4.3 y 10 <sup>1</sup>	6.4 y 10 <sup>-2</sup>	1.0 y 10 <sup>4</sup>	3.6 y 10 <sup>-2</sup>
Naval Reactors Facility	1.9 y 10 <sup>-1</sup>	6.3 y 10 <sup>-6</sup>	5.7 y 10 <sup>-1</sup>	5.6 y 10 <sup>-5</sup>
Power Burst Facility/Waste Experimental Reduction Facility	4.9 y 10 <sup>1</sup>	-	-	1.3 y 10 <sup>0</sup>
Radioactive Waste Management Complex	-	-	-	2.6 y 10 <sup>-5</sup>
Test Area North	1.2 y 10 <sup>-1</sup>	-	-	5.6 y 10 <sup>-6</sup>
Test Reactor Area	1.6 y 10 <sup>2</sup>	1.6 y 10 <sup>-2</sup>	3.3 y 10 <sup>3</sup>	3.0 y 10 <sup>0</sup>
INEL total	2.1 y 10 <sup>3</sup>	1.1 y 10 <sup>-1</sup>	1.2 y 10 <sup>5</sup>	5.6 y 10 <sup>0</sup>

a. With the exception of the Idaho Chemical Processing Plant, emissions estimates a operations. Idaho Chemical Processing Plant emissions are based on 1993 emissio upward to reflect operation of the New Waste Calcining Facility at maximum permi Anticipated projects in the baseline include the Waste Experimental Reduction Fa and sizing operations but not incineration), Argonne National Laboratory-West Fu and Portable Water Treatment Unit, as described in Appendix F of Volume 2.

b. Mixed fission and activation products that are primarily particulate in nature ( cobalt-60, strontium-90, and cesium-137).

c. U/Th/TRU = Radioisotopes of uranium, thorium, or transuranic elements such as pl americium, and neptunium.

d. A dash (-) indicates that the emissions for this group are negligibly small or z Source: Volume 2, Table 4.7-1.

measurements (ambient air monitoring) and uses calculation techniques (atmospheric modeling) to assess existing levels of radiation (both cosmic and manmade) in and n assess doses to workers and the surrounding population.

The offsite population can receive a radiation dose as a result of radiological attributable to existing INEL operations. DOE assesses such a dose for a maximally individual and for the population as a whole. The maximally exposed individual is person whose habits and proximity to the site are such that the person would receiv projected to result from sitewide radioactive emissions. The calculated annual dos

as a result of current and anticipated sitewide emissions is 0.05 millirem (Section 4.7 to Volume 2). This value is a small fraction of both the National Emission Standards for Hazardous Air Pollutants dose limit of 10 millirem per year (CFR 1992a) and the dose received from natural background sources of 351 millirem per year (Section 4.7 to Volume 2). Figure 4.7-2 compares

The collective annual dose to the surrounding population, determined using 1990 Bureau data for the total population residing within an 80-kilometer (50-mile) radius on the site, is about 0.3 person-rem (Section 4.7 to Volume 2). This value is small compared to the annual dose received by the same population from background sources, which is about 40,000 person-rem (Section 4.7 to Volume 2).

Workers at each major INEL facility can receive radiation exposures. DOE has been conducting an assessment of the dose to these workers on contributions from sources at each facility expected to become operational before June 1, 1995. The results of this assessment show that the maximum dose received by a worker at any onsite area is about 4.3 millirem per year (Section 4.7 to Volume 2), well below the National Emissions Standard for Hazardous Air Pollutants of 10 millirem per year. The standard applies to the highest exposed member of the public who is occupationally exposed to radiation. However, it is the most restrictive limit for airborne release of radionuclides and is not a useful comparison. This dose value of 4.3 millirem per year includes the maximum predicted dose from the operation of the Portable Water Treatment Unit at the Power Burst Facility Area. If the unit were in operation, it would be temporary (1 to 2 years) and is not representative of a permanent baseline. If this facility were not included, the baseline dose to the worker would be 0.2 millirem per year.

Figure 4.7-2. Comparison of dose to maximally exposed individual (MEI) to the National Emissions Standard for Hazardous Air Pollutants.

## 4.8 Water Resources

This section describes existing regional and site hydrologic conditions and distribution of surface and subsurface water and water use and rights. The subsurface water section describes the vadose zone (or unsaturated zone and perched water bodies) located between the ground surface and the water table.

### 4.8.1 Surface Water

Other than surface-water bodies formed from accumulated runoff during snowmelt and precipitation and manmade infiltration and evaporation ponds, there is little surface water on the site. The following sections discuss regional drainage conditions, local runoff, floodplains, and surface-water quality. Figure 4.8-1 supports discussions in this section.

#### 4.8.1.1 Regional Drainage. The INEL is in the Pioneer Basin, a closed drainage basin that

includes three main surface-water bodies--the Big and Little Lost Rivers and Birch Creek. These water bodies drain mountain watersheds directly west and north of the site. However, surface-water flow is diverted for irrigation before it reaches site boundaries (Barrow). As a result, there is little or no flow for several years inside the site boundaries (Pittman).

The Big Lost River drains approximately 3,755 square kilometers (1,450 square miles) before reaching the site. Approximately 48 kilometers (30 miles) upstream of Arco, Idaho, the dam controls and regulates the flow of the river, which continues southeast past the dam and Arco and onto the Eastern Snake River Plain. The river channel then crosses the boundary of the site, where the INEL Diversion Dam controls surface-water flow. During runoff events, the dam diverts surface water to a series of natural depressions, dry lake beds, and areas. The Big Lost River continues northeasterly across the site to an area of natural basins (playas or sinks) near Test Area North. In dry years, surface water does not reach the western boundary of the site, and because the INEL is located in a closed drainage basin, water never flows off the site.

Birch Creek drains an area of approximately 1,943 square kilometers (750 square miles) upstream of the site, surface water from Birch Creek is diverted to provide irrigation water.

Figure 4.8-1. Selected facilities and predicted inundation map for probable maximum flood. In the winter, water flow crosses the northwest corner of the site through a manmade channel 6.4 kilometers (4 miles) north of Test Area North, where it then enters the Snake River channel gravels.

The Little Lost River drains an area of approximately 1,826 square kilometers (705 square miles). Streamflow is diverted for irrigation north of Howe, Idaho. Surface water

River has not reached the site in recent years; however, during high stream flow years reach the site and infiltrate into the subsurface (E3&G 1984).

#### **4.8.1.2 Local Runoff. Surface water generated from local precipitation will flow into**

topographic depressions (lower elevations than the surrounding terrain) on the site either evaporates or infiltrates into the ground, increasing subsurface saturation and subsurface migration (Wilhelmson et al. 1993).

Localized flooding can occur at the site when the ground is frozen and melting with heavy spring rains. Test Area North was flooded in 1969 (Koslow and Van Haaften 1969). Extensive flooding caused by snowmelt occurred in the lower Birch Creek Valley. Studies have shown that both the 25- and 100-year, 24-hour rainfall/snowmelt storm flooding within the Radioactive Waste Management Complex (Dames & Moore 1992). The system, including dikes and erosion prevention features designed to mitigate potential flooding, are being upgraded.

#### **4.8.1.3 Floodplains. Intermittent surface-water flow and the INEL Diversion Dam (built in**

1958 and enlarged in 1984) have effectively prevented flooding from the Big Lost River. However, onsite flooding from the river could occur if high water in the Mackay Dam River were coupled with a dam failure. Koslow and Van Haaften (1986) examined the possibility of structural failure of the Mackay Dam due to a seismic event, coupled with a probable flood (the largest flood assumed possible in an area). This scenario predicts flooding of the INEL Diversion Dam and spreading at the Idaho Chemical Processing Plant, Naval Facility, and the Test Area North Loss-of-Fluid Test Facility (Figure 4.8-1). In the combined Mackay Dam failure and a 100-year flood (flood that occurs on an average once in 100 years), flooding along the Big Lost River would also occur, with low velocities on the INEL (Koslow and Van Haaften 1986). The area inundated under the Mackay Dam scenarios probably would use more than the 100- or 500-year floodplains for the Big Lost River. A 100-year floodplain study for the INEL is in progress.

#### **4.8.1.4 Surface-Water Quality, Water quality in the Big and Little Lost Rivers and Birch**

Creek is similar and has not varied a great deal over the period of record. Measures of chemical, and radioactive parameters have not exceeded applicable drinking water quality. Chemical composition is determined primarily by the mineral composition of the rock in the mountain ranges northwest of the site and by the chemical composition of irrigation water with the surface water (Robertson et al. 1974; Bennett 1990).

Site activities do not directly affect the quality of surface water outside the site. Discharges from site facilities are to manmade seepage and evaporation basins or stormwater wells. Effluents are not discharged to natural surface waters. In addition, surface water flows directly off the site (Hoff et al. 1990). However, water from the Big Lost River, a tributary from evaporation basins and stormwater injection wells, does infiltrate the Snake River (Robertson et al. 1974; Wood and Low 1988; Bennett 1990). These areas are inspected and sampled as stipulated in the INEL Stormwater Pollution Prevention Program (DOE-

### **4.8.2 Subsurface Water**

Subsurface water at the site occurs in the Snake River Plain Aquifer and the vadose zone. This section describes regional and local hydrogeologic conditions, vadose zone hydrology and subsurface-water quality. Generally, the term "groundwater" refers to usable groundwater that enters freely into wells under confined and unconfined conditions within an aquifer.

#### **4.8.2.1 Regional Hydrogeology. The INEL overlies the Snake River Plain Aquifer, the**

largest aquifer in Idaho (Figure 4.8-2). This aquifer underlies the Eastern Snake River Plain and covers an area of approximately 24,900 square kilometers (9,611 square miles). Groundwater in the aquifer generally flows south and southwestward across the Snake River Plain. The estimated storage in the aquifer is  $2.5 \times 10^{12}$  cubic meters (2 billion acre-feet, which is about the same volume of water contained in Lake Erie) (Robertson et al. 1974). A typical irrigation

much as  $13.9 \times 10^6$  cubic meters ( $3.7 \times 10^9$ ) gallons) per year of water if pumped (Garabedian 1989). The Snake River Plain Aquifer is among the most productive aquifer in the region.

The drainage basin recharging the Snake River Plain Aquifer covers an area of about 90,643 square kilometers (35,000 square miles). The aquifer is recharged by infiltration of precipitation, seepage from stream channels and canals, underflow from tributary stream valleys into the watershed, and direct infiltration from precipitation (Garabedian 1989). Most of the water in surface water-irrigated areas and along the northeastern margins of the plain. Groundwater discharges primarily from the aquifer through springs that flow into the Snake River and the American Falls Reservoir (southwest of Pocatello) and the Thousand Springs area between the dam and King Hill (near Twin Falls).

#### 4.8.2.2 Local Hydrogeology. The INEL site covers 2,305 square kilometers (890 square

miles) of the north-central portion of the Snake River Plain Aquifer. Depth to ground surface at the site ranges from approximately 61 meters (200 feet) in the north to 190 meters (625 feet) in the south (Pittman et al. 1988) (see Figure 4.8-3). Groundwater flow is generally from north to south, and the upper surface is primarily unconfined (not overlain by bedrock). However, the aquifer behaves as if it were partially confined because of geologic conditions. The occurrence and movement of groundwater in the aquifer depend on the geologic setting and the recharge and discharge of water within that setting. Most of the aquifer consists primarily of numerous relatively thin, basaltic lava flows with interbedded sandstones extending to depths of 1,067 meters (3,500 feet) below the land surface (Irving 1999). Groundwater migrates horizontally through fractured, basaltic interflow zones (break zones) that occur at various depths. Water also migrates vertically along joints and fractures of interflow zones (Garabedian 1986). Sedimentary interbeds restrict the vertical movement of groundwater. The variability in how the aquifer stores and transmits water increases with depth, making aquifer investigations and modeling difficult.

The rate at which water moves through the ground depends on the hydraulic gradient (elevation and pressure with distance in a given direction) of the aquifer, the effective porosity (percentage of void spaces), and hydraulic conductivity (capacity of a porous medium to transmit water). Because aquifer porosity and hydraulic conductivity decrease with depth, most of the water in the aquifer moves through the upper 61 to 152 meters (200 to 500 feet). Estimated flow rates within the aquifer range from 1.5 to 6.1 meters (5 to 20 feet) per day (Barraclough et al. 1981).

The aquifer's ability to transmit water (transmissivity), and its ability to store water (specific storage) are important physical properties of the aquifer. In general, the hydraulic characteristics enable the easy transmission of water, particularly in the upper portions.

Figure 4.8-3. Hydrostratigraphy across the INEL and water table surface. Recharge to the aquifer occurs from the north. Most of the inflow to the aquifer results from the underflow of groundwater from alluvial-filled valleys adjacent to the Eastern Snake River Plain and adjacent surface water (i.e., Big and Little Lost Rivers and Birch Creek). In addition, recharge at the site occurs from precipitation, particularly snowfall, for a given year (Barraclough et al. 1981).

#### 4.8.2.3 Vadose Zone Hydrology The vadose (unsaturated) zone extends from the land

surface down to the water table. Within the vadose zone, water and air occupy open spaces in geologic materials. Subsurface water in the vadose zone is referred to as vadose water. This complex zone consists of surface sediments (primarily clay and silt, with some sand) and many relatively thin basaltic lava flows, with some sedimentary interbeds. This complex zone occurs in the northern part of the site, which thins to the south where basalt is exposed.

The vadose zone protects the groundwater by filtering many contaminants through the zone, buffering dissolved chemical wastes, and slowing the transport of contaminated liquids. The vadose zone also protects the aquifer by storing large volumes of liquid or dissolved substances released to the environment through spills or migration from disposal pits or ponds until natural decay processes occur.

Travel times for water through the vadose zone are important for an understanding of contaminant movement. The flow rates in the vadose zone depend directly on the extent of the vadose zone, the percentage of sediments versus basalt, and the moisture content of the vadose zone. Flow rates increase under wetter conditions and slow under dryer conditions.



#### 4.8.2.4 Perched Water. Locally, saturated conditions that exist above the water table are

called perched water. Perched water occurs when water migrates vertically and later surface until it reaches an impermeable layer (Irving 1993). As perched water spreads sometimes for hundreds of meters, it moves over the edges of the impermeable layer downward. Several perched water bodies can form between the land surface and the water table.

In general, perched water bodies slow the downward migration of fluids that infiltrate the vadose zone from the surface because the downward flow is not continuous. The occurrence of perched water at the site is related to the presence of disposal ponds or other structures which studies have detected at the Idaho Chemical Processing Plant, Test Reactor Area North. For example, a 1986 field study at the Idaho Chemical Processing Plant showed perched water occurs in three areas at possibly three depth zones, ranging from approximately 30 feet to 98 meters (322 feet) below the ground surface and extending laterally 1,097 meters (3,600 feet). In general, the chemical concentrations, shape, and size have fluctuated over time in response to the volume of water discharged to the infiltration zone (Irving 1993).

#### 4.8.2.5 Subsurface Water Quality. Natural water chemistry and contaminants originating at

the site affect subsurface water quality. The INEL Groundwater Protection Management conducts monitoring programs. This program collects samples from surface water, perched water, and aquifer wells to identify contaminants and contaminant migration to and within the aquifer.

##### 4.8.2.5.1 Natural Water Chemistry - Several factors determine the natural groundwater

chemistry of the Snake River Plain Aquifer beneath the site. These factors include reactions that occur as water interacts with minerals in the aquifer and the chemical composition of the water. (1) groundwater originating outside the site; (2) precipitation falling directly on the site; (3) streams, rivers, and runoff infiltrating the aquifer (Wood and Low 1986, 1988). The groundwater is different, depending on the source areas. For example, groundwater in the northwest contains calcium, magnesium, and bicarbonate leached from sedimentary rocks. Groundwater from the east contains sodium, fluorine, and silicate resulting from coal rocks (Robertson et al. 1974).

Although the natural chemical composition of groundwater beneath the site does not meet Environmental Protection Agency drinking water standards for any component, the natural composition affects the mobility of contaminants introduced into the subsurface from INEL activities. Dissolved contaminants adsorb (or attach) to the surface of rocks and minerals in the aquifer, thereby retarding the movement of contaminants in the aquifer and inhibiting further contamination. However, many naturally occurring chemicals compete with contaminant adsorption sites on the rocks and minerals or react with contaminants to reduce the adsorption on mineral surfaces.

##### 4.8.2.5.2 Groundwater Quality - Previous waste discharges to unlined ponds and deep

wells have introduced radionuclides, nonradioactive metals, inorganic salts, and organic compounds into the subsurface.

Table 4.8-1 summarizes the highest detected concentrations of contaminants observed in the aquifer between 1987 and 1992, concentrations near the site boundary, Environmental Protection Agency maximum contaminant levels, and DOE Derived Concentration Guides. The following table summarizes the highest detected concentrations of contaminants in groundwater at the Idaho Chemical Processing Plant. Paragraphs discuss each category of contaminants and comparisons of observed concentrations to maximum contaminant levels.

**Radionuclides** - In general, radionuclide concentrations in the Snake River Plain Aquifer beneath the site have decreased since the mid-1980s because of changes in disposal practices, decay, adsorption of radionuclides to rocks and minerals, and dilution by natural groundwater entering the aquifer (Pittman et al. 1988; Orr and Cecil 1991; Bargelt et al. 1994). Radionuclides released and observed in the soil and groundwater include tritium, strontium-90, iodine-129, cobalt-60, cesium-137, plutonium-238, plutonium-239/240, and americium-241 (Bargelt et al. 1994). Most of these radionuclides have been observed at the Idaho Chemical Processing Plant and Test Reactor Area facility areas. However, radionuclides have also been observed in the Snake River Plain Aquifer.

Test Area North disposal well.

Concentrations of radionuclides in the aquifer have decreased over time. This decrease is due to reduced discharges, adsorption, radioactive decay, and improved waste management. In 1992, concentrations of iodine-129, cobalt-60, tritium, strontium-90, and cesium-137 were well below the EPA maximum contaminant levels for radionuclides in drinking water in localized areas within the INEL boundary. Currently, there are no individual maximum contaminant levels for plutonium-239, plutonium-240, and americium-241. However, these radionuclides have been detected above the established limits for gross radioactivity or the proposed adjusted activity maximum contaminant level for drinking water (Golder Associates 1994; Mann and Cecil 1991).

Extremely low concentrations of iodine-129 and tritium have migrated outside the site boundary. In 1992, iodine-129 concentrations were well below the maximum contaminant levels in approximately 6 and 13 kilometers (4 and 8 miles) south of the site boundary (Mann and Cecil 1991). Tritium concentrations were much below maximum contaminant levels just south of the site boundary. By 1988 the tritium plume encompassed by the 500 picocurie per liter contour was about 1 kilometer in size, and its size has continued to decrease (Pittman et al. 1988; Orr and Cecil 1991). Cobalt-60, strontium-90, cesium-137, plutonium-238, plutonium-240, and plutonium-241 have not been detected outside the site boundaries.

**Nonradioactive Metals** - The INEL has released sodium, chromium, lead, and mercury to the subsurface through unlined ponds and deep wells. Of these metals, sodium is released in the greatest quantity from waste treatment processes; however, sodium does not have an established maximum contaminant level. In 1988 chromium concentrations were measured near the Test Reactor Area. Lead and mercury were detected at concentrations below the maximum contaminant level near the Idaho Chemical Processing Plant (Orr and Cecil 1991).

**Inorganic Salts** - Human activities at the site have released chloride, sulfate, and nitrate to the subsurface. Although chloride and sulfate releases have occurred, only nitrate has been detected at elevated concentrations near the Idaho Chemical Processing Plant (1981). Disposal to the injection well and infiltration ponds at the Idaho Chemical Processing Plant has resulted in elevated nitrate levels in the central portion of the site. By 1988 the levels of nitrate were below the maximum contaminant level. Irrigation in the Mud Lake area might be causing contaminants to enter the northeastern portion of the site in concentrations comparable to nearby irrigated areas (Orr et al. 1991; Robertson et al. 1974; Edwards et al. 1990).

**Organic Compounds** - Concentrations of volatile organic compounds have been detected in the aquifer beneath the site. However, many of these compounds were detected at or below the detection limit (0.002 milligram per liter), or two parts per billion, which is the minimum concentration at which a specific analytical method can detect a contaminant. However, concentrations of some compounds exceeding the maximum contaminant levels have occurred in and around the Test Area North disposal well: carbon tetrachloride, chloroform, 1,2-cis-dichloroethylene, 1,1-dichloroethylene, 1,2-trans-dichloroethylene, trichloroethylene, tetrachloroethylene (Leenheer and Bagby 1982; Mann and Knobel 1987; Mann 1990; Liszewski and Mann 1991).

#### 4.8.2.5.3 Perched Water Quality - Wastewater discharges from INEL operations have

infiltrated into the vadose zone and created most of the perched water beneath the site. Studies have detected elevated concentrations of the following contaminants in samples: tritium, cobalt-60, chromium, and sulfate concentrations in deep perched water near the Test Reactor Area; strontium-90 in perched water near the Idaho Chemical Processing Plant and at Test Area North (Irving 1993; Schafer-Perini 1993). DOE has not yet measured potential concentrations of other contaminants in all INEL perched water bodies. In general, the chemical concentrations of these bodies have fluctuated over time in response to the volume of water discharged into infiltration ponds.

### 4.8.3 Water Use and Rights

The INEL does not withdraw or use surface water for site operations, nor does it discharge effluents to natural surface water. However, the three surface-water bodies at or near the INEL (Little Lost Rivers and Birch Creek) have the following designated uses: agricultural and wildlife biota, salmonid spawning, and primary and secondary contact recreation. Waters in the Big Lost River and Birch Creek have been designated for domestic water use and special resource waters.

Groundwater use on the Snake River Plain includes irrigation, food processing and

and domestic, rural, public, and livestock supply. Water use for the upper Snake River and the Snake River Plain Aquifer was 16.4 billion cubic meters (4.3 trillion gallons) which was more than 50 percent of the water used in Idaho and approximately 7 percent of agricultural withdrawals in the nation. Most of the water withdrawn from the Eastern Snake River Plain [1.8 billion cubic meters (0.47 trillion gallons) per year] is for agricultural use. The Eastern Snake River Plain is the primary source of all water used at the INEL. Site activities withdraw water at an average rate of 1.9 billion gallons per year (DOE-ID 1993e). However, the baseline withdrawal rate dropped to 6.5 million cubic meters (1.7 billion gallons) in 1995. The average withdrawal is equal to approximately 0.4 percent of the water consumed from the Eastern Snake River Aquifer, or 53 percent of the maximum annual yield of a typical irrigation well. Of the water pumped from the aquifer, a substantial portion is discharged to the surface and eventually returned to it (DOE-ID 1993d,e).

A sole-source aquifer, as designated by the Safe Drinking Water Act (SDWA 1974), supplies 50 percent of the drinking water consumed in the area overlying the aquifer. Sole-source aquifer areas have no alternative source or combination of sources that could physically and economically supply all those who obtain their drinking water from the aquifer. Because the aquifer supplies 100 percent of the drinking water consumed within the Eastern Snake River Plain (Northwest 1988) and an alternative drinking water source or combination of sources is not available, the Environmental Protection Agency designated the Snake River Plain Aquifer a sole-source aquifer in 1991 (FR 1991b).

DOE holds a Federal Reserved Water Right for the INEL, which permits a water capacity of 2.3 cubic meters (80 cubic feet) per second and a maximum water consumption of 43 million cubic meters (11.4 billion gallons) per year for drinking, process water cooling. Because it is a Federal Water Right, the site's priority on water rights depends on the establishment of the INEL.

## 4.9 Ecological Resources

This section describes the biotic resources - flora, fauna, threatened and endangered species, and wetlands - on the INEL site, which are typical of the Great Basin and Columbia River Basins. Because the proposed actions are most likely to affect areas near existing major facilities, this section emphasizes the biotic resources in those areas. However, because the proposed actions affect other resources outside such areas (e.g., more mobile species like pronghorn, Antelope, and elk), it also describes biotic resources for the entire INEL site.

### 4.9.1 Flora

Vegetation on the INEL site is primarily of the shrub-steppe type and is a small fraction of the 45,000 square kilometers (111.2 million acres) of this vegetation type in the Intermountain West. Fifteen vegetation associations on the INEL site range from primarily shrub-steppe at low altitudes through sagebrush- and grass-dominated communities to juniper woodlands at the top of the nearby mountains and buttes (Rope et al. 1993; Kramber et al. 1992; Anderson et al. 1992). These associations can be grouped into six basic types: juniper woodland, grassland, shrub-steppe, sagebrush-steppe, salt desert shrubs, and lava, bareground-disturbed vegetation. Shrub-steppe vegetation, which is dominated by big sagebrush (*Artemisia tridentata*), saltbush (*Atriplex* spp.), and rabbitbrush (*Chrysothamnus* spp.) covers more than 90 percent of the INEL. Grasses include cheatgrass (*Bromus tectorum*), Indian ricegrass (*Oryzopsis hymenoides*), wheatgrasses (*Agropyron* spp.), and squirreltail (*Sitanion hystrix*). Herbaceous plants include phlox (*Phlox* spp.), wild onion (*Allium* spp.), milkvetch (*Astragalus* spp.), Russian thistle (*Suaeda* spp.), and various mustards. Work being conducted by Idaho State University will provide additional information on INEL plant communities and the status of sensitive plant species.

Facility and human-disturbed (grazing not included) areas cover only about 2 percent of the INEL. Introduced annuals, including Russian thistle and cheatgrass, frequently dominate these areas. These species usually are less desirable to wildlife as food and cover, and less desirable perennial native species. These disturbed areas serve as a seed source, and the potential for the establishment of Russian thistle and cheatgrass in surrounding lands is high. Vegetation inside facility boundaries is generally disturbed or landscaped. Species diversity in the INEL is comparable to that of like-sized areas with similar terrain in other parts of the West. Plant diversity is typically lower in disturbed and modified areas.

### 4.9.2 Fauna

The INEL site supports animal communities characteristic of shrub-steppe vegeta habitats. More than 270 vertebrate species occur, including 46 mammal, 204 bird, 1 amphibian, and 9 fish species (Arthur et al. 1984; Reynolds et al. 1986). Common s genera include mice (*Reithrodontomys* spp. and *Peromyscus* spp.), chipmunks (*Tamias* s jackrabbits (*Lepus* spp.), and cottontails (*Sylvilagus* spp.).

Songbirds and passerines commonly observed at the INEL include the American rob migratorius), horned lark (*Eremophila alpestris*), black-billed magpie (*Pica pica*), (*Oreoscoptes montanus*), Brewer's sparrow (*Spizella breweri*), sage sparrow (*S. belli meadowlark* (*Sturnella neglecta*), while resident upland gamebirds include the sage g (*Centrocercus urophasianus*), chukar (*Alectoris chukar*), and grey partridge (*Perdix migratory bird species, which use the INEL for part of the year, include a variety [e.g., mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), and Canada goos canadensis]] and raptors [e.g., Swainson's hawk (*Buteo swainsoni*), rough-legged haw and American kestrel (*Falco sparverius*)]).*

The most abundant big-game species that occurs on the INEL is the pronghorn, bu (*Odocoileus hermonius*), moose (*Alces alces*), and elk (*Cervus elaphus*) are present i as transients. Other large mammals observed on the INEL include the coyote (*Canis common across the site, and the badger (*Taxidea taxus*) and bobcat (*Felis rufus*), bo present across the site but are much less abundant. Fish, including kokanee salmon nerka), rainbow trout (*Oncorhynchus mykiss*), and mountain whitefish (*Prosopium will on the INEL only when the Big Lost River flows onto the site (as a result of heavy in the mountains to the northwest); they are not full-time residents.**

A number of researchers have studied effects of radiation exposure from contami INEL on small mammals and birds, and have concluded that subtle sublethal effects ( growth rates and life expectancies) can occur in individual animals as a result of However, they can attribute no population or community-level impacts to such exposu Markham 1978; Evenson 1981; Arthur et al. 1986; Millard et. al 1990).

The monitoring of radionuclide levels outside the boundaries of the various INE off the INEL site has detected radionuclide concentrations above background levels and animals (Markham 1974; Craig et al. 1979; Markham et al. 1982; Morris 1993), bu data suggest that populations of exposed animals (e.g., mice and rabbits) as well a on these exposed animals (e.g., eagles and hawks) are not at risk.

### 4.9.3 Threatened, Endangered, and Sensitive Species

State and Federal regulatory agency lists (Lobdell 1992, 1995), the Idaho Depar Game Conservation Data Center list, and information from site surveys provided the identify Federal- and state-protected, candidate, and sensitive species that potent INEL. This information identified two Federal endangered (bald eagle, and peregrin Federal Category 2 candidate (white-faced ibis, northern goshawk, ferruginous hawk, long-eared myotis, small-footed myotis, pygmy rabbit, Townsend's western big-eared pointheaded grasshopper) species as animals that potentially occur on the INEL site Five animal species listed by the state as Species of Special Concern occur on the observations of the Federal- or state-listed animal species have occurred near any where proposed actions would occur. This analysis did not identify any Federal- or species as potentially occurring on the INEL site. Eight plant species identified agencies and the Idaho Native Plant Society as sensitive, rare, or unique occur on and Henderson 1984).

### 4.9.4 Wetlands

The U.S. Fish and Wildlife Service National Wetlands Inventory has identified m areas inside the boundaries of the INEL that might possess some wetlands characteri conducted in the fall of 1992 indicate that these possible wetlands cover about 1.4 kilometers or 8,206 acres) of the INEL site (Hampton et al. 1993). Approximately 7 possible wetlands areas occur near the Big Lost River and its spreading areas and p Birch Creek Playa, and in an area north of and in the general vicinity of Argonne N Laboratory-West. Limited riparian (riverbank) communities with mature trees along River (Reynolds 1993) reflect the intermittent flow in the river (1986 and 1993 wer with flow reported on the site). The remainder of the possible wetlands are scatte INEL site. In 1994, INEL began evaluating these potential wetlands to determine if

Corps of Engineers definition of jurisdictional wetlands (COE 1987). Approximately near facilities and are mostly manmade (e.g., industrial waste and sewage treatment pits, and gravel pits).

**Table 4.9-1.** Threatened and endangered species, special species of concern, and se

	Name	Statusa
BIRDS	Northern goshawk ( <i>Accipiter gentilis</i> )	C2, SSC, FS, B
	Burrowing owl ( <i>Athene cunicularia</i> )	C2, BLM
	Ferruginous hawk ( <i>Buteo regalis</i> )	C2, SSC, BLM
	Swainson's hawk ( <i>Buteo swainsoni</i> )	BLM
	Great egret ( <i>Casmerodius albus</i> )	SSC
	Merlin ( <i>Falco columbarius</i> )	SSC, BLM
	Peregrine falcon ( <i>Falco peregrinus</i> )	E
	Gyr Falcon ( <i>Falco rusticolus</i> )	BLM
	Common loon ( <i>Gavia immer</i> )	SSC, FS
	Bald eagle ( <i>Haliaeetus leucocephalus</i> )	E
	Long-billed curlew ( <i>Numenius americanus</i> )	SPS, BLM
	American white pelican ( <i>Pelecanus erythrorhynchos</i> )	SSC
	White-faced ibis ( <i>Plegadis chihi</i> )	C2
MAMMALS	Merriam's shrew ( <i>Sorex merriami</i> )	SPS
	Pygmy rabbit ( <i>Brachylagus (Sylvilagus) idahoensis</i> )	C2, BLM, SSC
	California myotis ( <i>Myotis californicus</i> )	SSC
	Fringed myotis ( <i>Myotis thysanodes</i> )	SSC
	Western pipistrelle ( <i>Pipistrellus hesperus</i> )	SSC, BLM
	Townsend's western big-eared bat ( <i>Plecotus townsendii</i> )	C2, SSC, FS, B
	Long-eared myotis ( <i>Myotis evotis</i> )	C2
PLANTS	Small-footed myotis ( <i>Myotis subulatus</i> )	CS
	Lemhi milkvetch ( <i>Astragalus aquilonius</i> )	BLM, FS, INPS
	Painted milkvetch ( <i>Astragalus ceramicus</i> var. <i>apus</i> )	3c, INPS-M
	Winged-seed evening primrose ( <i>Camissonia pterosperma</i> )	BLM, INPS-S
	Nipple cactus ( <i>Coryphantha missouriensis</i> )	INPS-M
	Spreading gilia ( <i>Ipomopsis (Gilia) polycladon</i> )	BLM, INPS-2
	King's bladderpod ( <i>Lesquerella kingii</i> var. <i>cobrensis</i> )	INPS-M
INSECTS	Tree-like oxytheca ( <i>Oxytheca dendroidea</i> )	INPS-S
	Sepal-tooth dodder ( <i>Cuscuta denticulata</i> )	INPS-1
	Idaho pointheaded grasshopper ( <i>Acrolophitus pulchellus</i> )	C2, BLM
	a. Key:	
	C2 = Federal Category 2 species.	BLM = Bureau of Land Man
	3c = No longer considered for Federal listing.	FS = U.S. Forest Servic
	E = Federal and state endangered species.	INEL = Idaho National Eng
	SSC= State species of special concern.	SPS = State protected sp

## 4.10 Noise

The major noise sources at the INEL occur primarily in developed operational ar sources include facilities; equipment and machines (e.g., cooling towers, transform boilers, steam vents, paging systems, construction equipment, and materials-handlin aircraft; and bus, car, truck, and railroad traffic. At the INEL boundary, which i 3 kilometers (2 miles) from any facility, noise from most sources is barely disting background noise levels. Some disturbance of wildlife activities could occur at th noise from operational and construction activities. The State of Idaho and the cou INEL is located have not established any regulations that specify acceptable commun with the exception of prohibitions on nuisance noise.

Existing INEL-related noises of public significance are from the transportation materials to and from the site and in-town facilities via buses, trucks, private ve freight trains. During the normal workweek, most of the 4,000 to 5,000 employees w site (as opposed to those working in Idaho Falls) travel daily by buses from surrou (see Section 4.3). In addition, 300 to 500 private vehicles travel to the INEL sit communities each day (see Section 4.11). Noise measurements along U.S. Highway 20 15 meters (50 feet) from the roadway indicate that the sound level from traffic ran decibels, A-weighted (dBA) (Abbott et al. 1990), and that the primary source is bus While few people reside within 15 meters (50 feet) of the roadway, the results indi traffic noise might be objectionable to members of the public residing near princip bus routes. The acoustic environment along the INEL site boundary in rural areas a

away from traffic noise is typical of a rural location, with the day-night sound level range of 35 to 50 dBA (EPA 1974).

Public exposure to aircraft noise is due in part to INEL-related activities. A travel of INEL personnel via commercial air transport is a significant fraction of out of regional airports. Onsite INEL security patrol and surveillance flights do not terminate at the site because of the INEL's remoteness. For INEL helicopter flights or terminate in Idaho Falls, members of the public are exposed to the unique noises of aircraft. Because the number of flights per day is limited and most flights occur during hours, public exposure to aircraft nuisance noise is not great.

Normally only one train per day serves the INEL, via the Scoville spur. Noise from rail transport includes those from diesel engines, wheel-track contact, and whistle crossings. Even with only one or two exposures to these sources per day, individual railroad tracks might find the noises mildly objectionable.

## 4.11 Traffic and Transportation

Roads are the primary access to and from the INEL site. Commercial shipments are via truck and plane, some bulk materials are transported via rail, and waste is transported by rail. This section discusses the existing traffic volumes, transportation routes, and waste and materials transportation, including baseline radiological exposures from materials transportation. This section summarizes the information in Lehto (1993).

### 4.11.1 Roadways

#### 4.11.1.1 Infrastructure Regional and Site Systems. Figure 4.11 - 1 shows the existing

regional highway system. Two interstate highways serve the regional area. Interstate 84, a north-south route that connects several cities along the Snake River, is approximately (25 miles) east of the INEL site. I-86 intersects I-15 approximately 64 kilometers west of the INEL site, and provides a primary linkage from I-15 to points west. I-15 and US 20 are the primary access routes to the Shoshone-Bannock reservation. US 20 and US 26 are the routes to the southern portion of the INEL site. Idaho State Routes 22, 28, and 33 serve the northern portion of the INEL; State Route 33 provides access to the northern INEL site. **Table 4.11-1 lists the baseline (1991) traffic for several of these access routes.** These segments are currently designated "free flow," which is defined as "operation virtually unaffected by the presence of other vehicles."

The INEL has developed an onsite road system of approximately 140 kilometers (87 miles) of paved surface, including about 29 kilometers (18 miles) of service roads that are closed to the public. Most of the roads are adequate for the current level of normal transportation activities. Some increased traffic volume. DOE plans to reconstruct several deteriorating INEL roads in the 1990s that have been and will continue to be used to transport heavier-than-normal

#### 4.11.1.2 Infrastructure Idaho Falls. Approximately 4,000 DOE and contractor personnel

administer and support INEL work at offices in Idaho Falls. DOE shuttle vans provide transport between in-town facilities. One of the busiest intersections is Science Center and Fremont Avenue, which serves Willow Creek Building, Engineering Research Office Building, and the INEL. **Figure 4.11-1. Transportation routes in the vicinity of the INEL.** (not available in Table 4.11-1. Baseline traffic for selected highway segments. Electronic Technology Review, weekday hours, but it is designed for the current traffic.

#### 4.11.1.3 Transit Modes. Four major modes of transit use the regional highways, community

streets, and INEL site roads to transport people and commodities: DOE buses and shuttle vehicles, motor pool vehicles, commercial trucks, and personal vehicles. Table 4.11-2 summarizes vehicle miles for INEL-related traffic.

Table 4.11-2. Baseline annual vehicle miles traveled for Idaho National Engineering and Environmental Laboratory

### 4.11.2 Railroads

Figure 4.11-1 shows the Union Pacific Railroad lines in southeastern Idaho. Idaho railroad freight service from Butte, Montana, to the north, and from Pocatello and the south, The Union Pacific Railroad's Blackfoot-to-Arco branch, which crosses the of the INEL, provides rail service to the site for the shipment of spent nuclear fuel bulk commodities, and radioactive materials. This branch connects with a DOE-owned Scoville Siding, then links with developed INEL areas. Table 4.11-3 lists rail ship Years 1988 through 1992.

Table 4.11-3. Loaded rail shipments to and from the Idaho National Engineering La

### 4.11.3 Airports and Air Traffic

Commercial airlines provide Idaho Falls with jet aircraft passenger and cargo commuter service to both the Idaho Falls and Pocatello airports. In addition, local available in Idaho Falls, and private aircraft use the major airport and many other Total landings at the Idaho Falls airport for 1991 and 1992 were 5,367 and 5,598, r Idaho Falls and Pocatello airports collectively record nearly 7,500 landings annual

Non-DOE air traffic over the INEL site is limited to altitudes greater than 305 (1,000 feet) over buildings and populated areas, and non-DOE aircraft are not permitted. The primary air traffic at the INEL site is DOE helicopters, which are used for security purposes. These helicopters have specific operations stations and duties.

### 4.11.4 Accidents

From 1987 through 1992, the average motor vehicle accident rate was 0.94 accident kilometers (1.5 accidents per million miles) for INEL vehicles, which compares with of 1.5 accidents per million kilometers (2.4 accidents per million miles) for all D and 8 accidents per million kilometers (12.8 accidents per million miles) nationwide vehicles (Lehto 1993). There are no recorded rail or air accidents associated with date, no fatal air traffic accidents have involved flights through either the Idaho airports.

### 4.11.5 Transportation of Waste, Materials, and Spent Nuclear Fuel

Hazardous, radioactive, industrial commercial, and recyclable wastes are transported site. Federal and State regulations and requirements govern the transportation of hazardous radioactive materials (Lehto 1993). Hazardous materials include commercial chemical hazardous wastes that are nonradioactive; they are regulated and controlled based on toxicity. Onsite spent nuclear fuel comes from Argonne National Laboratory - West, Reactors Facility, and the Advanced Test Reactor; it is transported by truck to various and research and development facilities.

This assessment used six years of data (1987 through 1992) to establish a baseline doses from incident-free, onsite total nonnaval spent nuclear fuel transportation. **Table 4.11-4 lists the results in terms of cumulative doses (1995-2035) and health** do not include onsite naval shipments, which are assessed in Attachment A to Appendix Volume 1 of this EIS. The baseline includes no offsite shipments, which are addressed in Appendixes D and I.

Table 4.11-4. Cumulative dose and cancer fatalities from incident-free onsite shipments

## 4.12 Occupational and Public Health and Safety

### 4.12.1 Radiological Health and Safety

DOE Order 5480.11, "Radiation Protection for Occupational Workers" (DOE 1992b), radiation dose that INEL workers can receive to 5 rem per year; administrative control worker dose to 2 rem per year, except under unusual circumstances. In addition, DOE has a comprehensive program, known as ALARA (As Low As Reasonably Achievable), to ensure reduction of occupational doses to the extent practicable.

The largest fraction of the occupational dose received by INEL workers is from

radiation. Internal radiation doses constitute a small fraction of the occupational radiation doses. Individuals could receive annual external radiation exposures with measured doses greater than thermoluminescent dosimeter that they must wear at all times during work on the site. The recorded doses for 1987 to 1991 as a baseline for routine site operations for this period, the INEL monitored about 6,000 workers annually for radiation exposure. About those individuals received measurable radiation doses. Monitoring reports indicate that in 1991, 20 individuals (most of whom were maintenance and construction workers employed by M-K Ferguson at the Idaho Chemical Processing Plant) received annual doses larger than 0.156 rem (4 individuals in 1987, 1 in 1989, and 15 in 1990).

From 1987 to 1991, the average occupational dose to individuals who had received measurable doses was 0.156 rem per year, resulting in an average collective dose (the number of workers receiving measurable doses was about 32 percent or 1,920) of about 300 person-rem. The resulting number of expected excess latent cancer fatalities would be less than 1 for the period.

This analysis based the doses to the maximally exposed individual and offsite population on baseline radioactive concentrations associated with normal operations. The baseline dose to the maximally exposed individual is  $5.6 \times 10^{-2}$  millirem, which corresponds to a latent cancer probability of  $2.8 \times 10^{-8}$ . The baseline population dose is  $7.0 \times 10^{-2}$  person-rem with a latent fatal cancer incidence of less than 1 ( $4 \times 10^{-5}$ ) annually and less than 1 in 40 years.

#### 4.12.2 Nonradiological Exposure and Health Effects

DOE used the air quality data in Table 4.7-2 to evaluate health impacts associated with exposure to two compound classes: criteria pollutant and toxic. This analysis is based on air emissions only, and not water pathways, because none of the alternatives would discharge pollutants to surface waters or the subsurface. Table 4.7-2 lists 56 criteria and 26 toxic compounds. The classification of two of the toxic compounds (benzene and carcinogens) was consistent with EPA designations published in the Integrated Risk Information System (IRIS) data base (DOE 1991b). However, this data base does not include sufficient quantitative inhalation cancer risk assessment.

To obtain a hazard index, this analysis evaluated toxic and criteria pollutant health effects by adding hazard quotients for each compound. The EPA Risk Assessment Guidance for Superfund (EPA 1989) describes this approach. The hazard quotient is the ratio of concentration or dose to a Reference Concentration (RfC) or Dose (RfD). For compounds not listed, Reference Concentration or Dose values, the analysis used appropriate State health effects data. The use of the noncancer hazard index assumes a level of exposure (standard) below which health effects would be unlikely. The hazard index is not a statistical probability but can be interpreted as such.

This analysis based toxic and criteria pollutant compound hazard index values for the maximally exposed individual on the maximum concentrations for the compounds at the INEL site, public access roads inside the INEL site boundary, and the Craters of the Moon Wild. Because the hazard index for criteria pollutants is less than 1, no adverse health effects are expected from routine operations for either workers or the maximally exposed individual. Because the hazard index for toxic pollutants exceeds 1, the potential for carcinogenic health risks cannot be ruled out. Varying spatial and temporal distributions of the concentrations of individual air pollutants make it unlikely that any individual would be exposed to all the pollutants all the time. Because the hazard indices for the toxic compounds are less than 1, adverse health effects are not expected.

#### 4.12.3 Occupational Health and Safety

Total injury and illness incidence rates at the INEL varied from an annual average of 4.9 per 200,000 work hours from 1987 to 1991. During this time, total lost workday from a low of 1 per 200,000 work hours in 1988 and 1989 to a high of 2.6 per 200,000 work hours in 1991. The rates appear higher for 1991 because of a 1990 change in reporting requirements for injuries and illnesses. INEL rates for 1987 to 1989 are below overall DOE rates (2.1 illness incidence and 1.4 total lost workday cases per 200,000 work hours) and Bureau of Labor Statistics rates (8.5 total injury and illness incidence and 4.0 total lost workday cases per 200,000 work hours). For 1990 and 1991, INEL rates are slightly above overall DOE rates, but below Bureau of Labor Statistics rate.

There were 1,337 total recordable injury and illness cases at the INEL from 1987 to 1991, an average of 8,385 employees working 79,654,000 hours. Of these cases, 114 (8.5 percent)



occupational illnesses, of which 48 percent were repeated trauma disorders and 30 percent classified as skin diseases or disorders. One fatality occurred at the INEL between 1987 and 1991 when an employee was struck and killed by a forklift.

### 4.13 Idaho National Engineering Laboratory Services

This section discusses water, electricity, fuel capacities and consumption, waste management, and security and emergency protection at INEL facilities.

#### 4.13.1 Water Consumption

A system of about 30 wells, with pumps and storage tanks, provides the water supply for the INEL site. Because of the distance between site facility areas, the water supply system is independent. The site uses no natural surface water. The City of Idaho Falls water system, which includes about 16 wells, provides water to DOE and contractor facilities at the INEL site.

A Water Rights Agreement between DOE and the State of Idaho regulates groundwater use at the INEL site. Under this agreement, INEL has claim to 2,300 liters per second (36 million gallons) of groundwater, not to exceed 43 billion liters (11 billion gallons) per year. INEL has not measured the total pumping rate from the aquifer, which would depend on the pumps operating. There is a slight possibility that the site could exceed the regulated pumping rate during very short periods, such as during recovery from an extended power outage when many tanks run to refill depleted storage tanks.

The average INEL site water consumption from 1987 through 1991 was 7.4 billion (1.9 billion gallons) per year, based on the cumulative volumes of water withdrawn (Teel 1993). The projected baseline usage for 1995 will be about 6.5 billion liter gallons). The estimated average water consumption of Idaho Falls facilities is 300 million (80 million gallons) per year.

#### 4.13.2 Electricity Consumption

The Antelope substation supplies commercial electric power to the INEL site through the Federally owned Scoville substation. The Scoville substation supplies electricity to the INEL electric power distribution system (Teel 1993). The contract with Idaho Power Company to supply electric power to the INEL site provides "up to 45,000 kilowatts monthly" at (IPC/DOE 1986). Hydroelectric generators along the Snake River in southern Idaho and Valmy coal-fired thermal electric generation plants in southwestern Wyoming and Nevada, respectively, generate the electric power supplied by Idaho Power. The Experimental Breeder Reactor-II can also provide approximately 12 to 15 megavolt-amperes of capacity for the power loop (Teel 1993).

The rated capacity of the INEL site power transmission loop line is 124 megavolt-ampere peak demand on the system from 1990 through 1993 was about 40 megavolt-amperes, and usage was slightly less than 217,000 megawatt-hours per year (Teel 1993). This usage decreased by about 4 percent by 1995.

The INEL facilities in Idaho Falls receive electric power from the City of Idaho Falls, which operates four hydroelectric power generation plants on the Snake River along with its distribution facilities. The Bonneville Power Administration, which operates hydroelectric power on the Columbia River system, supplies supplemental power to the City of Idaho Falls. Idaho Falls facilities used 31,500 megawatt-hours of electricity (Teel 1993).

#### 4.13.3 Fuel Consumption

Fuels consumed at the INEL site include several liquid petroleum fuels, coal, and natural gas. Fuels are transported to the site for storage and use. Natural gas is the only fuel transported to the INEL Idaho Falls facilities; the Intermountain Gas Company provides this fuel through underground lines (Teel 1993).

The average annual fuel consumption at the INEL site from 1990 through 1993 was fuel oil, 10,578,000 liters (2,795,000 gallons); diesel fuel, 5,690,000 liters (1,500,000 gallons); propane gas, 568,000 liters (150,000 gallons). The INEL also uses about 8,200 metric tons (9,000 tons) of coal. Fuel storage is provided at each facility and inventories are maintained as necessary. No fossil fuel shortage has ever occurred at the INEL site (Teel 1993).

#### 4.13.4 Wastewater Disposal

Sanitary wastewater systems at the smaller onsite facility areas consist primarily of drain fields. The larger areas, such as Central Facilities Area, Idaho Chemical Processing Plant, and Test Reactor Area, have wastewater treatment facilities. The City of Idaho Falls wastewater treatment system serves the Idaho Falls facilities (Teel 1993).

The average annual wastewater discharge volume at the INEL site from 1989 through 1998 was 537 million liters (142 million gallons). The wastewater from DOE and contractor-operated facilities in Idaho Falls is not metered but is estimated to be 300 million liters (80 million gallons). The primary causes of the difference between water pumped and estimated wastewater volume are evaporation from ponds and cooling towers, irrigation of landscaped areas, and direct discharge of wastewater (Teel 1993). Some industrial wastewater, such as steam condensate, is discharged to evaporation ponds and injection wells.

#### 4.13.5 Security and Emergency Protection

This section describes the fire protection and prevention, security, and emergency response resources for the INEL site and the surrounding areas. This discussion includes the fire protection, DOE and INEL Emergency Preparedness, and DOE and INEL Security. DOE uses an Emergency Management System that incorporates all applicable requirements for emergency planning, preparedness, and response at the INEL. Each INEL facility must prepare an Emergency Plan that contains detailed contingency plans and emergency procedures.

##### 4.13.5.1 DOE Fire Department. The contractor-operated Fire Department staffs and operates

three fire stations on the INEL that support the entire site. Each station has the expertise to respond to explosions, fires, spills, and medical emergencies. These stations are located at the north end at Test Area North, at Argonne National Laboratory-West, and at the Central Facilities Area. Each station has a minimum of one engine company capable of supporting any fire emergency in its assigned area. The Fire Department has a staff of 44 firefighters and 11 support personnel. It operates with a minimum critical staff of 7 firefighters at any time. In addition to firefighting services, the Fire Department provides the INEL ambulance, emergency medical services (EMT), and hazardous material response services. The Fire Department has mutual aid agreements with other firefighting organizations, such as the Bureau of Land Management and the City of Idaho Falls, Blackfoot, and Arco. Through these agreements, the Idaho Falls Fire Department provides support to facilities in the City of Idaho Falls.

##### 4.13.5.2 DOE and INEL Emergency Preparedness. Each DOE INEL contractor

administers and staffs its own emergency preparedness program under the direction of DOE. All contractor programs for emergency control and response are compatible. The Emergency Communication Center is in the DOE Headquarters building and staffed by the INEL personnel with DOE oversight; it is the communication and overall control center for support of emergency commanders in charge of an emergency response. The DOE emergency preparedness system has mutual aid agreements with all regional county and major city fire departments, police departments, and hospitals. Through the agreements, the Idaho Falls emergency preparedness organization provides support to facilities in the City of Idaho Falls.

##### 4.13.5.3 DOE and INEL Security. DOE has oversight responsibility for safeguards and

security at the INEL. The security program has three categories: security operations, physical security, and safeguards. The security operations division provides asset protection for special nuclear material, facilities, and personnel) and technical security (computer security). Under this category, DOE administers the INEL protective force, which is supplied by DOE personnel. The DOE personnel security staff processes personnel security clearances. The safeguards division is responsible for the management and accountability of special nuclear materials. The physical security force, consisting of 200 armed guards and 350 support personnel, provides the onsite security and administers the programs. Each INEL contractor has a safeguards and security staff, in a similar manner, to manage the security associated with its facilities. Contractor

security staffs range from about 5 to 60 persons, depending on the size and complex associated facilities. Each staff works with the INEL protective forces.

## 4.14 Materials and Waste Management

This section summarizes the management of materials and wastes (high-level, trans low-level, low-level, hazardous, industrial and commercial solid wastes and hazardous INEL and Idaho Falls facilities, and presents an overview of the current status of types generated, stored, and disposed at the INEL.

The total amount of waste generated and disposed has been reduced through waste and treatment. The INEL attains waste minimization by reducing or eliminating waste recycling, and by reducing the volume, toxicity, or mobility of waste before storage. In addition, the site has achieved volume reduction of radioactive wastes through more surveying, waste segregation, and use of administrative and engineering controls.

The quantitative data presented in this section are from Volume 2 of this EIS, noted.

### 4.14.1 High-Level Waste

At present, about 11,900 cubic meters (4,970 cubic yards) of calcine solid and 2,14 liquid) of high-level waste are in storage at the INEL Idaho Chemical Processing Plant for locations of major waste management facilities). This facility blends liquid waste, aluminum and zirconium wastes from past spent nuclear fuel reprocessing, and sodium and processes them through calcination to produce a granular calcine solid. Because of termination of reprocessing, the site no longer generates liquid high-level waste, high-level waste residues. Liquid high-level wastes generated by prior reprocessing solidified at the site. At present, the site generates liquid waste that is not directly reprocessing. The site manages this liquid as high-level waste. The site will calculate high-level waste that does not contain sodium, and as much sodium-bearing high-level waste practicable by January 1, 1998, in accordance with the Amended Order Modifying Order 1993, United States District Court for the District of Idaho, December 22, 1993. The baseline for high-level waste generation is 750 cubic meters (980 cubic yards) annually.

### 4.14.2 Transuranic Waste

About 65,000 cubic meters (85,000 cubic yards) of transuranic and alpha-contaminated wastes are retrievably stored and 62,000 cubic meters (81,000 cubic yards) of trans (Morton and Hendrickson 1995) have been buried at the Radioactive Waste Management Complex at the INEL. At present, no facilities can dispose of transuranic waste; however, DOE can retrieve, repackage, certify, and ship stored transuranic wastes at the INEL to a repository for final disposition. DOE has not determined the disposition of alpha-level waste and buried waste. Since the October 1988 ban by the State of Idaho prohibiting transuranic waste to the INEL, DOE has shipped only minor amounts of transuranic waste generated on the site to the INEL Radioactive Waste Management Complex for interim storage. At present, there are no treatment facilities for transuranic wastes at the INEL. The baseline for transuranic waste generation is 6 cubic meters (8 cubic yards) annually.

### 4.14.3 Mixed Low-Level Waste

At present, DOE accepts only mixed low-level waste generated at the INEL for treatment and disposal at the INEL. DOE stores mixed low-level waste generated at the INEL at interim storage facilities until treatment systems become available or operational. A total of 1,800 (2,400 cubic yards) of mixed low-level waste interim storage capacity is available. Current mixed low-level waste interim storage is approximately 1,100 cubic meters (1,400 yards). Treatment technologies exist for much of the mixed low-level waste generated, and waste minimization eliminates potential sources of mixed low-level waste before projected 1995 baseline for mixed low-level waste is 525 cubic meters (687 cubic yards) (EG&G 1993).

#### 4.14.4 Low-Level Waste

Through 1991, DOE disposed of 145,000 cubic meters (190,000 cubic yards) of low level waste at the Radioactive Waste Management Complex. In 1991, the total available low-level waste capacity at the complex was 37,000 cubic meters (48,000 cubic yards). DOE has curtailed low-level waste treatment since 1991 while waiting for updated safety documentation and an environmental impact assessment for the Waste Experimental Reduction Facility. The INEL stores low-level waste awaiting treatment on asphalt or concrete pads at the Waste Experimental Reduction Facility. The INEL stores low-level radioactive waste storage containers at the generating facilities. The projected low-level waste generation is 4,270 cubic meters (5,585 cubic yards) annually (EG&G 1991).

#### 4.14.5 Hazardous Waste

DOE collects hazardous waste generated at the INEL and stores it temporarily at the Waste Storage Facility before shipping it off the site. The Hazardous Waste Storage Facility has adequate storage capacity [approximately 64 cubic meters (84 cubic yards)] to manage hazardous waste generated at the INEL. The site recycles, reuses, or reprocesses waste where possible, and might replace some hazardous substances with nonhazardous substances.

#### 4.14.6 Industrial/Commercial Solid Waste

DOE disposes of the industrial and commercial solid waste generated at the site at the Landfill Complex at the Central Facilities Area. The Landfill Complex has approximately 910,000 square meters (225 acres) of land available for solid waste disposal, including an area at Landfill III, which is currently in use. The estimated capacity of the INEL will be sufficient to dispose of INEL waste for 30 to 50 years; however, capacity of the excavations will be filled by 1998. DOE has proposed expanding the excavation. Volume 1 describes the landfill expansion project. The industrial and commercial solid waste currently in use is in a 48,000-square-meter (12-acre) gravel pit area north of Disposal Facility. DOE does not expect to store solid waste intended for disposal. Waste segregation occurs at the facility so recyclable materials do not enter the solid waste stream. The average waste disposed at the Central Facilities Area landfill from 1988 through 1992 was 52,000 cubic meters (68,000 cubic yards) (also the projected 1995 baseline) (EG&G 1991).

#### 4.14.7 Hazardous Materials

The INEL 1993 chemical inventory lists 774 hazardous chemicals. The number and weight of hazardous chemicals used on the site and at individual facilities change over time. The annual Superfund Amendments and Reauthorization Act reports for the INEL include year-to-year inventories.

## 5. ENVIRONMENTAL CONSEQUENCES

### 5.1 Overview

This chapter discusses the potential environmental consequences for each spent nuclear fuel management alternative described in Chapter 3. The U.S. Department of Energy (DOE) conducted environmental consequence analyses of nonnaval spent nuclear fuel management from Volume 1 input for this chapter; however, DOE made necessary adjustments to accommodate the differences between Volume 1 and Volume 2 alternatives. In addition, DOE adjusted the 10-year horizon for Volume 2 alternatives to 40 years for Volume 1.

As described in Chapter 1, this chapter analyzes only nonnaval DOE actions; how they affect the environment. Section 5.16, "Cumulative Impacts and Impacts from Connected or Similar Actions," is derived from the Naval Nuclear Propulsion Program and nonnaval DOE impacts that are cumulative. Appendix B restriction of analysis to nonnaval actions results in Alternative 2 (operational) becoming a single alternative.

Chapter 5 addresses potential impacts from construction and normal operations for

of the affected environment described in Chapter 4. In addition, it provides potential impacts from accidents and several types of summary information. In cases where the consequences do not result in a distinction among the alternatives, this chapter describes the division by alternative to avoid needless repetition. Tables 3-4 through 3-6 in Section 3 and compare the potential impacts associated with each alternative.

## 5.2 Land Use

Alternatives 1, 2, 4b(2), and 5a [No Action, Decentralization, Regionalization (Elsewhere), and Centralization at other DOE sites] would have the least impact on 0.8 acre (0.003 square kilometer); Alternatives 4b(1) [Regionalization by Geography] and 5b (Centralization at the INEL) would result in the greatest changes, impacting nearly 0.12 square kilometer).

Overall environmental impacts on land use by any of the alternatives would be small. DOE would build new facilities in developed areas that it has already dedicated to that previous activities have disturbed. Under all the alternatives, proposed activities would be consistent with the existing land use plans discussed in Section 4.2 and would be in existing developed areas on the site. None of the proposed activities would involve INEL boundaries, and no effects on surrounding land uses or local land use plans should be expected.

No onsite land use restrictions due to Native American treaty rights would exist for the alternatives described in this EIS. Potential impacts on Native American and other resources are discussed in Section 5.4 (Cultural Resources) and in Appendix L (Environmental

## 5.3 Socioeconomics

This section describes the potential effects of the spent nuclear fuel management alternatives on socioeconomic resources of the region of influence described in Section 4.3. Table 5.3-1 lists proposed changes in the INEL-related workforce and population. Figure 5.3-1 shows the proposed changes.

### 5.3.1 Methodology

This section addresses socioeconomic impacts in terms of both direct and second-order and population effects. Direct effects are changes in INEL employment that DOE expects under each alternative and include construction and operations phase impacts. Second-order effects include indirect and induced impacts. Indirect effects are impacts to regional business employment resulting from changes in DOE regional purchases or nonpayroll expenditures. Induced effects are impacts to regional businesses and employment that result from changes in income by affected INEL employees. The total economic impact to the region is the sum of direct, indirect, and induced effects.

The bases for the estimated direct impacts in this section are project summary information developed in cooperation with INEL contractors. Employment impacts represent actual INEL staffing; they do not include changes in staffing due to a reassignment of the workforce. The projected decline in baseline INEL activity is not part of any alternative. A comprehensive analysis of potential impacts was not included. Projected declines in employment are presented in Figure 5.3-1 in order to provide the reader with a frame of reference for evaluating potential employment and population impacts. This assessment used RIMS to estimate total employment impacts with multipliers that the U.S. Bureau of Economic Analysis developed specifically for the INEL region of influence. A comprehensive discussion of the methodology is provided in Appendix F-1 of Volume 2. Cumulative impacts on socioeconomic resources in the region are discussed in Section 5.16.

**Table 5.3-1.** Estimated changes in employment and population for Alternatives 3, 4a, and 5b, 1995 - 2004.

Factor	1995	1996	1997	1998	1999	2000	2001	2002	2003
Direct employment	0	0	0	0	250	250	375	375	375
Secondary employment	0	0	0	0	352	352	528	528	528
Total employment	0	0	0	0	602	602	903	903	903
Change in ROIB labor force (%)	0.0	0.0	0.0	0.0	0.5	0.5	0.8	0.8	0.8

Change in ROI employment (%)	0.0	0.0	0.0	0.0	0.6	0.6	0.8	0.8	0.8
Population change	0	0	0	0	2,027	2,027	3,040	3,040	3,0
Change in ROI population (%)	0.0	0.0	0.0	0.0	0.8	0.8	1.1	1.1	1.1

a. Sources: Johnson (1995); USBEA (1993); USBC (1992).

b. ROI = region of influence.

**Table 5.3-2.** Estimated changes in employment and population for Alternatives 4b(2) 1995 - 2004.

Factor	1995	1996	1997	1998	1999	2000	2001	2002	200
Direct employment	50	50	0	0	0	0	0	0	0
Secondary employment	70	70	0	0	0	0	0	0	0
Total employment change	120	120	0	0	0	0	0	0	0
Change in ROIa labor force (%)	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Change in ROI employment (%)	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Population change	405	405	0	0	0	0	0	0	0
Change in ROI population (%)	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

a. Sources: Johnson (1995); USBEA (1993); USBC (1992).

b. ROI = region of influence.

### 5.3.2 Alternatives 1 and 2 - No Action and Decentralization

Activities associated with Alternatives 1 and 2 would not result in any addition operations jobs at the INEL; therefore, implementation of either of these alternatives would have no impact on socioeconomic resources in the region of influence.

### 5.3.3 Alternatives 3, 4a, 4b(1), and 5b - 1992/1993 Planning Basis, Regionalization by Fuel Type,

Regionalization by Geography (INEL), and Centralization at the INEL

#### 5.3.3.1 Construction. As listed in Table 5.3-1, construction employment under these

alternatives would peak during the period from 2001 to 2004 with approximately 375 jobs per year. When added to the estimated 528 indirect jobs, the total employment region would be an addition of approximately 903 jobs. Employment would decline to

Based on historic data, approximately 97 percent of the new employees who would be hired would live in the seven-county region of influence. As listed in Table 5.3-1, if a were filled by in-migrants to the region, there would be a 0.8-percent increase in force and in regional employment during the peak years. These changes would be minor and have no adverse impacts on socioeconomic resources in the region. In fact, although implementation of any of these alternatives would result in an increase over project levels, as shown in Figure 5.3-1, there would be an overall decline in employment from 1995 levels.

Assuming each new employee represented one household and 3.47 persons per household would be a corresponding increase in regional population levels of 1.1 percent (approximately 3,000 people). Given this minor change in population, DOE expects potential impact for community resources and services such as housing, schools, police, health care, to be negligible.

#### 5.3.3.2 Operations. Activities associated with Alternatives 3, 4a, 4b(1), and 5b would not

require any additional operations jobs at the INEL. Therefore, the implementation of these alternatives would have no impact on socioeconomic resources in the region of influence.

### 5.3.4 Alternatives 4b(2) and 5a - Regionalization by Geography (Elsewhere) and Centralization at Other

#### DOE Sites

#### 5.3.4.1 Construction. As listed in Table 5.3-2, construction employment under these

alternatives would peak during the period from 1995 to 1996 with approximately 50 a jobs per year. When added to the estimated 70 indirect jobs, the total employment region would be approximately 120 jobs. Employment after 1996 would drop to zero.

Figure 5.3-1. INEL employment by SNF alternative relative to site employment pro Based on historic data, approximately 97 percent of the new employees who would would live in the seven-county region of influence. As listed in Table 5.3-2, if a were filled by in-migrants to the region, there would be a 0.1-percent increase in force and in regional employment levels during the peak years. These changes would would have no adverse impacts on socioeconomic resources in the region. In fact, a implementation of any of these alternatives would be an increase over projected emp from 1995 to 1996, as shown in Figure 5.3-1, there would be an overall decline in e projected 1995 levels.

Assuming each new employee represented one household and 3.47 persons per househ would be a corresponding increase in regional population levels of 0.2 percent (app 400 people). Given this minor change in population, DOE expects potential impacts for community resources and services such as housing, schools, police, health care, to be negligible.

#### 5.3.4.2 Operations. Activities associated with Alternatives 4b(2) and 5a would not result in

any additional operations jobs at the INEL. Therefore, the implementation of eithe alternatives would have no impact on socioeconomic resources in the region of influ

## 5.4 Cultural Resources

This section summarizes the potential impacts of spent nuclear fuel management cultural resources at the INEL site.

This assessment evaluated both direct and indirect impacts due to the proposed the INEL, direct impacts to archaeological resources usually would be those associa disturbance from construction activities. Direct impacts to existing historic stru demolition, modification, deterioration, isolation from or alteration of the charac setting; or introduction of visual, audible, or atmospheric elements out of charact property's setting. In addition, indirect impacts to archaeological resources coul overall increase in activity at the INEL, which could bring a larger workforce clos sites. Direct impacts to traditional resources could occur through land disturbanc changes to the environmental settings of traditional use and sacred areas. Impacts pollution, noise, and contamination that could affect the traditional hunting and g visual or audible settings of sacred areas.

The potential for adverse impacts on cultural resources would be the least unde 2, 4b(2), and 5a, which would disturb approximately 0.8 acres (0.003 square kilomet would be minor because surveys of the area to be disturbed found no eligible cultur (Reed et al. 1986; DOE 1993a).

The potential for adverse impacts on cultural resources would be similar under 4b(1), and 5b with the greatest potential under Alternatives 4b(1) and 5b [Regional Geography (INEL) and Centralization at the INEL], which would involve the disturban acres (0.12 square kilometer). Again, impacts would be minimal because surveys of disturbed area found no eligible cultural resources (Reed et al. 1986). Under thes proposed modifications at the Idaho Chemical Processing Plant facilities could adve historically significant structures and could require consultation with the Idaho S Preservation Office (Braun et al. 1993).

The Shoshone-Bannock Tribes are also concerned with the potential impact to imp American resources from changes in the visual setting, noise, air quality, or water

activities associated with spent nuclear fuel management would take place within ex currently engaged in similar activities, DOE does not expect any impacts to importa American resources from alteration of the visual setting or noise associated with i any of the alternatives. There could be temporary, minor impacts on air quality fr associated with construction activities. Emissions of radionuclides to the air und would be minor and would be well below applicable standards and guidelines. Under operating conditions, radioactive discharges to the soil or directly to the aquifer

DOE would minimize the potential for direct and indirect adverse impacts on tra resources from pollution, noise, and contamination through compliance with applicab Federal laws and regulations. Impact avoidance and other mitigation measures for c are described in Section 5.20.2.

## 5.5 Aesthetic and Scenic Resources

None of the alternatives for spent nuclear fuel management at the INEL would ha consequences on scenic resources or aesthetics because DOE would confine the propos developed areas. Although the construction of the proposed facilities would produc could temporarily affect visibility, the INEL would follow standard construction pr both erosion and dust generation. Facility operations under each alternative would emissions to the atmosphere that would impact visibility.

## 5.6 Geology

This section discusses the potential effects of the spent nuclear fuel manageme geologic resources at the INEL site.

Proposed INEL spent nuclear fuel management activities would only have minor lo impacts on the geology of the site for all the alternatives. Direct impacts to geo site would be associated with the disturbance or extraction of surface deposits to facilities. These impacts could include excavations into the soil and rock of the and banking, and the extraction of aggregate materials from gravel and borrow pits Table 5.6-1 lists estimated extractions of aggregate from site gravel pits for all **fuel, environmental restoration, and waste management projects**. These values serve spent nuclear fuel project usage.

A secondary impact to geological resources from construction activities would b for increased soil erosion. DOE would minimize any potential soil erosion by the u Management Practices designed to control stormwater runoff and slope stability.

**Table 5.6-1.** Estimated INEL gravel/borrow use (cubic meters). ,b

Alternative	Estimated Gravel/Borrow Use
1. No Action	158,000
2. Decentralization	158,000
3. 1992/1993 Planning Basis	392,000
4a. Regionalization by Fuel Type	392,000
4b(1) Regionalization by Geography (INEL)	1,772,000
4b(2) Regionalization by Geography (Elsewhere)	296,000
5a. Centralization at other DOE Sites	296,000
5b. Centralization at the INEL	1,772,000

a. Source: EG&G (1994).

b. To convert cubic meters to cubic yards, multiply by 1.31.

## 5.7 Air Quality and Related Consequences

This section describes the potential nonradiological and radiological impacts t associated with each alternative. The term "baseline concentrations" is defined as concentrations resulting from potential emissions from current operations and those planned upgrades or modifications that DOE would construct or operate prior to any actions described in this EIS. Additional information is provided in Section 5.7 a Volume 2.

### 5.7.1 Alternative 1 - No Action



### 5.7.1.1 Nonradiological Air Quality. Construction activities associated with this alternative

would be limited to upgrading an existing facility. Potential impacts to air quality activities would include fugitive dust and exhaust emissions from support equipment the impacts from construction using the EPA Fugitive Dust Model (FDM) (Winges 1992) modeling results showed that the expected construction-related air quality impacts and highly localized.

Minimal spent nuclear fuel activities would occur under this alternative. That the ambient concentrations levels from normal operations would be similar to that **Table 4.7-1 lists nonradioactive emissions from normal operations.** Tables 5.7-1 an maximum potential concentrations for the proposed alternatives; they are all below standards and guidelines. Ambient concentrations from Alternative 1 activities will applicable standards and guidelines.

### 5.7.1.2 Radiological Air Quality. No radiological impacts to the environment would result

from construction activities.

No additional facilities that would be in operation for this alternative would emissions. Therefore, for normal operations, doses to the maximally exposed individual population, and workers would be equivalent to baseline doses, as listed in Table 5 lists associated emission rates.

**Table 5.7-1.** Maximum impacts to nonradiological air quality from spent nuclear fuel pollutants. ,b

Pollutant	Averaging time	Applicable standard (-g/m3)	Maximum baseline concentration (-g/m3)	Baseline plus maximum alternativec (-g/m3)
Carbon monoxide	1-hr	40,000	610	610
	8-hr	10,000	280	280
Nitrogen dioxide	Annual	100	4	4
Lead	Quarterly	1.5	0.001	0.001
Particulate matter (PM10)	24-hr	150	80	80
	Annual	50	5	5
Sulfur dioxide	3-hr	1,300	580	580
	24-hr	365	140	140
	Annual	80	6	6

a. Source: Section 5.7 of Volume 2 of this EIS and Belanger et al. (1995).

b. Listed concentrations are the maximum of those calculated at the INEL site bound inside the INEL site boundary, and the Craters of the Moon Wilderness Area.

c. The listed concentrations are the maximums for any of the proposed alternatives.

**Table 5.7-2.** Maximum impacts to nonradiological air quality from spent nuclear fuel pollutants. ,b

Pollutant	Averaging time	Applicable standard (-g/m3)	Maximum baseline concentration (-g/m3)	Impact from maximum alternativec (-g/m3)
Ammonia	Annual	1.8y102	6.0y100	1.8y100
Benzene	Annual	1.2y10-1	2.9y10-2	2.3y10-2
Formaldehyde	Annual	7.7y10-2	1.2y10-2	4.4y10-2
Methyl isobutyl ketone	Annual	2.1y103	(e)	2.6y101
Hydrofluoric acid	Annual	2.5y101	(e)	1.8y10-2
Tributylphosphate	Annual	2.5y101	(e)	6.1y10-2

a. Source: Section 5.7 of Volume 2 of this EIS and Raudsep (1995).

b. Listed concentrations are the maximum of those calculated at the INEL site bound inside the INEL site boundary, and the Craters of the Moon Wilderness Area.

c. The listed concentrations are the maximums for any of the proposed alternatives, sources expected to become operational after May 1, 1994.

d. In accordance with State of Idaho regulations for toxic air pollutants, the perc based on concentrations resulting from the alternatives and from new or modified operational since May 1, 1994.

e. Baseline concentrations for these pollutants were not analyzed because their emi

levels.

**Table 5.7-3.** Annual dose increments by alternative in comparison to the baseline.

Alternative	INEL worker (millirem)	Maximally exposed individual (millirem)	Populati (person-
Baseline	4.3y100c	5.6y10-2	3.4y10-1
1. No Action	3.3y10-4	3.5y10-3	1.0y10-1
2. Decentralization	3.3y10-4	3.5y10-3	1.0y10-1
3. 1992/1993 Planning Basisc	3.3y10-3	8.0y10-3	1.9y10-1
4a. Regionalization by Fuel Type	3.3y10-3	8.0y10-3	1.9y10-1
4b(1). Regionalization by Geography (INEL)d	4.2y10-3	4.8y10-2	3.9y10-1
4b(2). Regionalization by Geography (Elsewhere)	7.0y10-5	3.9y10-3	8.3y10-2
5a. Centralization at Other DOE Sites	7.0y10-5	3.9y10-3	8.3y10-2
5b. Centralization at the INEL	4.2y10-3	4.8y10-2	3.9y10-1

a. Source: Section 5.7 of Volume 2 of this EIS.

b. Population dose is calculated based on the projected population in 2000 or 2010

c. Baseline worker dose includes the maximum projected operation of the portable wa Power Burst Facility area. However, the operation would be temporary (1 to 2 ye representative of a permanent increase in the baseline. If this facility were n the worker would be about 0.2 millirem per year.

d. Alternative 4b(1) doses are slightly less than Alternative 5b doses.

## 5.7.2 Alternative 2 - Decentralization

### 5.7.2.1 Nonradiological Air Quality. Potential impacts to air quality from construction

activities would include fugitive dust and exhaust emissions from support equipment assessment showed that the expected construction-related air quality impacts should highly localized.

Emissions resulting from normal operations under this alternative would include emissions and those resulting from the startup of the proposed facilities. Emissio with startup would be less than 1 percent of those from normal operations. Tables the maximum concentrations predicted for the proposed alternatives. Ambient concen Alternative 2 activities would be below applicable standards and guidelines.

**Table 5.7-4.** Radionuclide emissions by alternative for spent nuclear fuel projects

Project and Location	Associated Alternative	Radionuclides and Emission		
		H-3/ C-14	Co-60	Kr-85
TAN Pool Fuel Transfer Project	1, 2, 3, 4a			
a. Drying operations	4b(1), 5b	9.6y102	-	-
b. Storage operations (Test Area North)		3.9y10-1	-	-
Additional Increased Rack Capacity (Idaho Chemical Processing Plant)	3, 4a, 4b(1), 5b	2.0y10-1	1.2y10-8	-
Dry Fuels Storage Facility (Idaho Chemical Processing Plant)	3, 4a, 4b(1), 4b(2), 5a, 5b	1.8y10-2	1.9y10-6	-
Fort St. Vrain Spent Fuel Storage (Idaho Chemical Processing Plant)	3, 4a, 4b(1), 5b	-	5.6y10-8	-
Increased Rack Capacity (Idaho Chemical Processing Plant)	3, 4a, 4b(1), 5b	2.0y10-1	1.2y10-8	-
EBR-II Blanket Treatment (Argonne National Laboratory - West)	3, 4a, 4b(1), 5b	1.6y102	-	4.9y1
Electrometallurgical Process Demonstration Project (Argonne National Laboratory - West)	3, 4a, 4b(1), 4b(2), 5a, 5b	8.4y102	-	1.4y1
Spent Fuel Processing Facility	4b(1), 5b	3.1y103	1.9y10-6	5.0y1

a. Source: Appendix F-3 of Volume 2 of this EIS.

**5.7.2.2 Radiological Air Quality. No radiological impacts to the environment would result**

from construction activities.

Emissions resulting from normal operations under this alternative would include emissions and those resulting from the startup of the proposed facilities. Table 5 rates for the spent nuclear fuel alternatives, including Decentralization. Table 5 doses to the maximally exposed individual, the population, and workers. These values compared to the National Emission Standards for Hazardous Air Pollutants dose limit per year, the dose limit received from background sources of 351 millirem per year, population dose from background sources of 40,000 person-rem.

**5.7.3 Alternative 3 - 1992/1993 Planning Basis****5.7.3.1 Nonradiological Air Quality. Potential impacts to air quality from construction**

activities would include fugitive dust and exhaust emissions from support equipment assessment showed that expected construction-related air quality impacts should be highly localized.

Emissions resulting from normal operations under this alternative would include emissions and those resulting from the proposed facilities. Emission rates associated would be less than 1 percent of those from normal operations. Tables 5.7-1 and 5.7 maximum potential concentrations for the proposed alternatives. Ambient concentrations Alternative 3 activities would be below applicable standards and guidelines.

**5.7.3.2 Radiological Air Quality. No radiological impacts to the environment would result**

from construction activities.

Emissions resulting from normal operations under this alternative would include emissions and those resulting from the startup of the proposed facilities. Table 5 rates for the spent nuclear fuel alternatives. Table 5.7-3 lists the resulting doses to the maximally exposed individual, the population, and workers. These values are small in comparison to the National Emission Standards for Hazardous Air Pollutants dose limit of 10 millirem per year, received from background sources of 351 millirem per year, and the population dose from background sources of 40,000 person-rem.

**5.7.4 Alternative 4a - Regionalization by Fuel Type****5.7.4.1 Nonradiological Air Quality. Potential impacts to air quality from construction**

activities would include fugitive dust and exhaust emissions from support equipment assessment showed that the expected construction-related air quality impacts should be highly localized.

Emissions resulting from normal operation under this alternative would include emissions and those resulting from the startup of the proposed facilities. Emissions with startup would be less than 1 percent of those from normal operations. Tables 5.7-1 and 5.7-2 maximum potential concentrations for the proposed alternatives. Ambient concentrations Alternative 4 activities would be below applicable standards and guidelines.

**5.7.4.2 Radiological Air Quality. No radiological impacts to the environment would result**

from construction activities.

Emissions resulting from normal operation under this alternative would include emissions and those resulting from the proposed facilities. Table 5.7-4 lists emissions for the spent nuclear fuel alternatives including Regionalization. Table 5.7-3 lists the resulting doses to the maximally exposed individual, the population, and workers. These values are small in comparison to the National Emission Standards for Hazardous Air Pollutants dose limit of 10 millirem per year, received from background sources of 351 millirem per year, and the population dose from background sources of 40,000 person-rem.

### **5.7.5 Alternative 4b(1) - Regionalization by Geography (INEL)**

#### **5.7.5.1 Nonradiological Air Quality. Potential impacts to air quality from construction**

activities would include fugitive dust and exhaust emissions from support equipment assessment showed that the expected construction-related air quality impacts should highly localized.

Emissions resulting from normal operation under this alternative would include emissions and those resulting from the startup of the proposed facilities. Emissions with startup would be less than 1 percent of those from normal operations. Tables the maximum potential concentrations from the proposed alternatives. Ambient concentrations Alternative 4b(1) activities would be below applicable standards and guidelines.

#### **5.7.5.2 Radiological Air Quality. No radiological impacts to the environment would result**

from construction activities.

Emissions resulting from normal operation under this alternative would include emissions and those resulting from the proposed facilities. Table 5.7-4 lists assumptions for spent nuclear fuel alternatives including Regionalization by Geography (INEL). resulting doses to the maximally exposed individual, the population, and workers. small in comparison to the National Emission Standards for Hazardous Air Pollutants millirem per year, the dose limit received from background sources of 351 millirem population dose from background sources of 40,000 person-rem.

### **5.7.6 Alternative 4b(2) - Regionalization by Geography (Elsewhere)**

#### **5.7.6.1 Nonradiological Air Quality. Potential impacts to air quality from construction**

activities would include fugitive dust and exhaust emissions from support equipment assessment showed that the expected construction-related air quality impacts should highly localized.

Emissions resulting from normal operation under this alternative would include emissions and those resulting from the startup of the proposed facilities. Emissions with startup would be less than 1 percent of those from normal operations. Tables the maximum potential concentrations from the proposed alternatives. Ambient concentrations Alternative 4b(2) activities would be below applicable standards and guidelines.

#### **5.7.6.2 Radiological Air Quality. No radiological impacts to the environment would result**

from construction activities.

Emissions resulting from normal operation under this alternative would include emissions and those resulting from the proposed facilities. Table 5.7-4 lists assumptions for spent nuclear fuel alternatives including Regionalization by Geography (Elsewhere). resulting doses to the maximally exposed individual, the population, and workers are small in comparison to the National Emission Standards for Hazardous Air Pollutants 10 millirem per year, the dose limit received from background sources of 351 millirem the population dose from background sources of 40,000 person-rem.

### **5.7.7 Alternative 5a - Centralization at Other DOE Sites**

#### **5.7.7.1 Nonradiological Air Quality. Potential impacts to air quality from construction**

activities would include fugitive dust and exhaust emissions from support equipment assessment showed that the expected construction-related air quality impacts should highly localized.

Emissions resulting from normal operation under this alternative would include emissions and those resulting from the startup of the proposed facilities. Emissions with startup would be less than 1 percent of those from normal operations. Tables

the maximum potential concentrations from the proposed alternatives. Ambient concentrations from Alternative 5a activities would be below applicable standards and guidelines.

#### **5.7.7.2 Radiological Air Quality. No radiological impacts to the environment would result**

from construction activities.

Emissions resulting from normal operation under this alternative would include emissions and those resulting from the proposed facilities. Table 5.7-4 lists associated emissions for spent nuclear fuel alternatives including Centralization at other DOE sites. The resulting doses to the maximally exposed individual, the population, and workers are small in comparison to the National Emission Standards for Hazardous Air Pollutants (NESHAP) of 10 millirem per year, the dose limit received from background sources of 351 millirem per year, and the population dose from background sources of 40,000 person-rem.

### **5.7.8 Alternative 5b - Centralization at the INEL**

#### **5.7.8.1 Nonradiological Air Quality. Potential impacts to air quality from construction**

activities would include fugitive dust and exhaust emissions from support equipment. Assessment showed that the expected construction-related air quality impacts should be highly localized.

Emissions resulting from normal operation under this alternative would include emissions and those resulting from the proposed facilities. Emission rates associated with the proposed facilities would be less than 1 percent of those from normal operation. Table 5.7-2 lists the maximum potential concentrations from the proposed alternatives. Concentrations from Alternative 5b activities would be below applicable standards and guidelines.

#### **5.7.8.2 Radiological Air Quality. No radiological impacts to the environment would result**

from construction activities.

Emissions resulting from normal operation under this alternative would include emissions and those resulting from startup of the proposed facilities. Table 5.7-4 lists emission rates for spent nuclear fuel alternatives including Centralization at the INEL. The resulting doses to the maximally exposed individual, the population, and workers are small in comparison to the National Emission Standards for Hazardous Air Pollutants (NESHAP) of 10 millirem per year, the dose limit received from background sources of 351 millirem per year, and the population dose from background sources of 40,000 person-rem.

## **5.8 Water Resources and Related Consequences**

This section discusses potential environmental consequences to water resources from spent nuclear fuel management alternatives. DOE evaluated each alternative with respect to impacts on water quality (both surface and subsurface water), water use, and human health.

Any liquid effluents from facilities proposed for the spent nuclear fuel management alternatives would be contained in tanks or lined evaporation basins. Under normal operating conditions, radioactive dust or soil or directly to the aquifer would not occur. Creed (1994) presents spent nuclear fuel management data for the analysis of the potential impacts resulting from a hypothetical leak of 100 gallons per day from secondary containment around the SNF storage pools during operations. This section addresses the effects that this leak could have on the quality of subsurface water. Preliminary results indicate that there will be no contaminants above maximum concentrations at the INEL boundary resulting from the postulated operational leak. Some storage pool leakage has occurred in the past. However, based on the bounding accident scenario for high-level liquid leakage, leakage during the implementation of the selected spent nuclear fuel management alternative would cause negligible impacts to water resources (Bowman 1994). None of the proposed alternatives for the management of spent nuclear fuel would result in any renewed discharges to the environment. Section 5.15 discusses potential releases of hazardous or radioactive liquids as a result of facility accidents.

With respect to water usage, Alternative 4b(1) [Regionalization by Geography] (INEL) Alternative 5b (Centralization at the INEL) would consume the largest volume of water. Alternative 4b(1) would consume 400 million gallons over 40 years. The greatest water consumption for the other alternatives would be 50,000 cubic meters (13 million gallons) per year (Hendrickson 1994).

incremental usage would represent approximately a 0.7 percent increase over the total withdrawal rate at the INEL of 7.4 million cubic meters (1.9 billion gallons) per year. Consumptive use water right is 43 million cubic meters (11.4 billion gallons) per year. Alternatives 4b(1) and 5b would have negligible impact on the quantity of water in the River Plain Aquifer.

## 5.9 Ecology

DOE expects that construction impacts, which would include the loss of some wildlife due to land clearing and facility development, would be greatest under Alternative [Regionalization by Geography (INEL)] and Alternative 5b (Centralization at the INEL). Construction activity would take place either within the boundaries of heavily developed areas adjacent to those areas, it would have minimal impact on ecological resources. However, activities could provide opportunities for the spread of exotic plant species (e.g., Russian thistle).

There would be no construction impacts to wetlands, which would be excluded from development, and impacts to threatened and endangered species would be unlikely, given (previously-developed areas) and the maximum size [approximately 31 acres (0.125 square kilometers)] of the affected area. Construction activities at the INEL probably would affect some of the endangered species identified in Section 4.9.3 (the bald eagle and peregrine falcon). These birds of prey are associated with riparian areas, wetlands, and larger bodies of water (reservoirs) and inhabit dry upland areas only temporarily when migrating (National Audubon Society 1987). Disturbance to other sensitive (but not Federally-listed) species in Section 4.9.3 (e.g., the burrowing owl, northern goshawk, ferruginous hawk, Swainson's thrush, Townsend's western big-eared bat, and pygmy rabbit) would be possible but minor on the scale of the planned construction. Any impacts would be negligible and short-lived as long as the construction activities.

Representative impacts from operations would include the disturbance and displacement of animals (such as the pronghorn) caused by the movement and noise of personnel, equipment, and vehicles. Such impacts would be greatest under Alternative 4b(1) [Regionalization by Geography (INEL)] and Alternative 5b (Centralization at INEL), which would involve a general operational activity; however, these impacts would be minor under all the proposed alternatives.

## 5.10 Noise

As discussed in Section 4.10, noises generated on the INEL do not travel off the site that affect the general population. Therefore, INEL noise impacts for each alternative are limited to those resulting from the transportation of personnel and materials to and from the INEL, which would affect nearby communities, and from onsite sources that could affect wildlife.

Transportation noises would be a function of the size of the workforce (e.g., a larger workforce would result in increased employee traffic and corresponding increases in truck and rail; a decreased workforce would result in decreased employee traffic and decreases in deliveries). This analysis of traffic noise considered railroad noise on roadways that provide access to the INEL. DOE does not expect the number of freight trains in the region and through the site to change as a result of any of the alternatives for spent nuclear fuel, regardless of the alternative, would be a small fraction of the Blackfoot-to-Arco Branch of the Union Pacific System line that crosses the INEL. Transportation of employees and personnel on roads would be the principal source of community noise near the INEL.

This analysis used the day-night average sound level to assess community noise, the EPA (EPA 1974, 1982) and the Federal Interagency Committee on Noise (FICON 1992) analysis based its estimate of the change in day-night average sound level from the baseline for each alternative on projected changes in employment and traffic levels. The analysis considers the combination of construction and operation employment. The baseline is comparable to that for the No-Action alternative. Section 4.10 discusses levels relative to the No-Action alternative. The traffic noise analysis considered U.S. Highway 20, which provides access to the INEL from Idaho Falls. Changes in noise level below 3 decibels probably result in a change in community reaction (FICON 1992).

The new employment associated with each alternative is a small percentage of the total workforce. The maximum new employment of about 375 INEL onsite jobs would occur with Alternatives 3, 4a, 4b(1), and 5b during the peak construction period beginning in

Section 5.3, Socioeconomics). No new operations employment is projected for any of except Alternatives 4b(1) and 5b for which there would be 25 new jobs beginning in cumulative onsite workforce under each alternative would be greatest in 1995 and would thereafter. The peak cumulative onsite workforce for Alternatives 4b(2) and 5a would be 1995 by less than 1 percent compared to the No-Action baseline. There would be a small increase in private vehicle and truck trips to the site. The day-night sound level (50 feet) from the roads that provide access to the INEL probably would increase by 1 decibel. The peak cumulative onsite workforce for Alternative 2 in 1995 would be for the No-Action baseline.

For any of the alternatives, truck activity would consist of a few trips per day at the site carrying spent nuclear fuel. This increase in truck trips would not result in an increase in traffic noise levels along the routes to the INEL. The day-night average sound level on Highway 20 and other access routes probably would decrease slightly as a result of the overall decrease in employment levels at the INEL. DOE expects no change in the community's reaction to noise along this route and other access routes. No mitigation efforts

## 5.11 Traffic and Transportation

### 5.11.1 Introduction

Spent nuclear fuel management activities involve the transportation of spent nuclear fuel within the boundaries of the INEL (onsite) and on highways and rail systems outside the boundaries of the INEL (offsite). This section summarizes the methods of analysis used to determine the consequences of onsite transportation of nonnaval spent nuclear fuel under normal conditions (incident-free) and of transportation accidents. The impacts include doses and health effects. Appendices D and I of Volume 1 address consequences of shipments to or from the INEL and other DOE sites and spent nuclear fuel-related locations.

### 5.11.2 Methodology

#### 5.11.2.1 Incident-Free Transportation. Radiological impacts were determined for two

groups of people during normal incident-free transportation: (1) crewmen (drivers) and (2) members of the public. Members of the public are persons sharing the transport link (on-link) and off-link. Radiological impacts were determined for Onsite shipments because members of the public have access to the roads on the INEL. Radiological impacts were calculated using the RADTRAN 4 (Ne Kanipe 1992) and RISKIND (Yuan et al. 1993) computer codes.

The magnitude of the incident-free dose depends mainly on the Transport Index of the shipment and the on-link vehicle densities. The Transport Index is defined as the dose rate (3.28 feet) from the surface of a radioactive package; it is measured in millirem per hour. Spent nuclear fuel was assigned a dose rate of 14 millirem per hour at 1 meter from the surface. This dose rate yielded a dose rate of 10 millirem per hour at 2 meters (6.56 feet) from the transport vehicle, which is the regulatory limit for an exclusive use vehicle (see 40 CFR 171.11).

Radiological doses were converted to cancer fatalities using risk conversion factors of  $5.0 \times 10^{-6}$  fatal cancer per person-rem for members of the public and  $4.0 \times 10^{-5}$  fatal cancer per person-rem for workers. These risk conversion factors are from Publication 60 of the International Commission on Radiological Protection (ICRP 1991).

Because the onsite transportation of spent nuclear fuel at the INEL is considered incident-free nonradiological risk (from exhaust emissions and dust resuspension) with

#### 5.11.2.2 Accidents. The doses of the maximum reasonably foreseeable onsite spent nuclear

fuel transportation accident were calculated using the RISKIND computer code. Doses were calculated for generic rural and suburban population densities, assuming 6 persons per square mile for rural areas and 719 persons per square kilometer for suburban areas. Areas within 80 kilometers of INEL have population densities between rural and suburban but are closer to the suburban population density. Doses were also assessed under both neutral and stable atmospheric conditions. Radiation doses calculated were used to estimate the potential for fatal cancers in the population using risk factors developed by the International Commission on Radiological Protection (ICRP 1991).

The probability of the maximum reasonably foreseeable onsite spent nuclear fuel accident was estimated taking into account spent nuclear fuel handling procedures w Test Reactor facility as well as factors related to transportation of the spent nuc accident to occur, errors must occur in loading the wrong spent nuclear fuel into t radiation surveys of the loaded cask fail to detect abnormally high radiation level vehicle must breakdown or rollover during the short transit between the Advanced Te the Idaho Chemical Processing Plant, and operators fail to ensure that adequate coo maintained inside the cask. The estimated probability of this accident is no greate million years.

The risk of the onsite spent nuclear fuel transportation accident was estimated accident doses by the accident probability, taking into account the probability of conditions used. The resulting risk value gives a bounding estimate of the annual p cancers occurring in the local population due to onsite spent nuclear fuel transpor

### 5.11.3 Onsite Spent Nuclear Fuel Shipments

For each spent nuclear fuel management alternative, a small number of onsite DO fuel shipments would be likely each year as a result of continuing reactor operatio Test Reactor and the Experimental Breeder Reactor-li. The alternatives would not af of these two facilities, thus the shipments be'tween these facilities and the Idaho Plant, integrated over 40 years, would be the same for each spent nuclear fuel mana

Spent nuclear fuel shipments to the Idaho Chemical Processing Plant from four l INEL (including the Test Reactor Area, Argonne National Laboratory-West, Test Area Power Burst Facility) were evaluated. The number of shipments would not change with because DOE plans to ship all spent nuclear fuel to the Idaho Chemical Processing P that would ship spent nuclear fuel off the site under Regionalization [Alternatives and Centralization (Alterntives Sa and Sb) would ship it first to the Idaho Chemica for canning or other stabilization prior to shipment. DOE estimated the total proje shipments over 40 years of operation (1995-2035) from each facility from either his current inventories. DOE based the projected number of shipments for Test Reactor A Argonne National Laboratory-West to the Idaho Chemical Processing Plant on historic 1987 through 1992, and the doses reflect shipments for 1995 through 2035. The proje shipments from Test Area North would include Three Mile Island canisters, Loss of F special case commercial fuel, and non-fuel-bearing components stored in the Test Ar The projected number of shipments from the Power Burst Facility includes all spent at that facility.

Onsite shipments would include those that originated and ended on the INEL site that originate or terminate at non-INEL facilities are offsite shipments. Appendixe the consequences of naval and DOE offsite spent fuel shipments, respectively. Movem nuclear fuel inside (INEL) facility fences (e.g., from the CPP-603 Underwater Stora Fuel Storage Area) are operational transfers, not onsite shipments; therefore, this consider such shipments

### 5.11.4 Incident-Free Impacts

The occupational and general population collective doses from onsite spent nucl shipments and the resulting incidence of latent cancer fatalities were calculated. same regardless of alternative. Occupational radiation exposure would potentially b resulting in 0.0014 latent cancer fatalities. General population exposure would pot person-rem, resulting in 0.000044 latent cancer fatalities.

In addition to collective radiation exposure, the maximally exposed individual onsite SNF shipments were calculated for a driver (occupational exposure), a person shipment, and a person standing beside the road as a single shipment passes by (gen the public). The calculated dose to a driver would be 1.7 rem, assuming that person shipments over 40 years. The calculated maximally exposed individual dose to a pers single shipment covering the longest distance from Test Area North to the Idaho Che Plant would be 0.015 millirem, and to a person exposed to passing shipment at a dis (3.28 feet), the dose would be 0.0014 millirem (Maheras 1995).

Traffic impacts for the spent nuclear fuel shipments were estimated from data i (1994). The maximum number of spent nuclear fuel shipments of 691 per year would oc Alternative Sb, Centralization at the INEL. A maximum 23-percent increase in traffi would occur with this alternative, based on the estimates of the number of trips re



transport of construction equipment, material, spent nuclear fuel, other wastes, and from the INEL. Even if this average daily traffic volume were to occur for 1 hour, traffic volume would increase to 145 vehicles per hour for US 20, US 26, Routes 33 would not change the baseline level of service, which is designated as "free flow."

### 5.11.5 Accident Impacts

An onsite spent nuclear fuel transportation accident involving the inadvertent cooled fuel element from the Advanced Test Reactor to the Idaho Chemical Processing considered to be the maximum reasonably foreseeable accident. The melted spent nuclear potential to relocate into a critical configuration. However, the probability of a much less than  $1 \times 10^{-7}$  per year and would be considered to be not reasonably for 5.11-1 lists the calculated maximally exposed individual dose and collective dose in the maximally impacted sector and corresponding risk of fatal cancers. The dose exposed individual is considered an occupational exposure.

As listed in Table 5.11-1, the total number of fatal cancers expected in the sector affected by the transportation for neutral and stable meteorological conditions would be respectively. For the neutral case, this would represent a 0.01-percent increase for fatal cancers that would be likely from normal incidence in the affected population case, this would represent a 0.20-percent increase from the number of fatal cancers likely from normal incidence in the affected population.

The total number of fatal cancers expected in the rural population affected by for neutral and stable meteorological conditions would be 0.75 and 6.0, respectively. **Table 5.11-1.** Impacts from maximum reasonably foreseeable spent nuclear fuel transport and suburban population densities).

Population density category <sup>a</sup>	Meteorology <sup>c</sup>	Accident frequency <sup>d</sup> (events/yr)	Dose to MEI <sup>e</sup> (rem)	Offsite population dose (person-rem)	Risk fatal per y
Rural	Neutral	$1.0 \times 10^{-6}$	$7.6 \times 10^1$	$1.5 \times 10^3$	$7.5 \times 10^1$ (7.5y)
Rural	Stable	$1.0 \times 10^{-7}$	$2.5 \times 10^2$	$1.2 \times 10^4$	$6.0 \times 10^1$ (6.0y)
Suburban	Neutral	$1.0 \times 10^{-6}$	$7.6 \times 10^1$	$2.1 \times 10^4$	$1.1 \times 10^1$ (1.1y)
Suburban	Stable	$1.0 \times 10^{-7}$	$2.5 \times 10^2$	$1.7 \times 10^5$	$8.5 \times 10^1$ (8.5y)

- Source: Enyeart (1994).
- Results are for generic rural and suburban population densities. The generic rural persons per square kilometer; the generic suburban population density has an average comparison, the sector with the highest population density within 80 kilometers Plant and Test Reactor Area at the INEL with an average population density of 53.
- Neutral meteorology is characterized by Stability Class D, 4 meters-per-second wind time. Stable meteorology is characterized by Stability Class F, 1 meter-per-second time.
- Accident frequency includes both the event frequency and the frequency of the meteorology approximately one-tenth the frequency of neutral meteorology.
- Maximally exposed individual located at the point of maximum exposure to the air (1,280 feet) downwind, depending on meteorology. For onsite accidents the maximum worker.
- Fatal cancer risk = dose times accident frequency times (ICRP 60 risk factor for cancer per rem for public,  $4.0 \times 10^{-4}$  fatal cancer per rem for workers. For doses doubled. Numbers in parentheses indicate the total number of fatal cancers in the exposed individual dose is considered an occupational exposure. case, this would represent a 0.09-percent increase from the number of fatal cancers likely from normal incidences in the affected population. For the stable case, this 1.7-percent increase from the number of fatal cancers that would be likely from normal the affected population.

The estimated maximum nonradiological occupational and general population traffic over 40 years due to any of the spent nuclear fuel management alternatives would be  $2.5 \times 10^{-3}$ , respectively. These estimated fatalities were based on fatality risk shipments (Cashwell et al 1986).

### 5.11.6 Onsite Mitigative and Preventative Measures

All onsite shipments would be in compliance with DOE ID Directive 5480.3, "Hazardous Materials Packaging and Transportation Safety Requirements." These requirements provide that, under normal conditions, the INEL would meet as-low-as-reasonably-achievable reasonably foreseeable accident situations (those with a probability of occurrence per year) would not result in a loss of shielding or containment or a criticality, release of radioactive material would generate a timely response.

DOE would approve the type packages used for onsite shipments or would obtain a Regulatory Commission or DOE certificate of compliance. If the Type B onsite package requires Nuclear Regulatory Commission or DOE certification, the user of the package would have to maintain administrative controls and site-mitigating circumstances would ensure that the maintain containment and shielding integrity. The administrative and emergency response considerations would provide sufficient control so that accidents would not result in containment or shielding, in criticality, or in an uncontrolled release of radioactive material that create a hazard to the health and safety of the public or workers.

In the event of an accident, each DOE site has an established emergency management program. This program incorporates activities associated with emergency planning, preparedness, and participation with government agencies with plans that are interrelated with the INEL Emergency Action Plan. The State of Idaho, Bingham County, Bonneville County, Butte County, Jefferson County, the Bureau of Indian Affairs, and Fort Hall Indian Reservation. When an emergency condition exists at a facility, the Emergency Action Director is responsible for classification, notification, and protective action recommendations. At INEL, emergency resources include fire protection, radiological and hazardous chemical material response team, the INEL Warning Communication Center, the INEL Site Emergency Operations Center, and medical facilities.

## 5.12 Occupational and Public Health and Safety

This section presents DOE's estimates of the health effects from spent nuclear fuel activities at the INEL for the following human receptor groups:

- Involved Workers - workers at the facilities involved with spent nuclear fuel including existing workers and new hires for selected alternative
  - Maximally Exposed Individual (MEI) - person residing at the INEL site boundary
  - Population - the general offsite population in the INEL region
  - Construction Worker - labor force associated with construction activities
  - Nonconstruction Worker - DOE labor force associated with nonconstruction activities
- Radiological, chemical, and industrial safety hazards were considered in the estimates.

### 5.12.1 Radiological Exposure and Health Effects

The measure of impact used for evaluation of potential radiation exposures is risk of cancer. Worker and maximally exposed individual effects are reported as individual (in rem) and the estimated lifetime probability of fatal cancer. Population effect is reported as collective radiation dose (in person-rem) and the estimated number of fatal cancers in the population. Tables 5.12-1, 5.12-2, 5.12-3, and 5.12-4 summarize the radiological health calculations for each alternative.

Activities that workers would perform under each of the alternatives would be similar to those currently performed at the INEL. Therefore, the potential hazards encountered in the alternatives would be similar to those that currently exist at the INEL. Further, DOE would mitigate occupational and radiological safety programs operating under the same regulatory standards that currently apply at the INEL. For these reasons, DOE anticipates that the average annual occupational radiation exposure and employment summary.

	No Action (1)	Decentralization (2)	1992/1993 Planning Basis (3)	Regionalization by Fuel Type (4a)b
Number of Workers (annual average over years 1995- 2004)c	1	1	200	200

Worker Collective    0.027                      0.027                      5.4                      5.4  
Dosed  
(person-rem/year)

a. Source: Johnson (1995).

b. Alternative 4b(1), Regionalization by Geography (INEL), values are the same as t  
Regionalization by Geography (Elsewhere), values are the same as those for Alter

c. This 10-year average yields conservatively high employment; the 40-year average

d. Based on thermoluminescence dosimetry records.

**Table 5.12-2.** Annual nonoccupational radiation exposure summary.

	No Action (1)	Decentralization (2)	1992/1993 Planning Basis (3)	Regionalization by Fuel Type (4a)b
MEI Dose (mrem/year)	3.5y10-3	3.5y10-3	8.0y10-3	8.0y10-3
Population Dosea (person- rem/year)	1.0y10-1	1.0y10-1	1.9y10-1	1.9y10-1

a. Population dose is calculated based on the projected population in 2000.

b. Alternative 4b(1), Regionalization by Geography (INEL), values are the same as t  
Regionalization by Geography (Elsewhere), values are the same as those for Alter

**Table 5.12-3.** Annual fatal cancer incidence and probability summary from radiologi

	No Action (1)	Decentralization (2)	1992/1993 Planning Basis (3)	Regionalization by Fuel Type (4a)b
Worker probability	1y10-5	1y10-5	1y10-5	1y10-5
incidence	1y10-5	1y10-5	2y10-3	2y10-3

Maximally  
exposed member  
of the public

probability	2y10-9	2y10-9	4y10-9	4y10-9
Population incidence	5y10-5	5y10-5	1y10-4	1y10-4

a. Risk factors for the worker (4y10-4 probability of occurrence per rem) or offsit  
recommended by the International Commission on Radiological Protection (ICRP 199

b. Alternative 4b(1), Regionalization by Geography (INEL), values are the same as t  
Regionalization by Geography (Elsewhere), values are the same as those for Alter

**Table 5.12-4.** 40-year fatal cancer incidence summary from radiological exposure.

	No Action (1)	Decentralization (2)	1992/1993 Planning Basis (3)	Regionalization Fuel Type (4a)
Workers incidence	4y10-4	4y10-4	8y10-2	8y10-2
Population incidence	2y10-3	2y10-3	4y10-3	4y10-3

a. Alternative 4b(1), Regionalization by Geography (INEL), values are the same as t  
Regionalization by Geography (Elsewhere), values are the same as those for Alter  
and the number of reportable cases of injury and illness would be proportional to t  
workers at the INEL under each alternative.

Table 5.12-1 lists involved worker doses based on an historic annual average do  
determined from thermoluminescent dosimeter data of workers involved in various INE  
work over the period 1987 to 1991 (see Appendix F of Volume 2). As mentioned abov  
associated with spent nuclear fuel activities are the same as the hazards associate  
activities. Table 5.12-2 lists the exposure summaries for the maximally exposed in  
population, based on radioactive emissions from normal operations and those resulti  
proposed facilities for the various alternatives. Note that population collective  
worker collective dose only under alternatives 1 and 2. For the alternatives, ther  
worker averaged over 40 years. The nonoccupational population has more people to b  
When the worker population increases under Alternatives 3, 4, and 5, the worker dos  
than the population dose. Section 5.7 presents the exposure information. Dose cal  
on air emissions only, and not water pathways because none of the alternatives woul  
discharge of pollutants to surface waters or to the subsurface. Section 5.8 summar

Table 5.12-3 summarizes the fatal cancer incidence and probability for workers, exposed individuals, and the offsite population based on the risk factors consistent with the International Commission on Radiological Protection (ICRP 1991). For the alternatives, the probability of developing fatal cancer for any individual would be a maximum value of  $1 \times 10^{-5}$  for the involved worker. The calculated incidence of fatal cancer for the total number of workers for each alternative and the offsite population would be less than  $1 \times 10^{-5}$ .

Table 5.12-4 summarizes the 40-year projection of fatal cancer incidence associated with workers and offsite populations. The highest involved worker and offsite population, respectively, would be associated with Alternative 5b.

Radiation doses associated with construction activities would be as low as feasible and no greater than 2 rem per year to any worker. Historical offsite doses associated with the project are summarized in the Idaho National Engineering Laboratory Historical Dose Evaluation. The Centers for Disease Control and Prevention is conducting a more comprehensive review of radiation doses from INEL operations.

### 5.12.2 Nonradiological Exposure and Health Effects

The air quality data listed in Tables 5.7-1 and 5.7-2 were used to evaluate health effects associated with potential exposure to two compound classes, criteria pollutant and noncriteria pollutant. Table 5.7-1 lists five pollutant criteria and Table 5.7-2 lists six toxic air pollutant compounds. Compounds were classified as noncarcinogens or carcinogens, consistent with EPA designations published in the Integrated Risk Information System (IRIS) data base. However, the data does not include sufficient data to perform a quantitative inhalation cancer risk assessment.

Nonradiological health effects (hazard indices) for the INEL worker or maximally exposed individual were estimated by summing the ratios of the appropriate pollutant concentration to applicable standards presented in Table 5.7-1 and Table 5.7-2. Table 5.7-1 presents concentrations at public access roads, which are the maximum of those calculated at the boundary, public access roads inside the INEL site boundary, and the Craters of the Moon. The hazard index for the five criteria pollutants is less than 1 (0.2) for the maximally exposed individual, based on concentrations for the longest averaging time. Table 5.7-2 presents toxic air pollutant concentrations at the public access roads, which are the maximum when compared with concentrations at the INEL site boundary and the Craters of the Moon Wilderness Area. The hazard index for the toxic air pollutants is also less than 1 for workers or the maximally exposed individual, based on concentrations with annual averaging time. Accordingly, health effects are unlikely for either the criteria pollutants or the toxic air pollutants from spent nuclear fuel-related activities. The hazard index is not a risk index; therefore, it cannot be interpreted as such.

### 5.12.3 Industrial Safety

This section describes the following measures of impact for workplace hazards: (1) reportable injuries and illness and (2) fatalities in the work force. This analysis evaluates fatality rates for construction workers only since the alternatives do not result in new operations employment. Table 5.12-5 lists the maximum annual number of projected illnesses and fatalities for construction workers by alternatives based on the maximum levels for any year between 1995-2035.

**Table 5.12-5. Annual industrial safety health effects incidence summary.** ,b

	No Action (1)	Decentralization (2)	1992/1993 Planning Basis (3)	Regionalization by Fuel Type (4a) c
Construction workers				
Injury/illness	0	0	23	23
Fatality	0	0	<1	<1

a. 1988-1992 averages for occupational injury/illness and fatality rates for DOE and INEL.

b. Sources: DOE (1993b) and Section 5.3 of this appendix.

c. Alternative 4b(1) values are the same as those for Alternative 5b. Alternative 5b values are the same as those for Alternative 5a.

### 5.13 Idaho National Engineering Laboratory Services

This section discusses the potential impacts from spent nuclear fuel management and transportation activities associated with the project.

energy at the INEL. It considers the consumption of water, electrical energy, fossil wastewater discharge at the INEL site.

### 5.13.1 Construction

Table 5.13-1 summarizes estimates of annual requirements for electricity, water diesel fuel for construction activities associated with each alternative and compares 1995 use levels for these resources. In general, the smallest increase in the demand would result from Alternatives 4b(2) and 5a [Regionalization by Geography (Elsewhere Centralization at Other DOE Sites)] and the largest increase would be associated with 4b(1) and 5b [Regionalization by Geography (INEL) and Centralization at INEL].

**Table 5.13-1.** Estimated increase in annual electricity, water, wastewater treatment requirements for construction activities associated with each alternative.

Service	Projected 1995 usage w/o Alternative	Estimated additional demand		
		Alternatives 1 and 2	Alternatives 3 and 4a	Al 4b
Electricity (MWha per year)	208,000	71	150	2,
Water (millions of liters per year) <sup>b</sup>	6,450	No increase	2.1	2.
Sanitary wastewater (millions of liters per year)	540	No increase	1.5	4.
Diesel fuel (liters per year)	5,830,000	6,400	8,500	14

a. MWH = megawatt hours.

b. To convert liters to gallons, multiply by 0.264.

Source: Hendrickson (1995).

Under Alternatives 4b(1) and 5b, the estimated annual increases in utility and from construction activities would be 2,100 megawatt-hours of electricity, 2.2 million (580,000 gallons) of water, 4.5 million liters (1,200,000 gallons) of wastewater and 14,000 liters (3,700 gallons) of diesel fuel. These changes represent modest increases near zero percent to 1.0 percent above projected 1995 usage levels and are well within capabilities and usage limits (see Section 4.13). The other alternatives would result in increases in energy usage and would have no adverse impact on utility services at the site.

### 5.13.2 Operations

Table 5.13-2 summarizes estimates of annual requirements for electricity, water diesel fuel for operations activities associated with each alternative and compares them to usage of these resources. In general, the smallest increase in the demand for site from Alternatives 1 and 2 (No-Action and Decentralization) and the largest would be Alternatives 4b(1) and 5b [Regionalization by Geography (INEL) and Centralization at INEL].

Service	Projected 1995 usage w/o Alternative	Estimated additional demand		
		Alternatives 1 and 2	Alternatives 3 and 4a	Al 4b
Electricity (MWha per year)	208,000	180	2,200	11
Water (millions of liters per year) <sup>b</sup>	6,450	No increase	No increase	48
Sanitary wastewater (millions of liters per year) <sup>c</sup>	540	No increase	No increase	0.
Fuel oil (liters per year)	11,100,000	28,000	330,000	1,

a. MWH = megawatt hours.

b. To convert liters to gallons, multiply by 0.264.

c. Some industrial wastewater, such as steam condensate, is also discharged to evaluate Sources: Hendrickson (1995).

Under Alternatives 4b(1) and 5b, the estimated annual increases in utility and from operations activities would be 11,000 megawatt-hours of electricity, 48 million gallons of water, 0.3 million liters (79,000 gallons) of wastewater, and 1,100,000

(290,000 gallons) of fuel oil. These changes represent modest increases ranging from 1 percent to 10 percent and are well within current system capabilities and usage limits (Section 4.13). The other alternatives would result in smaller increases in energy use and have no adverse impact on utility services at the INEL.

## 5.14 Materials and Waste Management

This section discusses the impacts to the management of materials and wastes at the Idaho Falls facilities as a result of the implementation of the spent nuclear fuel alternatives. Alternatives 4b(1), and 5b, both with the spent fuel processing option, represent the upper bound of potential impacts on projected rates of generation, treatment, storage, and inventories of materials and wastes. Table 5.14-1 and 5.14-2 summarize waste generation for each alternative. The tables present average generating rates over the life cycle and maximum annual increments over peak generation periods.

### 5.14.1 Alternative 1 - No Action

Under the No Action Alternative, 9 cubic meters of industrial solid waste would be generated during construction of the Alternate Fuel Storage Facility for the TAN Pool Fuel Treatment at the Idaho Chemical Processing Plant. At the completion of this project in 1998, there would be 485 cubic meters of non-fuel solid low-level waste consisting of Three Mile Island debris that would be removed and dispositioned in a separate project. These impacts are described in Table 5.14-1 as an increase in low-level waste generation.

### 5.14.2 Alternative 2 - Decentralization

In general, the character of the impacts to materials and waste management would be similar to those under the No Action Alternative.

### 5.14.3 Alternative 3 - 1992/1993 Planning Basis

Industrial solid waste would be generated from construction and operation of the projects under Alternative 3. This nonradioactive waste would be disposed of in the Area landfill. Landfill space is nonrestrictive for industrial solid waste disposal activities. Table 5.14-1. Average annual waste generation projections for selected SNF management alternatives.

Alternative	Waste type	Phase
No Action (Alternative 1) and Decentralization (Alternative 2)	Industrial	Construction
1992/1993 Planning Basis (Alternative 3) and Regionalization by Fuel Type (Alternative 4a)	Industrial	Construction
	Low-Levelb,c	Operation
	High-Level	Operation
	Mixed Low-Level	Operation
	Transuranic	Operation
Regionalization by Geography (INEL) [Alternative 4b(1)] and Centralization at INEL (Alternative 5b)	Industrial	Construction
	Low-Levelb,c	Operation
	High-Level	Operation
	Mixed Low-Level	Operation
	Transuranic	Operation
Regionalization by Geography (Elsewhere) [Alternative 4b(2)] and Centralization at Other	Industrial	Construction
		Operation

DOE Sites (Alternative 5a)

Low-Level	Operation
High-Level	Operation
Mixed Low-Level	Operation
Transuranic	Operation

a. Source: Appendix C of Volume 2 of this EIS.

b. Low-level waste from TAN Pool Fuel Transfer Project to be removed and dispositioned.

c. Low-level waste generated from dispositioning and decontamination of fuel racks

Table 5.14-2. Peak waste generation highlights for selected SNF management alternatives

Alternative	Waste type	Phase
No Action (Alternative 1) and Decentralization (Alternative 2)	Industrial	Construction
1992/1993 Planning Basis	Industrial	Construction
(Alternative 3) and Regionalization by Fuel Type (Alternative 4a)	Low-Levelb,c	Operation Construction Concurrent Acti
	High-Level	Operation
	Mixed Low-Level	Operation
	Transuranic	Operation
Regionalization by Geography (INEL) [Alternative 4b(1)] and Centralization at INEL (Alternative 5b)	Industrial	Construction Operation
	Low-Levelb,c	Construction Operation Concurrent Acti
	High-Level	Operation
	Mixed Low-Level	Operation
	Transuranic	Operation
Regionalization by Geography (Elsewhere) [Alternative 4b(2)] and Centralization at Other DOE Sites (Alternative 5a)	Industrial	Construction Operation
	Low-Level	Operation
	High-Level	Operation
	Mixed Low-Level	Operation
	Transuranic	Operation

a. Source: Appendix C of Volume 2 of this EIS.

b. Low-level waste from TAN Pool Fuel Transfer Project to be removed and dispositioned.

c. Low-level waste generated from dispositioning and decontamination of fuel racks

d. Construction and operations occurring simultaneously.

waste. The Fuel Receiving, Canning, Characterization, and Shipping Facility will generate industrial waste of any of the projects, 490 cubic meters per year from 2005 through 2009.

In addition, the Fuel Receiving, Canning, Characterization, and Shipping Facility will generate 220 cubic meters per year of low-level waste during the same period. The Dry Storage Facility will generate an additional 5 cubic meters of low-level waste annually from 2005 through 2009. Liquid low-level waste, the Increased Rack Capacity and Additional Increased Rack Capacity would increase generation rates by 570 cubic meters annually during construction from 1997. Low-level waste would decrease to approximately 160 cubic meters per year from 1999 with the completion of the Increased Rack Capacity project. Liquid low-level waste would be disposed in existing liquid waste processing systems at the Idaho Chemical Processing Plant. Radioactive wastes would be packaged and disposed of at the Radioactive Waste Management Complex, or incinerated at the Waste Experimental Reduction Facility, whichever is appropriate. Low-level waste from reracking fuel racks for the Increased Rack Capacity Project would be decontaminated and dispositioned by a licensed commercial vendor.

Experimental Breeder Reactor-II Blanket Treatment will generate 7 cubic meters of low-level waste for 1 year from 1997 to 1998.

The storage of low-level waste for incineration is not considered to be restricted through 2005. However, beyond 2005, low-level waste storage capacity may become a constraint. Commercial facilities to incinerate the backlog of low-level waste is under consideration. To reduce or prevent the accumulation of low-level waste, but no firm commitment or contract has been established (EG&G 1993a).

The Radioactive Waste Management Complex appears to have adequate disposal capacity for low-level waste between 1995 and 2005. However, beyond 2005, additional capacity may be required. Excess capacity would be provided with the development of the proposed Low-Level Waste

Low-Level Waste Disposal Facility (EG&G 1993a).

The Electrometallurgical Process Demonstration Project will generate high-level level, low-level, transuranic, and industrial wastes from the demonstration and tes fuel management processes from 1996 through 2024.

Experimental Breeder Reactor-II Blanket Treatment will also generate high-level level, and transuranic wastes.

High-level waste would be immobilized after 2005, and may eventually be transpo Federal high-level waste and spent nuclear fuel repository for disposal. Transuran waste acceptance criteria to be developed could be shipped to a potential Federal r disposal should one be selected (EG&G 1993a).

#### **5.14.4 Alternative 4a - Regionalization by Fuel Type**

In general, the character of the impacts to materials and waste management woul those under Alternative 3.

#### **5.14.5 Alternative 4b(1) - Regionalization by Geography (INEL)**

The character and intensity of impacts on waste management activities at the IN those under Alternatives 3 and 4a for some of the SNF management projects including Fuel Transfer Project at the Idaho Chemical Processing Plant; the Increased Rack Ca Additional Increased Rack Capacity projects; the Experimental Breeder Reactor-II Bl facility; and the Electrometallurgical Process Demonstration Project. Under Altern Fuel Storage Facility is expanded and Fuel Receiving, Canning/Characterization, and waste streams decrease relative to Alternatives 3 and 4a; however, the net effect o on industrial/commercial solid waste generation and low-level waste generation for and operation results in waste generation rates similar to those under Alternatives

The increase in average and peak generation rates over Alternatives 3 and 4a (T 5.14-2) is due to the Spent Fuel Processing option included under Alternative 4b(1) for the relative increase in generation rates over Alternatives 3 and 4a. Fuel pro in order to stabilize the spent nuclear fuel and remove risks associated with stora to manage the resultant high-level waste in a cost-effective manner. If this alter aggressively, the generated high-level waste residual resulting from segregating fi the spent nuclear fuel may require additional high-level waste tankage. This incre would be covered by the High-Level Tank Farm New Tanks project described in Volume

Capacity discussions for industrial/commercial solid waste and low-level waste Alternative 3 apply to Alternative 4b(1).

#### **5.14.6 Alternative 4b(2) - Regionalization by Geography (Elsewhere)**

Construction phase activities would generate a cumulative total of 50 cubic met and commercial solid waste. Overall, waste generation would be lower than all of t management alternatives, with the exceptions of the No Action and Decentralization

#### **5.14.7 Alternative 5a - Centralization at Other DOE Sites**

In general, the character of the impacts to materials and waste management woul those under Alternative 4b(2).

#### **5.14.8 Alternative 5b - Centralization at the INEL**

In general, the character of the impacts to materials and waste management woul those under Alternative 4b(1).

### **5.15 Accidents**

#### **5.15.1 Introduction**



Activities associated with the transportation, receipt, handling, stabilization nuclear fuel at the INEL involve substantial quantities of radioactive materials and toxic chemicals. Under certain circumstances, the potential exists for accidents in materials to occur, which would result in exposure to INEL workers or members of the contamination of the surrounding environment. Accidents can be categorized as follows:

- Abnormal events such as minor spills
- Design-basis events, which a facility is designed to withstand
- Beyond-design-basis events, which a facility is not designed to withstand (consequences it may nevertheless mitigate)

This section summarizes postulated radiological and toxic material accidents in category and describes their estimated consequences to workers, members of the public environment. The scope of this section is limited to accidents within facilities; accidents between facilities are addressed in Section 5.11. [Further information on summarized in this section, as well as information on other "lower consequence" accidents provided in Slaughterbeck et al. (1995)].

An accident is a series of unexpected or undesirable "initiating" events that release radioactive or toxic materials within a facility or to the environment. This analysis events that can lead to a spent nuclear fuel-related facility accident in three broad categories: external initiators, internal initiators, and natural phenomena initiators. External initiators (e.g., nearby explosions or toxic material releases) originate outside the facility and are of the facility to maintain confinement of radioactive or hazardous material. Internal initiators originate within a facility (e.g., equipment failures or human error) and are usual operation. Sabotage and terrorist activities (i.e., intentional human initiators) or internal initiators. Natural phenomena initiators include weather-related (e.g., and seismic events. This analysis defines initiators in terms of events that cause a release of radioactive or hazardous materials within a facility or to the environment by bypass of confinement.

Tables 5.15-1 through 5.15-4 summarize the radiological results of the analyses in this section. Section 5.15.2 summarizes historic accidents at the INEL associated with fuel-related activities. Section 5.15.3 describes the methodology used to identify radiological accidents associated with spent nuclear fuel receipt, handling, storage, and transportation activities. Sections 5.15.4 and 5.15.5 evaluate the postulated maximum foreseeable radiological and toxic material accidents, respectively.

## 5.15.2 Historic Perspective

Many of the actions proposed under the different spent nuclear fuel management considered in this EIS are continuations or variations of past practices at the INEL. This section describes the consequences to the public from historic INEL accidents in detail and has determined (DOE 1991).

Consequences of accidents can involve fatalities, injuries, or illness. Fatalities (immediate), such as in construction accidents, or latent (delayed), such as cancer exposure. While public comments received in scoping meetings for this EIS included about potential accidents at the INEL, the historic record demonstrates that DOE facilities at the INEL, have a very good safety record, particularly in comparison to commercial (e.g., agriculture and construction). Figure 5.15-1 shows the rate of worker fatalities at other DOE sites (DOE 1993b) compared to national-average rates that the National Safety Council (NSC 1993) and State of Ohio (Hendrix 1994). While past accident occurrence rates are not necessarily indicative of future rates, the historic record reflects the DOE emphasis on safe operations.

There have been no prompt fatalities and no known latent fatalities to members of the public from accidental releases of radioactive or hazardous materials associated with spent nuclear fuel management activities in the 40-year history of INEL facilities, although some accidents have occurred. Table 5.15-1. Summary of radiological accidents for worker located 100 meters downwind.

Accident Description	Attribute	Alternative 1 No Action	Alternative 2 Decentralized
1. Fuel handling accident, fuel pin breach, venting of noble gases and iodine at HFEFb	Consequences	(d)	(d)
	Adjusted annual frequency	1.0y10 <sup>-2</sup>	1.2y10 <sup>-2</sup>

	Adjusted point estimate of risk	(d)	(d)
2. Uncontrolled chain reaction (criticality) at ICPPf	Consequencesc	3.9y10-5	3.9y10-5
	Adjusted annual frequency	1.0y10-3	1.0y10-3
	Adjusted point estimate of risk	4.0y10-8	4.0y10-8
3. Fuel melting of small number of assemblies at HFEF resulting from seismic event and cell breach	Consequencesc	2.5y10-4	2.5y10-4
	Adjusted annual frequency	1.0y10-5	1.0y10-5
	Adjusted point estimate of risk	2.5y10-9	2.5y10-9
4. Material release from HFEF resulting from aircraft crash and ensuing fire	Consequencesc	1.8y10-3	1.8y10-3
	Adjusted annual frequency	1.0y10-7g	1.0y10-7g
	Adjusted point estimate of risk	1.8y10-10	1.8y10-10
5. Inadvertent nuclear criticality at ICPPf CPP-666 during processing	Consequencesc	(h)	(h)
	Adjusted annual frequency	(h)	(h)
	Adjusted point estimate of risk	(h)	(h)
6. Hydrogen explosion in ICPPf CPP-666 dissolver	Consequencesc	(h)	(h)
	Adjusted annual frequency	(h)	(h)
	Adjusted point estimate of risk	(h)	(h)
7. Inadvertent dissolution of 30-day cooled fuel at ICPPf CPP-666	Consequencesc	(h)	(h)
	Adjusted annual frequency	(h)	(h)
	Adjusted point estimate of risk	(h)	(h)

- a. The radiological accident results for Alternative 4b(1), "Regionalization by Geo Alternative 5b, as discussed in Section 5.15.4.4. The radiological accident res presented for Alternative 5a, as discussed in Section 5.15.4.4.
- b. HFEF = Hot Fuel Examination Facility.
- c. Consequences are presented in terms of latent fatal cancers based on conservativ estimated exposure (i.e., dose) by an International Commission on Radiological P cancer per rem if the estimated exposure is greater than 20 rem).
- d. The safety analysis report utilized for this accident analysis does not provide As demonstrated by the dose to the maximally exposed individual, consequences to 4. However, given the high frequency for Accident 1 compared to Accidents 2 thr
- e. This attribute is equal to consequences y frequency (events per year). The info
- f. ICPP = Idaho Chemical Processing Plant.
- g. This frequency is a qualitative bounding estimate for a potential aircraft crash
- h. Resuming processing at the INEL under this alternative is not considered.

**Table 5.15-2.** Summary of radiological accidents for individual located at the near  
 Accident Attribute Alternative 1 Alternative  
 Description No Action Decentraliz

1. Fuel handling accident, fuel	Consequencesc	(d)	(d)
---------------------------------	---------------	-----	-----

pin breach, venting of noble gases and iodine at HFEFb	Adjusted annual frequency	1.0y10 <sup>-2</sup>	1.2y10 <sup>-2</sup>
	Adjusted point estimate of risk	(d)	(d)
	Consequencesc	7.0y10 <sup>-7</sup>	7.0y10 <sup>-7</sup>
2. Uncontrolled chain reaction (criticality) at ICPPf	Adjusted annual frequency	1.0y10 <sup>-3</sup>	1.0y10 <sup>-3</sup>
	Adjusted point estimate of risk	7.0y10 <sup>-10</sup>	7.0y10 <sup>-10</sup>
	Consequencesc	3.3y10 <sup>-4</sup>	3.3y10 <sup>-4</sup>
3. Fuel melting of small number of assemblies at HFEF resulting from seismic event and cell breach	Adjusted annual frequency	1.0y10 <sup>-5</sup>	1.0y10 <sup>-5</sup>
	Adjusted point estimate of risk	3.3y10 <sup>-9</sup>	3.3y10 <sup>-9</sup>
	Consequencesc	1.6y10 <sup>-4</sup>	1.6y10 <sup>-4</sup>
4. Material release from HFEF resulting from aircraft crash and ensuing fire	Adjusted annual frequency	1.0y10 <sup>-7g</sup>	1.0y10 <sup>-7g</sup>
	Adjusted point estimate of risk	1.6y10 <sup>-11</sup>	1.6y10 <sup>-11</sup>
	Consequencesc	(h)	(h)
5. Inadvertent nuclear criticality ICPPf CPP-666 during processing	Adjusted annual frequency	(h)	(h)
	Adjusted point estimate of risk	(h)	(h)
	Consequencesc	(h)	(h)
6. Hydrogen explosion in ICPPf CPP-666 dissolver	Adjusted annual frequency	(h)	(h)
	Adjusted point estimate of risk	(h)	(h)
	Consequencesc	(h)	(h)
7. Inadvertent dissolution of 30-day cooled fuel at ICPPf CPP-666	Adjusted annual frequency	(h)	(h)
	Adjusted point estimate of risk	(h)	(h)
	Consequencesc	(h)	(h)

a. The radiological accident results for Alternative 4b(1), "Regionalization by Geo same as those presented for Alternative 5b, as discussed in Section 5.15.4.4. The "Regionalization by Geography (Elsewhere)," are identical to those presented for Al b. HFEF = Hot Fuel Examination Facility.

c. Consequences are presented in terms of latent fatal cancers based on conservative Consequences are calculated by multiplying the estimated exposure (i.e., dose) by a Protection conversion factor of 5.0 y 10<sup>-4</sup> cancer per person-rem for the offsite po the estimated population exposure is greater than 20 rem for any individual member

d. The safety analysis report utilized for this accident analysis does not provide to DOE Order 5480.23 requiring this information. As demonstrated by the dose to the public from this accident could be less than the consequences from Accidents 2 thro this accident compared to Accidents 2 through 4, the risk could actually be greater e. This attribute is equal to consequences y frequency (events per year). The info meteorological conditions.

f. ICPP = Idaho Chemical Processing Plant.

g. This frequency is a qualitative bounding estimate for a potential aircraft crash

h. Resuming processing at the INEL under this alternative is not considered.

**Table 5.15-3.** Summary of radiological accidents for maximally exposed hypothetical

Accident Description	Attribute	Alternative 1 No Action	Alternative Decentraliz
1. Fuel handling accident, fuel pin breach, venting of noble gases and iodine at HFEFb	Consequencesc	1.0y10-6	1.0y10-6
	Adjusted annual frequency	1.0y10-2	1.2y10-2
	Adjusted point estimate of riskd	1.0y10-8	1.2y10-8
2. Uncontrolled chain reaction (criticality) at ICPPe	Consequencesc	5.0y10-7	5.0y10-7
	Adjusted annual frequency	1.0y10-3	1.0y10-3
	Adjusted point estimate of riskd	5.0y10-10	5.0y10-10
3. Fuel melting of small number of assemblies at HFEF resulting from seismic event and cell breach	Consequencesc	2.5y10-3	2.5y10-3
	Adjusted annual frequency	1.0y10-5	1.0y10-5
	Adjusted point estimate of riskd	2.5y10-8	2.5y10-8
4. Material release from HFEF resulting from aircraft crash and ensuing fire	Consequencesc	2.5y10-3	2.5y10-3
	Adjusted annual frequency	1.0y10-7f	1.0y10-7f
	Adjusted point estimate of riskd	2.5y10-10	2.5y10-10
5. Inadvertent nuclear criticality ICPPe CPP-666 during processing	Consequencesc	(g)	(g)
	Adjusted annual frequency	(g)	(g)
	Adjusted point estimate of riskd	(g)	(g)
6. Hydrogen explosion in ICPPe CPP-666 dissolver	Consequencesc	(g)	(g)
	Adjusted annual frequency	(g)	(g)
	Adjusted point estimate of riskd	(g)	(g)
7. Inadvertent dissolution of 30-day cooled fuel at ICPPe CPP-666	Consequencesc	(g)	(g)
	Adjusted annual frequency	(g)	(g)
	Adjusted point estimate of riskd	(g)	(g)

a. The radiological accident results for Alternative 4b(1), "Regionalization by Geo Alternative 5b, as discussed in Section 5.15.4.4. The radiological accident res presented for Alternative 5a, as discussed in Section 5.15.4.4.

b. HFEF = Hot Fuel Examination Facility.

c. Consequences are presented in terms of latent fatal cancers based on conservativ estimated exposure (i.e., dose) by an International Commission on Radiological P (or 1.0 y 10-3 cancer per rem if the estimated population exposure is greater th

d. This is equal to consequences y frequency (events per year). The information is

e. ICPP = Idaho Chemical Processing Plant.

f. This frequency is a qualitative bounding estimate for a potential aircraft crash

g. Resuming processing at the INEL under this alternative is not considered.

**Table 5.15-4.** Summary of radiological accidents for offsite population within 80 k  
 Accident  
 Description

Attribute		Alternative 1 No Action	Alternative Decentraliz
1. Fuel handling accident, fuel pin breach, venting of noble gases and iodine at HFEFb	Consequencesc	(d)	(d)
	Adjusted annual frequency	1.0y10-2	1.2y10-2
	Adjusted point estimate of riske	(d)	(d)
2. Uncontrolled chain reaction (criticality) at ICPPf	Consequencesc	3.0y10-4	3.0y10-4
	Adjusted annual frequency	1.0y10-3	1.0y10-3
	Adjusted point estimate of riske	3.0y10-7	3.0y10-7
3. Fuel melting of small number of assemblies at HFEF resulting from seismic event and cell breach	Consequencesc	7.0y100	7.0y100
	Adjusted annual frequency	1.0y10-5	1.0y10-5
	Adjusted point estimate of riske	7.0y10-5	7.0y10-5
4. Material release from HFEF resulting from aircraft crash and ensuing fire	Consequencesc	1.0y100	1.0y100
	Adjusted annual frequency	1.0y10-7g	1.0y10-7g
	Adjusted point estimate of riske	1.0y10-7	1.0y10-7
5. Inadvertent nuclear criticality ICPPf CPP-666 during processing	Consequencesc	(h)	(h)
	Adjusted annual frequency	(h)	(h)
	Adjusted point estimate of riske	(h)	(h)
6. Hydrogen explosion in ICPPf CPP-666 dissolver	Consequencesc	(h)	(h)
	Adjusted annual frequency	(h)	(h)
	Adjusted point estimate of riske	(h)	(h)
7. Inadvertent dissolution of 30-day cooled fuel at ICPPf CPP-666	Consequencesc	(h)	(h)
	Adjusted annual frequency	(h)	(h)
	Adjusted point estimate of riske	(h)	(h)

a. The radiological accident results for Alternative 4b(1), "Regionalization by Geo  
 Alternative 5b, as discussed in Section 5.15.4.4. The radiological accident res  
 presented for Alternative 5a, as discussed in Section 5.15.4.4.

b. HFEF = Hot Fuel Examination Facility.

c. Consequences are presented in terms of latent fatal cancers based on conservativ  
 estimated exposure (i.e., dose) by an International Commission on Radiological P  
 (or 1.0 y 10-3 cancer per rem if the estimated population exposure is greater th

d. The safety analysis report utilized for this accident analysis does not provide  
 As demonstrated by the dose to the maximally exposed individual, consequences to  
 4. However, given the high frequency for this accident compared to Accidents 2

- e. This attribute is equal to consequences y frequency (events per year). The info
- f. ICPP = Idaho Chemical Processing Plant.
- g. This frequency is a qualitative bounding estimate for a potential aircraft crash
- h. Resuming processing at the INEL under this alternative is not considered.

Figure 5.15-1. Comparison of fatality rates among workers in various industry gr  
Processing Plant CPP-601 Fuel Element Cutting Facility failed during decontaminatio  
estimated 100 curies of particulate radioactivity were released over an area of app  
(0.809 square kilometers) in the vicinity of the Idaho Chemical Processing Plant.  
39 curies became airborne, resulting in an estimated dose of 0.11 millirem to a hyp  
individual located at the nearest site boundary (DOE 1991).

Three inadvertent nuclear chain reactions (i.e., nuclear criticalities) occurre  
Chemical Processing Plant in 1959, 1961, and 1978. The 1959 criticality occurred i  
and cell floor drain collection tank. Available evidence indicates that the critic  
from an accidental transfer of concentrated uranyl nitrate solution to the waste co  
a line normally used to transfer decontaminating solutions to the waste tank. The  
release from this incident was 3,700 curies, and the estimated dose to the maximall  
hypothetical individual located at the nearest site boundary was 1.1 millirem (DOE  
and 1978 nuclear criticalities resulted from spent nuclear fuel dissolution and rep  
Estimated releases to the environment as a result of these accidents were 120 curie  
the 1961 and 1978 accidents, respectively, and the calculated radiation doses at th  
boundary were less than 0.1 millirem for both releases (DOE 1991).

The INEL Fluorinel and Storage (FAST) facility (CPP-666), which historically pe  
nuclear fuel-related reprocessing activities, is currently shut down. Activities a  
this facility in a permanent shutdown mode. Restart of this facility and the poten  
nuclear criticality resulting from operating this facility are considered in Sectio  
[Alternatives 4b(1) and 5b, respectively]. Because DOE has no current plans to res  
fuel reprocessing activities at the Idaho Chemical Processing Plant, events similar  
nuclear criticalities discussed above will be unlikely in future INEL spent nuclear  
activities. Additional information regarding the historical accidents summarized a  
Slaughterbeck et al. (1995).

In the site's 40-year history, three prompt fatalities of INEL workers have occ  
involving radiation exposure. In 1961, a steam explosion resulting from an unplann  
criticality in an experimental reactor (Stationary Low-Power Reactor No. 1) killed  
were manually moving reactor control elements. The estimated dose from this accide  
hypothetical individual located at the nearest site boundary was approximately 3 mi  
All the accidents discussed above have caused contamination that has led to seconda  
as the contamination of facility equipment and land inside the site boundary, and h  
cleanup.

Twenty workers at the Argonne National Laboratory-West facility area were injur  
1994 when, in an accident involving toxic material exposure, approximately 9 kilogr  
of chlorine gas used to treat potable (i.e., drinking) water were accidentally releas  
Although an investigation into this incident by the DOE was still ongoing at the ti  
performed, the accident is presumed to have occurred while a vendor was removing an  
nearly empty chlorine cylinder. A maintenance employee assisting in the activity a  
disconnected the nearly empty in-service chlorine gas cylinder from the potable wat  
cylinder valve in the open position, resulting in the remaining tank contents being  
environment. As a result of the accidental release, 20 workers were sent to a loca  
workers reported for treatment of minor respiratory distress, one worker reported s  
serious respiratory problems, and one worker reported back injuries as a result of  
responding to the accident. (ANL 1994 and DOE 1994b).

### **5.15.3 Methodology for Determining the Maximum Reasonably Foreseeable Radiological Accidents**

#### **5.15.3.1 Selection of Spent Nuclear Fuel Facilities and Operations Requiring**

Accident Analyses. The accident analyses performed to support this EIS considered  
nonreactor nuclear facilities that support spent nuclear fuel-related activities wi  
those at the Naval Reactors Facility (NRF) area. Appendix D of this EIS discusses  
nuclear fuel management alternatives and postulated accident scenarios associat  
Reactors Facility and other naval spent nuclear fuel facilities.

DOE Order 5480.23 (DOE 1992a) defines nonreactor nuclear facilities as those ac

operations that involve radioactive or fissionable materials in such form and quantity that a significant hazard potentially exists to the workers or the general public. This analysis considers spent nuclear fuel facilities designed and constructed as direct support to reactor facilities (e.g., Reactor Storage Canal, which stores spent nuclear fuel and irradiated fuels) as non-hazardous facilities.

DOE manages spent nuclear fuel at the following INEL facility areas: Idaho Chemical Processing Plant, Naval Reactors Facility, Test Reactor Area, Auxiliary Reactor Area Facility, Argonne National Laboratory-West, and Test Area North. For further information on the activities conducted in these areas, refer to Chapter 2. After identifying all facilities within these facility areas that stabilize, handle, or store spent nuclear fuel, DOE ranked the facilities according to potential hazards using preexisting facility "hazard ranking" criteria. DOE Order 5480.23 requires contractors operating nonreactor nuclear facilities to perform a classification of a facility to assess the consequences of an unmitigated release of hazardous material in one of the following categories(1):

- Category 1. The hazard analysis shows the potential for significant offsite consequences.
- Category 2. The hazard analysis shows the potential for significant onsite consequences.
- Category 3. The hazard analysis shows the potential for only significant local consequences.

The classification of nonreactor nuclear facilities in one of these three categories is in accordance with DOE Standard DOE-STD-1027-92 (DOE 1992b). This standard provides guidance for the hazard categorization of nuclear facilities based on facility inventories of radionuclides and the potential for those radionuclides to affect workers or the public if released to the environment.

This analysis used these categories as a screening threshold to identify those facilities (i.e., those spent nuclear fuel-related facilities with sufficient quantities of radionuclides) that have the potential for significant impacts to workers or the public if released to the environment. Facilities excluded (screened out) Category 3 (low hazard) facilities if they present possible consequences enveloped by postulated accidents at Category 2 facilities. Facilities classified as 2 or greater (or Category 3 facilities that were not screened out further, as discussed in the next section).

#### 5.15.3.2 Determination of Maximum Reasonably Foreseeable Radiological

Accidents. After determining spent nuclear fuel-related facilities with sufficient radionuclides to present radiological consequences to workers or the public (as discussed in Section 5.15.3.1), the analysis generated potential accident scenarios for each of the following activities:

1. These categories were formerly labeled "high", "moderate," and "low" in accordance with DOE Order 5480.23 for nonreactor nuclear facilities.

Section 5.15.3.1), the analysis generated potential accident scenarios for each of the following activities:

- Reviewing historic spent nuclear fuel-related accidents that have occurred in the history of the INEL.
- Reviewing existing accident analyses and safety analysis reports for spent nuclear fuel-related activities and facilities.
- Identifying potential internal, external, and natural phenomena events that could result in spent nuclear fuel-related accidents other than those previously analyzed.
- Performing additional accident analyses for those accidents considered to present potential consequences to workers or the public, as necessary.

The analysis considered internal and external initiators associated with a wide range of activities (e.g., research and development and construction or modification of facilities) not included in existing safety analyses. For example, potential radiological accident scenario construction activities associated with constructing new spent nuclear fuel-related facilities modifying existing spent nuclear fuel-related facilities (as proposed under the variances) were postulated. Typically, events involved in the construction of new spent nuclear fuel facilities would act as external initiators to existing facilities, while events in existing spent nuclear fuel facilities would act as internal initiators. Examples of industrial-type events that could initiate a radiological accident included fires, equipment failure, equipment failure, and human error.

Additional considerations used to determine potential internal and external initiators for spent nuclear fuel-related radiological accidents included vulnerabilities associated with handling, stabilizing, and storing severely degraded spent nuclear fuel and equipment. In November 1993, DOE issued a report (DOE 1993c) discussing vulnerabilities associated with spent nuclear fuel-related facilities across the DOE complex. The report identifies

the CPP-603 Underwater Fuel Storage Facility, as requiring immediate management at unnecessary increases in worker exposures, cleanup costs, and postulated accident f Activities have begun to stabilize spent nuclear fuel inventories in the CPP-603 fa them to another facility (CPP-666); these activities will continue for several year 1995 Record of Decision for this EIS. Therefore, the analysis considered postulate associated with stabilizing and relocating CPP-603 spent nuclear fuel inventories t accident initiators in developing the radiological accidents summarized in this EIS accident scenarios considered as a result of degraded spent nuclear fuel or faciliti inadvertent nuclear criticalities, physical damage of spent nuclear fuel and spent and radionuclide releases resulting from handling and stabilizing degraded spent nu postulated accident scenarios at facilities other than the CPP-603 Underwater Fuel analysis also considered the potential for long-term degradation of facility struct spent nuclear fuel inventories that could lead to an increased probability for radi

To compare the various possible spent nuclear fuel-related accident scenarios a those maximum reasonably foreseeable accidents that present the greatest consequenc the public, the analysis divided each postulated spent nuclear fuel-related accident frequency category (abnormal events, design-basis accidents(2), or beyond-design-ba according to its estimated frequency of occurrence. Table 5.15-5 lists the frequen with the abnormal event, design-basis accident, and beyond-design-basis accident ca in Section 5.15.1.

The estimated frequency of each postulated accident was based on an identificat physical basis for the accident and the events required for the accident to occur. postulated accidents or their constituent events (initiators or precursors) have ra frequency data based on historic experience were not available. Therefore, in many necessary to develop a frequency estimate on the basis of events for which experien engineering judgment. More than 40 sources of frequency data for the accident even reviewed, including analyses and reports prepared for the DOE, U.S. Nuclear Regulat (NRC), Electric Power Research Institute, and private industry. [For further infor development of estimated accident frequencies, refer to Slaughterbeck et al. (1995)

After the division of the postulated spent nuclear fuel-related accidents into defined in Table 5.15-5, the analysis identified the postulated nonprocessing-relat each frequency range determined to present the maximum offsite consequences as a ma

2. For facilities where design-basis accident analyses were unavailable, evaluation accident scenarios (postulated accident scenarios used where documented design basi analyses do not exist) were considered in accordance with DOE-DP-STD-3005-YR (DOE 1

Table 5.15-5. Accident frequency categories.

Frequency Category	Accident Frequency Range (accidents per year)
Abnormal events	frequency > 1y10-3 per year
Design-basis accidents	1y10-3 per year > frequency > 1y10-6 per year
Beyond-design-basis accidents	1y10-6 per year > frequency > 1y10-7 per year

reasonably foreseeable radiological accident to be further analyzed for this EIS. nonprocessing-related accident scenarios were chosen as maximum reasonably foreseea because of the shutdown status of the INEL facility (CPP-666) that historically pro fuel. However, because existing inventories of spent nuclear fuel at the INEL woul increase under Alternatives 4b(1) and 5b [Regionalization by Geography (INEL) and C the INEL, respectively], there could be a need to resume processing operations to s spent nuclear fuel operations and assure adequate storage space for spent nuclear f other sites(3). Therefore, in addition to the maximum reasonably foreseeable nonpr accident scenarios, this analysis considers the three postulated processing-related the maximum offsite consequences as additional maximum reasonably foreseeable accid Alternatives 4b(1) and 5b.

In addition, a postulated inadvertent nuclear criticality accident at the CPP-6 Storage Facility was considered for further analysis because significant vulnerabil its spent nuclear fuel inventories have been identified (DOE 1993b) and postulated have been addressed in virtually all nonreactor DOE EISs and safety analysis report accidents are reasonably foreseeable because of public concerns regarding their pot the seven radiological accidents summarized in Section 5.15.4 were determined to be reasonably foreseeable radiological accidents (i.e., greatest consequences). Furth analysis information for each of these accidents, as well as other accidents analyz Slaughterbeck et al. (1995). Appendix D identifies maximum reasonably foreseeable



associated with transporting, receiving, handling, and storing naval spent nuclear fuel. The postulated accidents summarized in this section considered with the INEL facilities are:

3. Processing would be performed in the Fluorinel and Storage (FAST) facility (CPP-666), a new facility to be constructed, the Fuel Processing Restoration (FPR) facility (CPP-603). Processing would consist of dissolving spent nuclear fuel to immobilize radionuclides for final waste disposal.

Appendix D provides a basis for characterizing the potential risks and consequences of managing spent nuclear fuel at the INEL over the next 40 years.

Seismic events were the only identified common-cause initiators with the potential for radioactive material releases to the environment at more than one spent nuclear fuel facility at the INEL. However, a seismic event resulting in significant damage and radioactive releases at more than one facility area (e.g., Idaho Chemical Processing Plant and Fluorinel) is considered beyond reasonably foreseeable (frequency less than one in ten million years) the physical distance and isolation between facility areas. In accordance with DOE (1994a), a seismic event initiating multiple-facility releases in more than one facility was screened from further consideration because of its extremely low frequency of occurrence.

Analyses were performed that evaluated the potential consequences and risks associated with multiple-facility releases within a single INEL facility area resulting from a severe seismic event (Slaughterbeck et al. 1995). For example, within a 500-meter radius in the Idaho Chemical Processing Plant facility area, there are several spent nuclear fuel facilities, the primary fuel storage facilities and the CPP-666 and CPP-603 underwater fuel storage facilities. Analysis was performed (Slaughterbeck et al. 1995) to determine whether simultaneous releases from these facilities could result from a severe seismic event. Because the CPP-666 and CPP-603 were designed and qualified to withstand a severe seismic event, they are not expected to have the consequences and risks resulting from a severe seismic event impacting the Idaho Chemical Processing Plant. However, because of known structural deficiencies and vulnerabilities associated with nuclear fuel at the CPP-603 facility, the CPP-603 facility is expected to be significantly impacted following a severe seismic event, resulting in one or more criticalities and the release of radioactive material to the surrounding environment. While the consequences from these simultaneous multiple-release mechanisms (one or more criticalities and water drainage) would be analyzed for CPP-603 facility (Section 5.15.3.3.2), the consequences of releases are expected to be bounded by the other accidents analyzed in the EIS--primary event that causes fuel melting at the Argonne National Laboratory-West Hot Fuel Examination Facility (highest consequence accident), and a fuel handling accident in the same facility (where risk = consequence x frequency). Similar analyses (DOE 1993a) for the Test Area 1 Argonne National Laboratory-West also demonstrate that potential multiple-facility multiple-release mechanisms from a single facility resulting from a severe seismic event are bounded by accidents postulated for the Hot Fuel Examination Facility. Based on the accident selection methodology described in 5.15.3.1, the consequences and risks of multiple-facility releases were screened from further consideration since they do not represent bounding accident scenarios within the frequency categories defined in Table 5.15-5.

In addition, the screening methodology did not specifically include potential accidents associated with operating new spent nuclear fuel handling and storage facilities for various alternatives considered in this EIS because postulated accident scenarios for these facilities would bound the consequences associated with potential accidents at new facilities. This is appropriate for two primary reasons. First, the missions of new spent nuclear fuel facilities would be similar to the missions of existing spent nuclear fuel-related DOE facilities, and DOE would consider the same types of accident scenarios for the new facilities as for existing facilities. Second, DOE would design and build new facilities that would include preventive and mitigative features to reduce the frequency and potential consequences of postulated accidents.

To compare the consequences of the same accident scenario at an identical hypothetical site (constructed at each DOE site included in this EIS (based on local geological and meteorological conditions), Appendix D summarizes postulated accident scenarios for a new Expanded Operations Facility at Oak Ridge, Hanford Site, Savannah River Site, or Nevada Test Site.

To determine the radiological and toxicological consequences presented throughout the EIS associated with the postulated accidents and with spent nuclear fuel-related activities, the following definitions are used:

- Worker. An individual 100 meters (328 feet) downwind of the facility location where a release occurs.
- Nearest Public Access. The nearest point of public access to the location where a release occurs, sometimes inside the site boundary.

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4. The worker is defined as the individual located at 100 meters because reliable s quantifying the impacts (e.g., dose and health effects) to workers at distances les (i.e., "close-in" workers) meters fram an accidental release of radionuclides are u The effects on and risks to workers closer in than 100 meters are recognized and di Section 5.15.3.3. Each of the maximum reasonably forseeeable accidents considered in particularly the design-basis and beyond-design-basis accidents, contains some risk or death at distances closer than 100 meters.

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- Maximally Exposed Offsite Individual. A hypothetical resident at the site to the facility where the release occurs.
- Offsite Population. The collective total of individuals within an 80-kilom radius of the INEL.
- Environment. The area outward from 100 meters (328 feet) downwind of the f the release occurs.

#### **5.15.3.3 Impact of Accidents on Close-In Workers. An evaluation has been made on the**

radiological impact to close-in workers from the selected accident scenarios. Inju might occur due to an external event, such as a severe seismic disturbance or airpl structure, are not considered in this evaluation since they are not attributable to consequences. Seven accident scenarios for nonprocessing-related and processing-re considered maximum reasonably foreseeable accidents.

##### **5.15.3.3.1 Mechanical Handling Accident at the Argonne National Laboratory**

West Hot Fuel Examination Facility - This accident is assumed to result in fuel pin venting of noble gases and iodine.

No fatalities to workers are expected from this event. However, a substantial iodine dose to the thyroid could cause radiation-induced hypothyroidism disorder.

##### **5.15.3.3.2 Criticality Accident at the Idaho Chemical Processing Plant -**

CPP-603 - This event is an unplanned nuclear criticality associated with underwater fuel storage at the CPP-603 facility.

Based on shielding provided by the pool water, it is likely that no fatalities would occur. To the extent water is expelled due to the energy of th workers could receive substantial radiation exposure. Worker presence in the area very close to the edge of the pool is not routine. The impact of the event would l nearby equipment operators if the criticality were initiated by a handling error.

##### **5.15.3.3.3 Seismic Event Leading to Fuel Melt at the Argonne National**

Laboratory West Hot Fuel Examination Facility - A seismic event is postulated to r breach of the main cell used for examination of the fuel, which is assumed to lead fuel cooling system.

It is likely that the release of radioactive materials from fuel melting would occu slowly enough to allow evacuation of all workers before any appreciable exposure. radiation-induced fatalities would be expected.

##### **5.15.3.3.4 Airplane Crash and Fire at Argonne National Laboratory West Hot**

Fuel Examination Facility - An airplane crash and subsequent fire sustained by airp could result in a major breach of the confinement barriers and could lead to a subs release of radionuclides.

Workers unaffected by the airplane crash or fire would not be expected to remain in the area long enough to receive substantial radiation exposure. It is as of the radioactive material due to the fire would mitigate the direct radiological workers, substantially reducing the likelihood of radiation induced worker fataliti

#### 5.15.3.3.5 Criticality Accident During Processing at the Idaho Chemical

Processing Plant - CPP-666 - This is the first of three evaluated accidents that could occur if processing were resumed at the Fluorinel and Storage Facility (FAST).

Three inadvertent nuclear criticalities have occurred in INEL processing facilities and none has resulted in each event, radioactive material was released to the atmosphere and close-in worker exposure. If processing were resumed, the techniques and controls implemented to prevent processing-related criticalities would be employed again. Due to the cell wall concrete walls that are several feet thick, it is expected that no workers would receive radiation exposure.

#### 5.15.3.3.6 Hydrogen Explosion at the Idaho Chemical Processing Plant - A

hydrogen explosion in the dissolver off-gas system of the Fluorinel and Storage Facility (FAST) result in release of radioactive material to the facility.

If workers were near the dissolver off-gas system, they could receive substantial radiation exposure from the explosion. No fatalities are expected, but radiation-induced health detriments could occur.

#### 5.15.3.3.7 Dissolution of Short-Cooled Fuel at the Idaho Chemical Processing

Plant - An explosion in the dissolver tank could occur if fuel that has not cooled was inadvertently shipped to the dissolver at the Fluorinel and Storage Facility (FAST). This energetic

event would likely breach the dissolver off gas system and could breach the dissolver in the areas closely associated with the dissolver tank could receive substantial radiation. It is likely that no radiation-induced fatalities would occur.

#### 5.15.3.4 Analysis of Radiological Accident Consequences. The quantities of

radioactive materials and the ways these materials interact with human beings are important in determining health effects. The ways in which radioactive materials reach human beings, absorption and retention in the body, and the resulting health effects have been studied by The International Commission on Radiological Protection (ICRP) has made specific recommendations for quantifying these health effects (ICRP 1991). This organization is the recognized authority for establishing standards for the protection of workers and the public from the effects of radiation exposure. Health effects can be classified into two categories: prompt (also referred to as latent). Prompt health effects are those experienced immediately after exposure and the body up to and including death. Latent health effects are those experienced some time after exposure and include cancers and hereditary symptoms. An INEL-developed computer code, Radiological Safety Analysis Computer Program-5 (RSAC-5), estimates potential radiation dose to maximally exposed individuals or population groups from accidental releases of radioactive materials. The code, which is customized to specific INEL conditions, uses well-established and generally accepted scientific engineering principles as the basis for its various calculational steps. The code is based on guidance provided in NRC Guide 1.145 (NRC 1983) and has been validated to comply with NRC standards for such software. [For a detailed description of RSAC-5, refer to Slagter (1995).]

The RSAC-5 code determined estimated consequences to the worker, an individual who could be stranded at the nearest point of public access, the maximally exposed hypothetical individual at the nearest site boundary, and the offsite population within 80 kilometers (50 miles) of the site. Accidents postulated under Alternative 1, No Action. Postulated frequencies and consequences analyzed under Alternative 1 are based on (1) the approximate amount of spent nuclear fuel at the INEL [measured in Metric Tons Heavy Metal (MTHM)], (2) the estimated increase in inventories resulting from spent nuclear fuel generated by operating INEL reactors removed from a reactor that has not had sufficient time to cool, and (3) the estimated handling activities associated with stabilizing or relocating spent fuel inventories at the site boundary. Although the four nonprocessing-related maximum reasonably foreseeable radiation exposure accident scenarios identified for Alternative 1 are also considered under Alternative 2, proposed changes in INEL spent nuclear fuel inventories and the number of fuel handling

associated with these changes could affect the estimated frequencies and consequences Alternatives 2 through 5. Therefore, to reasonably estimate the frequencies and consequences associated with activities proposed under Alternatives 2 through 5, the frequencies for the accidents presented under Alternative 1 require appropriate "adjustment" or

To be conservative, the analysis assumed that the increase in the annual frequency of handling accidents would be equal to the estimated increase in the annual number of accidents proposed under Alternatives 2 through 5. However, the consequences associated with handling accidents would not vary with a change in the number of handling events because of material involved in each event would not change. To determine potential change in mechanical handling accident frequencies between the different spent nuclear fuel management alternatives, the analysis based its estimates of the annual number of fuel handling accidents on spent fuel shipment rates anticipated for the next 40 years, as discussed in Table 5.15-6. Estimates of long-term (40-year) and short-term (5-year) shipments at the INEL were used to determine the annual shipment rates for each alternative. The basis for the number of shipments include spent nuclear fuel the INEL will continue to receive from operations of DOE, Naval Nuclear Propulsion Program, university, and research reactors. Short-term shipments consist of shipments that would be required to relocate existing spent fuel inventories under the various alternatives. Table 5.15-6 summarizes the estimated annual shipments from the INEL under each alternative, and within INEL site boundaries. The estimates in Table 5.15-6 consider both onsite and offsite shipments.

**Table 5.15-6.** Determination of accident frequency adjustment factors for Alternatives 1 through 5 based on estimated number of annual spent nuclear fuel shipments under each alternative

	Estimated Shipment Rate (per year) <sup>a</sup>	Adjustment Factor (shipment rate/baseline)
1. No Action	41	Baseline
2. Decentralization	50	1.2
3. 1992/1993 Planning Basis	128	3.1
4a. Regionalization by Fuel Type	195	4.8
4b(1) Regionalization by Geography (INEL)	824	20.0
4b(2) Regionalization by Geography (Elsewhere)	351	8.6
5a. Centralization at Other DOE Sites	351	8.6
5b. Centralization at the INEL	824	20.0

a. Data presented for the estimated annual shipment rate is based on information taken from Appendix I. The annual shipment rate for the No-Action Alternative (baseline) is taken from Table 3 of Wichmann 1994.

Based on the number of annual shipments estimated for Alternatives 2 through 5, Table 5.15-6, the analysis calculated multiplication factors by dividing the estimated annual shipment rate for each alternative by the baseline (Alternative 1) shipment rate. To determine the estimated frequency for the maximum reasonably foreseeable mechanical handling accidents for each alternative, the frequency identified for Alternative 1 was multiplied by the adjustment factor. The same approach determined estimated frequencies for Accident 1 (fuel handling accident and noble gases and iodine release from the Hot Fuel Examination Facility) under Alternatives 2 through 5. For Accident 2 (inadvertent criticality in the CPP-603 U Storage Facility resulting from a handling accident associated with degraded spent nuclear fuel) the estimated frequency considered under Alternative 1 (1 y 10<sup>-3</sup> event per year) is based on handling activities associated with relocation of the CPP-603 spent nuclear fuel in the CPP-666 facility. Because proposed changes in INEL inventories under the different alternatives would not affect handling events associated with relocating spent fuel from the CPP-666 facility, the estimated frequency for this mechanical handling event would be the same for all alternatives. The result of this approach and the fact that 3 of the 4 accident scenarios that present consequences are not handling accidents, Accident 1 is the only accident requiring adjustment for each alternative.

Variable source-term-sensitive accidents would have consequences that depended on the amount of spent nuclear fuel in storage. One example is the accidental drainage of a spent fuel pool. Results in the release of corrosion products in the canal to the environment. The larger the inventory in the canal, the larger the release of corrosion products to the environment draining the canal. (Drainage of a water canal completely filled with spent nuclear fuel is considered in the determination of the maximum reasonably foreseeable accidents and to present lower consequences than other accident scenarios analyzed.) Variable source-term accidents depend only on spent nuclear fuel inventories and do not require adjustment of estimated frequencies of occurrence. Because none of the postulated accidents sum-

Alternative 1 is source-term sensitive (e.g., spent nuclear fuel inventories in the Facility are not likely to increase), adjustment of the estimated consequences calc Alternative 1 is not required for Alternatives 2 through 5.

#### 5.15.4 Impacts from Postulated Maximum Reasonably Foreseeable Radiological Accidents

Section 5.15.4.1 summarizes impacts (e.g., exposures and health effects) from the nonprocessing-related maximum reasonably foreseeable radiological accidents postulated for Alternative 1 (No Action). Sections 5.15.4.4.2.1 through 5.15.4.5.2 describe changes in postulated accident impacts resulting from changes in spent nuclear fuel inventory activities under the other alternatives. Sections 5.15.4.4.2.1 and 5.15.4.5.2 also describe impacts from three additional maximum reasonably foreseeable accidents associated with reprocessing activities at the INEL. Section 5.15.6 provides more information about the analyses performed for each of the radiological accidents discussed under each

##### 5.15.4.1 Alternative 1: No Action. Based on the quantity of spent nuclear fuel at the INEL

(excluding naval fuel at Naval Reactors Facility, which is analyzed in Appendix D), configuration (wet versus dry), the amount of time the spent fuel has been allowed for consideration of various internal, external, and natural phenomena initiators (as discussed in Section 5.15.3), the postulated accidents listed in Table 5.15-7 would have the greatest consequences within the abnormal event, design-basis accident, and beyond-design-basis accident under this alternative. For each accident, Table 5.15-7 also lists estimated accident radiation exposures to the offsite population within 80 kilometers (50 miles), a member of the public stranded at the nearest point of public access inside the INEL site boundary, a hypothetical exposed individual (MEI) at the nearest site boundary, and a worker; point estimate of the risk of the maximally exposed individual contracting a fatal cancer during his/her lifetime; annualized and total radiation exposure; and point estimates of risk of the expected number of fatalities (annualized and total) in the offsite population. The estimates of the consequences of the offsite population are based on conservative (95 percentile) and average (50 percentile) meteorological conditions. The estimates of the consequences and risk to the maximally exposed individual are based on conservative (95 percentile) meteorological conditions. The postulated accidents identified for the INEL Naval Reactors Facility in Appendix D, characterize the potential impacts and risks associated with the proposed spent fuel management activities at the INEL under Alternative 1.

Atmospheric transport of radionuclides from the postulated accidents could result in secondary impacts, such as contamination of the environment or impacts to national

5. Conservative (95 percentile) meteorological conditions are defined as the meteorological conditions that, for a given release, the concentration at a fixed receptor location will not be exceeded 95 percent of the time. Average (50 percentile) meteorological conditions are defined as the meteorological conditions that, for a given release, the concentration at a fixed receptor location will not be exceeded 50 percent of the time.

**Table 5.15-7.** Impacts from selected maximum reasonably foreseeable radiological accidents for Alternative 1, No Action (50 and 95 percentile meteorological conditions).

Accident	Frequency (events per year)	Worker Dose (rem)	Nearest Public Access (rem)	Dose to MEI (rem)	Offsite Population Dose (95%) (person-rem)	Po (p)
						ME 95
1. Fuel handling accident, fuel pin breach, venting of noble gases and iodine at HFEFe	1.0y10 <sup>-2</sup>	(f)	(f)	2.0y10 <sup>-3</sup>	(f)	1.
2. Inadvertent criticality in ICPPg CPP-603 storage facility	1.0y10 <sup>-3</sup>	9.7y10 <sup>-2</sup>	1.4y10 <sup>-3</sup>	1.0y10 <sup>-3</sup>	5.9y10 <sup>-1</sup>	5.

3. Fuel melting of small number of assemblies at HFEF resulting from seismic event and cell breach
 

1.0y10 <sup>-5</sup>	6.2y10 <sup>-1</sup>	6.5y10 <sup>-1</sup>	5.0y100	1.4y10 <sup>4</sup>	2.
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4. Material release from HFEF resulting from aircraft crash and ensuing fire
 

1.0y10 <sup>-7</sup> (i)	4.6y100	3.2y10 <sup>-1</sup>	5.0y100	2.0y10 <sup>3</sup>	2.
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- a. A worker is defined as a worker located 100 meters (328 feet) from the point of
- b. Public individual assumed to be stranded at the nearest point of public access i
- c. MEI = Maximally exposed hypothetical offsite individual, located at the nearest
- d. Maximally exposed individual and offsite population fatal cancer risk = dose y a 5.0 y 10<sup>-4</sup> fatal cancer per rem (ICRP-60 conversion factor) if dose is less than more the ICRP-60 conversion factor is doubled, or 1.0 y 10<sup>-3</sup>. Numbers in parent number of fatal cancers in the population if the accident occurred.
- e. HFEF - Hot Fuel Examination Facility.
- f. The safety analysis report utilized for this accident analysis does not provide developed prior to DOE Order 5480.23 requiring this information. As demonstrate maximally exposed individual, consequences to the public from this accident coul consequences from Accidents 2 through 4.
- g. ICPP = Idaho Chemical Processing Plant.
- h. Although three nuclear criticalities associated with spent nuclear fuel reproces the INEL during its 40-year operating history, the estimated frequency for an in based on historic reprocessing data because reprocessing is not considered under frequency estimates vary from 1.0 y 10<sup>-4</sup> (CPP-666 underwater storage facility) t underwater storage facility) event per year.
- i. This frequency is a qualitative bounding estimate for a potential aircraft crash Section 5.15.6.4.

prevent these radionuclides from increasing any potential safety concerns, DOE would activities if an accident occurred, and no irreversible environmental impacts would Table 5.15-8 summarizes postulated secondary impacts resulting from the postulated accidents listed in Table 5.15-7.

This analysis takes limited credit for emergency response actions in determining listed in Table 5.15-7. DOE would initiate INEL emergency response programs, as ap following the occurrence of an accident to prevent or mitigate potential consequenc emergency response programs, implemented in accordance with 5500-DOE series Orders, involve emergency planning, emergency preparedness, and emergency response actions. emergency response plan utilizes resources specifically dedicated to assist a facil management. These resources include but are not limited to the following:

- INEL Warning Communications Center
- INEL Fire Department
- Facility Emergency Command Centers
- DOE Emergency Operations Centers
- County and State Emergency Command Centers
- Medical, health physics, and industrial hygiene specialists
- Protective clothing and equipment (respirators, breathing air supplies, etc.)
- Periodic training exercises and drills within and between the organizations i implementing the response plans

#### 5.15.4.2 Alternative 2: Decentralization. Adjustments in estimated accident frequencies

and point estimates of risk presented for Alternative 1 would be related to (1) the and storage activities associated with the additional spent nuclear fuel inventorie in overall spent nuclear fuel-related storage, relocation, and handling activities Alternative 1. Because no changes in the accident consequences estimated for Alter to occur under this alternative from increased fuel inventories (i.e., the same amo material would accidentally be released to the environment as discussed in Section changes are likely in the postulated secondary impacts listed in Table 5-15-8. Tab summarizes the four postulated accidents with the greatest radiological impacts und Table 5.15-8. Estimated secondary impacts resulting from the maximum reasonably fo Action, assuming conservative (95 percentile) meteorological conditions.

Environmental or Social Impacts

Radiological (Assuming 88 millirem per year limit with 24-hour-per-day expo  
Accident  
Summary

	Biotic Resources	Water Resources	Economic Impacts	Na De
1. Fuel handling accident, fuel pin breach, venting of noble gases and iodine at HFEFb (1x10 <sup>-2</sup> per year)	Limited adverse effects expected vegetation or wildlife.	Limited adverse effects expected to surface water or groundwater.	Limited economic impacts expected. Any cleanup required would be localized and could be accomplished with existing workforce and equipment.	No na ex
2. Uncontrolled chain reaction (criticality) at ICPPc (1x10 <sup>-3</sup> per year)	Limited adverse effects expected vegetation or wildlife.	Limited adverse effects expected to surface water or groundwater.	No economic impacts expected. Any cleanup required would be localized and could be accomplished with existing workforce and equipment.	No na ex
3. Fuel melting of small number of assemblies at HFEF resulting from seismic event and cell breach (1x10 <sup>-5</sup> per year)	Limited adverse effects expected vegetation or wildlife.	Limited adverse effects expected to surface water or groundwater.	Potential interdiction of affected agricultural products on nearby lands. Local cleanup in the vicinity of HFEF.	No na ex
4. Material release from HFEF resulting from aircraft crash and ensuing fire (1x10 <sup>-7</sup> per year)	Limited adverse effects expected vegetation or wildlife.	Limited adverse effects expected to surface water or groundwater.	Potential interdiction of affected agricultural products on nearby lands. Local cleanup in the vicinity of HFEF.	No na ex

a. Postulated secondary impacts based on 10-microrem-per-hour exposure (88 millirem from the plume. This approach in estimated secondary impacts is conservative because background radiation is 100 millirem per year.

b. HFEF = Hot Fuel Examination Facility.

c. ICPP = Idaho Chemical Processing Plant.

d. To convert acres to square kilometers, multiply by 0.004.

**Table 5.15-9.** Impacts from selected maximum reasonably foreseeable accidents - Alternative Decentralization (50 and 95 percentile meteorological conditions).

Accident	Adjusted Frequency (events per year)	Worker Dose (rem)	Nearest Public Access (rem)	Dose to MEID (rem)	Offsite Population Dose (95%) (person- rem)
1. Fuel handling accident, fuel pin breach, venting of noble gas and iodine at HFEFf	1.2y10 <sup>-2</sup> (1.2)	(g)	(g)	2.0y10 <sup>-3</sup>	(g)
2. Inadvertent criticality in ICPPh CPP-603 storage facilityi	1.0y10 <sup>-3</sup> (1.0)j	9.7y10 <sup>-2</sup>	1.4y10 <sup>-3</sup>	1.0y10 <sup>-3</sup>	5.9y10 <sup>-1</sup>

3. Fuel melting of small number of assemblies at HFEF resulting from seismic event and breach  
 1.0y10<sup>-5</sup>      6.2y10<sup>-1</sup>      6.5y10<sup>-1</sup>      5.0y100      1.4y10<sup>4</sup>
4. Material release from HFEF resulting from aircraft crash and ensuing fire  
 1.0y10<sup>-7</sup>(k)      4.6y100      3.2y10<sup>-1</sup>      5.0y100      2.0y10<sup>3</sup>

- a. Numbers in parentheses indicate multiplication factor used to scale or adjust estimates under Alternative 1, as described in Section 5.15.3.3.
- b. A worker is defined as a worker located 100 meters (328 feet) from the point of release.
- c. Public individual assumed to be stranded at the nearest point of public access.
- d. MEI = Maximally exposed hypothetical offsite individual located at the nearest site.
- e. Maximally exposed individual and offsite population fatal cancer risk = dose  $\times$  a  $5.0 \times 10^{-4}$  fatal cancer per rem (ICRP-60 conversion factor) if dose is less than or more, the ICRP-60 conversion factor is doubled, or  $1.0 \times 10^{-3}$ . Numbers in parentheses indicate multiplication factor used to scale or adjust estimates under Alternative 1, as described in Section 5.15.3.3.
- f. HFEF = Hot Fuel Examination Facility.
- g. The safety analysis report utilized for this accident analysis does not provide information developed prior to DOE Order 5480.23 requiring this information. As demonstrated, the maximally exposed individual, consequences to the public from this accident could be less than those estimated in the safety analysis report.
- h. ICPP = Idaho Chemical Processing Plant.
- i. Although three nuclear criticalities associated with spent nuclear fuel reprocessing at the INEL during its 40-year operating history, the estimated frequency for an incident based on historic reprocessing data since reprocessing is not considered under this alternative, frequency estimates vary from  $1.0 \times 10^{-4}$  (ICPP-666 underwater storage facility) to  $1.0 \times 10^{-3}$  (underwater storage facility) events per year.
- j. Refer to Sections 5.15.3.3 and 5.15.6.2 for details on why this frequency was not used for Alternative 1.
- k. This frequency is a qualitative bounding estimate for a potential aircraft crash at the INEL. See Section 5.15.6.4.

5.15.4.3 Alternative 3: 1992/1993 Planning Basis. Under this alternative, the INEL would receive the following spent nuclear fuel:

- Spent nuclear fuel from domestic DOE and university reactors and foreign research reactors
- All Training Reactor Isotopics General Atomics (TRIGA) spent nuclear fuel from the INEL and Hanford reactors
- Fort St. Vrain spent nuclear fuel from Public Service Company of Colorado
- Special case commercial pressurized water reactor and boiling water reactor fuel from West Valley, New York
- Naval spent nuclear fuel from sites such as the Norfolk or Puget Sound Naval Shipyard

Adjustments in estimated accident frequencies and point estimates of risk presented for Alternative 1 would be related to (1) the receipt, handling, and storage activities associated with additional spent nuclear fuel inventories; and (2) the increase in overall spent nuclear fuel inventories and handling activities not allowed under Alternative 1. Because no change in accident consequences estimated for Alternative 1 are likely to occur under this alternative, increased fuel inventories (i.e., the same amount of radioactive material would be added to the environment as discussed in Section 5.15.3.3), no changes are likely in the impacts listed in Table 5.15-8. Table 5.15-10 summarizes the postulated accidents and their radiological impacts under this alternative.

5.15.4.4 Alternative 4: Regionalization. Under this alternative, there are two regionalization alternatives: (1) Alternative 4a (Regionalization by Fuel Type), where spent nuclear fuel inventories will be distributed between the DOE sites based primarily on similarity of fuel types, although DOE would also consider transportation distances, stabilization capabilities, available storage capacities, or a combination of these; and (2) Alternative 4b (Regionalization by Geography), where existing and new spent nuclear fuel inventories in the western region of the country will be centralized at a single western site and existing and new spent nuclear fuel inventories in the eastern region of the country will be centralized at a single eastern site.

**Table 5.15-10.** Impacts from selected maximum reasonably foreseeable accidents - Alternative 1 Planning Basis (50 and 95 percentile meteorological conditions).

Accident	Adjusted	Worker	Nearest	Dose to	Offsite	A
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	Frequency (events per year)	Dose (rem)	Public Access (rem)	MEI (rem)	Population Dose (95%) (person-rem)	c
						M 9
1. Fuel handling accident, fuel pin breach, venting of noble gases and iodine at HFEF	3.1y10-2 (3.1)	(g)	(g)	2.0y10-3	(g)	3
2. Inadvertent criticality in ICPPh CPP-603 storage facility	1.0y10-3 (1.0)	9.7y10-2	1.4y10-3	1.0y10-3	5.9y10-1	5
3. Fuel melting of small number of assemblies at HFEF resulting from seismic event and cell breach	1.0y10-5 (1.0)	6.2y10-1	6.5y10-1	5.0y100	1.4y104	2
4. Material release from HFEF resulting from aircraft crash and ensuing fire	1.0y10-7 (1.0)	4.6y100	3.2y10-1	5.0y100	2.0y103	2
a. Numbers in parentheses indicate multiplication factor used to scale or adjust es under Alternative 1, as described in Section 5.15.3.3.						
b. A worker is defined as a worker located 100 meters (328 feet) from the point of						
c. Public individual assumed to be stranded at the nearest point of public access i						
d. MEI = Maximally exposed hypothetical offsite individual located at the nearest s						
e. Maximally exposed individual and offsite population fatal cancer risk = dose y a 5.0 y 10-4 fatal cancer per rem (ICRP-60 conversion factor) if dose is less than or more, the ICRP-60 conversion factor is doubled, or 1.0 y 10-3. Numbers in pa number of fatal cancers in the population if the accident occurs.						
f. HFEF = Hot Fuel Examination Facility.						
g. The safety analysis report utilized for this accident analysis does not provide developed prior to DOE Order 5480.23 requiring this information. As demonstrate maximally exposed individual, consequences to the public from this accident coul consequences from Accidents 2 through 4. However, given the high frequency for Accidents 2 through 4, the risk could actually be greater than for Accidents 2 t						
h. ICPPh = Idaho Chemical Processing Plant.						
i. Although three nuclear criticalities associated with spent nuclear fuel reproces the INEL during its 40-year operating history, the estimated frequency for an in based on historic reprocessing data since reprocessing is not considered under t frequency estimates vary from 1.0 y 10-4 (CPP-666 underwater storage facility) t underwater storage facility) events per year.						
j. Refer to Sections 5.15.3.3 and 5.15.6.2 for details on why this frequency was no alternative.						
k. This frequency is a qualitative bounding estimate for a potential aircraft crash Section 5.15.6.4.						

#### 5.15.4.4.1 Alternative 4a - Regionalization By Fuel Type - Adjustments in the estimated

accident frequencies and point estimates of risk presented for Alternative 1 would receipt, handling, and storage activities associated with the additional spent nucl and (2) the increase in overall spent nuclear fuel-related storage, relocation, and allowed under Alternative 1.

Because no changes in the accident consequences estimated for Alternative 1 are likely to occur under this alternative from increased fuel invent amount of radioactive material would accidentally be released to the environment as Section 5.15.3.3), no changes are likely in the postulated secondary impacts listed Table 5.15-11 summarizes the postulated accidents with the greatest radiological im alternative.

#### 5.15.4.4.2 Alternative 4b - Regionalization by Geography - Under this alternative, spent

nuclear fuel inventories in the western region of the country would be centralized Hanford Site, or Nevada Test Site.

**Alternative 4b(1) considers regionalization at the INEL.**

Alternative 4b(2) considers regionalization at the Hanford Site or Nevada Test Site

#### 5.15.4.2.1 Alternative 4b(1) - Regionalization by Geography (INEL) - Under

this alternative, existing and new spent nuclear fuel inventories in the western re would be centralized at the INEL. Fuel stabilization would be performed in the Flu (FAST) facility (CPP-666) and a new facility to be constructed, the Fuel Processing facility (CPP-691), to dissolve spent nuclear fuel and stabilize (i.e., immobilize) Because the volume of spent nuclear fuel considered under this alternative is only that considered under Alternative 5b, adjustments in the estimated accident frequen estimates of risk for the four accidents presented under Alternative 1 were conserv equivalent to the adjustments required under Alternative 5b (i.e., centralization o Nuclear Propulsion Program, university, and research reactor spent nuclear fuel in INEL). Adjustments in the estimated accident frequencies and point estimates of ri accidents presented under Alternative 1 would be related to (1) the receipt, handli activities associated with the additional spent nuclear fuel inventories; and (2) t spent nuclear fuel-related storage, relocation, and handling activities not allowed Because no changes in the accident consequences estimated for Alternative 1 are lik this alternative from increased fuel inventories (i.e., the same amount of radioact accidentally be released to the environment as discussed in Section 5.15.3.3), no c the postulated secondary impacts listed in Table 5.15-8.

**Table 5.15-11.** Impacts from selected maximum reasonably foreseeable accidents - Al Regionalization by Fuel Type (50 and 95 percentile meteorological conditions).

Accident	Adjusted Frequency <sup>a</sup> (events per year)	Worker Dose <sup>b</sup> (rem)	Nearest Public Access <sup>c</sup> (rem)	Dose to MEI <sup>d</sup> (rem)	Offsite Population Dose (95%) (person-rem)	Ad ca  ME 95
1. Fuel handling accident, fuel pin breach, venting of noble gases and iodine at HFEF <sup>f</sup>	4.8y10 <sup>-2</sup> (4.8)	(g)	(g)	2.0y10 <sup>-3</sup>	(g)	4.
2. Inadvertent criticality in ICP CPP-603 storage facility <sup>i</sup>	1.0y10 <sup>-3</sup> (1.0) <sup>j</sup>	9.7y10 <sup>-2</sup>	1.4y10 <sup>-3</sup>	1.0y10 <sup>-3</sup>	5.9y10 <sup>-1</sup>	5.
3. Fuel melting of small number of assemblies at HFEF resulting from seismic event and cell breach	1.0y10 <sup>-5</sup> (1.0)	6.2y10 <sup>-1</sup>	6.5y10 <sup>-1</sup>	5.0y10 <sup>0</sup>	1.4y10 <sup>4</sup>	2.
4. Material release from HFEF resultin from aircraft cras and ensuing fire	1.0y10 <sup>-7</sup> (k) (1.0)	4.6y10 <sup>0</sup>	3.2y10 <sup>-1</sup>	5.0y10 <sup>0</sup>	2.0y10 <sup>3</sup>	2.

- Numbers in parentheses indicate multiplication factor used to scale or adjust es under Alternative 1, as described in Section 5.15.3.3.
- A worker is defined as a worker located 100 meters (328 feet) from the point of
- Public individual assumed to be stranded at the nearest point of public access i
- MEI = Maximally exposed hypothetical offsite individual located at the nearest s
- Maximally exposed individual and offsite population fatal cancer risk = dose y a 5.0 y 10<sup>-4</sup> fatal cancer per rem (ICRP-60 conversion factor) if dose is less than or more, the ICRP-60 conversion factor is doubled, or 1.0 y 10<sup>-3</sup>. Numbers in pa number of fatal cancers in the population if the accident occurs.
- HFEF = Hot Fuel Examination Facility.
- The safety analysis report utilized for this accident analysis does not provide

- developed prior to DOE Order 5480.23 requiring this information. As demonstrate maximally exposed individual, consequences to the public from this accident coul consequences from Accidents 2 through 4. However, given the high frequency for Accidents 2 through 4, the risk could actually be greater than for Accidents 2 t
- h. ICPP = Idaho Chemical Processing Plant.
  - i. Although three nuclear criticalities associated with spent nuclear fuel reproces the INEL during its 40-year operating history, the estimated frequency for an in based on historic reprocessing data since reprocessing is not considered under t frequency estimates vary from 1.0 y 10<sup>-4</sup> (CPP-666 underwater storage facility) t underwater storage facility) events per year.
  - j. Refer to Sections 5.15.3.3 and 5.15.6.2 for details on why this frequency was no alternative.
  - k. This frequency is a qualitative bounding estimate for a potential aircraft crash Section 5.15.6.4.

Because the option exists to restart processing activities, three additional proc maximum reasonably foreseeable accidents are considered under this alternative (as Section 5.15.3.2). Since the amount of radioactive material that would accidentall environment from these accidents is expected to be lower than in Accidents 3 and 4 melt and aircraft crash at the Hot Fuel Examination Facility, respectively), potent associated with these additional processing-related accidents would be less severe for the nonprocessing-related accidents in Table 5.15-8.

Table 5.15-12 summarizes the postulated accidents with the greatest radiological alternative.

**5.15.4.4.2 Alternative 4b(2) - Regionalization by Geography (Elsewhere) - Under this**

alternative, existing and new spent nuclear fuel inventories in the western region be centralized at either the Hanford Site or Nevada Test Site. Similar to Alternat considers centralization of existing INEL spent nuclear fuel inventories at another inventory of spent nuclear fuel at the INEL would be reduced substantially so that nuclear fuel at the INEL would consist of fresh fuel generated from operating INEL not cooled sufficiently for relocation to the regionalized or centralized site. Th considers the same amount of material considered under Alternative 1 until the regi accept existing inventories of INEL spent nuclear fuel and freshly generated spent sufficiently cooled.

Table 5.15-13 summarizes the postulated accidents with the greatest radiological alternative.

**5.15.4.5 Alternative 5: Centralization. Under this alternative, DOE would collect all**

current and future spent nuclear fuel inventories from both DOE and the Naval Nucle Program at one site. For the INEL, there are two possibilities: (1) Alternative 5 spent fuel inventories and activities would take place at the Hanford Site, Savanna Test Site, or Oak Ridge Reservation; or (2) Alternative 5b, in which all spent fuel activities would be centralized at the INEL.

**5.15.4.5.1 Alternative 5a: Centralization at Other DOE Sites - This alternative**

would consider approximately the same amount of material considered under Alternati centralized site could accept existing INEL spent nuclear fuel inventories and fres Table 5.

15-12. Impacts from selected maximum reasonably foreseeable accidents - Alternativ Regionalization by Geography (INEL) (50 and 95 percentile meteorological conditions Accident

Adjusted Frequencya (events per year)	Worker Doseb (rem)	Nearest Public Accessc (rem)	Dose to MEId (rem)	Offsite Population Dose (95%) (person- rem)	A c
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- 1. Fuel handling

accident, fuel pin breach, venting of noble gases and iodine at HFEFf	2.0y10-1	(g)	(g)	2.0y10-3	(g)	2
2. Inadvertent criticality in ICPPh CPP-603 storage facilityj	1.0y10-3	9.7y10-2	1.4y10-3	1.0y10-3	5.9y10-1	5
3. Fuel melting of small number of assemblies at HFEF resulting from seismic event and cell breach	1.0y10-5	6.2y10-1	6.5y10-1	5.0y100	1.4y104	2
4. Material release from HFEF resulting from aircraft crash and ensuing fire	1.0y10-7 (k)	4.6y100	3.2y10-1	5.0y100	2.0y103	2
5. Inadvertent nuclear criticality ICPPh CPP-666 during processingl	1.0y10-3	9.1y10+0	4.9y10-2	2.8y10-2	5.6y10+0	1
6. Hydrogen in ICPPh CPP-666 dissolver	1.0y10-5	(m)	(m)	6.3y10-4	8.1y10-1	3
7. Inadvertent dissolution of 30-d1 cooled fuel at ICPPh CPP-666	1.0y10-6	(m)	(m)	3.0y10-2	2.9y10+1	1

a. Numbers in parentheses indicate multiplication factor used to scale or adjust es described in Section 5.15.3.3.

b. A worker is defined as a worker located 100 meters (328 feet) from the point of

c. Public individual assumed to be stranded at the nearest point of public access i

d. MEI = Maximally exposed hypothetical offsite individual located at the nearest s

e. Maximally exposed individual and offsite population fatal cancer risk = dose y a (ICRP-60 conversion factor) if dose is less than 20 rem. For doses of 20 rem or 1.0 y 10-3. Numbers in parentheses indicate total number of fatal cancers in th

f. HFEF = Hot Fuel Examination Facility.

g. The safety analysis report utilized for this accident analysis does not provide Order 5480.23 requiring this information. As demonstrated by the dose to the ma from Accident 1 could be less than the consequences from Accidents 2 through 4. compared to Accidents 2 through 4, the risk could actually be greater than for A

h. ICPP = Idaho Chemical Processing Plant.

i. Although three nuclear criticalities associated with spent nuclear fuel reproces operating history of CPP-666, the estimated frequency for an inadvertent critica nuclear conditions and fuel vulnerabilities. Nominal estimates vary from 1.0 y 10-3 (CPP-603 underwater storage facility) events per year.

j. Refer to Sections 5.15.3.3 and 5.15.6.2 for details on why this frequency was no

k. This frequency is a qualitative bounding estimate for a potential aircraft crash

l. The Idaho Chemical Processing Plant has experienced three inadvertent nuclear cr 14 years ago. This frequency is based on modern facility conditions and safegua

m. The safety analysis report utilized for this accident does not provide this info Order 5480.23 requiring this information. However, a comparison of the data pre a relative measure of the impacts to this receptor.

**Table 5.15-13.** Impacts from selected maximum reasonably foreseeable accidents - Al Regionalization by Geography (Elsewhere) (50 and 95 percentile meteorological condi

Accident	Adjusted Frequencya (events per year)	Worker Doseb (rem)	Nearest Public Accessc (rem)	Dose to MEId (rem)	Offsite Population Dose (95%) (person-rem)	A c M 9
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1. Fuel handling accident, fuel pin breach, venting of noble gases and iodine at HFEFf	8.6y10-2	(g)	(g)	2.0y10-3	(g)	8
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2.	Inadvertent criticality in ICPP storage facility	$1.0 \times 10^{-3}$	$9.7 \times 10^{-2}$	$1.4 \times 10^{-3}$	$1.0 \times 10^{-3}$	$5.9 \times 10^{-1}$	5
3.	Fuel melting of small number of assemblies at HFEF resulting from seismic event and cell breach	$1.0 \times 10^{-5}$	$6.2 \times 10^{-1}$	$6.5 \times 10^{-1}$	$5.0 \times 10^0$	$1.4 \times 10^4$	2
4.	Material release from HFEF resulting from aircraft crash and ensuing fire	$1.0 \times 10^{-7}$	$4.6 \times 10^0$	$3.2 \times 10^{-1}$	$5.0 \times 10^0$	$2.0 \times 10^3$	2

a. Numbers in parentheses indicate multiplication factor used to scale or adjust estimates under Alternative 1, as described in Section 5.15.3.3.

b. A worker is defined as a worker located 100 meters (328 feet) from the point of

c. Public individual assumed to be stranded at the nearest point of public access is

d. MEI = Maximally exposed hypothetical offsite individual located at the nearest site

e. Maximally exposed individual and offsite population fatal cancer risk = dose  $\times$  a  $5.0 \times 10^{-4}$  fatal cancer per rem (ICRP-60 conversion factor) if dose is less than or more, the ICRP-60 conversion factor is doubled, or  $1.0 \times 10^{-3}$ . Numbers in parentheses indicate number of fatal cancers in the population if the accident occurs.

f. HFEF = Hot Fuel Examination Facility.

g. The safety analysis report utilized for this accident analysis does not provide information developed prior to DOE Order 5480.23 requiring this information. As demonstrated, maximally exposed individual, consequences to the public from this accident could be greater than for Accidents 2 through 4. However, given the high frequency for Accidents 2 through 4, the risk could actually be greater than for Accidents 2 through 4.

h. ICPP = Idaho Chemical Processing Plant.

i. Although three nuclear criticalities associated with spent nuclear fuel reprocessing at the INEL during its 40-year operating history, the estimated frequency for an incident based on historic reprocessing data since reprocessing is not considered under this alternative, frequency estimates vary from  $1.0 \times 10^{-4}$  (CPP-666 underwater storage facility) to  $1.0 \times 10^{-3}$  (underwater storage facility) events per year.

j. Refer to Sections 5.15.3.3 and 5.15.6.2 for details on why this frequency was not used for Alternative 1.

k. This frequency is a qualitative bounding estimate for a potential aircraft crash at the INEL, as described in Section 5.15.6.4.

fuel that had cooled sufficiently. On demonstration of the centralized site's capacity to store spent nuclear fuel, the inventory of spent fuel at the INEL would be reduced substantially. Only spent nuclear fuel at the INEL would consist of fresh fuel generated from operating reactors that had not cooled sufficiently for relocation to the centralized site.

Adjustments in estimated accident frequencies and point estimates of risk presented for Alternative 1 would be related to (1) the receipt, handling, and storage activities associated with the additional spent nuclear fuel inventories; and (2) the increase in overall spent nuclear fuel-related storage, relocation, and handling activities not allowed under Alternative 1. Because no changes in accident consequences estimated for Alternative 1 are likely to occur under this alternative, increased fuel inventories (i.e., the same amount of radioactive material would be released to the environment as discussed in Section 5.15.3.3), no changes are likely in the impacts presented in Table 5.15-8. Table 5.15-14 summarizes the postulated accident impacts under these alternatives.

#### 5.15.4.5.2 Alternative 5b: Centralization at the INEL - Adjustments in estimated

accident frequencies and point estimates of risk presented for Alternative 1 would be related to (1) the receipt, handling, and storage activities associated with the additional spent nuclear fuel inventories; and (2) the increase in overall spent nuclear fuel-related storage, relocation, and handling activities not allowed under Alternative 1.

Because no changes in the accident consequences estimated for Alternative 1 are likely to occur under this alternative from increased fuel inventories, increased fuel inventories (i.e., the same amount of radioactive material would be released to the environment as discussed in Section 5.15.3.3), no changes are likely in the postulated secondary impacts presented in Table 5.15-15. Table 5.15-14 summarizes the postulated accident impacts under these alternatives.

Because the option exists to restart processing activities, three additional processing activities are likely to occur under this alternative.

maximum reasonably foreseeable accidents are considered under this alternative (as Section 5.15.3.2). Since the amount of radioactive material that would accidentally environment from these accidents is expected to be lower than Accidents 3 and 4 (i. and aircraft crash at the Hot Fuel Examination Facility, respectively), potential s associated with these additional processing-related accidents would be less severe for the nonprocessing-related accidents in Table 5.15-8.

**Table 5.15-14.** Impacts from selected maximum reasonably foreseeable accidents - Al Centralization at Other DOE Sites (50 and 95 percentile meteorological conditions).

Accident	Adjusted Frequency <sup>a</sup> (events per year)	Worker Dose <sup>b</sup> (rem)	Nearest Public Access <sup>c</sup> (rem)	Dose to MEI <sup>d</sup> (rem)	Offsite Population Dose (95%) (person-rem)	A c M 9
1. Fuel handling accident, fuel pin breach, venting of noble gases and iodine at HFEF <sup>f</sup>	8.6y10 <sup>-2</sup> (8.6)	(g)	(g)	2.0y10 <sup>-3</sup>	(g)	8
2. Inadvertent critical in ICPP <sup>h</sup> CPP-603 storage facility <sup>i</sup>	1.0y10 <sup>-3</sup> (1.0) <sup>j</sup>	9.7y10 <sup>-2</sup>	1.4y10 <sup>-3</sup>	1.0y10 <sup>-3</sup>	5.9y10 <sup>-1</sup>	5
3. Fuel melting of small number of assemblies at HFEF resulting from seismic event and cell breach	1.0y10 <sup>-5</sup> (1.0)	6.2y10 <sup>-1</sup>	6.5y10 <sup>-1</sup>	5.0y10 <sup>0</sup>	1.4y10 <sup>4</sup>	2
4. Material release from HFEF resulting from aircraft crash and ensuing fire	1.0y10 <sup>-7</sup> (1.0) <sup>k</sup>	4.6y10 <sup>0</sup>	3.2y10 <sup>-1</sup>	5.0y10 <sup>0</sup>	2.0y10 <sup>3</sup>	2

- a. Numbers in parentheses indicate multiplication factor used to scale or adjust es under Alternative 1, as described in Section 5.15.3.3.
- b. A worker is defined as a worker located 100 meters (328 feet) from the point of
- c. Public individual assumed to be stranded at the nearest point of public access i
- d. MEI = Maximally exposed hypothetical offsite individual located at the nearest s
- e. Maximally exposed individual and offsite population fatal cancer risk = dose y a 5.0 y 10<sup>-4</sup> fatal cancer per rem (ICRP-60 conversion factor) if dose is less than or more, the ICRP-60 conversion factor is doubled, or 1.0 y 10<sup>-3</sup>. Numbers in pa number of fatal cancers in the population if the accident occurs.
- f. HFEF = Hot Fuel Examination Facility.
- g. The safety analysis report utilized for this accident analysis does not provide developed prior to DOE Order 5480.23 requiring this information. As demonstrate maximally exposed individual, consequences to the public from this accident coul consequences from Accidents 2 through 4. However, given the high frequency for Accidents 2 through 4, the risk could actually be greater than for Accidents 2 t
- h. ICPP = Idaho Chemical Processing Plant.
- i. Although three nuclear criticalities associated with spent nuclear fuel reproces the INEL during its 40-year operating history, the estimated frequency for an in based on historic reprocessing data since reprocessing is not considered under t frequency estimates vary from 1.0 y 10<sup>-4</sup> (CPP-666 underwater storage facility) t underwater storage facility) events per year.
- j. Refer to Sections 5.15.3.3 and 5.15.6.2 for details on why this frequency was no alternative.
- k. This frequency is a qualitative bounding estimate for a potential aircraft crash Section 5.15.6.4.

**Table 5.15-15.** Impacts from selected maximum reasonably foreseeable accidents - Al Centralization at the INEL (50 and 95 percentile meteorological conditions).

Accident	Adjusted Frequency <sup>a</sup> (events per year)	Worker Dose <sup>b</sup> (rem)	Nearest Public Access <sup>c</sup> (rem)	Dose to MEI <sup>d</sup> (rem)	Offsite Population Dose (95%) (person- rem)	A c
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M  
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1. Fuel handling accident, fuel pin breach, venting of noble gases and iodine at HFEF	2.0y10 <sup>-1</sup> (20.0)	(g)	(g)	2.0y10 <sup>-3</sup>	(g)	2
2. Inadvertent criticality in ICP storage facility	1.0y10 <sup>-3</sup> (1.0)	9.7y10 <sup>-2</sup>	1.4y10 <sup>-3</sup>	1.0y10 <sup>-3</sup>	5.9y10 <sup>-1</sup>	5
3. Fuel melting of small number of assemblies at HFEF resulting from seismic event and cell breach	1.0y10 <sup>-5</sup> (1.0)	6.2y10 <sup>-1</sup>	6.5y10 <sup>-1</sup>	5.0y10 <sup>0</sup>	1.4y10 <sup>4</sup>	2
4. Material release from HFEF result in aircraft crash and ensuing fire	1.0y10 <sup>-7</sup> (1.0)	4.6y10 <sup>0</sup>	3.2y10 <sup>-1</sup>	5.0y10 <sup>0</sup>	2.0y10 <sup>3</sup>	2
5. Inadvertent nuclear criticality ICP during CPP-666 processing	1.0y10 <sup>-3</sup>	9.1y10 <sup>+0</sup>	4.9y10 <sup>-2</sup>	2.8y10 <sup>-2</sup>	5.6y10 <sup>+0</sup>	1
6. Hydrogen in ICP CPP-666 dissolver	1.0y10 <sup>-5</sup>	(m)	(m)	6.3y10 <sup>-4</sup>	8.1y10 <sup>-1</sup>	3
7. Inadvertent dissolution of day cooled fuel at ICP CPP-666	1.0y10 <sup>-6</sup>	(m)	(m)	3.0y10 <sup>-2</sup>	2.9y10 <sup>+1</sup>	1

- a. Numbers in parentheses indicate multiplication factor used to scale or adjust as described in Section 5.15.3.3.
- b. A worker is defined as a worker located 100 meters (328 feet) from the point of
- c. Public individual assumed to be stranded at the nearest point of public access i
- d. MEI = Maximally exposed hypothetical offsite individual located at the nearest s
- e. Maximally exposed individual and offsite population fatal cancer risk = dose y a (ICRP-60 conversion factor) if dose is less than 20 rem. For doses of 20 rem or 1.0 y 10<sup>-3</sup>. Numbers in parentheses indicate total number of fatal cancers in th
- f. HFEF = Hot Fuel Examination Facility.
- g. The safety analysis report utilized for this accident analysis does not provide Orders requiring this information. As demonstrated by the dose to the maximally this accident could be less than the consequences from Accidents 2 through 4. H compared to Accidents 2 through 4, the risk could actually be greater than for A
- h. ICP = Idaho Chemical Processing Plant.
- i. Although three nuclear criticalities associated with spent nuclear fuel reproces operating history of CPP-666, the estimated frequency for an inadvertent critica nuclear conditions and fuel vulnerabilities. Nominal estimates vary from 1.0 y 10<sup>-3</sup> (CPP-603 underwater storage facility) events per year.
- j. Refer to Sections 5.15.3.3 and 5.15.6.2 for details on why this frequency was no
- k. This frequency is a qualitative bounding estimate for a potential aircraft crash
- l. The Idaho Chemical Processing Plant has experienced three inadvertent nuclear cr 14 years ago. This frequency is based on modern facility conditions and safegua
- m. The safety analysis report utilized for this accident does not provide this info Order 5480.23 requiring this information. However, a comparison of the data pre provides a relative measure of the impacts to this receptor.

### 5.15.5 Impacts from Postulated Maximum Reasonably Foreseeable Toxic Material Accidents

Like radioactive materials, toxic materials (e.g., chemicals) are involved in a operations, including spent nuclear fuel-related activities, at the INEL. As a res and activities, the potential exists for releases of toxic materials to the environ types of initiators considered in determining the radiological accident scenarios d Section 5.15.4. This section summarizes analyses of postulated accident scenarios

spent nuclear fuel activities that could result in the release of toxic materials f

#### 5.15.5.1 Identification of Toxic Chemicals at the INEL. The facilities at the INEL use

many types and quantities of chemically toxic materials. To determine the spent fu that exist in sufficient quantities to present health effects to workers or the off performed an initial screening of the chemical inventories at the INEL. This scree identifying those hazardous chemicals at the INEL listed in the Superfund Amendment Reauthorization Act of 1986 (SARA) 312 Report for 1992 (Priestly 1992) that (1) exi quantities [assumed to be greater than 227 kilograms (500 pounds)]; or (2) exceed r [usually 0.45 kilogram (1 pound)] on the EPA Title III List of Lists (EPA 1990), wh hazardous chemicals defined in the following:

- SARA Section 302, Extremely Hazardous Substances (40 CFR Part 355, Appendix B, List of Extremely Hazardous Substances and Their Threshold Planning Quan (CFR 1993)
- Comprehensive Environmental Response, Compensation, and Liability Act Hazar Substances (40 CFR Part 302, Table 302.4, Lists of Hazardous Substances and Quantities) (CFR 1992a)
- SARA Section 313, Toxic Chemicals (CFR 1992b)
- Federal Register list of 100 extremely hazardous chemicals (FR 1994)

#### 5.15.5.2 Selection of Spent Nuclear Fuel-Related Toxic Chemicals Requiring

Accident Analysis. As indicated by the screening methodology discussed above, toxi inventories are located throughout INEL facilities in varying quantities and are in operations and activities performed by INEL facilities, including spent nuclear fue The screening identified no toxic chemicals associated with the dry storage of spen Except for processing-related activities that could be performed under the Regional Centralization at INEL alternatives [i.e., Alternatives 4b(1) and 5b, respectively] identified activities associated with the underwater storage of spent nuclear fuel water chemistry) as the only spent nuclear-fuel related activities that might utili sufficient quantities to present a potential for health effects to workers or the o potential contamination of the environment. For Alternatives 4b(2) and 5a, in whic relocate INEL spent nuclear fuel inventories and related activities to other DOE si chemical inventories at the INEL would be expected to slightly decrease. For Alter 5b, in which the INEL could potentially resume processing activities, a substantial chemical inventories, primarily hydrofluoric acid and anhydrous ammonia, would be e substantial changes in existing spent nuclear fuel-related toxic chemical inventori under Alternatives 1, 2, or 3.

To demonstrate how the consequences of the same accident at an identical hypoth constructed at the Hanford Site or the Savannah River Site under this alternative w INEL (based on local geological and meteorological conditions), Appendix D summariz accident scenarios for a new Expanded Core Facility that DOE could construct at any considered in this EIS.

To determine potential accident scenarios associated with handling or storing t the various spent nuclear fuel-related facilities, DOE performed an extensive revie analyses and walkdowns of various facilities. This review identified two nonproces chemicals at the Idaho Chemical Processing Plant - nitric acid and chlorine - as re evaluation to determine potential health effects to workers and the offsite populat two toxic chemicals that would be required to support the resumption of processing Idaho Chemical Processing Plant - hydrofluoric acid and anhydrous ammonia - were id requiring further evaluation(6). Although spent fuel-related facilities at the Ida Plant use several other toxic chemicals (e.g., oxalic acid), the quantities of thes sufficient to present an impact to workers or the environment from accidental relea

6. Although bulk quantities of nitric acid would be required to perform processing could be resumed Alternatives 4b(1) and 5b, the consequences of processing-related involving nitric acid would be bounded by the hydrofluoric acid and anhydrous accid Sections 5.15.3.3. and 5.15.3.4., respectively. Therefore, this analysis focuses on nitric acid accident resulting from the nonprocessing spent nuclear fuel-related ac considered under the other alternatives.

environment. (For postulated accident scenarios involving Naval spent nuclear fuel



the INEL, refer to Appendix D.)

Because DOE determined that it needed to evaluate postulated toxic chemical accidents at the Idaho Chemical Processing Plant as part of this EIS, it did not consider postulated accidents at the Advanced Test Reactor Storage Canal and the Hot Fuel Examination Facility could be involved in spent fuel-related activities(7) for further evaluation in the reasons:

- In general, quantities of spent nuclear fuel-related chemicals at the Idaho Chemical Processing Plant are substantially greater than those at the Advanced Test Canal and Hot Fuel Examination Facility.
- The Idaho Chemical Processing Plant is located approximately 1,000 meters (closer to the nearest site boundary than the Advanced Test Reactor).

Based on a review of safety documentation for the Test Area North spent nuclear storage facility and discussions with facility personnel, DOE determined that none of the chemicals identified in the screening (Section 5.15.5.1) is related to spent fuel handling activities.

#### 5.15.5.3 Toxic Chemical Accident Analysis. For chemically toxic materials, several

government agencies recommend quantifying health effects that cause short-term effects at values of concentrations in air or water. The long-term health consequences of humankind from toxic materials are not as well understood as the long-term health consequences resulting from exposure to radioactive materials. Thus, the potential health effects for exposures to toxic chemicals are those for radioactive materials. Factors such as receptor locations, terrain, meteorological release conditions, and characteristics of chemical inventories are required parameters for determinations of airborne concentrations of toxic chemicals at various distances from the point of release.

7. The scope of this analysis has been restricted to the Advanced Test Reactor fuel canal. Everything inside the reactor gas-tight boundary and associated with reactor operations has been excluded from consideration because reactor operations are not related to nuclear fuel activities considered in this EIS.

EPICode<sup>TM</sup> was used to estimate airborne concentrations resulting from spent nuclear fuel toxic chemical releases at the INEL. [For a detailed description of EPICode<sup>TM</sup>, refer to et al. (1995).]

To determine the potential health effects from accidental releases of toxic chemicals, the concentrations determined by EPICode<sup>TM</sup> against Emergency Response Planning Guideline values, where available. These values, which are specific for each substance, are compared to three general severity levels:

- Exposure to concentrations greater than Emergency Response Planning Guideline-1 for a period of time greater than 1 hour results in an unacceptable likelihood that a person would experience mild transient adverse health effects, or perception of a objectionable odor.
- Exposure to concentrations greater than Emergency Response Planning Guideline-2 for a period of time greater than 1 hour results in an unacceptable likelihood that a person would experience or develop irreversible or other serious health effects, or could impair one's ability to take protective action.
- Exposure to concentrations greater than Emergency Response Planning Guideline-3 for a period of time greater than 1 hour results in an unacceptable likelihood that a person would experience or develop life-threatening health effects.

If there were no Emergency Response Planning Guideline values for a toxic substance, the analysis substituted other chemical toxicity values, as follows:

- Threshold limit values/time-weighted average values (ACGIH 1988) substituted for Emergency Response Planning Guideline-1. This is the time-weighted average for a normal 8-hour workday and a 40-hour workweek to which nearly all workers could be repeatedly exposed, day after day, without adverse effect.
- Level of concern values (equal to 0.1 of the immediately dangerous to life or health values) substituted for Emergency Response Planning Guideline-2. The level of concern value is the concentration of a hazardous substance in the air above which serious irreversible health effects or death as a result of a single exposure over a short period of time.
- Immediately dangerous to life or health values are substituted for Emergency Response Planning Guideline-3. The immediately dangerous to life or health value is the concentration from which a person could escape within 30 minutes without a

without experiencing any impairment of escape or irreversible side effects. As stated in the above section, four toxic chemicals - chlorine, nitric acid, and anhydrous ammonia - at the Idaho Chemical Processing Plant were identified as requiring evaluation to estimate potential health effects to workers and the public. The following summarizes the analyses performed for these chemicals.

#### 5.15.5.3.1 Accidental Chlorine Release - Chlorine, while not directly associated with

spent nuclear fuel-related activities at the INEL, is used to treat drinking water at spent fuel facilities.

Therefore, an analysis of a postulated accidental chlorine release at the Idaho Chemical Processing Plant was performed to determine potential impacts on workers at spent fuel-related facilities.

At the Idaho Chemical Processing Plant, chlorine is contained in two pressurized [65 atmospheres at 20°C (68°F)], a 68-kilogram (150-pound) bottle and a 55-kilogram (120-pound) bottle, totaling 123 kilograms (270 pounds). To be conservative, DOE assumes a breach of the drain line causes an instantaneous release of the total inventory of highest chlorine concentrations at the receptor locations would result from the longest shortest time period. Therefore, the release duration was assumed to be approximately 10 minutes.

An accidental chlorine release from one of the chlorine tanks could be initiated by events, such as a handling event, piping or valve rupture, or human error. Because the tanks are physically separated, an accidental simultaneous release from both tanks would require an initiator such as a delivery accident, a common maintenance failure, or a natural phenomenon (e.g., seismic) that damaged or punctured both tanks. The frequency of an accident at a pressurized tank is  $1.0 \times 10^{-4}$  event per year (EPA/FEMA/DOT 1987). A common cause for the release of chlorine from two separated tanks is assumed to be no greater than the time given for the first tank failure. Therefore, the estimated frequency of release from both tanks is  $5.0 \times 10^{-6}$  events per year (with no credit taken for pressure vessel failure training).

Table 5.15-16 summarizes the concentrations of the subject chlorine release at receptor locations: a facility worker, a member of the public stranded at the nearest access inside the INEL boundary, and a maximally exposed hypothetical member of the public at the nearest site boundary. As listed in Table 5.15-10, the peak chlorine concentrations for workers could result in life-threatening health effects (i.e., Emergency Response Planning Guidelines (ERPG) values are exceeded) for both conservative (95 percentile) and average (50 percentile) conditions.

**Table 5.15-16.** Summary of chemical concentrations for postulated nonprocessing-related releases at the Idaho Chemical Processing Plant under Alternatives 1 through 5.

Receptor Location	Chemical Concentrations (milligrams per cubic meter) <sup>a</sup>		
	95% Meteorology <sup>b</sup>		50% Meteorology <sup>c</sup>
	Chlorine	Nitric Acid	Chlorine
	ERPG-1d = 3 (1)	TWA = 5.2 (2)	ERPG-1d = 3 (1)
	ERPG-2 = 9 (3)	LOC = 25.5 (10)	ERPG-2 = 9 (3)
	ERPG-3 = 60 (20)	IDLH = 255 (100)	ERPG-3 = 60 (20)
1. Worker located at 100 meters (325 feet).	84,000 (28,000)	250 (95)	1,600 (540)
2. Nearest point of public access where a member of the public is assumed stranded at the time of the release.	19.5 (6.5)	0.32 (0.12)	1.8 (0.6)
3. Maximally exposed hypothetical individual located at the nearest site boundary.	4.2 (1.4)	0.12 (0.047)	0.4 (0.15)

a. Numbers in parentheses reflect concentrations in parts per million.

b. The 95 percentile meteorology is based on Class F (unfavorable) meteorological conditions: 1.1 miles per hour wind speed for receptors located within 2 kilometers and 2 meters per second (4.5 miles per hour) for receptors beyond 2 kilometers.

c. The 50 percentile meteorology is based on Class D (typical) meteorological conditions: 10 miles per hour wind speed for all receptors.

d. ERPG = Emergency Response Planning Guidelines.

- e. Because Emergency Response Planning Guideline values are not available for nitric acid, average values are substituted for ERPG-1 values, level of concern values are substituted for ERPG-2 values, and immediately dangerous to life or health values are substituted for Emergency Response Planning Guideline-3 values. Refer to Section 5.15.5.3 for further information regarding
- f. The nearest point of public access from this postulated release is 5,870 meters
- g. The nearest site boundary is located at 14,000 meters (15,310 yards).

Peak chlorine concentrations estimated at the nearest point of public access are Emergency Response Planning Guideline-2 value assuming 95 percentile meteorological conditions listed in Table 5.15-10. Symptoms associated with exposure to these concentrations include burning of the eyes, nose, and throat, coughing, choking, and possibly skin burns.

As listed in Table 5.15-16, the estimated peak averaged chlorine concentration at the site boundary would be above the Emergency Response Planning Guideline-1 value for 95 percentile meteorological conditions. However, due to the nature of the release, this concentration would not last for more than a few minutes. Therefore, it would be unlikely that individuals in the area would experience more than mild transient adverse health effects.

This analysis took limited credit for emergency response actions following a release by calculating the concentrations listed in Table 5.15-16. To mitigate the consequences of a release to the environment, the same emergency response programs and actions described for radiological accident scenarios (Section 5.15.4.1) would be initiated following the actual health effects experienced by persons inside the site boundary would be realistic values listed in Table 5.15-16.

Because the estimated airborne concentration of chlorine at 100 meters (328 feet) exceeds the guidelines listed in Table 5.15-16, workers could be fatally injured or long-term or permanent health effects. Potential secondary impacts associated with an accident scenario would involve economic impacts such as workers' compensation, medical costs, potential lawsuits. No other secondary impacts, such as impacts on national defense resources, were identified.

#### 5.15.5.3.2 Accidental Nitric Acid Release - Nitric acid is used at various spent

nuclear fuel-related storage facilities for maintaining the chemistry of the water storage facilities(8).

Based on the toxic chemical screening discussed in Section 5.15.5.1, review of existing safety analyses, walkdowns of spent nuclear fuel-related facilities, and i

8. Although bulk quantities of nitric acid would be required to perform processing could be resumed under Alternatives 4b(1) and 5b, the consequences of processing-re involving nitric acid would be bounded by the hydrofluoric acid and anhydrous acid in Sections 5.15.5.3.3. and 5.15.5.3.4., respectively. Therefore, this analysis focuses on potential nitric acid accident resulting from the non-processing spent nuclear fuel activities considered under the other alternatives.

personnel, DOE determined that the potential exists for an accidental release of nitric acid from two 1,135 liters (300-gallon) storage tanks used to support spent nuclear fuel-related activities at the Idaho Chemical Processing Plant. Because one of the tanks is usually empty, tanks have separate valves, and they are physically separated, DOE could not identify a likely initiator that could cause an accidental simultaneous release from both tanks.

The quantity of nitric acid assumed available for release from a single initiator is 1,135 liters (300 gallons). The following assumptions were made for this analysis:

- An initiating event causes severe structural damage (e.g., large puncture)
- The entire inventory of nitric acid is released into the containment wall storage tank.
- The area of the containment wall is approximately 28 square meters (300 square feet)
- The total release of nitric acid [i.e., 1,135 liters (300 gallons)] evaporates into the atmosphere before the implementation of emergency response procedures can remove the nitric acid.

Table 5.15-16 summarizes the concentrations of the nitric acid release at the facility locations for both conservative (95 percentile) and average (50 percentile) meteorological conditions. For a facility worker, a member of the public stranded at the nearest point of public access to the INEL boundary, and a maximally exposed hypothetical member of the public at the nearest point of public access. The estimated frequency for this event is 1 y 10<sup>-5</sup> events per year.

This analysis took limited credit for emergency response actions following a release by calculating the concentrations listed in Table 5.15-16. To mitigate the consequences of a release to the environment, the same emergency response programs and actions described for radiological accidents are used.

scenarios (Section 5.15.4.1) would be initiated following a nitric acid release. The effects experienced by persons inside the site boundary would realistically be less listed in Table 5.15-16.

Other than limited economic secondary impacts, no other secondary impacts would this accident occurred.

#### 5.15.5.3.3 Accidental Hydrofluoric Acid Release - To resume spent nuclear fuel

processing activities at the Fluorinel and Storage (FAST) facility (CPP-666), which shutdown and being placed in a permanent shutdown mode, bulk quantities of hydrofluoric acid be required to support the dissolution process.

A hydrofluoric acid storage tank with an operating capacity of approximately 30,283 liters (8,000 gallons) is located in the Idaho Chemical Processing Plant facility area to support processing activities, although only 11,356 liters (3,000 gallons) of hydrofluoric acid remain in the tank, and efforts are currently underway to remove hydrofluoric acid in the tank from the INEL site.

Table 5.15-17 summarizes the potential impacts upon a maximally exposed hypothetical individual located at the nearest site boundary [14,000 meters (15,310 yards)] resulting from a potential hydrofluoric acid release at the Idaho Chemical Processing Plant assuming meteorological conditions. Slaughterbeck et al. (1995) provides further details on regarding this postulated accident scenario. Although Slaughterbeck et al. (1995) only the maximally exposed offsite hypothetical individual resulting from this post 95 percentile meteorological conditions, a comparison of the airborne concentration of hydrofluoric acid at 14,000 meters (15,310 yards) to the airborne concentrations from other post accident scenarios (as presented in Table 5.15-16) at the same receptor distance provides perspective on the significance of this accident.

**Table 5.15-17.** Summary of chemical concentrations for postulated processing-related releases at the Idaho Chemical Processing Plant under Alternatives 4b(1) and 5b.

Receptor Location	Chemical Concentrations (milligrams per cubic meter) at 95% Meteorology	
	Hydrofluoric Acid	Anhydrous Ammonia
Maximally exposed hypothetical individual located at the nearest boundary	0.078 (0.09)	82 (120.6)
ERP-1c = 4 (5)	ERP-1 = 17 (2)	
ERP-2 = 17 (20)	ERP-2 = 136 (170)	
ERP-3 = 43 (50)	ERP-3 = 680 (850)	

- Numbers in parentheses reflect concentrations in parts per million.
- The 95 percentile meteorology is based on Class F (unfavorable) meteorological conditions: 0.5 meter per second (1.1 miles per hour) wind speed for receptors located within 1.2 miles of the release and 2 meters per second (4.5 miles per hour) for receptors located 2 kilometers of the release.
- ERP = Emergency Response Planning Guidelines.
- The nearest site boundary is located at 14,000 meters (15,310 yards).

The estimated frequency for this event is 1 y 10<sup>-5</sup> events per year. It should be noted that the potential accident applies only to Alternatives 4b(1) and 5b, and is in addition to and nitric acid release accidents described in Sections 5.15.5.3.1 and 5.15.5.3.2.

This analysis took limited credit for emergency response actions following a hydrofluoric acid release in calculating the concentrations listed in Table 5.15-17. To mitigate the release to the environment, the same emergency response programs and actions described for radiological accident scenarios (Section 5.15.4.1) would be initiated following a hydrofluoric acid release. Therefore, actual health effects experienced by persons inside the site boundary would realistically be less than the values listed in Table 5.15-17.

Other than limited economic secondary impacts, no other secondary impacts would this accident occurred.

#### 5.15.5.3.4 Accidental Anhydrous Ammonia Release - To resume spent nuclear

fuel processing activities at the Fluorinel and Storage (FAST) facility (CPP-666), anhydrous ammonia would be required to support operation of the NOx-Abatement Facility (CPP-1670), a facility that would be constructed to treat airborne effluents from the fuel processing facilities before being released to the environment.

The NOx-Abatement Facility would be expected to utilize two anhydrous ammonia tanks.

with a storage capacity of 68,000 liters (18,000 gallons). Table 5.15-17 summarize impacts upon the maximally exposed hypothetical offsite individual located at the n boundary [14,000 meters (15,310 yards)] resulting from a short-term release of the storage tanks [i.e., 136,000 liters (36,000 gallons)] at the Idaho Chemical Process 95 percentile meteorological conditions. Slaughterbeck et al. (1995) provides furt discussion regarding this postulated accident scenario. Although Slaughterbeck et only impacts to the maximally exposed offsite hypothetical individual resulting fro accident for 95 percentile meteorological conditions, a comparison of the airborne anhydrous ammonia at 14,000 meters (15,310 yards) to the airborne concentrations fr postulated chemical accident scenarios (as presented in Table 5.15-16) at the same meaningful perspective on the significance of this accident.

The estimated frequency for this event is  $5 \times 10^{-6}$  events per year. The basis frequency is identical to that described for an accidental chlorine release from tw described in Section 5.15.5.3.1. It should be noted that this potential accident a Alternatives 4b(1) and 5b, and is in addition to the potential chlorine and nitric described in Sections 5.15.5.3.1 and 5.15.5.3.2, respectively.

This analysis took limited credit for emergency response actions following an a ammonia release in calculating the concentrations listed in Table 5.15-17. To miti consequences of a release to the environment, the same emergency response programs described for radiological accident scenarios (Section 5.15.4.1) would be initiated hydrofluoric acid release. Therefore, actual health effects experienced by persons boundary would realistically be less than the values listed in Table 5.15-17.

Other than limited economic secondary impacts, no other secondary impacts would this accident occurred.

### 5.15.6 Maximum Reasonably Foreseeable Radiological Accident Scenario Descriptions

The purpose of this section is to summarize the different accident scenarios id Section 5.15.4. The Facility Safety Report for the Argonne National Laboratory-West Examination Facility (ANL 1975) contains further details and discussions for Accide below. Slaughterbeck et al. (1995) provides further details, discussions, and refe through 7, discussed below. Additional discussions and references regarding the pr accidents summarized in this section are also provided in a study performed to dete impacts spent nuclear fuel processing-related accidents could have on the siting of reactor at the INEL (EG&G 1993b). These documents contain additional information, fractions, source terms, and other assumptions used in the accident analyses. Appe postulated accident scenarios associated with Naval spent nuclear fuel-related faci the INEL.

#### 5.15.6.1 Accident 1: Fuel Pin Breach and Venting of Noble Gases and Iodine to

the Environment from a Mechanical Handling Accident at the Argonne National Laboratory-West Hot Fuel Examination Facility. The accident screening methodology in Section 5.15.3 identified a mechanical handling event at the Argonne National La Fuel Examination Facility as an initiator to the maximum reasonably foreseeable acc abnormal event frequency range. This event would result in a fuel pin breach and v gases and iodine to the environment. The identification of this accident as a maxi foreseeable accident is based on the estimated radiological consequences to the max hypothetical offsite individual at the nearest site boundary presented in the Hot F Facility Safety Report (ANL 1975). Other postulated accidents associated with hand fuel in the Hot Fuel Examination Facility before the identification of the fuel pin the maximum reasonably foreseeable accident included an inadvertent criticality and fuel pin breach accident was chosen as the maximum reasonably foreseeable accident estimated frequencies for an inadvertent criticality and a sodium fire in the facil (ANL 1975).

The analyses defined in the Facility Safety Report (ANL 1975) made the followin

- The fuel subassemblies and experimental capsules being examined in the faci cooled for at least 15 days to ensure that the short-lived fission products
- The noble gases and iodines that could be released from this accident scena immediately released.
- One hundred percent of the noble gases, 25 percent of the iodines, and 1 pe particulates were available for escape to the atmosphere.
- The building containment structure, including the building ventilation syst

Cell, including the argon ventilation system, remained operational following accident. This assumption is considered appropriate because the mechanical accident scenario under consideration would not initiate a failure in these (Accident 3 considers the simultaneous failure of all these systems in conjunction with melting of fuel assemblies stored in the facility).

The Facility Safety Report (ANL 1975) contains specific information on the source term associated with breaching the fuel section of a pin. Because that report does not provide the frequency of occurrence for the subject mechanical handling accident scenario, the historic information and engineering judgment to determine the conservatively estimated frequency of this accident of  $1.0 \times 10^{-2}$  event per year.

For determining the impacts from this postulated accident scenario, the nearest access is equivalent to the nearest site boundary, which is 5,240 meters (5,730 yards) from the release. Although the Facility Safety Report (ANL 1975) does not estimate consequences offsite population resulting from this accident scenario, this analysis reasonably estimates (i.e., dose) to the offsite population would be less than the offsite population for Accidents 2 through 4 because the dose to the maximally exposed hypothetical individual in the nearest site boundary from this accident would be less than that estimated for Accident 1.

#### 5.15.6.2 Accident 2: Inadvertent Nuclear Chain Reaction in Wet Spent Nuclear Fuel

Fuel Storage (1 year 10<sup>19</sup> fissions, 8-hour release) at the Idaho Chemical Processing Plant (ICPP) Underwater Fuel Storage Facility. The accident screening methodology discussed in Section 5.15.3 identified an inadvertent nuclear criticality associated with underwater storage at the ICPP Underwater Fuel Storage Facility as an accident requiring further analysis. Other postulated accidents that were considered before the identification of an inadvertent nuclear criticality accident as a maximum reasonably foreseeable accident included pool leaks, fuel damage, and loss of cooling events. This analysis selected an inadvertent nuclear criticality accident for EIS over the other accidents for the following reasons:

- Postulated inadvertent nuclear criticality accidents have been addressed in previous reactor EISs and safety analysis reports in which such accidents were not considered because of public concerns regarding the potential for these accidents.
- The Idaho Chemical Processing Plant has experienced three inadvertent nuclear criticality accidents. Although none of these accidents involved a fuel storage facility, they demonstrate the potential and concern for such events.
- The consequences of water leakage from a pool-draining event would present consequences to workers that are more severe than a criticality because the INEL could implement response plans to evacuate workers before the risk to these workers could increase. In addition, a pool drain was considered to be an initiator to a criticality.
- Mechanical fuel damage events are less impacting than a nuclear chain reaction because some degree of fuel damage is part of the criticality accident scenario.

Of the different Idaho Chemical Processing Plant facility areas that store spent nuclear fuel, the ICPP Underwater Fuel Storage Facility was selected for analysis of a criticality accident for the following reasons:

- ICPP-603 facility storage includes most types of spent nuclear fuel stored on-site. Fuel stored at reactor basins is an exception (but was considered in the analysis of other reasonably foreseeable accident scenarios) because of its much shorter residence time after removal from a reactor.
- ICPP-603 facility spent nuclear fuel storage quantities are comparable to or greater than nuclear fuel inventories stored elsewhere on the site.
- The ICPP-603 facility is an older facility that does not contain all the present mitigative design features found in more modern facilities, such as the ICPP Spent Nuclear Fuel Storage Area.

The analysis selected the underwater fuel storage portion of the ICPP-603 facility for analysis because accidents involving fuels in dry storage probably would have less severe potential consequences because the fuel is removed from reactors for a much longer period of time and, because of their design, most of the remaining fission products would not be released if a criticality accident occurred.

Initiating events that the analysis considered possible to lead to an inadvertent nuclear criticality accident included operator error, hanger corrosion, equipment failure, an earthquake, pool level rise, or a crash. The scenario discussed in this EIS assumes a postulated criticality accident initiated by human error, equipment failure, or earthquake. Heat generated from the accident would easily dissipate and thereby avoid fuel melting but would still cause the release of fission products associated with 1 year 10<sup>19</sup> fissions over an 8-hour period.

Between 1945 and 1980, 40 known inadvertent criticalities occurred worldwide, none of which resulted in a major release of radioactive material.

involved the handling or storage of spent nuclear fuel in an underwater fuel storage addition, between 1975 and 1980, there were 160 nuclear power reactor facilities with storage facilities worldwide. None of these facilities ever had a nuclear criticality underwater storage facilities. Therefore, it is generally assumed that the likelihood in a modern underwater storage facility is unlikely, with a frequency estimated at 1 y 10<sup>-3</sup> event per year. This estimated frequency is supported by information in the safety analysis CPP-666 underwater storage facility, which is a modern facility (e.g., 1980s vintage) to store various types of spent nuclear fuel. In the CPP-603 Underwater Fuel Storage facility, however, where spent nuclear fuel inventories have substantially corroded or degraded and where the design of the facility and its supporting equipment do not meet current specifications, activities associated with handling and storing spent nuclear fuel increase the likelihood for an inadvertent nuclear criticality accident by as much as an order of magnitude. Therefore, this analysis conservatively assumes the estimated frequency for an inadvertent nuclear criticality associated with handling spent nuclear fuel in the CPP-603 Underwater Fuel Storage facility to be 1 y 10<sup>-3</sup> event per year for this analysis.

The handling activities associated with stabilizing CPP-603 facility spent nuclear fuel would occur under each of the five alternatives considered in this EIS. The estimated inadvertent nuclear criticality at the CPP-603 facility is an order of magnitude larger than the INEL facility (e.g., 1 y 10<sup>-3</sup> event per year), and is considered a "worst-case" frequency. Changes in estimated criticality frequencies at other INEL facilities resulting from activities associated with changes in spent nuclear fuel inventories. Therefore, the criticality frequency related to the CPP-603 as the estimated frequency under each alternative is a conservative bound on the estimated criticality frequencies for other spent nuclear fuel handling and storage facilities.

To determine the accident impacts from this postulated accident scenario, the area around the worker to be located 100 meters (328 feet) from the event, the nearest point of Route 20/26 is 5,870 meters (6,420 yards), and the nearest site boundary is located 15,310 yards).

#### 5.15.6.3 Accident 3: Earthquake-Induced Breach and Fuel Melt at the Argonne

National Laboratory-West Hot Fuel Examination Facility. The accident screening methodology discussed in Section 5.15.3 identified an earthquake-induced breach and Argonne National Laboratory-West Hot Fuel Examination Facility as a maximum reasonably foreseeable accident that would present higher radiological consequences to facility offsite population than other postulated accidents analyzed in the same accident frequency analysis. Postulated events leading to atmospheric release of radionuclides are as follows:

- The earthquake results in a peak horizontal ground acceleration of sufficient magnitude to cause structural damage to the building structure and a large breach in the building.
- Coincident with the breach, a failure of the fuel subassembly cooling system resulting in the melting of fresh assemblies.
- Radionuclides from the melting fuel subassemblies are released to the atmosphere.

The estimated probability of an earthquake in the Argonne National Laboratory-West Hot Fuel Examination Facility resulting in a peak horizontal acceleration of sufficient magnitude to damage the fuel cell is 1 y 10<sup>-5</sup> event per year. This analysis conservatively assumes the failure of the building structure, Main Cell, and subassembly cooling to be 1.0, given an earthquake has occurred. A preliminary assessment of the seismic integrity of the Examination Facility, as discussed in Slaughterbeck et al. (1995), indicates that, based on the analysis, significant failures could result at the Hot Fuel Examination Facility.

In determining the number of fuel assemblies that would be affected during this accident, the analysis assumed that 20 fuel subassemblies would melt due to failure of the forced circulation system. Although 40 storage positions are available for fuel that would require current plans do not estimate the need to use more than 20 of these positions. The analysis scenario is 30 days. To prevent doses greater than 5 rem to the public from this accident, the analysis assumed intervention by evacuation or prevention of contaminated food consumption. Calculated doses reflecting this assumption.

To determine the impacts from this postulated accident scenario, the analysis assumed the worker to be located 100 meters (328 feet) from the event, and the nearest point of public use is located 5,240 meters (5,730 yards).

9. As discussed in Slaughterbeck et al. (1995), accelerations with any of several peak ground motion levels with a combined estimated frequency of 1 \* 10<sup>-5</sup> per year are beyond the design of the Hot Fuel Examination Facility and were determined to compromise the ability of the structure to maintain confinement. Events this rare are beyond the requirements of the facility.

DOE Order 5480.28 and DOE-ID Architectural Engineering Standards for Category 1 (hazard) facilities.

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#### 5.15.6.4 Accident 4: Radiological Material Release from the Argonne National

Laboratory-West Hot Fuel Examination Facility Resulting from an Aircraft Crash and Ensuing Fire. The accident screening methodology discussed in Section 5.15.3 identifies radioactive material release from the Argonne National Laboratory-West Hot Fuel Examination Facility as the maximum reasonably foreseeable accident in the basis accident frequency range. Of externally initiated events, an aircraft crash Examination Facility is a maximum reasonably foreseeable accident because it could breach of confinement barriers, (2) involve a large portion of the material at risk energy release mechanism (physical impact followed by a sustained fire). The analysis considers other accident scenarios in this frequency range because they would not have energy sources to cause a large breach of confinement and release to the atmosphere. The facility contains little combustible material to sustain a fire, a fire caused by a crash could increase potential consequences over other beyond-design-basis accident events of an aircraft crash scenario are as follows:

- A large or high-velocity aircraft (e.g., commercial or military) crashes at the Fuel Examination Facility.
- The impact has sufficient force to cause catastrophic failure of the building of the Main Cell, and loss of forced cooling to subassemblies in the cell.
- The fuel in the aircraft is released to the facility and is ignited.
- The ensuing fire involves the contents of the Main Cell, Decontamination Cell Area, and Hot Repair Area, resulting in atmospheric release of radionuclides.

To determine aircraft crash probability, the analysis limited this scenario to jet airplanes. High-velocity military jets from the U.S. Air Force Base at Mountain Home, Idaho could enter the airspace of the INEL. In addition, large jet aircraft could fly at low altitudes in landing configurations over portions of the INEL for the likelihood of a large aircraft crash directly in the Hot Fuel Examination Facility is possible. Analyses of jet aircraft crashes at specific facilities, such as the Idaho Chemical Processing Plant, have resulted in predicted frequencies on the order of  $1.0 \times 10^{-7}$  event per year. Specific analyses have not determined the likelihood of an aircraft crash into the Facility (although it is expected that fewer flights occur over the Argonne National Facility area than the Idaho Chemical Processing Plant), the analysis conservatively assumes a frequency for an aircraft crashing into the Hot Fuel Examination Facility is  $1.0 \times 10^{-7}$  per year.

For determining impacts from this postulated accident scenario, the analysis assumed the facility was located 100 meters from the event; and the nearest point of public access (U.S. nearest site boundary) were both at 5,240 meters (5,730 yards).

#### 5.15.6.5 Accident 5: Inadvertent Nuclear Chain Reaction During Spent Nuclear

Fuel Processing ( $1 \times 10^{19}$  fissions) at the Idaho Chemical Processing Plant CPP-666 Fluorine and Storage (FAST) Facility. The accident screening methodology discussed in Section 5.15.3 identified an inadvertent nuclear criticality resulting from spent nuclear fuel reprocessing in the CPP-666 Fluorine and Storage Facility as a maximum reasonably foreseeable processing accident. Although the CPP-666 Fluorine and Storage Facility, which has reprocessed spent nuclear fuel to recover fissionable radionuclides (e.g., uranium-235), there may be a need to resume processing operations to dissolve spent nuclear fuel and stabilize the radionuclides in a waste form. Therefore, while the potential for criticality currently exists, the potential would exist if processing-related activities are resumed under Alternatives 4b(1) and 5b (Regionalization and Centralization at the INEL, respectively).

Initiating events that the analysis considered possible to lead to an inadvertent criticality during processing included human error, equipment failure, an earthquake, an aircraft crash, fissionable radionuclides in the spent nuclear fuel being processed, and reduced neutron concentrations. Consistent with the inadvertent criticality scenario associated with spent nuclear fuel described in Section 5.15.6.2, the fission yield associated with the accident is assumed to be  $1 \times 10^{19}$  fissions. Further information and references regarding this scenario are provided in Slaughterbeck et al. (1995) and EG&G (1993b).

As discussed in Section 5.15.2, three inadvertent nuclear criticalities have occurred at INEL processing facilities during the 40-year history of the INEL. The last of these occurred 14 years ago. As a result of these accidents, administrative controls and facility



implemented to reduce the potential for inadvertent nuclear criticality accidents r processing-related activities. If the decision is made to resume processing operat controls would be utilized. Therefore, the estimated frequency for a potential ina criticality is assumed to be  $1 \text{ y } 10^{-3}$  events per year, which is consistent with ass regarding the potential for an inadvertent criticality resulting from underwater st severely degraded spent nuclear fuel (as discussed in Section 5.15.6.2).

Limited credit was taken for mitigative features, such as emergency response pr determining worker and public exposures resulting from this postulated accident sce credit was taken for shielding walls placed in the facility to reduce potential per resulting from an inadvertent nuclear criticality.

To determine the accident impacts from this postulated accident scenario, the a the worker to be located 100 meters (328 feet) from the event, the nearest point of (U.S., Route 20/26) is 5,870 meters (6,420 yards), and the nearest site boundary is 14,000 meters (15,310 yards).

#### 5.15.6.6 Accident 6: Radionuclide Release During Spent Nuclear Fuel Processing

at the Idaho Chemical Processing Plant CPP-666 Fluorinel and Storage (FAST) Facilit Resulting from a Hydrogen Explosion in the Dissolver Off-Gas System. The accident screening methodology discussed in Section 5.15.3 identified a hydrogen explosion i Fluorinel and Storage Facility dissolver off-gas system as a maximum reasonably for processing accident. Despite CPP-666's current shutdown status, there may be a nee processing operation to dissolve spent nuclear fuel and stabilize the radionuclides Therefore, while the potential for this accident does not currently exist, the pote processing-related activities are resumed under Alternatives 4b(1) and 5b (Regional Centralization at the INEL, respectively).

Initiating events that the analysis considered possible to lead to a hydrogen e dissolver off-gas system included human error, equipment failure, and an earthquake information and references regarding this postulated accident scenario are provided et al. (1995) and EG&G (1993b).

Limited credit was taken for mitigative features, such as emergency response pr determining worker and public exposures resulting from this postulated accident sce determine the accident impacts from this postulated accident scenario, the analysis to be located 100 meters (328 feet) from the event, the nearest point of public acc Route 20/26) is 5,870 meters (6,420 yards), and the nearest site boundary is locate (15,310 yards).

#### 5.15.6.7 Accident 7: Radionuclide Release During Spent Nuclear Fuel Processing

at the Idaho Chemical Processing Plant CPP-666 Fluorinel and Storage (FAST) Facilit Resulting from the Inadvertent Dissolution of 30-Day Cooled Spent Nuclear Fuel. Th accident screening methodology discussed in Section 5.15.3 identified a radionuclid from the inadvertent dissolution of 30-day cooled spent nuclear fuel in the CPP-666 Storage Facility as a maximum reasonably foreseeable accident. There may be a need processing operation at CPP-666 to dissolve spent nuclear fuel and stabilize the ra waste form. Therefore, while the potential for this accident does not currently ex would exist if processing-related activities are resumed under Alternatives 4b(1) a (Regionalization and Centralization at the INEL, respectively).

Upon removal from a nuclear reactor, spent nuclear fuel is placed in an underwa (e.g., Advanced Test Reactor Storage Canal in the Test Reactor Area) to allow the f cool and short-lived radionuclides to decay. Inadvertent processing of spent nucle had the opportunity to sufficiently cool presents the potential for accidents durin fuel. Examples of accidents that could potentially occur are explosions in the dis inadvertent criticality. An explosion resulting from inadvertent dissolving spent not sufficiently cooled (i.e., 30-day cooled fuel) is considered for this analysis criticality is already considered (as discussed in Section 5.15.6.6).

The potential initiating event considered for this accident involves several op result in the wrong spent nuclear fuel assemblies being dissolved. First, fuel coo would have to be shipped to and received by the Fluorinel and Storage Facility. Se the CPP-666 Fluorinel and Storage Facility would have to inadvertently dissolve the cooled fuel. Based on the individual probability of these events, and the probabil fuel would accidentally release radionuclides to the environment, the estimated fre is  $1 \text{ y } 10^{-6}$  events per year. Further information and references regarding this pos

scenario are provided in Slaughterbeck et al. (1995) and EG&G (1993b).

Limited credit was taken for mitigative features, such as emergency response prior to determining worker and public exposures resulting from this postulated accident. To determine the accident impacts from this postulated accident scenario, the analysis to be located 100 meters (328 feet) from the event, the nearest point of public access (Route 20/26) is 5,870 meters (6,420 yards), and the nearest site boundary is located (15,310 yards).

## 5.16 Cumulative Impacts and Impacts from

### Connected or Similar Actions

The INEL already contains major DOE facilities unrelated to spent nuclear fuel. The INEL will continue to operate throughout the life of the spent nuclear fuel management program associated with these existing facilities. These facilities produce environmental consequences that are in the baseline environmental conditions (Chapter 4) against which it has assessed the spent nuclear fuel alternatives. In addition, the cumulative impacts assessed other past, present, and reasonably foreseeable future actions that DOE expects to such as spent nuclear fuel management, Naval Nuclear Propulsion Program activities, restoration and waste management activities, as well as any known offsite projects, government agencies, businesses, or individuals. Onsite projects include decontamination, decommissioning, repair, and upgrades of existing facilities. Offsite projects include commercial development, and changes in manufacturing plants.

Consistent with the DOE sliding scale approach and the programmatic aspects of cumulative impacts are discussed commensurate with the degree of impact. Therefore of analysis from Chapter 5 is represented in this section. DOE used information from Volume 2 of this EIS as input for this section. Section 5.15 of Volume 2 provides discussion of cumulative impacts.

Tables 5.16-1 and 5.16-2 list the cumulative impacts identified for each alternative. Necessary adjustments to accommodate the differences between Volume 1 and Volume 2 Cumulative impacts from Alternatives 3 and 4a are nominally the same, as are cumulative impacts from Alternatives 1 and 2, 5a and 4b(2), and 5b and 4b(1).

### 5.16.1 Land Use

Implementation of any of the alternatives would contribute to the cumulative loss of open-space land use. However, the cumulative amount of land that would no longer be available for other land uses would be small compared to the size of INEL or region discussed in Section 5.2, Land Use, the maximum land disturbance, 31 acres (0.12 square miles) would occur under Alternative 4b(1) [Regionalization by Geography (INEL)] and 5b (C INEL). While exact maximum figures are not available, over 200 acres (0.81 square miles) of vacant land in nearby communities are scheduled for development. Projects that would contribute to cumulative impacts are listed in Table 5.16-1. Nonhealth-related cumulative impacts.

Discipline/Unit of measure	1 (No Action) and 2 (Decentralization)	3 4a
Land use/amount of land not available for other use	Small compared to regional land uses	Small compared to land uses
Socioeconomics/change in number of total jobs	Overall decrease of 4,800	Overall decrease of 4,800
Cultural resources/minimum number of potentially historic structures/archaeological sites disturbed	6 structures and 0 sites	70 structures
Air resources	Below applicable standards	Below applicable standards

Waste management/waste volume total pending disposition	High-leveld	12,100 m3	12,500 m3
	Transuranice	67,000 m3	73,000 m3
	Mixed low- level	17,000 m3	17,000 m3
	Low-level	46,000 m3	72,000 m3
	Hazardousf	12,000 m3	12,000 m3
	Commercial and industriale	540,000 m3	590,000 m3

- a. Numbers for archaeological sites potentially impacted would be expected to incre  
b. See Table 5.16-2 for cumulative health risks related to air emissions.  
c. Derived in Freund (1994), Morton and Hendrickson (1995).  
d. High-level waste includes both liquid and calcine forms. Liquid high-level wast  
of all high-level waste stored onsite.  
e. Numbers do not include existing dispositioned waste stored or buried onsite.  
f. Numbers represent total volume stored onsite.

**Table 5.16-2.** Health-related cumulative impacts.

Radiologicala	Pathway	Type of impact	1 (No Action 2 (Decentral
Public	Atmospheric	Estimated excess fatal cancers	<1
	Groundwater	Estimated excess fatal cancers	<1
	Biotic	Estimated excess fatal cancers	<1
Workersb	Atmospheric	Estimated excess fatal cancers	Negligible
	Occupational exposures	Estimated excess fatal cancers	1
Public	Atmospheric (Carcinogens)	Estimated lifetime cancers	<1
	Atmospheric (Noncarcinogens) c	Estimated adverse health effects	0

**Table 5.16-2.** (continued).

Radiologicala	Pathway	Type of impact	1 (No Action 2 (Decentral
Workersb	Atmospheric (Carcinogens)	Estimated lifetime cancers	<1
	Atmospheric (Noncarcinogens) c	Estimated adverse health effects	0
	Routine workplace safety hazards	Estimated fatalities	3

- a. Approximate numbers. See Volume 2, Section 5.12 and Volume 2, Appendix F for details.
- b. Estimated excess fatal cancers calculated from dosimeter measurements.

disturb previously disturbed land are scheduled to take place on about 270 acres (1 at the INEL. An additional 1,060 acres (4.3 square kilometers) of open space INEL disturbed by potential projects.

### 5.16.2 Socioeconomics

Any of the spent fuel management alternatives would cause minimal cumulative impacts on socioeconomic resources of the INEL region when combined with known onsite or offsite. The implementation of any of the alternatives would create temporary additional employment during construction; the upper bound of potential impact would occur under Alternative 3. In the long term, the expected future decrease in employment at the INEL would more than offset any increases from known offsite projects. Therefore, the cumulative employment would be an overall decrease. Potential population declines associated with the cumulative effect on regional employment are estimated to represent less than 2 percent of the regional population. It is unlikely that a change in population of this size would have long-term adverse impacts to housing, community services, or public finance in the region.

### 5.16.3 Cultural Resources

The types of cumulative impacts on cultural resources are the same for all alternatives, when combined with associated onsite and offsite activities, could impact cultural resources. However, surveying, recording, and stabilizing archeological structures at the INEL would increase scientific knowledge of the region's cultural resources. Stabilizing resources may adversely affect their significance to Native American groups. Unchecked deterioration of both structures and historic documents on nuclear facilities could have a long-term adverse impact on these resources. Long-term effects may also impact traditional resources that may not be mitigated through scientific studies. Cumulative impacts associated with Alternatives 3 and 4a (see 1992/1993 Planning Basis and Regionalization Type) and Alternatives 5b and 4b(1) [Centralization at INEL and Regionalization by INEL] have the greatest potential for impacts. Alternatives 1 and 2 (No Action alternative) would have the least potential for impacts.

### 5.16.4 Air Quality

For radiological emissions, all cumulative impacts at onsite and offsite locations are applicable standards and are a small fraction of the dose received from natural background. The highest dose to a maximally exposed member of the public would be caused by Alternatives 3 and 5b and would be about 0.05 millirem per year. When added to the projected dose from INEL proposed projects of approximately 0.7 millirem per year and the maximum baseline dose of 0.05 millirem per year, this dose would be well below the National Emissions Standards for Air Pollutants limit of 10 millirem per year (CFR 1992c). The National Council on Radiation Protection and Measurements has identified a dose rate below 1 millirem per year as acceptable (NCRP 1987).

Cumulative nonradiological impacts were analyzed in terms of concentrations of toxic air pollutants in ambient air. At site boundary locations, the highest potential concentrations of air pollutants remain well below applicable National Ambient Air Quality Standards. Concentrations at public road locations within the INEL boundary could increase slightly above current levels, but would remain well below applicable standards.

### 5.16.5 Occupational and Public Health and Safety

Work activities and the exposure to radiological and chemical hazards under each alternative are discussed in Volume 2, Section 5.16.5.

alternatives would be similar to those at present. Therefore, average radiation dose chemicals, and associated health effects would be related to the number of site workers alternative. Because the cumulative impacts of any alternative would be a decrease workers, the cumulative impact of any alternative on occupational health would be health effects to the levels listed in Table 5.16-2. The incidence of expected health effects similar for all alternatives because the relative difference in employment effects effects on the health of those employed) is very small. While air emissions present pathway for public radiation exposure due to spent nuclear fuel management, groundwater pathways are included in Table 5.16-2 due to Volume 2 analyses of environmental resource waste management activities.

Occupational health data concerning historic accidents are incomplete and not reliable. Though historical records of accidents at the INEL are available, occupational dose is not known and reported. Worker dose data are currently being collected and analyzed under the Institute of Occupational Safety and Health program. Historical offsite doses associated are summarized in the Idaho National Engineering Laboratory Historical Dose Evaluation. The Centers for Disease Control and Prevention is conducting a more comprehensive review of doses from INEL operations. An assessment of the cumulative impacts of accidents on the health of INEL workers is not available at this time.

Cumulative transportation impacts are addressed in Volume 1, Appendix I.

### 5.16.6 Materials and Waste Management

The total volumes of waste existing and projected to be generated or shipped to spent nuclear fuel management, as well as known onsite and offsite projects over a period presented by waste stream for each alternative in Table 5.16-1. The storage of low-level waste incineration is not considered to be restrictive between 1995 and 2005; however, additional capacity may be required. Although spent nuclear fuel management would not exceed permitted storage capacity to exceed its limits without available treatment or disposal Action and Decentralization Alternatives, it is anticipated that the permitted storage of low-level waste will be exceeded during the first year of a 10-year timeframe. All alternative include facility construction for storage of, or shipping of, mixed low-level waste capacity is accounted for.

## 5.17 Adverse Environmental Effects That Cannot Be Avoided

The construction and operation of any of the alternatives at the INEL could result in impacts to the environment. Changes in project design and other measures would avoid or mitigate most of these impacts to minimal levels. This section identifies only adverse impacts that mitigation could not reduce to minimal levels or avoid altogether.

Under each alternative, the continued deterioration of structures with historical potential and historic documents on nuclear facilities could have a long-term adverse impact on resources at the INEL. However, DOE would avoid potentially adverse impacts by preserving the historic value of the property through appropriate research, or by conducting limited demolition of these structures. This impact is discussed in Section 5.4.

As discussed in Section 5.2, the maximum loss of habitat would involve the conversion of industrial use of about 31 acres (0.12 square kilometers) of previously disturbed habitat to quality and limited use to wildlife; conversion would occur under Alternatives 4b(1) and 4c(1).

The amount of radiation exposure from normal operation of the spent nuclear fuel management would be a small fraction of the existing natural background at the INEL and would be within applicable regulatory standards. In all cases, the number of estimated additional workers is a fraction of 1 per year of site operation through 2035. This effect is discussed in Section 5.15.

With the exception of the unavoidable temporary increase in noise due to construction, any impact of noise from activities under any of the alternatives would be minor and avoidable.

An unavoidable adverse impact of the proposed activities with any of the alternatives is an accident either at the involved facilities or during the transportation of construction dismantled components. Accidents are discussed in Section 5.15; transportation is discussed in Section 5.11.

Spent nuclear fuel management supports the continuation of beneficial activities such as radiopharmaceutical and other research. An unavoidable adverse impact of the No-Action Alternative would be a reduction in the support of such activities.

As discussed in Section 5.14, the increased generation of industrial solid waste under all alternatives is an unavoidable adverse impact. However, the amount generated

alternative would be a very small percentage increase from the projected 1995 baseline

## 5.18 Relationship Between

### Short-Term Use of the Environment and the Maintenance and Enhancement of Long-Term Productivity

Under all alternatives, short-term use of the environment is generally associated with demands for spent nuclear fuel management activities. Resource demands also include for upgrade, construction, and operation of facilities. These short-term demands provide a foundation and direction for the long-term productivity of INEL; they also have an influence on the success of future INEL missions. A brief discussion of the influence proposed activities have on the long-term productivity of the INEL follows. The INEL missions, including spent nuclear fuel management, are discussed in Section 2.1.

The No-Action Alternative would provide few long-term benefits and would not allow the DOE-Idaho Operations Office to fulfill its missions regarding the disposition and management of spent nuclear fuel. The activities proposed in this alternative would not support future technology development. Further, the No-Action Alternative could bring enforcement actions that would not meet all the requirements of existing DOE regulatory commitments such as those in the Federal Facility Agreement and Consent Order.

To a varying degree, Alternatives 2, 3, and 4(a) would provide more flexibility in the management of spent nuclear fuel. These alternatives provide for fulfilling existing or future missions and actions at INEL. Near-term actions under these alternatives ensure compliance with regulatory requirements and protect the environment. Furthermore, these alternatives would provide a diverse decisionmaking framework for future actions concerning disposition of DOE spent nuclear fuel. Facilities constraining technologies developed under these alternatives could be used for a wide range of activities, including interim treatment and storage or preparation and packaging for transportation offsite.

The approach that would be taken for spent nuclear fuel under Alternatives 4b(2) and 5b would confine and hinder long-term productivity at INEL. Efforts would focus on shipment of spent nuclear fuel to other locations. No emphasis would be placed on solving particular spent nuclear fuel problems or increasing the understanding of how certain spent nuclear fuels react or decay.

Alternatives 4b(1) and 5b would direct INEL's future mission and development programs toward large-scale canning and characterization, storage, and disposal of all INEL and DOE spent nuclear fuel. These alternatives could limit INEL's flexibility in managing and enhancing future INEL-specific missions.

## 5.19 Irreversible and Irretrievable Commitment of Resources

The irreversible and irretrievable commitment of natural and manmade resources associated with the construction and operation of facilities related to the spent nuclear fuel alternatives includes materials and resources that could not be recovered or recycled or that would be committed to unrecoverable forms. Some of these commitments would be irretrievable because of the commitment or the cost of reclamation. For example, the construction and operation of spent nuclear fuel facilities at the INEL would consume irretrievable amounts of electric power, concrete, steel, aluminum, copper, plastics, lumber, sand, gravel, groundwater, and chemicals.

Alternatives 4b(1) and 5b are each estimated to require approximately 11,000 megawatt-hours of electricity, 1,100,000 liters (290,000 gallons) per year of fuel oil, and 4 million gallons (13 million gallons) per year of water above the projected baseline (1995) usage of (see Section 5.13). These changes would represent a modest increase of 5.3 percent for electricity, 0.7 percent for fuel oil, and 0.7 percent for water, and are well within current system capabilities and usage. Alternatives 4b(2) and 5b would place smaller demands on these resources, commensurate with the construction and operation activities proposed.

Alternatives 4b(1) and 5b would also commit 31 acres (0.12 square kilometer) of land to industrial use; the conversion of this acreage would result in the loss of quality wildlife habitat and natural resource services. Alternatives 4b(1) and 5b would also require the greatest irretrievable consumption of other resources, such as construction materials and supplies. However, this demand would not constitute a permanent drain on local resources because any material that is in short supply in the region.

Other commitments would be irreversible because the construction or operation related to the spent nuclear fuel alternatives would consume the resource. Proposals also require an expenditure of labor that would be irretrievable.

## 5.20 Potential Mitigation Measures

This section summarizes measures that DOE would use to avoid or reduce impacts environment caused by spent nuclear fuel management activities at the INEL. The potential measures for each aspect of the affected environment described below are the same for all alternatives. Section 5.7 of Volume 1 discusses other generalized measures DOE could

### 5.20.1 Pollution Prevention

DOE is committed to comply with Executive Order 12856, Federal Compliance with Know Laws and Pollution Prevention Requirements; Executive Order 12873, Federal Acquisition Recycling and Waste Prevention; and applicable DOE Orders and guidance documents in implementing pollution prevention at the INEL. The DOE views source reduction as the first in its pollution prevention program, followed by an increased emphasis on recycling and disposal are considered only when prevention or recycling is not possible or practical.

### 5.20.2 Cultural Resources

The lack of detailed specifications associated with the proposed construction of various alternatives precludes identifying specific project impacts and potential impacts on particular structures and facilities. Basic compliance under cultural resource law requires that DOE would be essentially the same under all alternatives. These steps are (a) identification of resources in danger of impact, (b) assessment of effects to these resources, (c) development of plans and documents to minimize any adverse effects, (d) consultation with the State Historic Preservation Office and representatives of the Shoshone-Bannock Tribal Advisory Council on Historic Preservation and tribal representatives as to the appropriate mitigation measures, and (e) implementation of potential mitigation measures. There has been no resource survey has not been performed in an area planned for ground disturbance under proposed alternatives, consultation would be initiated with the Idaho State Historic Preservation Office and the survey would be conducted prior to any disturbance. If cultural resources were identified, they would be evaluated according to National Register criteria. Wherever possible, resources would be left undisturbed. If the impacts are determined to be adverse and cannot be avoided, then measures would be initiated to reduce impacts. Mitigation plans would be developed in consultation with the State Historic Preservation Office and Tribal Advisory Council on Historic Preservation and would conform to appropriate standards and guidelines established for historic preservation activities by the Secretary of the Interior.

Some actions may affect areas of religious, cultural, or historic value to Native Americans. DOE has implemented a Working Agreement (DOE 1992d) to ensure communication with the Shoshone-Bannock Tribe, especially relating to the treatment of archeological sites during construction as mandated by the Archeological Resources Protection Act (ARPA 1979); the protection of human remains, as required under the Native American Graves Protection and Repatriation Act (NAGPRA 1990); and the free exercise of religion as protected by the American Indian Religious Freedom Act (AIRFA 1978). In keeping with DOE Native American policy (DOE 1990), DOE Order 1230 (DOE 1992c), and procedures to be defined in the final Cultural Resources Management Plan, DOE would conduct Native American consultation during the planning and implementation of proposed alternatives. Procedures for dealing with the inadvertent discovery of human remains be consistent with the Native American Graves Protection and Repatriation Act (NAGPRA). If human remains are discovered, DOE will notify all tribes that have expressed an interest in the repatriation of graves as required under NAGPRA, including the Shoshone-Bannock, Shoshone, and the Northwestern band of the Shoshone Nation. These tribes will then have an opportunity to claim the remains and associated artifacts in accordance with the requirements of NAGPRA. Procedures for the repatriation of "cultural items" in accordance with NAGPRA will be developed as part of a curation agreement that will be finalized by June 1996.

In addition to consultation, other measures would mitigate potential adverse effects on American Resources, in particular effects to air, water, plants, animals, and visual resources. Measures include avoidance of sensitive areas, placement of facilities within existing construction, revegetation with native plants of areas with ground disturbance, monitoring and animals within hunting and gathering areas for radiological contamination, reduction of night lights outside of existing facilities, monitoring tanks, ponds and runoff for minimizing ground disturbance, use of dust suppressers during construction, and use

other air pollutant control equipment to reduce air contaminants.

### 5.20.3 Traffic and Transportation

All onsite shipments of spent nuclear fuel would be in compliance with ID Direct "Hazardous Materials Packaging and Transportation Safety Requirements." These requirements provide assurance that, under normal conditions, the INEL would meet as-low-as-reasonably-achievable conditions, reasonably foreseeable accident situations (those with probability greater than  $1 \times 10^{-7}$  per year) would not result in a loss of shielding or containment; an unintentional release of radioactive material would result in a timely response.

DOE would approve the type packages used for onsite shipments or would obtain a Regulatory Commission or DOE certificate of compliance. If the onsite package did not have a Regulatory Commission or DOE certification, the user of the package would have to establish administrative controls or other potential mitigating measures would ensure that they maintain containment and shielding integrity. The administrative and emergency response considerations would provide sufficient control so that accidents would not result in containment or shielding, in criticality, or in an uncontrolled release of radioactive material that create a hazard to the health and safety of the public or workers. Accident mitigation is discussed below.

### 5.20.4 Accidents

The DOE would initiate INEL emergency response programs, as appropriate, following occurrence of an accident to prevent or mitigate consequences. These emergency response programs implemented in accordance with 5300-DOE series Orders, typically involve emergency preparedness, and emergency response actions. Participating government agencies and plans that are interrelated with the INEL Emergency Plan for Action include the State of Utah, Bingham County, Bonneville County, Butte County, Clark County, Jefferson County, the Navajo Indian Affairs, and Fort Hall Indian Reservation. When an emergency condition exists, the Emergency Action Director is responsible for recognition, classification, notification, and action recommendations. Each emergency response plan utilizes resources specifically to assist a facility in emergency management. These resources include but are not limited to the following:

- INEL Warning Communications Center
- INEL Fire Department
- Facility Emergency Command Centers
- DOE Emergency Operations Centers
- County and State Emergency Command Centers
- Medical, health physics, and industrial hygiene specialists
- Protective clothing and equipment (respirators, breathing air supplies, etc)
- Periodic training exercises and drills within and between the organizations implementing the response plans

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### 6. REFERENCES

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**STAINLESS STEEL SHEET AND PLATE**

		price per cwt for Atlanta					
Type		26-Jun	24-Jul	28-Aug	25-Sep	25-Oct	27-Nov
sheet steel							
14 gauge		\$ 193.54	\$ 193.54	\$ 193.54	\$ 193.54	\$ 193.54	\$ 193.54
16 guage		\$ 195.70	\$ 195.70	\$ 195.70	\$ 195.70	\$ 195.70	\$ 195.70
20 gauge		\$ 199.20	\$ 199.20	\$ 197.00	\$ 197.00	\$ 197.00	\$ 197.00
plate							
304 1/4", 72"x240"		\$ 189.50	\$ 189.50	\$ 188.00	\$ 188.00	\$ 188.00	\$ 188.00
316 1/4", 96"x140"		\$ 189.50	\$ 210.75	\$ 208.00	\$ 208.00	\$ 208.00	\$ 208.00

The above prices are FOB warehouse based on Engineering News-Record mothly spot pricing from a single source

