APPENDIX E Spent Nuclear Fuel Management Programs At Other Generator/Storage Locations

Department of Energy
Programmatic
Spent Nuclear Fuel Management
and
Idaho National Engineering Laboratory
Environmental Restoration and
Waste Management Programs
Environmental Impact Statement
Preliminary Final
Volume 1
Appendix E
Spent Nuclear Fuel Management Programs
At Other Generator/Storage Locations
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1. INTRODUCTION

The U.S. Department of Energy (DOE) is performing a DOE-wide programmatic evaluation of spent nuclear fuel (SNF) management alternatives in order to determin appropriate means of managing existing and projected quantities of SNF from now unt 2035. At the same time, the DOE is performing a site-specific assessment of the Id Engineering Laboratory (INEL) in order to determine how to manage environmental res waste management, and SNF at the INEL. Sites currently involved with the managemen major fractions of DOE SNF (i.e., the Hanford Site, Savannah River Site, and INEL), sites being analyzed for management of SNF (Oak Ridge Reservation and Nevada Test S sites involved with management of SNF from Naval Reactors are addressed in separate appendixes to this volume of the environmental impact statement (EIS).

This appendix addresses other DOE sites and locations which currently generate manage small quantities of SNF. These facilities are presently storing and/or gene cases, relatively small quantities of SNF which the DOE has taken title to, has pos will take possession of at sometime in the future. These facilities, referred to i "originating sites," include the following:

- DOE, University, and Other Research and Test Reactors

  The following DOE facilities are addressed in this appendix:

  Brookhaven National Laboratories
  - High Flux Beam Reactor
  - Brookhaven Medical Research Reactor

  Los Alamos National Laboratory
  - Omega West Reactor
  - Chemistry-Metallurgy Research Facility

  Sandia National Laboratories
  - Manzano Storage Structures
  - Annular Core Research Reactor
  - Sandia Pulse Reactor II and III and Critical Assembly
  - Hot Cell Facility
  - Special Nuclear Materials Storage Facility

  Argonne National Laboratory - East
  - Alpha-Gamma Hot Cell

- Chicago Pile 5

In addition, the DOE has title to SNF from university and other domestic re reactors. These facilities are identified and data provided on both the qu spent fuel in storage and estimates of the future generation rate of SNF at facilities. However, rather than address each of these university and othe reactor facilities individually, representative facilities will be used whe specific topics related to facilities, the SNF, or projected environmental associated with the various fuel management alternatives.

- Commercial Power Reactor Fuels

The DOE has possession of 125 spent nuclear fuel assemblies and 20 complete sectioned spent nuclear fuel rods from various nuclear power plants that we used to support DOE-sponsored research and development programs. This SNF currently in storage at either the West Valley Demonstration Project in Wes New York, or the B&W Lynchburg Technology Center in Campbell County, Virgin In addition, according to the terms of a three-party agreement between the Services Company of Colorado, General Atomics, and the Atomic Energy Commis the DOE has a commitment to provide dry storage at the INEL for eight segme Fort St. Vrain spent fuel (approximately 1,920 spent fuel elements). Three of this SNF have been shipped to the INEL; the other five are currently bei at the Fort St. Vrain site.

The DOE also has possession of other commercial SNF, including that from th Arkansas, Calvert Cliffs, Connecticut Yankee, Consolidated Edison, Cooper, H. B. Robinson, Monticello, Oconee, Peach Bottom, Point Beach, Quad Cities, Shippingport, Surry, and Three Mile Island reactors. These represent very quantities of SNF and are currently stored at the Hanford Site, INEL, SRS, Reactor Facility at the INEL, or the ORR. This commercial SNF is addressed corresponding appendix for each of these sites and is not discussed in deta appendix.

Spent nuclear fuel from commercial power reactors which is currently at com reactor sites will fall under the purview of the DOE's Office of Civilian R Waste Management and is outside the scope of this EIS.

Although these facilities represent small sources of SNF, an evaluation has bee in order to consider the impacts at these originating sites along with the cumulati management of all DOE SNF.

Of the five SNF management alternatives being evaluated (Volume 1, Chapter 3), two alternatives that preclude the shipment of SNF (Alternative 1 - No Action and A - Decentralization) have a definable impact on the sites and facilities discussed i Several facilities generating SNF have limited storage capacities, and/or the facil the U.S. Nuclear Regulatory Commission (NRC) may limit the quantity of fuel permitt stored onsite. Implementation of the No Action Alternative could mean that some of facilities with limited SNF storage capacity would have to shut down. The impact o facilities would be the need to construct additional onsite SNF storage capacity in continue safe operation. Expansion of SNF storage capacity is only viable provided space and adequate funding are available and expansion is approved through the NRC process.

In the case of the West Valley Demonstration Project, the SNF is currently bein accordance with the applicable DOE Orders. Extended storage of SNF at this site wo construction of a concrete pad for a dry storage facility. However, the DOE has en agreement with an agency of the State of New York to remove all SNF from the West V Demonstration Project. An extension to the schedule for removal of SNF has been re DOE and the agreement with the state is being renegotiated.

The other alternatives, which involve the shipment of the SNF from the site at generated to one or more DOE SNF interim storage facilities, reflect the current mo management at the generating facilities. Even though the selection of a site where transported and stored may be different than the current planning basis, shipment t location does not impact the facility or site at which the SNF is generated.

Section 2 of this appendix presents a description of SNF management at the orig sites, including an overview of the types and inventories for SNF in three major ca test and experimental reactors; domestic research reactors; and nuclear power react Section 3 presents summary descriptions of the potentially affected environments fo categories, and Section 4 describes the environmental consequences of SNF managemen alternatives at these sites. Cumulative impacts are presented in Section 5, advers cannot be avoided in Section 6, and irreversible and irretrievable commitments in S

2. SNF MANAGEMENT AT ORIGINATING SITES

2.1 Overview of SNF Types, Inventories, and Generation Rates

This appendix addresses the management of SNF at originating sites, defined as and experimental reactors, domestic research reactors, and certain nuclear power pl fuels now in storage. Specific discussions of the various sites are provided in fol

DOE experimental reactors and small-quantity storage: These reactors and SN storage facilities are located on DOE-owned sites, such as Brookhaven Natio Laboratory, Los Alamos National Laboratory, and Sandia National Laboratorie These sites host a variety of research and development or production activi may include test or experimental reactors and storage of small quantities o different areas of the site.

- Domestic research reactors: The greatest variations in site characteristics associated with research reactors. Most sites are at colleges or universiti a few of them are sited at government and industrial facilities.
- Nuclear power plant spent fuel: The SNF in this category is not located at operating nuclear reactor facilities. The facilities housing the subject SN at the following sites: 1) the former West Valley fuel reprocessing site, 2 shutdown Fort St. Vrain nuclear power plant site (currently undergoing decommissioning), and 3) a commercial research laboratory (B&W Lynchburg Technology Center) located on a large rural site. The DOE also has possessi other commercial SNF, including that from the Arkansas, Calvert Cliffs, Con Yankee, Consolidated Edison, Cooper, Dresden H. B. Robinson, Monticello, Oc Peach Bottom, Point Beach, Quad Cities, Saxton, Shippingport, Surry, and Th Island reactors. These represent very small quantities of SNF and are curre at the Hanford Site, INE~ SRS, Naval Reactors Facility at the INEl, or the This commercial SNF is addressed in the corresponding appendix for each of sites and is not discussed further in this appendix.

The SNFs addressed in this appendix are of varying sizes and design configurati general, nuclear fuel consists of an assembly of structural components, such as pla rods, containing fissionable material. The fuel may be in the form of metal or a co oxide, carbide, nitride) and may vary in the degree of enrichment of the uranium -2 The structural materials may be aluminum, stainless steel, zirconium alloy, or othe as ceramics. They form a barrier isolating the fuel (and fission products) from the coolant or storage facility environment as well as providing structural support for geometry of the fuel. The components are arranged into a specific geometric configu determined by the type of reactor and desired performance. This assembly of fuel-be components is referred to as a "fuel element" (also referred to in the nuclear indu assembly).

For each of the major facility categories, the following subsections provide de quantities of SNF currently in storage and the quantities of additional SNF expecte produced by the end of the year 2035.

2.1.1 DOE Experimental Reactors and Small-Quantity Storage

The Brookhaven National Laboratory, Los Alamos National Laboratory, and Sandia National Laboratories use test and experimental reactors for research and for small production of medical and other specific isotopes. In addition, small quantities of currently in storage at these sites as well as at Argonne National Laboratory - Eas of SNF generated by these facilities, the amount expected to be generated through t and accommodations being undertaken at the present time to store the SNF located at facilities are discussed in the following sections.

2.1.1.1 Brookhaven National Laboratory.

2.1.1.2.1 High Flux Seam Reactor-By mid-1995 there are projected to be 937

High Flux Beam Reactor elements (0.

241 MmlIM) in the reactor or in onsite wet storage. A
total of 5,600 additional SNF elements (1.498 MThM) are predicted to be produced if
reactor continues operation through the year 2035 (Wichmann 1995a).

2.1.1.2.2 Brookhaven Medical Research Reactor-The Brookhaven Medical

Research Reactor is operating at the present time and has 36 elements (0.
0034 MTHM) in the
rcactor or in onsite wet storage. Thirty-two additional SNF elements (0.0028 MTHM)
expected to be produced by the year 2035 (Wichmann 1995a).

2.1.1.2 Los Alamos National Laboratory.

2.1.1.2.1 Omega West Reactor-The Omega West Reactor has been permanently

shut down.
This reactor is being decommissioned. There are no elements in the reactor, and all
of the 86 elements (0.014 MTHM) are in temporary dry storage at the Chemistry and M
Research Complex (Wichmann 1 995a).

Additional reactor sites and critical facilities that are part of the los Alamo
Laboratory are listed below. Each contains some radioactive and fissionable materia
not routinely produce SNF (ANS 1988):

Big Ten Critical Assembly
- Fast Burst Reactor - GODWA
- Fast Burst Reactor - SKUA
- Flattop Critical Assembly
- General Purpose Critical Assembly - COMET
- General Purpose Critical Assembly - HONEYCOMB
- General Purpose Critical Assembly - PLANET
- General Purpose Critical Assembly - VENUS
- General Purpose Critical Assembly Machine
- Solution High Energy Burst Assembly

2.1.1.3 Sandla National Laboratories. The Sandia National Laboratory reactors operate

as needed on a low duty cycle, so the fission product inventories remain low and th
lasts for the life of the reactor, eliminating routine generation of spent fuel. He
few broken plates that are in storage, the SNF at Sandia National Laboratories is s
the reactors (DOE 1993d).

The Sandia National Laboratories contain five SNF storage facilities: the Manza
Structures, the Annular Core Research Reactor Facility, the Sandia Pulse Reactor Fa
Hot Cell Facility, and the Special Nuclear Materials storage facility (DOE 1993b).

2.1.1.3.1 Manrano Storage Structures-The Manzano Storage Structures are

reinforced concrete bunkers located in the southeast portion of Kirtland Air Force
Until
recently, when Sandia National Laboratories took responsibility for the site, the M
facilities were operated and maintained by the Department of Defense. The Sandia Na
Laboratories currently use four structures for dry storage of reactor-irradiated nu
(DOE 1993b). There is a total of 0.025 metric tons of heavy metal (MTHM) of SNF in
at this facility (Wichmann 1995a).

2.1.1.3.2 Annular Core Research Reactor-The Annular Core Research Reactor is

a pool-type research reactor capable of steady-state, pulse, and tailored transient
The
Annular Core Research Reactor facility includes the reactor pool, one safe, and eig
storage vaults, all located in the high-bay of Building 6588. The eight storage vau
bay floor are used to securely store irradiated experiments containing a variety of

materials, but principally U-235. Materials from only three experiments containing irradiated nuclear materials are stored at the Annular Core Research Reactor (DOE 1 There are a total of 438 elements plus uranium from three experiments (for a total 0.04MTHM) in use or storage at these facilities (Wichmann 1995a).

In addition, DOE is considering using the Annular Core Research Reactor for pro molybdenum-99. If the molybdenum -99 production mission is assigned to the Annular Research Reactor, the current reactor fuel would likely be removed and would need t at the start of, or within a few years of starting, operation (SNL 1994).

2.1.1.3.3 Sandia Pulse Reactor Hand HI, and Critical Assembly- Three reactors

are in operation at the Sandia Pulse Reactor facility: Sandia Pulse Reactor II and Reactor III are unmoderated, fast-burst reactors capable of pulsed and steady-state The Critical Assembly is a small, water-moderated reactor used to perform measureme reactor parameters to benchmark the computer calculations and thereby refine the de planned space propulsion reactor. The yard storage holes are 19 stainless-steel typ corner of the Sandia Pulse Reactor compound. These tubes are surrounded by a high-d concrete monolith. The yard holes are used to securely store irradiated experiments variety of nuclear materials, but principally U-235. All of the materials remain in containers, some of which consist of double containment. At the Special Nuclear Mat storage facility, Sandia National Laboratories stores previously failed fuel elemen Pulse Reactor II and elements from experiments that have been exposed to short irra periods (DOE 1993b). There are a total of 43 elements (with a total of 0.37 MTHM) o use or storage at these facilities (Wichmann 1995a).

Future plans include bringing on-line an additional pulse reactor named Sandia Reactor IlIM. With this new reactor, a total of three pulse reactors would be locat National Laboratories' Technical Area V.

2.1.1.3.4 Hot Cell Facilty-The Hot Cell Facility at Sandia National Laboratories is

a nonreactor nuclear facility housed in Building 6580 in Technical Area V.
Research programs
at Sandia National Laboratories--material studies, fuel studies, and safety studies experiments containing radioactive materials be assembled and/or disassembled, samp prepared, and microscopic and chemical analyses performed. The principal storage fa the Hot Cell Facility is Room 108, which is a heavily shielded room used previously preparation room next to the irradiation room of the Sandia Engineering Reactor, wh been defueled. There are a series of 13 storage holes under the Hot Cell Facility M are available to store irradiated material coming into or out of the Hot Cell Facil the holes is currently in use. The other areas of the Hot Cell Facility are used fo amounts of material (DOE 1993b) There is a total of 0.009 MTHM of SNF in storage at facility (Wichmann 1995a).

2.1.1.4 Argonne National Laboratory - East. The Alpha-Gamma Hot Cell Facility,

operated by the Materials Science Division, consists of a concrete-shielded, low-fl atmosphere complex that was designed for the examination of irradiated plutonium fu assemblies and related hardware (DOE 1993d). There are a total of four units of Exp Breeder Reactor fuel, one canister containing remnants of commercial SNF, and 16 SN elements from Oak Ridge (For a total of 0.081 MTHM) in storage (Wichmann 1995a).

The Chicago Pile 5 Building houses a heavy-water, moderated reactor whose fuel removed and shipped offsite. Currently, the Chicago Pile S is in the process of bei decontaminated and decommissioned and contains only two highly enriched uranium tar converter) elements (DOE 1993d).

2.1.2 Domestic Licensed Research Reactors

Table 2.1-1 identifies 57 non-DOE facilities representing domestic, licensed, s generators of SNF (NRC 1993a; ANS 1988). They include training, research, and test universities, commercial establishments, and several government installations; all (McClellan Air Force Base) have been licensed by the NRC. Although they are not DOE

Facilities, DOE has title to the SNF and has the responsibility for interim storage disposition.

In order to assess their SNF management capabilities, these 57 facilities have identified as belonging to one of three categories. These categories identify the k characteristics of a facility relevant to the assessment of DOE-postulated SNF alte three categories are:

Category 1 - Facilities that have limited onsite storage capacity compared amount of SNF projected to be generated at their facility by the year 2035

Category 2 - Facilities that do not routinely generate additional SNF

Category 3 - Facilities that no longer possess SNF onsite.

The category for each facility is identified in Table 2.1-1.

Table 2.1-1. Domestic non-DOE research reactors.

Licensee location	Reactor type	NRC Docket no.	Category
Aerotest San Ramon, CA	TRIGA (Indus)	50-228	2
Arkansas Tech Univ. Russellville, AR	TRIGA	50-606	2
Armed Forces Radiobiology Research Institute (AFRRI) Bethesda, MD	TRIGA	50-170	2
Brigham Young Univ. Provo, UT	L-77	50-262	3
Catholic University Washington, DC	AGN-201	50-77	3
Cintichem, Inc. Tuxedo, NY	Pool	50-54	3
Cornell University Ithaca, NY	TRIGA	50-157	2
Cornell University Ithaca, NY	ZPR	50-97	2
Dow Chemical Company Midland, MI	TRIGA	50-264	2
General Atomics San Diego, CA	TRIGA Mark I	50-89	2
General Atomics San Diego, CA	TRIGA Mark F	50-163	2
General Electric Co. Pleasanton, CA	NTR	50-73	1
Georgia Institute of Technology Atlanta, GA	Research HW	50-160	2
Idaho State University Pocatello, ID	AGN-201	50-284	2
Iowa State University Ames, IA	MTR-10 Pool	50-116	2
Kansas State University Manhattan, KS	TRIGA	50-188	1

Licensee location	Reactor type	NRC Docket no.	Category
McClellan Air Force Base McClellan, CA	SNRS	None	2
Manhattan College Riverdale, NY	Tank-ZPR	50-199	2
Massachusetts Institute Research of Technology Cambridge, MA	HW	50-20	1
N.S. Savannah Mount Pleasant, SC	PWR	50-238	3
NASA Plum Brook Sandusky, OH	NASA Tr. Tank	50-185	3
National Institute of Standards and	Test	50-184	1

Technology (NIST) Gaithersburg, MD			
North Carolina State U. Raleigh, NC	Pulstar	50-297	2
Ohio State University Columbus, OH	Pool	50-150	2
Oregon State University Corvallis, OR	TRIGA	50-243	2
Penn State University University Park, PA	TRIGA	50-5	2
Purdue University West Lafayette, IN	Lockheed	50-182	2
Reed College Portland, OR	TRIGA	50-288	2
Rensselaer Polytechnic Institute Troy, NY	Critical Assembly	50-225	2
Rhode Island Atomic Energy Commission Narragansett, RI	Pool	50-193	1
State Univ. of New York Buffalo Buffalo, NY	Pulstar	50-57	1
Texas A&M University College Station, TX	AGN-201	50-59	2
Texas A&M University College Station, TX	TRIGA	50-128	1
U.S. Geological Survey Denver, CO	TRIGA	50-274	1
University of Arizona Tucson, AZ	TRIGA	50-113	2
University of California at Berkeley Berkeley, CA	TRIGA	50-224	3
University of California at Irvine Irvine, CA	TRIGA	50-326	2
University of California at Los Angeles Los Angeles, CA	Educator	50-142	3
University of Florida Gainesville, FL	Argonaut	50-83	2
University of Illinois Urbana, IL	LOPRA	50-356	1
University of Kansas Lawrence, KS	Lockheed	50-148	3
University of Maryland College Park, MD	TRIGA	50-166	2
University of Mass. at Lowell Lowell, MA	GE Pool	50-223	2
University of Michigan Ann Arbor, MI	Pool	50-2	1
University of Missouri Columbia Columbia, MO	Tank	50-186	1
University of Missouri Rolla Rolla, MO	Pool	50-123	2
University of New Mexico Albuquerque, NM	AGN-201	50-252	2
University of Texas Austin, TX	TRIGA-Mark II	50-602	2

University of Utah Salt Lake City, UT	TRIGA	50-407	2
University of Virginia Charlottesville, VA	Pool	50-62	1
University of Washington Seattle, WA	Argonaut	50-139	3
University of Wisconsin Madison, WI	TRIGA	50-156	2
Veterans Admin. Medical Center Omaha, NE	TRIGA	50-131	2
Washington State U. Pullman, WA	TRIGA	50-27	2
Watertown Army Materials Research Reactor Watertown, MA	Pool	50-47	3
Westinghouse Zion Training Reactor Pittsburgh, PA	W Tank	50-22	3
Worcester Polytechnic Institute Worcester, MA	Pool	50-134	2

2.1.2.1 Reactors with Limited Storage Capacity. The sites in Category I have limited

storage capacity when compared to the amount of SNF that is projected to be generat Table 2.1-2 lists the projected inventory as of June 1, 1995 with the corresponding **each of the Category 1 sites.** Assuming continuing operation of each reactor, the pr amount of additional SNF that would be generated through 2035 is also provided in T

To reduce the risk of theft or diversion of highly enriched uranium fuel and th consequences to public health, safety, and the environment from such theft or diver has imposed limitations on the use of highly enriched uranium fuel in domestic nonp reactors. Unless the NRC has determined that the nonpower reactor has a unique purp requiring the use of high enriched uranium fuel, each licensee will replace all hig uranium fuel in its possession with available low enriched uranium fuel acceptable Commission. If federal government funding for conversion is not available, the conv high enriched uranium fuel to low enriched uranium fuel may be deferred on an annua number of domestic research reactors are in the process of converting from highly e uranium fuel to low enriched uranium fuel.

2.1.2.2 Reactors with Sufficient Storage Capacity. Licensed domestic research reactor

sites with sufficient SNF storage capacity are listed in Table 2.1-3. These Categor operating facilities with low fuel burnup rates, where the amount of SNF generated expected to exceed the current onsite storage capacity. Some Category 2 sites are a converting from highly enriched uranium fuel to low enriched uranium fuel but have capacity to store this additional SNF onsite.

The projected inventory at each reactor site as of June 1, 1995 and the corresp MTHM are presented in Table 2.1-3. The amount of SNF that is projected to be genera through the year 2035 is also listed in Table 2.1-3.

2.1.2.3 Reactors without SNF Onsite. The licensed domestic research reactors that are

no longer operating and have shipped all SNF offsite are identified as Category 3 i These sites either have been decommissioned or are in the process of decommissionin the facilities have been decontaminated, although they may not have been completely

Table 2.1-2. Category 1 projected SNF inventories.

Licensee location	Inventory as of June 1, 1995 Elements	MTHM	Future increases through 2035 Elements	MTHM

Kansas State University Manhattan, KS	107	0.020	140	0.027
Massachusetts Institute of Technology Cambridge, MA	66	0.021	480	0.150
National Institute of Standards and Technology Gaithersburg, MD	186	0.04	1,160	0.300
Rhode Island Atomic Energy Commission Narragansett, RI	57	0.030	160	0.222
State University of New York - Buffalo Buffalo, NY	25	0.493	5	0.100
Texas A&M (TRIGA) College Station, TX	186	0.030	378	0.060
U.S. Geological Survey Denver, CO	161	0.032	39	0.010
University of Illinois Urbana, IL	198	0.037	313	0.59
University of Michigan Ann Arbor, MI	103	0.072	480	0.400
University of Missouri Columbia, MO	82	0.055	1,040	0.700
University of Virginia Charlottesville, VA	65	0.066	60	0.210

a. Source: Wichmann 1995a.
Note: Projected inventory as of June 1, 1995 is 0.896 MTHM.
Projected additional SNF generated through 2035 is 2.769 MTHM.

Table 2.1-3. Category 2 projected SNF inventories.

Licensee location	Inventory as of June 1, 1995 Elements	MTHM
Aerotest San Ramon, CA	91	0.015
Arkansas Tech. Univ. Russellville, AR	0	0
Armed Forces Radiobiology Research Institute Bethesda, MD	95	0.018
Cornell University (TRIGA) Ithaca, NY	123	0.023
Cornell University (ZPR) Ithaca, NY	814d	1.7d
Dow Chemical Company Midland, MI	78	0.014
General Atomicsc San Diego, CA	263	0.058
GE Nuclear Test Reactor Plesanton, CA	8	0.008
Georgia Institute of Technology Atlanta, GA	50	0.030
Idaho State University Pocatello, ID	9d	0.011d

Iowa State University Ames, IA	27	0.024
McClellan Air Force Base McClellan, CA	90	0.015
Manhattan College Riverdale, NY	17d	0.019d
North Carolina State U. Raleigh, NC	34	0.428
Ohio State University Columbus, OH	24 and 638b	0.021
Oregon State University Corvallis, OR	96	0.017
Pennsylvania State Univ. University Park, PA	175	0.041
Purdue University West Lafayette, IN	13	0.002
Reed College Portland, OR	67	0.013
Rensselaer Polytechnic Instituteb Troy, NY	597d	0.388d

Licensee location	Inventory as of June 1, 1995		Future increase through 2035	
	Elements	MTHM	Elements	MTH
Texas A&M - AGN-201 College Station, TX	9	0.011	0	0
University of Arizona Tucson, AZ	97	0.081	8	0.0
University of California Irvine Irvine, CA	113	0.021	0	0
University of Florida Gainesville, FL	23	0.04	22	0.1
University of Maryland College Park, MD	93	0.016	93	0.0
University of Mass. Lowell Lowell, MA	26	0.004	26	0.1
University of Missouri Rolla, MO	56	0.269	0	0
University of New Mexico Albuquerque, NM	9d	0.004d	0	0
University of Texas Austin, TX	154	0.029	0	0
University of Utah Salt Lake City, UT	139	0.026	0	0
University of Wisconsin Madison, WI	228	0.039	0	0
Veterans Admin. Medical Center Omaha, NE	56	0.001	0	0
Washington State Univ. Pullman, WA	215	0.037	112	0.0
Worcester Polytechnic Institute Worcester, MA	27e	0.022	0	0

a. Source: Wichmann 1995a and Wichmann 1995b.

b. Fuel pins, not reactor assemblies.

c. Reactor scheduled to shut down in 1998.

d. Contact-handled fuel/targets (i.e., with radiation levels low enough to permit

shielding or remote operations), even though slightly irradiated, are not inclu

Note: The projected inventory as of June 1, 1995 is expected to be 1.323 MTHM an approximate total for the additional SNF projected to be generated through MTHM. Numbers may not sum due to rounding.

The SNF that originated at these sites has either been reprocessed or is stored and at DOE storage facilities.

2.1.3 Nuclear Power Plant Spent Nuclear Fuel

This subsection addresses spent nuclear power plant fuel that DOE has possessio take possession of sometime in the future. Currently this fuel is in storage at one the West Valley Demonstration Project, the Fort St. Vrain nuclear power plant site, B&W Lynchburg Technology Center in Lynchburg, Virginia. In all cases, no new additi is being or will be added to existing SNF inventories.

2.1.3.1 West Valley Demonstration Project. The West Valley Demonstration~ Project is

located on the site of the first U.S. commercial nuclear fuel reprocessing plant, w operated by Nuclear Fuel Services, Inc., until 1972 (WVNS 1994).

Nuclear Fuel Services, Inc., shut down the reprocessing facility in 1972 in ord implement modifications for the purpose of increasing the facility's capacity. From Nuclear Fuel Services, Inc., continued to accept a total of 750 SNF elements. Howev it withdrew from the reprocessing business (WVNS 1994).

In 1980 Congress enacted Public Law 96-368, the West Valley Demonstration Proje The act directed the DOE to develop and demonstrate the technology for solidifying waste in storage at the West Valley Demonstration Project so that this waste would for transportation to and long-term disposal in a federal repository (wvNS 1994).

The owners of the 750 SNF elements still in storage at the West Valley facility pool were informed in 1981 that they would have to take back their SNF. By 1986, 62 elements had been returned to their respective owners; then, however, DOE took poss the remaining 125 SNF elements (26.65 MTHM) under an agreement with Nuclear Fuel Se Inc. The DOE was to use these 125 elements to demonstrate the safe transportation a term storage of SNF in a dual-purpose cask. These 125 SNF elements are included in (Wichmann 1995a).

2.1.3.2 Fon St. Vrain. Fort St. Vrain, a 330 MWe (Megawatt electric) high-temperature

gas-cooled reactor power plant, went into operation in January 1979 and teriminated operation in August 1989. It is currently undergoing decommissioning (FSV 1990a; NR

Prior to August 1989 a three-party agreement was reached between the Public Ser Company of Colorado (the owner of Fort St. Vrain), General Atomics (the reactor dev and the DOE that called for the DOE to take possession of eight segments of approxi SNF elements each of SNF from the Fort St. Vrain for dry storage at the INEL. SNF f Fort St. Vrain had been shipped to the INEL when a court action was initiated by th Idaho to stop any additional shipment of SNF to INEL.

In an effort to facilitate the continued decommissioning of the Fort St. Vrain Public Services Company of Colorado has decided to store the Fort St. Vrain's SNF i vault dry storage system, which is a reinforced concrete and sheathed steel frame b on the Fort St. Vrain site immediately adjacent to but outside the fence around the Vrain site. The modular vault dry storage system, designed to house 1,482 high-temp cooled reactor SNF elements, 6 neutron source elements, and 37 keyed top reflector became operational in late 1991 (FSV 1990a). There are 1,464 elements (16 MTHM) cur in storage in the modular vault dry storage system (Wichmann 1995a).

2.1.3.3 B&W Lynchburg. The B&W facility in Lynchburg, Virginia, is engaged in

research and development on uranium fuels and the overall fuel cycle, and in the ex and testing of irradiated fuels (NRC 1987).

B&W Lynchburg currently has in storage at its facility 0.044 MTHM of SNF stored cannisters (Wichmann 1995a) consisting of 3 full.length fuel rods, 17 sectioned fue small quantity of fuel debris from Three Mile Island 2. All of this SNF material is

possession of the DOE and was provided to B&W under a DOE contract for Fuel Perform Improvements Programs. None of the activities ongoing at B&W Lynchburg could result generation of additional SNF for which the DOE has responsibility, since the facili reactors have been decommissioned (Wright 1993; ANS 1988).

2.2 Spent Nuclear Fuel Management Program Plans and Alternatives

The plans for management of SNF at originating sites, including generating and sites, or facilities generating small annual quantities of SNF, were determined by survey of the NRC licensees and others operating these sites. These plans, as they to be affected by the alternatives being assessed in this EIS, are presented in thi

Availability of onsite SNF storage capacity is the primary consequence of DOE S management decisions for all originating sites. Of the five DOE SNF management alte only Alternative 1 (No Action - no SNF transportation) may not have been addressed NRC licensing process for an individual SNF originating site. DOE management plans alternatives which involve SNF transportation- would not affect the originating sit management plans at the DOE facilities to which the SNF may be shipped are addresse sections of this EIS dealing with those DOE facilities. The alternate plans with re transportation are analyzed in Appendix I to Volume 1. Accordingly, the next few su will focus primarily on the No Action Alternative and describe general information produced at the originating sites, including non-DOE facilities storing SNF.

2.2.1 No Action

The No Action Alternative is intended to evaluate the impact of storage of SNF current storage and originating sites. This means that all facilities which are gen SNF and intend to ship SNF to a DOE facility would maintain their SNF onsite. If th originating site has adequate storage capacity, operations at the site would contin change of plans. If SNF storage capacity is inadequate, new plans, including expans capacity or decreasing the rate of fuel burn-up, would have to be considered. Possi management plans are discussed more specifically in the following subsections.

Of the total of approximately 2,700 MThM of SNF estimated as the total DOE inve by 2035, approximately 51 MTHM of SNF is associated with the facilities addressed i appendix (Wichmann 1995a).

2.2.1.1 DOE Experimental Reactors and Small Quantity Storage. There is insufficient

onsite storage capacity at the High Flux Beam Reactor at Brookhaven National Labora store all of the SNF projected to be generated through the year 2035. If SNF shipme made to another DOE storage facility, at the current rate of generation the remaini storage space would be depleted in January 1996. There is a plan to install a stora existing wet storage facility that would add space for 162 elements. Even with this space would be depleted in 1998. If SNF could not be shipped by that time, the arra existing racks could be modified to provide additional space. There are no plans to the reactor in the near future (Carelli 1993).

2.2.1.2 Domestic Research Reactors. Based on current projections, the onsite storage

capacity of 11 of the 45 domestic research reactors would be exhausted before the y the No Action Alternative were to be implemented. All 11 of these facilities have b identified as Category 1.

Several of the facilities in Category 1 have indicated that they would consider options of increasing storage capacity if the No Action Alternative were to be impl would consider reracking, one would consider expanding dry storage within the react three would consider expanding wet storage within the reactor building, and one wou adding 200 square feet (18.6 square meters) of wet storage area outside the reactor

Any previously planned expansion of onsite SNF storage capacity at individual o facilities is addressed in site-specific NRC environmental assessments and thus is to be a consequence of the proposed actions under this ElS. The facilities that are planning to expand their SNF storage capacity include the Massachusetts Institute o and the National Institute of Standards and Technology.

At one of these facilities the expanded storage capacity is projected to be ade the year 2005. However, without SNF transportation through the year 2035, none of t would have adequate storage capacity. One of the facilities in Category 1 has offlo enriched uranium fuel and would consider reracking but might elect to shut down in because of a lack of wet storage capacity (Jentz 1993).

All 34 facilities identified as Category 2 have sufficient SNF storage capacity accommodate any of the DOE SNF alternatives. Two facilities may elect to shut down the year 2005: one because it may not renew its license; the other because, without SNF offsite, it might not meet licensing limits on possession of uranium-235 after highly enriched uranium fuel to low enriched uranium fuel. One facility, which expe from highly enriched uranium fuel to low enriched uranium fuel, might elect to shut year 2005 if no offsite transportation were available, unless it can expand its SNF capacity. A few facilities have indicated that they will appeal the NRC-required co highly enriched uranium fuel to low enriched uranium fuel if no oflsite transportat Although several Category 2 facilities can operate practically indefinitely without questionable how many of them would operate as planned if there were no SNF transpo through the year 2035. Many research reactors operate with variable core loadings, reusing partially depleted fuel elements as well as adding new fuel to the reactor

2.2.1.3 Nuclear Power Plant Spent Nuclear Fuel. The No Action Alternative

necessitating extended interim onsite storage of SNF would require a revision of th management program at the West Valley Demonstration Project. The need to revise thi program is a result of the following (DOE 1993b):

- The West Valley fuel pool is almost 30 years old and does not meet current design criteria.
- The pool is single-walled, unlined, and lacks the capability for leak detec presenting the potential for an undetected release to the environment.
- Continued storage of fuel onsite would interfere with and for some areas pr ongoing decontamination and decommissioning activities at the West Valley Demonstration Project facility from proceeding as planned.

The management of SNF at the West Valley Demonstration Project is to continue t of the existing spent fuel pool with no modifications.

Loss of access to the INEL for storage of its SNF has already resulted in the c new onsite SNF storage at Fort St. Vrain. However, under this alternative Public Se Company of Colorado would not achieve its goal of becoming free of radioactive mate 1998 under this option.

Adequate storage capacity exists and the storage facilities are in adequate con B&W Lynchburg Technology Center (DOE 1993b).

2.2.2 Decentralization

Alternative 2, Decentralization, is similar to the No Action Alternative except offsite shipments are permitted as required to allow continued operation of the giv Decentralization is not expected to impose additional requirements for storing SNF facilities included in this appendix above those already identified under the No Ac Alternative. Planning at the sites receiving SNF shipments that would be allowed un alternative is addressed in Appendixes A, B, and C. Intersite transportation impact in Appendix I to Volume 1.

2.2.2.1 DOE Experimental Reactors and Smell Ouantity &orage. Compared to the

restrictions imposed under the No Action Alternative, Decentralization does not cha management plans at these DOE experimental reactors and small.quantity storage faci

2.2.2.2 Domestic Research Reactors. The Decentralization Alternative is similar to the

No Action Alternative, except that limited offsite shipments are permitted as requi continued operation of the given facility. Under this alternative, the domestic res are allowed to return to DOE any SNF in excess of their current onsite storage capa Additional storage capacity would be not be required at these originating facilitie

decentralization does not affect existing SNF management plans at university resear other facilities in the domestic research reactor group, except for possible rerout shipments to INEL or Savannah River Site.

2.2.2.3 Nuclear Power Plant Spent Nuclear Fuel. The Decentralization Alternative is

similar to the No Action Alternative, except that limited offsite shipments are per required to allow continued operation of the given facility. The three facilities b this subsection are only storing SNF and do not generate additional SNF. Because SN not be shipped offsite, SNF remaining at the site could interfere with the planned decontamination and decommissioning operations at West Valley Demonstration Project this option, Public Service Company of Colorado would not achieve its goal of becom radioactive material by 1998.

2.2.3 1992/1993 Planning Basis

Alternative 3, 1992/1993 Planning Basis, would not be expected to change any ex management plans at the sites included in this appendix. Alternative 3 would permit shipment of SNF from the originating sites to DOE interim storage facilities at INE Savannah River Site. Planning at these SNF-receiving sites is addressed in Appendix and C. Interstate transportation impacts are analyzed in Appendix I to Volume 1.

2.2.3.1 DOE Experimental Reactors and Small Quantity Storage. Implementation of

this alternative could require a transition period of several years. Therefore, lim construction of temporary SNF storage facilities or acquisition of SNF transportati suitable for use as temporary dry storage containers, may be necessary until shipme interim storage site(s) is accomplished.

2.2.3.2 Domestic Research Reactors, Alternative 3 does not affect the existing SNF

management plans at domestic research reactor facilities. Management of SNF at thes would continue to follow the same plans as in the past.

2.2.3.3 Nuclear Power Plant Spent Nuclear FueL Under Alternative 3, DOE plans to

ship the SNF currently in storage at the West Valley Demonstration Project to INEL North for storage. Implementation of this alternative would therefore preclude the additional action at the West Valley Demonstration Project related to providing a n SNF storage facility.

If Public Service Company of Colorado shipped the remaining fuel segments, the Vrain Site would be free of radioactive materials by 1998.

This alternative would have no impact on the management of the SNF material in at the B&W Lynchburg Technology Center.

2.2.4 Regionalization

Alternative 4, Regionalization, would not be expected to change any existing SN management plans at the sites included in this appendix, Alternative 4 would permit shipment of SNF from the originating sites to regional DOE interim storage faciliti at the SNF-recieving sites is addressed in Appendixes A, B, C, and F. Intersite tra impacts are analyzed in Appendix I to Volume 1.

2.2.4.1 DOE Experimental Reactors and Small Quantity Storage. Implementation of

this alternative could require a transition period of several years. Therefore, lim construction of temporary SNF storage facilities or acquisition of SNF transportati suitable for use as temporary dry storage containers, may be necessary until shipme

interim storage site(s) is accomplished.

2.2.4.2 Domestic Research Reactors. Regionalization does not affect the existing SNF

management plans at domestic research reactor facilities, except for possible rerou shipments.

2.2.4.3 Nuclear Power Plant Spent Nuclear Fuel. The Regionalization Alternative for

SNF addressed in this appendix is the same as the 1992/1993 Planning Basis Alternat that the SNF would be sent to other locations. With the exception of INEL, faciliti presently available for SNF storage at receiving sites considered under regionaliza from West Valley Demonstration Project and Fort St. Vrain. The SNF would remain in at West Valley Demonstration Project and Fort St. Vrain until facilities are availa at the selected regional SNF management sites.

2.2.5 Centralization

Alternative 5, Centralization, would not be expected to change any existing SNF management plans at the sites included in this appendix. Alternative 5 would permit shipment of SNF from the originating sites to centralized DOE interim storage facil planning at the SNF-receiving sites is addressed in Appendixes A, B, C, and F. Inte transportation plans are analyzed in Appendix I to Volume 1.

2.2.5.1 DOE Expedmental Reactors and Small Ouantity Storage. Implementation of

this alternative could require a transition period of several years. Therefore, lim construction of temporary SNF storage facilities or acquisition of SNF transportati suitable for use as temporary dry storage containers, may be necessary until shipme interim storage site(s) is accomplished.

2.2.5.2 Domestic Research Reactors. Centralization does not affect the existing SNF

management plans of domestic research reactor facilities except for rerouting of SN

2.2.5.3 Nuclear Power Plant Spent Nuclear Fuel. The Centralization Alternative for

SNF being addressed in this appendix is described as being the same as the 1992/199 Basis Alternative except that the SNF would be sent to other locations. With the ex INEL, facilities are not presently available for SNF storage at receiving sites con centralization for SNF from West Valley Demonstration Project and Fort St. Vrain. T would remain in storage at West Valley Demonstration Project and Fort St. Vrain unt are available for receipt of the SNF at the selected central SNF management site.

3. AFFECTED ENVIRONMENTS

Descriptions of those facilities generating and/or storing small quantities of fuel for which DOE has accepted responsibility are presented in this section. The subsections present environmental information for each of the three categories of o sites: DOE Test and Experimental Reactors, Domestic Research Reactors, and Nuclear Plant Spent Nuclear Fuel Storage Sites.

The wide variety of facilities and installations included in this category prec definition of their affected environments in a consistent and uniform manner. The available in existing facility documents used as the bases for this analysis varies nature of the installation and the requirements of the overseeing or regulatory age

3.1 DOE Experimental Reactors and Small-Quantity Storage

The DOE experimental reactors and small-quantity SNF storage facilities include category are located at the Brookhaven National Laboratory, Los Alamos National Lab Sandia National Laboratory, and Argonne National Laboratory - East. The facilities their environments are described in this section. Only those DOE sites at which sp fuel is currently generated and/or stored are discussed. Information on environmen that are not uniformly available in existing National Environmental Policy Act docu all four sites (including aesthetic and scenic resources, noise, traffic and transp utilities and energy) is not provided in this document.

3.1.1 Brookhaven National Laboratory

There are two reactors at the Brookhaven National Laboratory which generate SNF potentially affected by actions analyzed in this EIS: the 60 MW High Flux Beam Rea the 5 MW Brookhaven Medical Research Reactor (ANS 1988).

3.1.1.1 High Flux Beam Reactor. The 60 MW High Flux Beam Reactor is a heavy water

moderated and cooled research reactor which replaces an earlier 40 MW reactor. The Beam Reactor began operation in 1965. The High Flux Beam Reactor facility is compo five buildings located on the 5,265-acre (2,131-hectare) site of the Brookhaven Nat Laboratory. The distance from the reactor to the nearest site boundary is to the s feet (1288 meters). The spent nuclear fuel is stored in an 8-foot-wide, 43-foot-lo canal (2.4 meters wide, 13.2 meters long, 6.1 meters deep). Within the canal, the in storage racks, either in a 30-cell rack or in a long-term storage rack (Carelli

3.1.1.2 Brookhaven Medical Research Reactor. The Brookhaven Medical Research

Reactor is a 5 MW heterogeneous, thermal, tank type reactor which is light water mo cooled. The reactor, used for research, became fully operational in 1959. The Bro Medical Research Reactor is located in one building at the Brookhaven National Labo approximately 0.25 mile (0.4 kilometer) south of the High Flux Beam Reactor site. at the Brookhaven Medical Research Reactor consists of a shelf, lined with boral sh upper part of the reactor vessel above the active core region. The shelf is locate (2.5 meters) of water and is considered critically safe when fully loaded. Like th Beam Reactor, there is no facility for dry storage at the Brookhaven Medical Resear (Carelli 1993).

3.1.1.3 Affected Environment at Brookhaven National Laboratory.

3.1.1.3.1 Land Use-The Brookhaven National Laboratory is located approximately

60.
1 miles (97 kilometers) east of New York City on Long Island, New York. The site i in a primarily suburban area. Land on the 5,265-acre (2,131-hectare) site is divid undeveloped natural areas and the developed areas that support the laboratory's sci research (BNL 1992c).

Regional land use includes a variety of residential, commercial, industrial, ag institutional, recreational, and public uses. Although agricultural and undevelope have been the dominant land uses in the region, development pressures for residenti commercial land uses have increased steadily in recent years (BNL 1992c).

3.1.1.3.2 Socioeconomics-The Brookhaven National Laboratory is located in

central Suffolk County just at the fringe of developed areas, in an area of rapidly population.
About 1.32 million persons reside in Suffolk County and about 410,000 persons reside in Brookhaven Township, within which the Laboratory is situated. Between 19 2040, population in Suffolk County is expected to increase 14.6 percent (DOC 1991a)

Approximately 8,000 persons reside within a half mile (0.8 kilometer) of the labora (BNL 1992b).

The population of Suffolk County is approximately 96 percent urban and has a su higher median family income than the rest of the state (DOC 1991c). Between 1970 a total employment in Suffolk County increased 103.8 percent (DOC 1992).

Dominant industries in the area include government, manufacturing, retail and s approximately 20 percent of earnings in Suffolk County coming from government spend 1992).

The Brookhaven National Laboratory is composed of a total staff of 3449 regular (BNL 1993a).

As reported in 1988, there were a total of 69 personnel working at the reactors This number included operators, experimenting scientists, and support personnel. W their main occupation, part of the duties of the operators and some support personn tasks associated with refueling, storing, inventorying, packaging, and shipping SNF

3.1.1.3.3 Cultural Resources-The Brookhaven National Laboratory has no

properties designated as National Historic Landmarks.

The Old Reactor Building (Building 701) and the Old Cyclotron Enclosure (Buildi are eligible for inclusion on the National Register of Historic Places (NRHP). Cam training trenches from World War I are also eligible for inclusion on the NRHP.

3.1.1.3.4 Geology-The Brookhaven National Laboratory site is in the upper part

of the Peconic River Valley, which is bordered by two lines of low hills.
These extend east and
west beyond the limits of the valley nearly the full length of Long Island and form prominent topographic features (ERDA 1977).

A maximum horizontal ground surface acceleration of 0.19 g at Brookhaven Nation Laboratory is estimated to result from an earthquake that could occur once every 20 (DOE 1994a). The seismic hazard information presented in this EIS is for general s hazard comparisons across DOE sites. Potential seismic hazards for existing and ne should be evaluated on a facility specific basis consistent with DOE orders and sta specific procedures.

No earthquake has yet been recorded in the Brookhaven National Laboratory area Modified Mercalli intensity in excess of III. Long Island lies in the Uniform Buil 2A (moderate) seismic hazard area. No active earthquake producing faults are known Long Island area (ERDA 1977).

3.1.1.3.5 Air Resources-In terms of meteorology, the laboratory can be

characterized, like most Eastern Seaboard areas, as a well-ventilated site.
The prevailing ground-
level winds are from the southwest during the summer, from the northwest during the about equally from these two directions during the spring and fall (BNL 1992b).

The mean annual temperature for the site during 1991 was 52.8yF (11.6yC), with temperatures ranging from 21.2yF (-6yC) to 83.8yF (28.8yC). The annual precipitati 1991 was 45.3 inches (115 centimeters), which is about 3.6 inches (9.0 centimeters) 40-year annual precipitation average of 48.4 inches (123 centimeters) (BNL 1992b).

The State of New York has adopted ambient air quality standards that specify ma permissible short- and long-term concentrations for various contaminants. These st generally the same as the national standards for criteria pollutants (NYSDEC 1977). County, in which the site is located, is classified as being in nonattainment of th the criteria pollutant ozone. The county is in attainment of standards for carbon particluates, sulfur dioxide, nitrogen dioxide, and lead (NYSDEC 1993).

3.1.1.3.6 Water Resources-The Brookhaven National Laboratory site lies on the

western rim of the shallow Peconic River watershed.
The marshy areas in the north and eastern
sections of the site are a portion of the Peconic River headwaters. The Peconic Ri

recharges and receives water from the groundwater aquifer, depending on the hydroge potential. In times of drought the river water typically recharges to groundwater, of normal to above normal precipitation, the river receives water from the aquifer

Groundwater flow in the vicinity of Brookhaven National Laboratory is controlle factors. The main groundwater divide lies 1.25 to 5 miles (2 to 8 kilometers) sout Island Sound parallel to the Sound. This divide is known to shift 0.6 to 1.25 mile 2 kilometers), north to south. East of Brookhaven National Laboratory is a seconda groundwater divide that defines the southern boundary of the area contributing grou the Peconic River. The exact location of the triple-point intersection of these tw known and may be under Brookhaven National Laboratory. South of these divides, the groundwater moves southward to Great South Bay and to Moriches streams. In general groundwater from the area between the two branches of the divide moves out eastward Peconic River. North of the divide, groundwater moves northward to Long Island Sou Pressure of a higher water table to the west of the Brookhaven National Laboratory generally inhibits movement toward the west. Variability in the direction of flow Brookhaven National Laboratory site is a function of the hydraulic potential and is complicated by the presence of clay deposits that accumulate perched water at sever plus the pumping/recharge of groundwater that are part of Brookhaven National Labor operations. In general, groundwater in the northeast and northwest sections of the toward the Peconic River. On the western portion of the site, groundwater flow ten toward the south, while along the southern and southeastern sections of the site it toward the south to southeast (BNL 1992b).

In all areas of the site, horizontal groundwater velocity is estimated to range inches (30 to 45 centimeters) a day. The site occupied by Brookhaven National Labo been identified by the Long Island Regional Planning Board and Suffolk County as be deep recharge zone for Long Island. This implies the precipitation and surface wat recharges within this zone has the potential to replenish the lower aquifer systems and/or Lloyd) which exist below the Upper Glacial Aquifer. The extent to which the National laboratory site contributes to deep flow recharge is currently under evalu However, it is estimated that up to two-fifths of the recharge from rainfall moves aquifers. These lower aquifers discharge to the Atlantic Ocean (BNL 1992b).

The three aquifers (Upper Glacial, Magothy and Lloyd) underlying the Brookhaven National Laboratory comprise the Nassau/Suffolk Aquifer System, which has been desi a sole source aquifer by the U.S. Environmental Protection Agency. More detailed a characterization information can be found in the Brookhaven National Laboratory Sit Report (SAIC 1992).

3.1.1.3.7 Ecological Resources-Approximately 75 percent of Brookhaven National

Laboratory is primarily woodland.
Terrestrial habitats include pine plantations, moderately
mature pitch pine/oak forest, predominantly deciduous forest, early successional sh community, pine barrens shrub/sapling wetlands, and lawn areas (BNL 1993a).

The isolation of the Brookhaven National Laboratory site and its variety of wil have made it a refuge for a surprisingly diverse animal population. Thirty species have been recorded on site or within a 10-mile (16-kilometer) radius. All of these residents except for five summer-resident and two migrant species of bats. (BNL 19

About 400 non-extinct species of birds have been recorded on all of Long Island records have been kept, and at least 180 of these have been recorded on site. Thir species are found throughout the year and all except six of these breed on site. F species are summer residents. All except nine nest on site, four others probably d nest elsewhere on Long Island, most nearby (BNL 1993).

In September 1990, the U.S. Fish and Wildlife Service confirmed that no Federal endangered species occur in the vicinity of Brookhaven National Laboratory. Howeve endangered tiger salamander breeds in a pond in the southeast corner of the site (B

3.1.1.3.8 Public Health and Safety-The calculated effective dose equivalent

associated with effluent releases from the most recent reports for a 5-year period below (BNL 1993b, 1992a, 1992b, 1990, 1989).
The annual doses for each year are only a
fraction of the DOE Public Dose Limit of 100 millirem per year. The data are from laboratory operations, including storage of SNF.

Year	Airborne effluents (maximum site boundary)	Liquid effluents (maximum individual)
1988	0.113 millirem	0.15 millirem
1989	0.120 millirem	0.96 millirem
1990	0.067 millirem	0.85 millirem
1991	0.170 millirem	0.74 millirem
1992	0.097 millirem	0.91 millirem

The collective (population) dose equivalent (total population dose) beyond the boundary, within a radius of 50 miles (80 kilometers), attributed to laboratory ope reports for a 5-year period is presented below (BNL 1993b, 1992a, 1992b, 1990, 1989 are from all laboratory operations, including storage of SNF.

1988	2.5 person-rem
1989	3.2 person-rem
1990	1.8 person-rem
1991	3.6 person-rem
1992	3.2 person-rem

3.1.1.3.9 Waste Management-Brookhaven National Laboratory generates low-

level, low-level mixed and hazardous wastes, in conjunction with its activities as research center.
In 1992, the site generated approximately 508 tons (461 metric tons) of solid waste and 19.6 cubic yards (15 cubic meters) of liquid waste (DOE 1994b).

Brookhaven National Laboratory currently stores about 110 cubic yards (84 cubic low-level mixed waste and has no current or planned onsite treatment facilities. A streams are currently shipped to Hanford. These waste streams include organic liqu alkaline solutions, uranium hydride, cleaning/degreasing solvents, chromic acid cle and lead- and mercury-contaminated equipment (DOE 1993g).

In 1989, EPA listed BNL on the National Priorities Lists and in 1992 an Interag Agreement was signed among DOE, EPA Region II, and the New York State Department of Environmental Conservation. Seven operable units have been identified for remedial investigation/feasibility studies and evaluated for suitable remedial action. The consist of various groupings (generally by area) of buildings and sumps, undergroun tanks, the sewage runoff and discharge areas, trichloroethylene and reactor spill a groundwater. Some contamination at the site was the result of U.S. Army practices 1947 (DOE 1993g).

3.1.2 Los Alamos National Laboratory

The Omega West Reactor, operated by the Los Alamos National Laboratory, is a th heterogeneous, closed-tank research reactor normally functioning at a power level o Omega West Reactor was operational from 1956 until December 1992, when it was shut This reactor is permanently shut down and is being decommissioned. All spent nucle consisting of 86 fuel elements, is in temporary storage at the Chemistry and Metall Complex in Wing 9. They are being stored in old "Rover Project" casks which were o certified for transport of spent nuclear fuel. LANL has no permit for long-term st fuel.

3.1.2.1 Land Use. Los Alamos National Laboratory is located approximately 60 miles

(96 kilometers) north-northeast of Albuquerque, New Mexico. Los Alamos occupies an about 28,000 acres (11,000 hectares) located primarily in Los Alamos County in nort Mexico, about 24 miles (39 kilometers) northwest of Santa Fe. The County of Los Al zoned the entire area of the lab Federal Land. Los Alamos National Laboratory has nine land use classifications for its operations. There are no prime farmlands on National Laboratory, although portions are designated as a National Environmental R Park (DOE 1993a).

3.1.2.2 Socioeconomics. The civilian labor force in the region of interest grew 144

percent, increasing from 34,467 in 1970 to 84,107 in 1990. Total employment increa 31,155 to 79,846 between 1970 and 1990, an annual growth rate of 5 percent. The unemployment rates for 1970 and 1990 were 9.6 percent and 5.1 percent, respectively same years, personal income increased from approximately $324.7 million to $2.3 bil annual average of 10 percent), and per capita income increased from $3,396 to $15,3 1993a).

Between 1975 and 1990, employment at Los Alamos National Laboratory increased f 5,094 to 7,622, representing 10 percent of the region of interest employment in 199 September 1992, employment at Los Alamos National Laboratory had increased to 7,450 prepared Fiscal Year 1994 budget projects a reduction in expenditures at the site r reduced employment (DOE 1993a).

In 1991, more than half of the Los Alamos National Laboratory workforce resided unincorporated communities of Los Alamos and White Rock in Los Alamos County. Betw 1970 and 1990, the population in the region of interest increased 61 percent to 151 the same period, the New Mexico population increased 49 percent. The population in county region of interest is projected to increase from an estimated 169,000 in 200 2020, an annual rate of less than 1 percent (DOE 1993a).

Employment associated with SNF management such as routine operations of the fac including care and periodic inventories of the SNF amounts to about 1.3 person-year (Cruz 1995).

3.1.2.3 Cultural Resources. The prehistoric chronology for the Los Alamos National

Laboratory area consists of six broad time periods: Paleoindian (10,000-4000 B.C.) (5500 B.C.-A.D. 600), Early Developmental (A.D. 600-900), Late Developmental (A.D. Coalition (A.D. 1110-1325), and Classic (A.D. 1325-1600). Prehistoric site types i vicinity of Los Alamos National Laboratory include large multiroom pueblos, pithous field houses, talus houses, cave kivas, shrines, towers, rockshelters, animal traps water control features, agricultural fields and terraces, quarries, rock art, trail windbreaks, rock rings, and limited activity sites. Approximately 75 percent of Lo National Laboratory has been inventoried for cultural resources. Coverage for some has been less than 100 percent; however, about 60 percent of Los Alamos National L has received 100 percent coverage. Over 975 prehistoric sites have been recorded; percent of these sites are considered eligible or potentially eligible for the Nati Historic Places (DOE 1993a).

Native Americans in this area include those living in the San Ildefonso, San Ju Clara, Nambe, Tesuque, Pojoaque pueblos east of Los Alamos, and the Jemez and Cochi pueblos. Native American resources on Los Alamos National Laboratory may consist o prehistoric sites with ceremonial features such as kivas, village shrines, petrogly of these site types or features would be of concern to local groups (DOE 1993a).

3.1.2.4 Geology. Los Alamos National Laboratory is located on the Pajarito Plateau.

The surface of the plateau is dissected by deep, southeast-trending canyons separat narrow mesas (DOE 1993a).

Los Alamos National Laboratory lies in the Uniform Building Code Zone 2B seismi area. The strongest earthquake in the last 100 years within a 50-mile (80-kilomete estimated to have a magnitude of 5.5 to 6 and a Modified Mercalli Intensity of VII. suggest that several faults have produced seismic events with a magnitude of 6.5 to 500,000 years. Los Alamos National Laboratory operates a seismic hazards program w monitors seismicity through a seismic network and conducts studies in paleoseismolo studies have determined the presence of three faults in the area that are considere defined by 10 CFR 100, Appendix A. These form the Pajarito fault system, which inc Pajarito, Water Canyon, and Guaje Mountain faults. The Guaje Mountain fault had mo on it between 4,000 and 6,000 years ago. There is no evidence of movement along th fault system during historical times. The 100-year earthquake at Los Alamos is reg having a magnitude of 5, with an event of magnitude 7 being the maximum reasonably foreseeable earthquake. These values are currently used in design considerations a (DOE 1993a).

Maximum horizontal ground surface accelerations ranging from 0.17 to 0.25g at L National Laboratory are estimated to result from an earthquake that could occur onc

years (DOE 1994a). The seismic hazard information presented in this EIS is for gen hazard comparisons across DOE sites. Potential seismic hazards for existing and ne should be evaluated on a facility specific basis consistent with DOE orders and sta specific procedures.

Geological concerns associated with the Los Alamos National Laboratory area inc potential downslope movements in association with regional seismic activity. Altho rockfalls commonly occur from the canyon rims, landslides are an unlikely hazard (D

3.1.2.5 Air Resources. The climate at Los Alamos National Laboratory and in the

surrounding region is characterized as a semiarid tropical and subtropical steppe. barriers deplete a large portion of the moisture from the maritime air masses from Ocean, a condition that contributes to the semiaridness. The annual average temper area is 56.2oF (13.4oC); average daily temperatures range from 22.3oF (-5.4oC) in J 92.8oF (33.8oC) in July. The average annual precipitation in the area is 8.1 inche (20.6 centimeters). The average monthly precipitation ranges from 0.38 inch (0.97 November to 1.51 inches (3.84 centimeters) in August (DOE 1993a).

3.1.2.6 Water Resources. The major surface water body in the immediate vicinity of Los

Alamos National Laboratory is the Rio Grande east of the site. The primary surface features near Los Alamos National Laboratory are intermittent streams. Sixteen dra pass through or start in the Los Alamos National Laboratory site. Most Los Alamos Laboratory facilities are located well above the streambeds. Only those Technical within canyons would be within the 500-year floodplain (DOE 1993a).

No surface water is withdrawn at Los Alamos National Laboratory for either drin or facility operations. The water supply system for Los Alamos is based on a serie groundwater supply wells and springs (DOE 1993a).

Los Alamos, Sandia, and Mortandad canyons currently receive treated industrial effluent. Acid-Pueblo Canyon does not receive Los Alamos National Laboratory efflu Surface waters in these canyons are not a source of municipal, industrial, or agric supply. Only during periods of heavy precipitation or snow melt would waters from Los Alamos, or Sandia Canyons extend beyond Los Alamos National Laboratory boundari reach the Rio Grande. In Mortandad Canyon, there has been no surface runoff to the laboratory's boundary since studies were initiated in 1960 (DOE 1993a).

The main aquifer consists mainly of sediments of the Santa Fe Group. Nearly al groundwater at Los Alamos National Laboratory is obtained from deep wells that prod from this aquifer. The Bandelier Tuff, a volcanic unit that lies above the Santa F contains fractures that yield small amounts of water to springs. A minor amount of at Los Alamos National Laboratory is obtained from springs. The aquifers that lie Alamos National Laboratory are considered Class II aquifers, having current sources water and water with other beneficial uses (DOE 1993a).

The water in the main aquifer moves slowly from the major recharge area in the discharge springs in White Rock Canyon along the Rio Grande. The depth to the aqui from about 1,200 feet (365 meters) on the west to about 600 feet (183 meters) on th total saturated thickness penetrated by production wells ranges up to at least 1,70 (518 meters) (DOE 1993a).

3.1.2.7 Ecological Resources. Terrestrial habitats within undeveloped areas of Los

Alamos National Laboratory support six major vegetative communities: juniper-grass pine-juniper, ponderosa pine, mixed conifer, spruce-fir, and subalpine grassland. areas within Los Alamos National Laboratory provide habitat for a diversity of terr Los Alamos National Laboratory was designated a National Environmental Research Par 1976 (DOE 1993a).

National Wetland Inventory maps indicate that wetlands within Los Alamos Nation Laboratory are restricted to several canyons containing the Rio Grande or its tribu of the wetlands shown on the National Wetland Inventory maps have been designated a temporary or seasonal (DOE 1993a).

Aquatic habitats on Los Alamos National Laboratory are limited to the Rio Grand several springs and intermittent streams in the canyons. These habitats currently National Pollutant Discharge Elimination System-permitted wastewater discharges. F

species of fish are known to inhabit the roughly 6-mile (10-kilometer) reach of the between Los Alamos National Laboratory and Chochiti Lake. The springs and streams site support limited, if any, aquatic life (DOE 1993a).

Seventeen federally listed or New Mexico-listed threatened, endangered, or cand species potentially occur in the vicinity of Los Alamos National Laboratory. Four species have been observed on Los Alamos National Laboratory, including the bald ea (Haliaeetus leucocephalus)(a federally listed endangered species that roosts along Grande); the peregrine falcon (Falco peregrinus)(a federally listed endangered spec historically nests in the northeast corner of Los Alamos National Laboratory); the goshawk (Accipiter gentilis) (A Federal candidate Category 2 species that forages i corner of Los Alamos National Laboratory); and the giant helleborine orchid (Epipac (a state-listed endangered species that occurs near springs in White Rock Canyon). species occur in close proximity to Los Alamos National Laboratory and are likely t site (DOE 1993a).

3.1.2.8 Public Health and Safety. The total maximum individual dose to a member of

the public associated with both gaseous and liquid effluents from the most recent r year period is presented below (LANL 1993, 1992, 1990, 1989, 1988). The annual dos year are only a fraction of the DOE Public Dose Limit of 100 millirem per year. Th from all laboratory operations, including storage of SNF.

1987	6.1 millirem
1988	6.2 millirem
1989	3.9 millirem
1990	3.1 millirem
1991	4.4 millirem

The population collective effective dose equivalent attributable to laboratory persons living within 50 miles (80 kilometers) of the laboratory for a 5-year perio below (LANL 1993, 1992, 1990, 1989, 1988). The data are from all laboratory operat including storage of SNF.

1987	3.5 person-rem
1988	2.2 person-rem
1989	3.1 person-rem
1990	3.1 person-rem
1991	1.1 person-rem

3.1.2.9 Waste Management. Current low-level radioactive waste management activities

at Los Alamos National Laboratory may require expansion of the existing landfill at National Laboratory. A portion of the proposed expansion area for the existing lan contaminated by a chemical plume from the hazardous chemical disposal site, which r further development. DOE is considering the expansion to ensure continued operatio laboratory activities that generate low level radioactive waste and to provide safe wastes (DOE 1993a).

Waste minimization has been implemented by Los Alamos National Laboratory's Environmental Management Division using programmatic controls such as source reduct inventory control, product substitution, and waste exchange programs. A Waste Mini and Pollution Prevention Awareness Plan was completed in 1991. Major waste generat operations have been prioritized by severity of hazard and volume in order to deter generating systems to address. Also, halogenated solvent substitution has been eva number of research processes (DOE 1993a).

3.1.3 Sandia National Laboratories

Sandia National Laboratories, headquartered in Albuquerque, New Mexico, maintai facilities in three locations: Albuquerque, New Mexico; Livermore, California; and Nevada. The facilities discussed in this document refer only to the Albuquerque lo adjacent to the city of Albuquerque, New Mexico. The site is approximately 6.5 mil kilometers) southeast of downtown Albuquerque. Sandia National Laboratories consis acres (3,360 hectares) on Kirtland Air Force Base allocated to DOE.

Sandia National Laboratories use facilities at five Technical Areas and a Test 1993a).

- Technical Area I--Administration, site support, technical support, componen development, research, energy programs, microelectronics, defense programs, exploratory systems.
- Technical Area II--Testing of explosive components.
- Technical Area III--Testing and simulation of a variety of natural and indu environments, including two rocket sled tracks, two centrifuges, and a radi facility.
- Technical Area IV--A remote site for pulsed power sciences such as X-ray, g and particle beam fusion accelerators.
- Technical Area V--A remote area for experimental and engineering reactors a particle accelerators.
- Coyote Test Field--Land parcels scattered throughout the Coyote Test Field testing.

The Sandia National Laboratories contain five SNF storage facilities: the Manz Structures, the Annular Core Research Reactor Facility, the Sandia Pulse Reactor Fa Hot Cell Facility, and the Special Nuclear Materials storage facility (DOE 1993b).

3.1.3.1 Manzano Storage Structures. The Manzano Storage Structures are reinforced

concrete bunkers located in the southeast portion of Kirtland Air Force Base. Unti when the Sandia National Laboratories took responsibility for the site, the Manzano were operated and maintained by the Department of Defense. The Sandia National Laboratories currently use four structures for dry storage of reactor irradiated nu The two types of bunkers which Sandia National Laboratories utilize are reinforced bunkers with an earth covering, and reinforced concrete bunkers bored into the moun average storage space available is 1800 square feet (167 square meters). A ring ro the mountain and provides access to all of the bunkers. The ventilation is natural (DOE 1993b).

3.1.3.2 Annular Core Research Reactor. The Annular Core Research Reactor is a pool-

type research reactor capable of steady-state, pulse, and tailored transient operat reactor has a large central irradiation cavity (primary experiment location) that e the core, two interchangeable, fuel-ringed external cavities, an unfueled external neutron radiography facilities. The Annular Core Research Reactor facility include pool, one safe, and eight dry floor storage vaults, all located in the high-bay of The Annular Core Research Reactor is used primarily for testing electronics and for safety research. The eight storage vaults on the high-bay floor are used to secure irradiated experiments containing a variety of nuclear materials, but principally u Materials from only three experiments containing reactor irradiated nuclear materia at the Annular Core Research Reactor (DOE 1993b).

3.1.3.3 Sandia Pulse Reactor II and III, and Critical Assembly. Three reactors are

operated at the Sandia Pulse Reactor facility; Sandia Pulse Reactor II and Sandia P Reactor III are unmoderated, fast-burst reactors capable of pulsed and steady-state They are designed to produce a neutron energy spectrum similar to that produced fro The primary experiment location for each reactor is a central cavity that extends t core. The principal use of the reactors is to irradiate electronic devices requiri fluence and/or high dose rates. The Critical Assembly is a small, water-moderated to perform measurements of key reactor parameters to benchmark the computer calcula thereby refine the designs for a planned space propulsion reactor. The yard storag 19 stainless-steel types located in a corner of the Sandia Pulse Reactor compound. are surrounded by a high-density concrete monolith. The yard holes are used to sec irradiated experiments containing a variety of nuclear materials, but principally u of the materials reside in their own containers, some of which have double containm 1993b).

3.1.3.4 Hot Cell Facility. The Hot Cell Facility at Sandia National Laboratories is a

nonreactor nuclear facility that is housed in Building 6580 in Technical Area V. T

Facility includes the Hot Cell, the Glove Box Laboratory, Radiochemistry Laboratory support facilities in rooms 101, 104, 105, 106, 107, 108, 110, 111, 112, 113, 113A, This facility is designed to permit safe handling and experimentation with Special Materials, both irradiated and unirradiated. Research programs at Sandia National (material studies, fuel studies, and safety studies) require that experiments conta materials be assembled and/or disassembled, samples prepared, and microscopic and c analyses performed. The principal storage facility for the Hot Cell Facility is Ro a heavily shielded room used previously as a preparation room next to the irradiati the Sandia Engineering Reactor which has been defueled. There are a series of 13 s under the Hot Cell Facility Monorail that are available to store irradiated materia or out of the Hot Cell Facility. Only one of the holes is currently in use. The o Hot Cell Facility are used for storing minor amounts of material (DOE 1993b).

3.1.3.5 Special Nuclear Material Storage Facility. At this dry storage facility, Sandia

National Laboratories stores previously failed fuel elements from Sandia Pulse Reac elements from experiments that have been exposed to short irradiation periods. The also provides for a loading area, a maintenance area, and an administrative office ventilation consists of a forced air filtered system (DOE 1993b).

3.1.3.6 Affected Environment at Sandia National Laboratories.

3.1.3.6.1 Land Use-Sandia National Laboratories are located approximately

6.
5 miles (10.5 kilometers) southeast of downtown Albuquerque, New Mexico. There are prime farmlands on Sandia National Laboratories (DOE 1993a).

3.1.3.6.2 Socioeconomics-The civilian labor force in the region of interest grew

132 percent, increasing from 133,798 in 1970 to 310,252 in 1990.
Total employment increased
from 124,605 to 293,905 between 1970 and 1990, an annual growth rate of 4 percent. unemployment rates for 1970 and 1990 were 6.9 percent and 5.3 percent, respectively same years, personal income increased from approximately $1.3 billion to $9.4 billi average of 10 percent), and per capita income increased from $3,438 to $15,992 (DOE

Between 1970 and 1990, employment levels at Sandia National Laboratories increa 6.440 to 7,536, representing 3 percent of the region of interest employment in 1990 mission requirements have historically led to fluctuations in employment levels ove For example, employment decreased to 5,542 in 1975 and increased to 7,051 by 1985. September 30, 1992, employment levels at Sandia National Laboratories had increased The prepared Fiscal Year 1994 budget projects a reduction in expenditures at the si in reduced employment. The reduction in work force associated with the budget redu only estimated at this time (DOE 1993a).

Between 1970 and 1990, the population in the region of interest increased 58 pe 589,131. During the same period, the population of New Mexico increased 49 percent population in the three-county region of interest is projected to increase from an 682,000 in 2000 to 771,000 by 2020, an annual rate of less than 1 percent (DOE 1993

As reported in 1988, there were a total of 21 personnel working at the reactors This number included operators, experimenting scientists, and support personnel. W their main occupation, part of the duties of the operators and some support personn tasks associated with refueling, storing, inventorying, packaging, and shipping SNF

3.1.3.6.3 Cultural Resources-The prehistoric chronology for the Sandia National

Laboratories area consists of three broad time periods: Paleoindian (10,000-5500 B C.), Archaic
(5500 B.C.-A.D. 1), and Anasazi (A.D. 1600). Prehistoric site types include pueblo villages, rockshelters, hunting blinds, agricultural terraces, quarries, lithic and lithic scatters, and hearths. About 22 percent of Sandia National Laboratories/DOE land has been intensively inventoried for cultural resources; another 28 percent ha

intensive surveys. Because techniques and procedures varied greatly between projec areas, most surveys are not considered adequate. All five DOE Technical Areas have intensively surveyed; no prehistoric sites were recorded. Sixty-four prehistoric s recorded in DOE-owned or controlled lands beyond the five Technical Areas. About 8 of these sites are considered eligible for the National Register of Historic Places

Native Americans in this area include those living on the Sandia Pueblo, north Albuquerque, and the Isleta Pueblo, south of Kirtland Air Force Base. Native Ameri resources on Sandia National Laboratories/DOE-controlled lands may consist of prehi with ceremonial features such as kivas, village shrines, petroglyphs, or burials; a or features would be of concern to local groups (DOE 1993a).

3.1.3.6.4 Geology-Sandia National Laboratories lie on a sequence of sedimentary,

igneous, and Precambrian basement rocks.
The northern and western sections of Sandia
National Laboratories rest on Miocene to Quaternary gravels, sands, silts, and clay the basin formed by uplift of the mountains to the east. The eastern portion of Sa Laboratories is underlain primarily by Precambrian rocks (DOE 1993a).

The eastern portion of Sandia National Laboratories is cut by the Tijeras, Hubb Sandia, and Manzano faults. Both the Tijeras and Sandia faults, which intersect on considered capable faults (DOE 1993a).

Sandia National Laboratories lies in the Uniform Building Code 2B seismic hazar The facility is situated in a region of high seismic activity but low magnitude and Available records indicate that more than 1,100 earthquakes have occurred during th years. However, during the past century, only three have caused damage at Albuquer Intensities have been as high as a Modified Mercalli Intensity of VII, which can ca (DOE 1993a).

Possible geological concerns include potential ground shaking and rupturing ass regional seismic activity and the two capable faults intersecting on the site. Sta indicate that a nondamaging earthquake (Modified Mercalli Intensity less than III) expected every 2 years, with a damaging event every 100 years (DOE 1993a).

A maximum horizontal ground surface acceleration of 0.28g at Sandia National La is estimated to result from an earthquake that could occur once every 2000 years (D The seismic hazard information presented in this EIS is for general seismic hazard across DOE sites. Potential seismic hazards for existing and new facilities should a facility specific basis consistent with DOE orders and standards and site specifi

3.1.3.6.5 Air Resources-The climate at Sandia National Laboratories and in the

surrounding region is characteristic of a semiarid steppe.
The annual average temperature in the
area is 56.2oF (13.4oC); temperatures vary from an average daily minimum of 22.3oF January to an average daily maximum of 92.8oF (33.8oC) in July. The average annual precipitation is 8.1 inches (20.6 centimeters) (DOE 1993a).

3.1.3.6.6 Water Resources-Sandia National Laboratories are located within the

Kirtland Air Force Base on the Albuquerque East Mesa.
The mesa slopes gently southwest to
the Rio Grande, the primary drainage channel for the area. The average flow of the is 1,008 cubic feet (28.5 cubic meters) per second. No perennial streams flow thro National Laboratories area. The two primary surface channels at Sandia National La are Tijeras Arroyo and the smaller Arroyo del Coyote. The Arroyo del Coyote joins Arroyo to discharge into the Rio Grande approximately 5 miles (8 kilometers) from t edge of Kirtland Air Force Base. Both arroyos flow intermittently during spring sn following thunderstorms. Springs in the eastern mountains provide a perennial flow reaches of Tijeras Arroyo. Most of this flow evaporates or percolates into the soi reaching Kirtland Air Force Base (DOE 1993a).

High peak flows of short duration characterize floods in the area. High-intens thunderstorms produce the greatest flows, but the probability of flooding is not co at Kirtland Air Force Base. The southeast corner of Technical Area IV and the east Technical Area II lie within the 500-year floodplain of Tijeras Arroyo (DOE 1993a).

Sandia National Laboratories lie within the north-south trending Albuquerque ba principal aquifer of the Albuquerque basin is the Valley Fill aquifer. The Valley unconsolidated and semiconsolidated sands, gravels, silts, and clays that vary in t few feet (meters) adjacent to the mountain ranges to over 21,000 feet (6,400 meters 5 miles (8 kilometers) southwest of Kirtland Air Force Base airfield. The Valley F considered a Class IIa aquifer, having a current source of drinking water and water beneficial uses. (DOE 1993a)

The regional water table is separated by a fault complex that divides the area region on the west side of the complex and a shallower region on the east side. Th groundwater ranges from 50 to 100 feet (15 to 30 meters) on the east side of the fa and from 380 to 500 feet (115 to 1150 meters) on the west side. Based on available apparent direction of groundwater flow west of the fault complex is generally to th northwest. The direction of groundwater flow east of the fault complex typically i the fault system (DOE 1993a).

3.1.3.6.7 Ecological Resources-Most undeveloped lands within Technical Areas I

and III of Sandia National Laboratories support grassland vegetation. Terrestrial wildlife using grassland habitats on Sandia National Laboratories are typical of similar habitats Mexico. The size and diversity of wildlife populations are thought to be limited b availability of water. An inventory of wildlife species on Kirtland Air Force Base Sandia National Laboratories) has been recently updated (DOE 1993a).

No wetland inventories have been performed for Sandia National Laboratories, an National Wetland Inventory maps have been published. Several springs exist on Kirt Force base, including Sol se Mete Spring, Coyote Springs, and G Spring. These are with canyons and arroyos. No springs exist in Technical Areas I through V, and non within permitted land to which Sandia National Laboratories has access (DOE 1993a).

Potential aquatic habitat within Kirtland Air Force Base is limited to arroyos and the few springs associated with them. The nearest major perennial aquatic habi Grande, approximately 5 miles (8 kilometers) to the west (DOE 1993a).

No federally listed threatened or endangered species are known to occur on Sand National Laboratories. The peregrine falcon (Falco peregrinus), a federally and st endangered species, could potentially occur in the mountainous areas of Kirtland Ai surrounding Sandia National Laboratories, but the likelihood is low because of the habitat for this species. The grama grass cactus (Pediocactus papyracanthus), a Fe Candidate Category 2 and state-listed endangered species, is known to occur in gras Kirtland Air Force Base similar to those occurring on Sandia National Laboratories. bat (Euderma maculatum), also a Federal Category 2 and state-endangered species, ha probability of occurrence on Sandia National Laboratories. Sandia National Laborat within the breeding range of several Federal Candidate bird species (DOE 1993a).

3.1.3.6.8 Public Health and Safety-The annual dose to a maximally exposed

individual due to release of gaseous radionuclides from laboratory operations from 5-year period is presented below (SNL 1993, 1992, 1991, 1990, 1989). The data are from all laboratory operations, including storage of SNF.

1988	0.00034 millirem
1989	0.00088 millirem
1990	0.0020 millirem
1991	0.0014 millirem
1992	0.0034 millirem

The estimated population dose to persons living within a 50-miles (80-kilometer surrounding the laboratory due to release of gaseous radionuclides from laboratory from reports for a 5-year period is presented below (SNL 1993, 1992, 1991, 1990, 19 data are from all laboratory operations, including storage of SNF.

1988	0.039 person-rem
1989	0.097 person-rem
1990	0.82 person-rem
1991	0.052 person-rem
1992	0.020 person-rem

3.1.3.6.9 Waste Management-Low-level radioactive waste at Sandia National

Laboratories is generated in both technical and remote test areas as a result of re development activities.
Most of the low-level radioactive waste consists of contaminated equipment and combustible decontamination materials and cleanup debris. All genera level radioactive waste is temporarily stored at generator sites or above ground in containers at the Technical Area III disposal site. All low-level radioactive wast currently onsite pending approval of transport by commercial carriers offsite for b 1993a).

Mixed wastes include radioactively contaminated oils and solvents and radioacti contaminated or activated lead or other heavy metals. Other mixed wastes may be ge a result of weapons tests (DOE 1993a).

3.1.4 Argonne National Laboratory - East

The Argonne National Laboratory - East stores reactor irradiated nuclear materi Alpha-Gamma Hot Cell (Building 212, Wing F), the Chicago Pile 5 Building, and analy laboratories within Building 205. The principal mission (past and present) of the Hot Cell is research on the behavior of materials, fuel, and structures used in nuc Chicago Pile 5 houses a shut-down, heavy-water, moderated reactor whose fuel has be removed and shipped offsite. Currently Chicago Pile 5 is in the process of being d and decommissioned and contains only two highly enriched uranium target (i.e., conv elements. Building 205 contains analytical laboratories that perform analyses on g of SNF samples coming from the Alpha-Gamma Hot Cell (DOE 1993b).

3.1.4.1 Land Use. The laboratory and support facilities occupy about a 200-acre

(81-hectare) tract; 1,700 acres (688 hectares) within the site perimeter are devote landscaped areas. The Dupage County Forest Preserve District operates 2,040-acre (826-hectare) green belt forest preserve, known as the Waterfall Glen Forest Preser surrounds the site. Much of this forest preserve was formerly Argonne National Lab property but was deeded to the Forest Preserve District in 1973 for use as a public area, nature preserve, and demonstration forest. In the past few years, a number o parks have been constructed to the north and northwest of the laboratory. Also, ma commercial establishments and a large number of dwelling units have been constructe few miles (kilometers) of Argonne National Laboratory. Before being occupied by Ar National Laboratory, most of the site was wooded and the remaining land was used fo (ANL-E 1993a).

3.1.4.2 Socioeconomics. Argonne National Laboratory is located within the Chicago

Standard Metropolitan Statistical Area, which comprises six Illinois and two Indian around the southwest corner of Lake Michigan. The population between 1970 and 1990 region increased 1.2 percent from 6,491,300 to 6,568,800 people. During this time population increased 2.9 percent. Data sources for this information include U.S. B Census, Bureau of Economic Analysis, and Department of Energy documents (DOC 1992).

The nearby areas of Will and Cook Counties have generally developed at a consid lower rate than has the DuPage County area, except along the Illinois Waterway wher development has taken place. Included within a 50-mile (80-kilometer) radius are p Lake and Porter Counties in Indiana, and all of DuPage, Will, Cook, Kendall, and Ka in Illinois (DOC 1992).

Beyond the forest preserve at Argonne National Laboratory's perimeter, the popu density is low, except for a high-density residential area--over 15 units per acre hectare) and about 4,500 residents--beginning some 650 yards (600 meters) east of t DuPage County's growth rate has been the highest of any metropolitan Illinois count the total number of housing units within region equaled 2,548,736. Cook County con largest percentage of the region's housing units (DOC 1991b).

With its workforce of about 4,700 persons, Argonne National Laboratory is one o largest employers in DuPage County. Employees commute to Argonne National Laborato

from distances as far as 30 miles (50 kilometers); thus the payroll is spread over However, nearby villages, notably Lemont and Downers Grove, do house high numbers o Argonne National Laboratory employees. About 50 percent of Argonne National Labora employees reside within 10 miles (16 kilometers) of the site. The laboratory also of its utilities, outside services, equipment, and supplies locally (DOC 1992).

Employment associated with SNF management such as routine operations of the fac including care and periodic inventories of the SNF amounts to about 0.5 person-year (Neimark 1995).

3.1.4.3 Cultural Resources. The ANL-E site has no properties designated as National

Historic Landmarks or listed on the National Register of Historic Places.

In 1992, 26 archaeological properties had been recorded at ANL-E. One site has evaluated as being potentially eligible for the National Register, 19 sites are not eligible, and 6 sites have not been evaluated (ANL-E 1993a).

The Illinois State Historic Preservation Agency has not evaluated the ANL-E sit to contain additional unidentified archaeological or architectural resources. The ANL-E site to contain traditional cultural resources of interest to Native American not been evaluated (ANL-E 1993a).

3.1.4.4 Geology. The topography at ANL-E is generally gently rolling; the average

elevation is 725 feet (221 meters) above sea level. Slopes of consequence are foun adjacent to streams and near the southern edge of the site, where the fall into the River Valley begins (ANL-E 1993b). The geology of the Argonne National Laboratory consists of about a 100-foot-thick (30-meter-thick) deposit of glacial till on top bedrock. The bedrock at Argonne National Laboratory is the Niagaran and Alexandria dolomite of Silurian age (about 400 million years old). These formations are under Maquoketa shale of Ordovician age, and older dolomites and sandstones of Ordovician Cambrian age. The beds are nearly horizontal (ANL-E 1993b).

The Niagaran and Alexandrian dolomite are about 200 feet (60 meters) thick in t Argonne National Laboratory area, and are widely used in DuPage County as a source groundwater. The Maquoketa shale separates the upper dolomite aquifer from the und sandstone and dolomite aquifers. This shale retards hydraulic connection between t lower aquifers; the lower aquifer has a much lower piezometric level and does not a affected by pumpage from the overlying Silurian bedrock (ANL-E 1993a).

A capable fault is one that has had movement at, or near, the ground surface at within the past 35,000 years or recurring movement within the past 500,000 years (1 Appendix A). A few minor earthquakes have occurred in northern Illinois, believed caused by isostatic adjustments of the Earth's crust in response to glacial unloadi areas of seismic activity are present at moderate distances from ANL-E, including t Madrid Fault zone in the St. Louis area of southwestern Missouri, the Wabash Valley along the southern Illinois-Indiana border, and the Anna region of western Ohio. G motions induced by near and distance seismic sources are expected to be minimal at Laboratory (ANL-E 1993a).

A maximum horizontal ground surface acceleration of 0.15g at Argonne National Laboratory - East is estimated to result from an earthquake that could occur once e years (DOE 1994a). The seismic hazard information presented in this EIS is for gen hazard comparisons across DOE sites. Potential seismic hazards for existing and ne should be evaluated on a facility specific basis consistent with DOE orders and sta specific procedures.

No active volcanoes are considered to be in the ANL-E region (Keller 1979). Th the potential for damage from volcanic activity is minimal.

The major soil type present at ANL-E is Morley silt loam. This soil covers app 70 percent of the site. Stream valley soils, including the Askum, Peotone, and Saw loams, cover approximately 15 percent of the site, urban land soils approximately 1 other minor soils the remaining 5 percent (Mapes 1979).

3.1.4.5 Air Resources. The regional climate around Argonne National Laboratory is

characterized as being continental, with relatively cold winters and hot summers. subject to frequently changing weather as storm systems move from the Great Plains

east. The weather is slightly modified by Lake Michigan, which is about 22 miles (east-northeast of the Laboratory (ANL-E 1993a).

Meteorological data presented here were compiled from the National Weather Serv Station at the O'Hare International Airport in Chicago and from the meteorological operated at ANL-E. The prevailing winds for the airport are from the south and sou a northeast component. The frequency of calm winds, defined as those less than 2 m hour (1 meter per second), was approximately 4 percent. The 1992 average wind rose ANL-E site is very similar to this pattern, with prevailing winds from the west to more significant northeast component. In 1992, the percentage of calm winds at ANL approximately 3 percent (ANL-E 1993a).

The amount of rainfall recorded in 1992, 31.5 inches (80.01 centimeters), was n identical to the site's historical average of 31.48 inches (79.95 centimeter). The recorded during 1992 were also similar to the site's long-term averages. The colde during 1992 were January and December, with monthly averages of 27.9yF (-2.3yC) and (-2.2yC), respectively. The warmest months were July and August, with monthly aver 68.5yF (20.3yC) and 66.9yF (19.4yC), respectively (ANL-E 1993a).

The area experiences about 40 thunderstorms annually. Occasionally, these stor accompanied by hail, damaging winds, or tornadoes. From 1957 to 1969 there were 37 tornadoes in the state, with more than 65 percent occurring in the spring months. theoretical probability of a tornado strike at Argonne is 8.54 x 10-4 each year, or interval of 1 tornado every 1,200 years. The Argonne National Laboratory site was tornadoes in 1976 and 1978, with minor damage to power lines, roofs, and trees.

The State of Illinois has adopted ambient air quality standards that specify ma permissible short- and long-term concentrations of various contaminants (State of I and Regulations 1992). These standards are the same as the National Ambient Air Qu Standards for criteria pollutants (NAAQS; 40 CFR 50). In addition to standards for pollutants, the Illinois Environmental Protection Agency has made applicable all re promulgated by the EPA relating to National Emission Standards for Hazardous Air Po (NESHAP), under Section 112 of the Clean Air Act (40 USC 7412, 7601a).

The ANL-E site and the surrounding counties are classified by the EPA as severe nonattainment areas for the criteria pollutant ozone (O3). All other surrounding c areas are in attainment of the remaining National Ambient Air Quality Standards cri pollutants: nitrogen dioxide (NO2), sodium dioxide (SO2), lead (Pb), particulate m 10 microns in diameter (PM10) and carbon monoxide (CO) (with the exception of the L Township in southeast Chicago, which is listed as a moderate nonattainment area for (ANL-E 1993b).

3.1.4.6 Water Resources.

Surface Water - The ANL-E is in the Des Plaines River drainage basin 24 miles (39 k west of Lake Michigan and is on the northern margin of the Des Plaines River valley largest onsite stream is Sawmill Creek, which originates north of the site and ente Plaines River about 1.25 miles (2.01 kilometers) southeast from the center of the s streams originate onsite and combine to form Freund Brook, which discharges into a Creek. Most of ANL-E is drained by Freund Brook. The Des Plaines River flows sout about 30 miles (48 kilometers) until it joins with the Kankakee River to form the I (ANL-E 1993a). As noted in National Wild and Scenic Rivers System, December 1992 (1992) the ANL-E region has no federally designated wild and scenic rivers.

Flow in Sawmill Creek, upstream from the ANL-E wastewater outfall, averaged 6.3 feet (0.18 cubic meters) per second in 1992. Flow in the Des Plaines River near th approximately 900 feet3 (25.5 meters) per second (ANL-E, 1991). In addition, ANL-E are not in the 500-year floodplain. The floodplain areas are largely confined to a feet (61 meters) of the surface streams (ANL-E 1993a).

The potable and site water supplies are obtained from groundwater (ANL-E 1993b) first downstream location where surface water is used for drinking is at Alton, on River, about 370 miles (595 kilometers) from ANL-E. The first downstream location surface water is used for drinking is at Alton, on the Mississippi River, about 370 (595 kilometers) from ANL-E (ANL-E 1993b).

The ANL-E has nine National Pollutant Discharge Elimination System permitted ou most of which discharge directly or indirectly to Sawmill Creek (ANL-E 1991).

In addition to this outfall monitoring, surface water bodies in the region are monitored for radioactive and nonradioactive parameters. In 1990, measurable level americium-241, californium-249, californium-252, cesium-137, curium-242, curium-244 237, plutonium-238, plutonium-239, strontium-90, and tritium were detected in Sawmi

downstream from the only small fraction of the DOE-derived concentration guides for (DOE Order 5400.5). Dilution in the Des Plaines River reduced the concentration of measured radionuclides to levels below their respective detection limits. Streams the ANL-E region are routinely sampled for radionuclides at 3 onsite and 10 offsite These samples are not routinely analyzed for chemical constituents (ANL-E 1991).

Groundwater - The ANL-E vicinity uses two principal aquifers for its water supp upper aquifer is the Niagara and Alexandria dolomite, which is about 200 feet (61 m in the region and has a potentiometric surface between 500 and 100 feet (152 and 30 below ground (ANL-E 1993b). Water flows through this unit in a southern direction 1991). No aquifers in the region are considered sole source aquifers under the Saf Water Act regulations (EPA 1994).

The ANL-E receives its potable water supply from four wells in the Niagara dolo aquifer. These wells are approximately 300 feet (91 meters) deep and provide hard requires treatment before use (ANL-E 1993b). Treated sanitary and laboratory waste ANL-E are combined and discharged into Sawmill Creek. This effluent averaged 0.83 gallons (3.1 million liters) per day (ANL-E 1993a).

Groundwater is monitored for radioactive and nonradioactive parameters at 32 AN locations. Groundwater in the four onsite drinking water wells is also monitored fo and nonradioactive parameters, as required by the Safe Drinking Water Act. In 1990 were less than the limits established by the Safe Drinking Water Act except for ele total dissolved solids and turbidity. The average concentration of tritium was app percent of the EPA Primary Drinking Water Standard of 20,000 picocuries per liter. was removed from service in 1990 (ANL-E 1991).

3.1.4.7 Ecological Resources. The Argonne National Laboratory site lies within the

Prairie Peninsula Section of the Oak-Hickory Forest Region. The Prairie Peninsula of oak forest, oak openings, and tall-grass prairie occurring on glaciated parts of northwest Indiana, southern Wisconsin, and parts of other states. Forests in the A Laboratory-East region are predominantly oak hickory. Other forested areas consist maple, red oak, and basswood (ANL-E 1993a).

The mixture of vegetational communities (open fields, deciduous forests, pine p wetlands, and mowed rights-of-way), coupled with a large degree of protection from intrusion, makes the Argonne National Laboratory site an effective refuge for many animals. These animals are characteristically found in open fields, forests, and f communities in the Midwest. Also other bird species use the Argonne National Labor as a stopover during spring and fall migrations. By far, the most numerous animals are the small invertebrates (ANL-E 1993b).

The site is inhabited by fallow deer, (Dama dama), eastern cottontail rabbit, o raccoon and squirrels. Although fallow deer have several color varieties, only the occurs at Argonne. Invertebrate fauna consist primarily of dipteran larvae, crayfi larvae, and midge larvae. Few fish are present due to the low summer flows and hig temperatures. Wetlands include a cattail marsh and wooded swamp habitat (ANL-E 199

An opinion rendered by the U.S. Fish and Wildlife Service indicated that the on listed endangered or threatened vertebrate species likely to be present in the vici Argonne National Laboratory site is the Indiana bat (Miotis sodalis). An unconfirm an Indiana bat in nearby waterfall Glen Forest Preserves indicates that the bat may ANL-E site. In addition, a September 1980 updated of the "Red Book" for the North-Region lists the federally endangered bald eagle (Haliaeetus leucocephalus) as wint Will County. Both American and Arctic subspecies of the peregrine falcon (Falco pe anatum and F. p. tundrius) and Kirtland's warbler (Dendroica kirtlandii) migrate th northeastern Illinois and thus might occasionally be found on or near the Argonne N Laboratory site. All three of these bird taxa are on the Federal endangered specie 1993b).

At least two plant species proposed for Federal endangered/threatened designati known to occur in counties near the Argonne National Laboratory site and therefore present here. These are Thismia americana, found on wet prairies in Cook County; a cordata, a plant of wet woodlands recorded in Will County (ANL-E 1993b).

3.1.4.8 Public Health and Safety. The highest annual dose received by an offsite

resident from a combination of the separate airborne and direct exposure pathways f most recent reports for a 5-year period is presented below (ANL-E 1993a, 1992, 1991

1989). The annual doses are only a fraction of the DOE Public Dose Limit of 100 mi year. The data are from all laboratory operations, including storage of SNF.

1988	0.66 millirem
1989	0.49 millirem
1990	0.41 millirem
1991	0.29 millirem
1992	0.34 millirem

The total annual population dose to the entire area within a 50-mile (80-kilome of the laboratory for a 5-year period is presented below (ANL-E 1993a, 1992, 1991, The data are from all laboratory operations, including storage of SNF.

1988	25 person-rem
1989	17 person-rem
1990	15 person-rem
1991	15 person-rem
1992	17 person-rem

3.1.4.9 Waste Management. Activities conducted at ANL-E generate a variety of

radioactive and hazardous waste streams (DOE 1994b).

The ANL-E reports 10 mixed waste streams in the inventory of operations waste. eight are low-level mixed waste streams and two are mixed transuranic waste streams ANL-E currently stores about 2.5 cubic yards (1.9 cubic meters) of mixed transurani projects that 2.1 yards3 (1.6 meters3) of additional transuranic wastes will be gen the end of 1997. This waste will be processed as necessary (characterized, repackag immobilized) to meet the waste acceptance criteria of the Waste Isolation Pilot Pla (DOE 1993e).

The ANL-E has no facilities for treating low-level mixed waste and transuranic ANL-E currently stores about 125 cubic yards (96 meters3) of low-level transuranic includes low-level waste and transuranic waste reclassified as low-level transurani Roughly 30 meters3 (39 cubic yards) of low-level transuranic waste are projected to through the end of 1997 (DOE 1993e).

Two major, unused facilities at ANL-E are undergoing environmental restoration. Laboratory expects to complete removal of the Experimental Boiling Water Reactor ve the end of Fiscal Year 1995 and to complete the conversion of the CP-5 reactor buil interim safe storage condition during Fiscal Year 1994 (DOE 1993f).

3.2 Domestic Research Reactors

The environments of domestic research reactors that may be affected by SNF acti described in this section. Representative environments of sites generating and sto described as a basis for assessing the 57 reactor sites identified in Subsection 2. approach was selected to permit enveloping the characteristics of the large number covered. Additionally, it is recognized that the programmatic SNF analyses in this intended to be site specific. Site-specific environmental information has already to the NRC and analyzed as part of the facility licensing process.

Domestic research reactors are located in a wide variety of environmental setti from relatively densely populated urban areas to rural/semirural university campuse industrial parks. To provide reasonably representative descriptions of potentially environments for these diverse installations, environmental information has been pr 5 of the 11 Category 1 reactor sites. These five reactor sites encompass the diver reactor types and power level as well as diverse environmental setting.

As reported in 1988, there were a total of 268 personnel working at the 11 Cate reactors (ANS 1988). This number included operators, experimenting scientists, and personnel. While not their main occupation, part of the duties of the operators an support personnel include tasks associated with refueling, storing, inventorying, p shipping SNF.

Environmental information is provided for those facilities whose ability to sto limited when compared to their fuel burnup rate. For those operating facilities po adequate storage for their SNF, projected to be generated through 2035, there would incremental impacts on the surrounding environment. Accordingly, no environmental have been performed and no information is provided in this section.

The environmental information for each of these reactors has been presented as

their license applications to the NRC and has been assessed by that agency as part licensing process for each facility. The environmental impacts of expanded storage these facilities are expected to be minimal (although other effects on the institut may be extensive). Information on environmental factors that are not affected by t storing SNF at these sites (including cultural resources, aesthetic and scenic reso resources, noise, traffic and transportation, utilities and energy, materials and w is not provided in this document.

Data on the calculated doses to the general public resulting from effluents fro licensed research reactors is not available, since their license and reporting requ not the same as those for DOE facilities. At the time of the reports (1987-1993), release limits in 10 CFR 20 (specified as maximum permissible concentrations) were dose limit of 500 millirem per year to a hypothetical member of the public. The co assumptions made in calculating the 10 CFR 20 concentration limits were that the pe drank the water and breathed the air released from the licensed facility. The lice reactors proved to the NRC that the dose limit of 500 millirem per year for the gen was being met by maintaining the release concentrations at the site boundary below maximum permissible concentration limits specified in 10 CFR 20. In reality, the a received by any member of the public was well below the prescribed limit of 500 mil year because 1) no individual drinks the water discharged in the sewer systems from facilities, 2) no individual stands at the closest downwind location for 24 hours a year, and 3) the radioactivity concentrations at the site boundary are well below t concentration limits.

As of 1993, licensed research reactors are required to meet the dose limits spe EPA in 40 CFR 61 of 10 millirem per year to the maximum exposed individual from air effluents. In addition, as of 1994, the licensed research reactors are required to new 10 CFR 20, in which exposure to any member of the public from all pathways is l 100 millirem per year.

3.2.1 National Institute of Standards and Technology Research Reactor

The National Institute of Standards and Technology research reactor, formerly k National Bureau of Standards Reactor, is a highly enriched, heavy-water-cooled and vessel-type reactor. The National Institute of Standards and Technology reactor re Atomic Energy Commission provisional license in 1967 to operate at 10 MW. On May 1 the NRC upgraded the National Institute of Standards and Technology research reacto to operate for 20 years at up to 20 MW (NRC 1983).

The spent fuel storage pool, located in the basement of the confinement buildin store spent fuel under filtered, demineralized water until the fuel is shipped offs storage pool cooling system is installed to dissipate the decay heat from elements pool. Storage racks are provided to store both full fuel elements and cut fuel pie geometry. Boral or stainless steel spacers are placed between elements as required criticality. The storage rack arrangement ensures that the fuel in the pool remain (NRC 1983).

The National Institute of Standards and Technology site is a 576-acre tract of Montgomery County, Maryland, approximately 1 mile (1.6 kilometers) southwest of the Gaithersburg, Maryland. According to the 1990 census, the population of Gaithersbu 39,542 (Rand 1992). The general area is a combination of residential and rural. T population centers are Gaithersburg, adjacent to the site, and Rockville, 5 miles (southeast of the site. The National Institute of Standards and Technology site is approximately 20 miles (32 kilometers) northwest of the center of the District of C National Institute of Standards and Technology campus is bounded on the east by a m interstate highway (I-270), on the north and west by Maryland Route 124, and on the by Muddy Branch Road. The area adjacent to the reactor building is occupied by a p the reactor cooling tower, and roads. Thus, the area within a 500-foot (152-meter) reactor building stack is not readily available for the construction of new buildin for future development of the National Institute of Standards and Technology site d include any new buildings within 500 feet (152 meters) of the reactor stack. The s nearest to the National Institute of Standards and Technology reactor is approximat (0.4 kilometer) southwest of the reactor. The nearest offsite residential or comme about 1,500 feet (457 meters) to the southeast of the reactor (NRC 1983).

During the period 1955-1967, 28 tornadoes were reported in a 2 degree latitude- square containing the site. The computed recurrence interval for a tornado at the Institute of Standards and Technology site is about 2000 years. Numerous tropical

tornadoes and hurricanes have affected the area. In the period from 1871 to 1978, 20 tornadoes or hurricanes have passed within 100 miles (160 kilometers) of the sit

There is no known major fault in the site vicinity (Seismic Zone 1). There is relationship between mapped faults and the moderate seismicity in the region. The potential earthquake for the area was estimated to result in a maximum ground accel 0.07 g at the reactor site. The effects of stresses developed by 0.1 g earthquake been evaluated, and it was demonstrated that the confinement building and reactor e would remain intact and maintain their capability (NRC 1983).

A summary of the radioactive material released in airborne and liquid effluents National Institute of Standards and Technology from the most recent reports for a 5 is presented below (NIST 1993, 1992, 1991, 1990, 1989).

Year	Airborne effluents		Liquid effluents into sanitary sewer	
	Argon-41	Tritium	Tritium	Other beta-gamma emitters
1988	900 Ci	393 Ci	5.1 Ci	0.0026 Ci
1989	328 Ci	461 Ci	2.9 Ci	0.0039 Ci
1990	687 Ci	309 Ci	2.2 Ci	0.0011 Ci
1991	971 Ci	251 Ci	1.8 Ci	0.0016 Ci
1992	665 Ci	351 Ci	1.5 Ci	0.0004 Ci

3.2.2 Massachusetts Institute of Technology Research Reactor

The Massachusetts Institute of Technology Reactor is a tank-type, light-water c moderated, heavy-water reflected, plate fuel, research and training reactor. The M Institute of Technology Reactor received its 5 MW operating license June 9, 1958 an was designed to have a heavy-water moderated and cooled core utilizing curved plate elements, highly enriched in uranium-235. The major revision of the core design oc 1970 (MIT 1981, 1970).

The reactor building is a steel, gas-tight, 70-foot (21.3-meter) internal diame (15.2-meter) high, domed right cylinder with 2-foot (0.6-meter) thick concrete shie the inside. The reactor building basement contains an 8-foot (2.4-meter) diameter, (6-meter-deep) spent fuel storage tank of demineralized water. The containment bui air conditioning and multiple filter ventilation system which exhausts to a 150-foo stack.

Irradiated fuel elements can be stored in any of the following locations:

a) In the reactor core
b) In the cadmium-lined fuel storage ring (holds 27 SNF elements) attached to shroud, or briefly in a three-element rack in the core tank used during tra spent fuel out of the core tank
c) In 22 steel-lined dry storage holes, 5 inches (13 centimeters) in diameter, reactor top biological shield
d) In the spent fuel storage tank in the basement of the reactor building
e) In the fuel element transfer flask or other proper shield within the contro

The Massachusetts Institute of Technology Reactor is located a few blocks north main Massachusetts Institute of Technology campus in Cambridge, Massachusetts and l 2,000 feet (610 meters) from the Charles River, which separates Cambridge from Bost According to the 1990 census, Cambridge had a population of 95,802 (Rand 1992). Th Reactor is located in the midst of a heavily industrialized section of Cambridge. measures approximately 280 feet in length by 150 feet in width (85 meters by 46 met and Albany Railroad tracks, used exclusively for freight traffic, run parallel to t reactor exclusion area. Although the site boundary comes nearest to the reactor on facing the railroad tracks, the closest point of normal public occupancy near the s on the Albany Street side at approximately 120 feet (37 meters). (MIT 1970)

The Massachusetts Institute of Technology Meteorology Department has stated tha conditions for the reactor site should vary only slightly from those at Logan Airpo Boston. The area atmospheric conditions vary from highly stable situations with li unstable periods with strong winds in excess of 47 miles (75.6 kilometers) per hour drainage from the reactor site is into the Charles River and on into Boston Harbor Massachusetts Bay. The drainage in this section of Cambridge is such that after a breaking 20 inches (0.5 meter) of rain fell in 48 hours, the Charles River did not banks, nor was the area inundated (MIT 1970).

The Cambridge area lies in the Boston Basin which has been relatively free of e

in the past 150 years but had several earthquakes in the preceding centuries. The located in Seismic Zone 2. The most severe shock with a probable epicenter near Ca occurred in 1755 with a Rossi-Forel intensity of 9 (equivalent to Modified Mercalli or X). Partial or total destruction of some buildings occurred. Since 1817, no ea Rossi-Forel intensity of more than 5 (equivalent to Modified Mercalli Intensity VI) reported near Boston (MIT 1970).

A summary of the radioactive material released in airborne and liquid effluents Massachusetts Institute of Technology Research Reactor from the most recent reports year period is presented below (MIT 1992, 1991, 1990, 1989, 1988). Liquid radioact generated at the Massachusetts Institute of Technology Research Reactor facility ar only to the sanitary sewer serving the facility. All releases were in accordance w Specifications 3.8-1 and 10 CFR 20. All activities were substantially below the li 10 CFR 20.303. Gaseous radioactivity is discharged to the atmosphere from the cont building exhaust stack. All gaseous releases were in accordance with the Technical and all nuclides were below the limits of 10 CFR 20. The information is reported b from July 1 of the previous year to June 30 of the current year.

Year	Airborne effluents	Liquid effluents into sanitary sewer	
	Argon-41	Tritium	Other beta-gamma emitters
1988	2627 Ci	0.071 Ci	0.0011 Ci
1989	1529 Ci	0.107 Ci	0.0034 Ci
1990	543 Ci	0.059 Ci	0.0220 Ci
1991	684 Ci	0.115 Ci	0.0071 Ci
1992	728 Ci	0.023 Ci	0.0137 Ci

3.2.3 University of Missouri/Columbia Research Reactor

The University of Missouri/Columbia Research Reactor is a 10 MW tank in pool li moderated and cooled research reactor. The reactor uses plate-type fuel containing enriched uranium-235. The core forms an annular fuel region which is pressurized a forced convection. The University of Missouri/Columbia Research Reactor received i license October 11, 1966 and initially operated at 5 MW. The reactor power was inc 10 MW in 1974 (UMC 1965; NRC 1991b).

The reactor is housed in a five-level, poured-concrete, gas-tight containment b is in the center of the Research Reactor Facility, a one-level building of poured-c and brick construction. The reactor vessel is located eccentrically within an open (3 meters) in diameter and 30 feet (9 meters) deep. Permanent SNF storage is provi the biological shield, in a pool separated from the reactor by a massive submerged (UMC 1965).

The University of Missouri/Columbia Research Reactor currently has 44 fuel elem the core, 20 SNF elements in wet storage and none in dry storage. Without offsite SNF, the University of Missouri/Columbia Research Reactor's storage capacity of 120 would be filled by June 1996. Before this could occur, NRC approval would be requi the reactor's uranium-235 possession limit above 165 pounds (75 kilograms). Increa storage capacity could be achieved by reracking and building a new wet-storage area reactor building. However, there are no plans to expand the current SNF storage ca (Jentz 1993).

The University of Missouri/Columbia Research Reactor Facility is located within (0.344-square-kilometer) Research Park about 1 mile (1.6 kilometers) southwest of t campus of the University of Missouri, south of the main business district of the ci Boone County, Missouri. According to the 1990 census, the population of Columbia w (Rand 1992). The nearest permanent residence is approximately 1,000 feet (305 mete the reactor. There are a number of small industrial activities in the area, but fo agriculture is the leading activity.

Wind speeds up to 50 miles (80 kilometers) per hour are not uncommon at Columbi Ninety-four-mile-per-hour (151-kilometer-per-hour) winds have an average recurrence 100 years; winds of 105 miles (169 kilometers) per hour have an average recurrence 200 years. The frequency of tornadoes is so low that it is difficult to estimate t the event. In most of the Midwest, there are an average 2.5 tornadoes per year in 10,000 square-mile (25,900-square-kilometer) area. Surface drainage from the site to enter Hinkson Creek, which drains to Perche Creek and then to the Missouri River (UMC 1961).

Columbia's position within the stable area of Missouri (Seismic Zone 1) and the history of the area indicate that the probability of seismic damage to the area is

A summary of the radioactive material released in airborne and liquid effluents University of Missouri/Columbia Research Reactor from the most recent reports for a period is presented below (UMC 1992, 1991, 1990, 1989, 1988). The information is r fiscal year, from July 1 of the previous year to June 30 of the current year.

Year	Airborne effluents		Liquid effluents into sanitary sewer	
	Argon-41	Tritium	Tritium	Other beta-gamma emitters
1988	813 Ci	14.5 Ci	0.077 Ci	0.0080 Ci
1989	920 Ci	2.8 Ci	0.0352 Ci	0.0085 Ci
1990	590 Ci	2.3 Ci	0.555 Ci	0.0385 Ci
1991	520 Ci	15.0 Ci	0.1600 Ci	0.0250 Ci
1992	440 Ci	0.73 Ci	0.2094 Ci	0.0488 Ci

3.2.4 University of Michigan Ford Nuclear Reactor

The University of Michigan's Ford Nuclear Reactor is a pool-type heterogeneous 2-megawatt-thermal reactor that is light-water cooled and moderated. The Ford Nucl has been operated since 1957 and received a 20-year license renewal from the NRC on 1985 (NRC 1985c). Its principal function is for teaching, research, activation, an (NRC 1985d).

The reactor is located in a windowless, four-story reinforced concrete building approximately a 70-foot (21.3-meter) cube. The reactor room, designed to restrict equipped with its own ventilation system and exhaust stack (NRC 1985d).

The Ford Nuclear Reactor site situated on the North Campus, which is about 1.75 (2.8 kilometers) northeast of the old University of Michigan campus. The North Cam tract of nearly 900 acres (3.64 square kilometers), approximately 1.5 miles (2.4 ki northeast of the center of Ann Arbor. According to the 1990 census, the population of Ann Arbor was 109,592 (Rand 1992). The University of Michigan controls all the 1500 feet (457 meters) of the reactor site, with the exception of a small portion o right-of-way along Glacier Way to the southeast and the Arborcrest Cemetery, locate (244 meters) to the east of the site. The reactor exclusion area consists of all t (152 meters) to the east, 1000 feet (305 meters) to the west and north, and 1200 fe (366 meters) to the south (NRC 1985d).

The reactor building and the contiguous Phoenix Memorial Laboratory are located center of the North Campus area. The following guidelines were used by the univers developing the North Campus area: (1) only laboratory and research buildings will constructed within 50 feet (15 meters) of the reactor and (2) no housing or other b containing housing facilities will be erected within 1500 feet (457 meters) of the Therefore, all buildings, except the reactor and laboratory buildings, are generall during normal school hours only. The closest permanent residences are about 1500 f (457 meters) from the Ford Nuclear Reactor facility (NRC 1985d).

The heaviest rainfall intensity occurs in connection with thundershower activit heaviest recorded 24-hour period of rainfall was approximately 5 inches (13 centime intensities as high as 1.2 inches (3 centimeters). occur with a frequency of once e Average annual snowfall is 30.2 inches (76.7 centimeters.). Annual totals have ran 54 inches (33 to 137 centimeters). The heaviest recorded snowfall for a single day (15.7 centimeters). The highest wind velocity recorded in the Ann Arbor area was 6 hour (27 meters per second). Michigan lies at the northeastern edge of the nation' frequency belt for tornadoes. For the past decade, Michigan has averaged nine torn year, 90 percent of which have been in the southern half of the lower peninsula (NR

The University of Michigan Ann Arbor site, within the Central Stable Region, is characterized by a relatively low level of seismic activity (Seismic Zone 1). Rece interpretations of geophysical investigations suggest that different areas of the C Region exhibit different levels of seismic activity. For instance, Barstow et al. earthquake frequency map for the eastern United States that places Ann Arbor in a z 8-15 earthquakes per 4500 square miles (11,660 square kilometers), with Modified Me Intensities of III or greater, have occurred during the time period 1800-1977. The location experienced a frequency of 32-63 earthquakes per 4500 square miles (11,660 kilometers) with Modified Mercalli Intensity III or greater for the same time perio Michigan Basin area, in general, is considered to have had no more than 0-3 earthqu

4,500 square miles (11,660 square kilometers) of Modified Mercalli Intensity III or seismicity map developed by the Geological Survey of the State of Michigan shows th time period from 1872-1967, only 34 earthquakes were felt (reported) in the entire Michigan. A U.S. Geological Survey seismicity map of the State of Michigan shows a 83 earthquakes in the state since 1872. The nearest of these to Ann Arbor (March 1 Modified Mercalli Intensity IV) was about 30 miles (48 kilometers) away. Only six have been reported within 60 miles (96 kilometers) of Ann Arbor. The risk of damag earthquakes to well-designed structures is relatively low for the Ann Arbor area. earthquake intensity/magnitude potential is relatively low for the Michigan region, no known structures in the Ann Arbor area capable of causing earthquakes (NRC 1985d

A summary of the radioactive material released in airborne and liquid effluent Ford Nuclear Reactor from the most recent reports for a 5-year period is presented (UMI 1994, 1993, 1992, 1991, 1990).

Year	Airborne effluents Argon-41	Liquid effluents into sanitary sewer Tritium	Other beta-gamma emitters
1989	31 Ci	0.051 Ci	0.18 Ci
1990	35 Ci	0.069 Ci	0.48 Ci
1991	41 Ci	0.079 Ci	0.11 Ci
1992	39 Ci	No discharges	
1993	39 Ci	No discharges	

3.2.5 University of Texas TRIGA

The University of Texas General Atomic TRIGA Mk-II Reactor replaces an earlier Mk-I reactor which had been in operation on the main campus in Austin, Texas since TRIGA Mk-II is a 1.1 MW heterogeneous, pool-type reactor incorporating solid uraniu zirconium hydride fuel-moderator elements with an enrichment of 19.7 percent uraniu The University of Texas TRIGA core is similar to most other TRIGA reactors operated throughout the world as well as the United States. It received its NRC operating January 17, 1992 (NRC 1985a, 1992).

The University of Texas TRIGA Mk-II Reactor facility is housed in the Nuclear E Teaching Laboratory on the east tract of the Balcones Research Center about 7 miles (11.3 kilometers) north of the University of Texas main campus, in the City of Aust County. According to the 1990 census, the City of Austin had a population of 465,6 1992). Residential areas are located from 0.8 to 1.3 miles (1.3 to 2.1 kilometers) reactor facility. Most areas adjacent to the research center are developed for mix and industrial activities. Major activities in the area are from the University of campus at Austin and the State of Texas government and the business district of the Austin (NRC 1985a).

Destructive wind and damaging hailstorms are infrequent. On rare occasions, di tropical storms affect the city with strong winds and heavy rains. Tornado activit roughly one event per year per 1000 square miles (2,600 square kilometers), or 4 x for an area of 333 square feet (30.8 square meters), which is roughly equal to the area. Water drainage at the immediate site is primarily related to the potential b occurrence of extreme rainfall rates. Surface water runoff from the Balcones Resea site is drained into the Shoal Creek Watershed except for the extreme northeast reg site, which drains into the Walnut Creek watershed. The facility is located in the region with drainage into the Walnut Creek watershed. It is situated at an elevati the local area flood plain, and is located nearly equidistant 0.5 mile (0.8 kilomet drainage easements of both watersheds. Thus no significant general site area flood anticipated (NRC 1985a).

The University of Texas TRIGA reactor site is located in a zone where no damage earthquakes is expected (Seismic Zone 1). This does not mean, however, that the ar aseismic. The Austin region has experienced three (recorded) earthquakes within a (92.6-kilometer) radius since the late nineteenth century:

- May 1, 1873--Manor earthquake with epicentral Modified Mercalli Intensity I
- January 5, 1887--Paige earthquake with epicentral Modified Mercalli Intensi
- October 9, 1902--Creedmore earthquake with epicentral Modified Mercalli Int IV-V.

Other regions in central and east Texas have experienced earthquakes of epicentral Mercalli Intensity V and possibly VI. Damage from an Modified Mercalli Intensity V

earthquake is limited to cracked plaster and damage to chimneys. Structures of goo not begin to experience damage from intensities below Modified Mercalli Intensity V Therefore, when state-of-the-art engineering practices for general structures of co are adhered to, seismic excitations from earthquakes of Modified Mercalli Intensiti not expected to affect the integrity of the reactor (NRC 1985a).

The University of Texas TRIGA reactor recently became operational, with its fir occurring in March 1992. There is no history of releases and exposures for this re

3.3 Nuclear Power Plant Spent Nuclear Fuel

In this section, the environments of three facilities housing power reactor SNF managed by DOE are described. These facilities are the West Valley Demonstration P New York State; the Fort St. Vrain SNF Storage Facility in Colorado; and the B&W Re Technology Center in Virginia. General environmental concerns related to these faci their operation have been addressed either during their initial licensing/permittin during a subsequent amendment process. Information on environmental factors that a uniformly available in existing NEPA documentation for all three sites (noise, traf energy, and waste management) are not provided in this document.

3.3.1 West Valley Demonstration Project

The West Valley Demonstration Project consists of numerous structures and facil Fuel Receiving & Storage facility, located adjacent to the original fuel reprocessi where SNF management activities at the West Valley Demonstration Project are curren performed. The Fuel Receiving & Storage facility consists of the following buildin (WVNS 1993).

- Fuel Receiving & Storage Building - This building contains the spent fuel p unloading pool, cask decontamination area, cask and fuel handling equipment spent fuel pool water treatment system.
- The water treatment system maintains a water quality that ensures visual cl underwater operations and that degradation of the SNF is minimized.
- The spent fuel pool provides shielding from irradiated fuel and ensures tha assemblies are maintained in a critically safe geometry. The pool is about and was not designed with a liner or a leak detection system, nor were the designed to withstand a design-basis earthquake.
- Radwaste Process Building - This building houses the equipment for the Radw Treatment System, including the high integrity containers used to store spe and filter media, as well as shields for those containers.
- Recirculation Ventilation Building - This building houses the ventilation e the Fuel Receiving & Storage building including fans, filters, heaters, chi controls.

The Western New York Nuclear Service Center is located in the town of Ashford, Cattaraugus County, in rural western New York State, approximately 31 miles (50 kil south of Buffalo and 24.5 miles (40 kilometers) inland (east) of Lake Erie. The We Demonstration Project site consists of a 220-acre (88-hectare) tract which is locat of the 3,345-acre (1,341-hectare) Western New York Nuclear Service Center, (WVNS 19

3.3.1.1 Land Use. Regional land use is predominantly agricultural, with some scattered

residential areas. The communities of West Valley, Riceville, Ashford, Hollow, and Springville are located within 5 miles (8 kilometers) of the West Valley Demonstrat The proximity of the city of Buffalo, Lake Erie, and Lake Ontario influence land us the region (WVNS 1992a).

3.3.1.2 Socioeconomics. The West Valley Demonstration Project comprises Cattaraugus

and Erie Counties in the State of New York. These counties collectively account fo of the site's employee residential distribution. Most West Valley Demonstration Pr employees live in Erie County. Total employment in the region increased 14.4 perce 1970 and 1990. During the same period, total population in the region decreased 12 Personal income in 1990 for Cattaraugus and Erie County residents was $13,698 and $

respectively (DOC 1992). The total number of housing units within the region is 43
The number of regular employees working at West Valley Demonstration Project is personnel. Employment associated with SNF management at West Valley amounts to 9 p years per year (Connors 1995).

3.3.1.3 Cultural Resources. The cultural resources of 360 acres (145 hectares) that may

be affected by future West Valley Demonstration Project Plans and/or West Valley Demonstration Project completion and Western New York Nuclear Service Center closur been investigated. No recorded extant historic structures are located within or ad study area, but seven recorded prehistoric sites are within a 1.5-mile (2.4-kilomet study area described below. There are no structures or prehistoric sites within th within the town of Ashford that are listed on the New York State Register of Histor the National Register of Historic Places (WVNS 1994).

3.3.1.4 Aesthetic and Scenic Resources. The natural landscape in the area consists of

rolling wooded hillsides, a mix of actively used agricultural fields, inactive farm brush, and rural homesites. Large portions of the Western New York Nuclear Service are relatively undisturbed and consist of a mixture of abandoned agricultural areas stages of ecological succession, forested tracts, and wetlands joined by transition terrain in the area of the Western New York Nuclear Service Center is not unique in landforms, vegetation, expanses of water, or land use (WVNS 1993).

3.3.1.5 Geology. The West Valley Demonstration Project is located within the

Cattaraugus highlands, which is a transitional zone between the Appalachian Plateau and the Great Lakes Plain (WVNS 1993).

No fold or fault of any consequence is recognized within the site. The Clarend Structure is the closest active "capable" earthquake (fault)-producing feature know the region. It is approximately 23 miles (37 kilometers) from the site (WVNS 1993) has experienced a moderate amount of relatively minor seismic activity. During his ground motion at the site probably has not exceeded a Modified Mercalli Intensity o horizontal acceleration of 0.05g. It is estimated that the maximum earthquake on t Linden Structure would produce an earthquake of Modified Mercalli Intensity of VI t maximum horizontal acceleration of approximately 0.12g at the site. The Claredon-L Zone is located approximately 18 miles (29 kilometers) east of the West Valley Demo Project (WVNS 1993).

The West Valley Demonstration Project region has no active volcanoes (Keller 19 major soil types at the West Valley Demonstration Project include the well-drained gravelly loam, the poorly drained Erie silt loam, and the poorly drained Mahoning s

3.3.1.6 Air Resources. A 200 feet (60-meter) onsite meteorological tower is operated by

DOE at the West Valley Demonstration Project. A review of the West Valley Demonstr Project tower's 1992 data indicates that the prevailing wind was from the south-sou mean wind speed of 5.4 miles per hour (2.4 meters per second). The precipitation f 7.1 inches (18 centimeters) above the annual average of 40.9 inches (104 centimeter onsite 1992 wind data and National Weather Service wind data collected at Buffalo a not compare well, thereby indicating that Buffalo airport is not representative for conditions at the West Valley Demonstration Project.

The state of New York has adopted national ambient air quality standards. The Valley Demonstration Project is in a Class II Prevention of Significant Deteriorati nearest Class I Prevention of Significant Deterioration area is the Edwin B. Forsyt Wildlife Refuge, approximately 300 miles (483 kilometers) southeast of the site.

3.3.1.7 Water Resources. The West Valley Demonstration Project is located in the

Cattaraugus Creek drainage basin, which is part of the Great Lakes - St. Lawrence w All surface drainage from the West Valley Demonstration Project is to Buttermilk Cr

flows into Cattaraugus Creek and ultimately into Lake Erie (WVNS 1992a). Cattaraug is used for swimming, canoeing, and fishing. Although limited irrigation water for course greens and tree farms is taken from Cattaraugus Creek, no public water suppl from the creek downstream of the site. The West Valley Demonstration Project has t National Pollutant Discharge Elimination System permitted outfalls that discharge t Brook (WVNS 1992a).

The West Valley Demonstration Project site has two aquifers, but neither is con highly permeable. The Cattaraugus Creek Basin aquifer system is a sole source aqui Safe Drinking Water Act regulations (EPA 1994). Groundwater beneath the West Valle Demonstration Project is not used for process or drinking water. The site receives supply from surface water. Offsite water supplies north of the site and south of C Creek derive mainly from springs and shallow dug wells (WVNS 1992a).

More detailed aquifer characterization information can be found in the West Val Demonstration Project Safety Analysis Report for Project Overview and General Infor WVNS-SAR-001 (WVNS 1993).

3.3.1.8 Ecological Resources. The West Valley Demonstration Project lies within the

Humid Temperature Domain, Warm Continental Division (Bailey 1994). The West Valley Demonstration Project is in a transitional zone between the Appalachian Plateau to and east and the Great Lakes Plain to the north and west (WVNS 1992b). The West Va Demonstration Project is equally divided between forest land and abandoned farm fie 1993).

Native vegetation, removed by previous agricultural activity, is becoming reest if left undisturbed, will slowly revert by successional stages to a climax hardwood (WVNS 1992b).

Terrestrial wildlife is abundant within the Western New York Nuclear Services C surrounding areas because of the mixture of open areas and forested lands as well a Center's protected nature (WVNS 1992b). Fifty-four species of mammals potentially the site (22 have been recorded onsite). The most common mammal is the white-taile (Odocoileus virginianus), which is also the most abundant game species in the regio hunting is prohibited. Other common game and furbearer species include raccoon (Pr lotor), muskrat (Ondatra zibethica), red fox (Vulpes fulva), gray fox (Urocyon cine woodchuck (Marmota monax), mink (Mustela vison), beaver (Castor canadensis), easter cottontail (Sylvilagus floridanus), red squirrel (Tamiasciurus hudsonicus), and gra carolinensis) WVNS 1992b).

The various old-field, deciduous, and coniferous woodlands, marshes, reservoirs within the Western New York Nuclear Services Center provide a diversity of habitats wide variety of birds. Bird species at the West Valley Demonstration Project inclu and summer residents, migrants, and visitants. The abundance of upland meadow ecos within the Western New York Nuclear Services Center provides a unique habitat for s York protected birds (WVNS 1992b).

Aquatic communities at the Western New York Nuclear Services Center include com shiners, eastern blacknose dace, common white sucker, and bluegill sunfish (WVNS 19

Total wetland area is approximately 35 acres (14 hectares). The general types on the West Valley Demonstration Project can be described as palustrine, emergent, and forested (WVNS 1993a).

A riparian area on Cattaraugus Creek is recognized by New York State as Habitat Significant for Wildlife (WVNS 1992b; WVNS 1993). Canada geese and other waterfowl been observed periodically using the onsite reservoirs during migration (WVNS 1992b

3.3.1.9 Transportation. Transportation in the Western New York Nuclear Service

Center vicinity is primarily by highway system. Roads in Cattaraugus County are co roads, except for those in Olean and Salamanca, located 38 miles (61 kilometers) an (42 kilometers), respectively, south of the Western New York Nuclear Service Center State classifies rural roads as interstate, principal arterial, minor arterial, maj collector, and local. Rock Springs Road, next to the Western New York Nuclear Serv on the west, is a local road that services as the site-access road and connects wit about 2.5 miles (4 kilometers) west of the Western New York Nuclear Service Center. 219 connects with Interstate 90 (the New York State Thruway) approximately 25 miles (40 kilometers) north and with Interstate 17 (the Southern Tier Expressway) approxi 29 miles (46 kilometers) south of the Western New York Nuclear Service Center (WVNS

Rail service to the Western New York Nuclear Service Center is provided by the Pittsburgh Division of the CSX Railroad, located 0.6 mile (1 kilometer) east of the York Nuclear Service Center. A rail spur connects the West Valley Demonstration Pr the CSX (WVNS 1993a).

The Buffalo International Airport is located approximately 31 miles (50 kilomet A general aviation airport, Olean Municipal Airport, is approximately 20 miles (32 southeast of the Western New York Nuclear Service Center (WVNS 1993a).

3.3.1.10 Public Health and Safety. Nuclear Fuel Services, Inc. developed an

environmental surveillance program in March 1963 before beginning fuel reprocessing program was intended to establish onsite background levels of gross radiological ac surface water and air. The West Valley Demonstration Project began groundwater mon 1982 (WVNS 1994).

Fallout data show the environmental levels of deposition at West Valley to have the nationwide normal range of the Radiation Alert Network measurements. Gross bet measurements in air taken at West Valley also were within the normal range of such taken throughout the United States. Levels of airborne particulates and deposition Western New York Nuclear Service Center perimeter have consistently been indistingu from the natural background.

The calculated total dose associated with airborne and liquid effluents release Valley Demonstration Project for a 6-year period are presented below (WVNS, 1994). annual doses for each year are only a fraction of the DOE public dose limit of 100 year.

Year	Maximum Individual at Site Boundary EDE	Collective Dose Within 50-Miles (80-km)
1988	0.11 millirem	0.031 person-rem
1989	0.08 millirem	0.065 person-rem
1990	0.25 millirem	0.058 person-rem
1991	0.06 millirem	0.015 person-rem
1992	0.05 millirem	0.011 person-rem
1993	0.03 millirem	0.072 person-rem

3.3.2 Fort St. Vrain

Between 1979 and 1989 a high temperature gas-cooled reactor was in operation at St. Vrain site. In 1989, the Fort St. Vrain reactor was permanently shut down. At Public Services Company of Colorado, the owner of Fort St. Vrain, proceeded with pl decommission the Fort St. Vrain powerplant. To facilitate the decommissioning, the be removed from the reactor. However, implementation of an agreement between the D the Public Services Company of Colorado which would have provided for the storage o Vrain SNF at the INEL was blocked, requiring the Public Services Company of Colorad provide storage for the SNF from the Fort St. Vrain reactor. The SNF from the Fort being stored in an independent spent fuel storage installation located on the Fort (FSV 1990b).

The Fort St. Vrain site is located in Weld County in northeastern Colorado, app 3.5 miles (5.6 kilometers) northwest of the town of Platteville, 0.5 mile (0.8 kilo South Platte River, and 35 miles (56 kilometers) north of Denver. The Fort St. Vra consists of 2,798 acres (1,132 hectares). About 1 mile (1.6 kilometers) north of t portion of the site is the confluence of the South Platte River and St. Vrain Creek Creek flows in a northerly direction and passes within approximately 0.75 mile (1.2 west of the site at its nearest approach (NRC 1991c; PSC 1994).

3.3.2.1 Land Use. Most of the land in the immediate area of the Fort St. Vrain site is

disturbed, agricultural land. Its agricultural value is enhanced by a number of ir fed by surface water diversions from the South Platte River and St. Vrain Creek. T predominant use of the land, surface water, and groundwater is agricultural (NRC 19

3.3.2.2 Socioeconomics. The immediate area surrounding the Fort St. Vrain Nuclear

Generating Station site is rural, with many communities within commuting distance. community is Platteville. Larger cities in the vicinity include Boulder, Denver, E Collins, Greeley, Longmont, Loveland, and Lyons (NRC 1991a).

The population density in the vicinity of the Fort St. Vrain Nuclear Generating low. The nearest residence is more than 2,600 feet (0.8 kilometer) north-northwest The number of residents living within 1 mile (1.6 kilometer) of the Independent Spe Storage Installation site (based on projections from 1980 census data) is 39; the p for the year 2012 is 40. However, 1990 figures indicate populations are changing a low rate, less than 1 percent per year, and consequently the projections will not c significantly (NRC 1991a).

Based on the 1980 census, the population within a 5-mile (8-kilometer) radius o that time was 3,148, with 1,662 residing in the town of Platteville. The projected the year 2012 (through the 20-year license) for this same area is 4,526, with 3,040 Platteville (FSV 1990a).

At the present time there are approximately 230 personnel working at the Fort S site. Of these approximately 16 full time equivalent personnel work on the Fort St storage facility (Holmes 1995).

3.3.2.3 Cultural Resources. There are no known archaeological, cultural, or historical

resources within, adjacent to, or in the immediate vicinity of the Independent Spen Installation site. The nearest landmarks fitting any of these designations are mor (3.2 kilometers) from the site. They include (NRC 1991a):

- The Dent site, an archaeological excavation with mammoth remains left by pr Indians, situated about 4.5 miles (7.2 kilometers) northeast of Fort St. Vr
- The original Fort St. Vrain, located 2.5 miles (4 kilometers) northeast of Independent Spent Fuel Storage Installation site
- Fort Vasquez, located 4 miles (6.4 kilometers) southeast of the Independent Fuel Storage Installation, and listed on the National Register of Historic
- Fort Jackson, situated 8 miles (12.8 kilometers) southeast of the Independe Fuel Storage Installation site.

3.3.2.4 Aesthetic and Scenic Resources. The topography at the Independent Spent

Fuel Storage Installation site is flat. It is situated on the high plains, overloo of the Front Range, which rise about 20 miles (32 kilometers) to the west, and by t Range crest, which rises to 14,255 feet (4,345 meters) (Longs Peak) about 45 miles (72 kilometers) to the west. The Front Range crest due west of the Independent Spe Storage Installation site is the most easterly section of the continental divide in Mountains. The divide runs along ridges at an altitude of approximately 12,000 fee meters) to a high point of 13,327 feet (4,062 meters) (McHenry's Peak) (NRC 1991a).

3.3.2.5 Geology. The Fort St. Vrain site is located on the east flank of the Colorado

Front Range, a complexly faulted anticlinal arch. Numerous faults and smaller fold superimposed on the arch and are related to the uplift of the Front Range which beg Late Cretaceous and continued into the Tertiary. In addition to the axes of the su folds, two groups of high angle faults have been recognized: a series of faults al front that extend in a generally northwest-southeast direction from the Precambrian Paleozoic-Mesozoic sediments, and northeast-southwest-oriented faults observed prim mines located east of Boulder (NRC 1991a).

The Fort St. Vrain site has not experienced any observed earthquake activity (S Zone 1). A field examination and photo interpretation of the area provided no evid recent movement along any of the known faults. The closest area of recent activity 25 miles (40 kilometers) south of the site. Between April 1962 and May 1967, there approximately 1,130 earthquake events in this area with magnitudes ranging from 1.0 the Richter Scale. The 5.0 earthquake produced ground accelerations in the Vrain V 0.002 y 0.001 g. An earthquake with a Modified Mercalli intensity of VII (slight t damage to structures) occurred on November 7, 1882, and was felt throughout Colorad Southern Wyoming. Due to the sparse population in the epicentral region, the assig may in actuality be an underestimate. A reasonable guess for its Richter magnitude

implying that most of the strain energy released by earthquakes of Colorado in the was released in this one earthquake (NRC 1991a).

3.3.2.6 Air Resources. The general climate around the Fort St. Vrain site is typical of

the Colorado eastern-slope plains region. The weather is generally mild. Most sea characterized by low humidity and sunny days, with occasional brief storms bringing to the area. Thermal radiation losses resulting from lack of cloud cover provide c variation in temperature from night to day. In this semiarid region, the precipita to 15 inches (25 to 38 centimeters) a year, mostly from thunderstorms in late sprin Snowfall is significant; however, the snow cover is usually melted in a few days. humidity averages about 40 percent during the day and 65 percent at night (NRC 1991

Meteorological conditions in the local area include a preponderance of stable meteorological conditions and rather low wind speeds. Wind speeds generally range miles per hour (0.45 to 3.2 meters per second) 80 percent of the time. Wind direct rather evenly distributed, although there is a preponderance of winds from the sout northeast quadrants. Seasonally, winds tend to be strongest in the late winter and season with high chinook frequency, and again in the summer, when thunderstorms occ frequently. Strong winds, especially under chinook conditions, have been observed occasions in easter Colorado. The chinook winds are strongest immediately to the e mountain ridge and diminish rapidly over the plains with increasing distance from t (NRC 1991a).

The region typically experiences five tornadoes per year per 10,000 square mile square kilometers), with peak tornado activity occurring during the month of June. the National Weather Service, Weld County has had 117 tornadoes during the period 1 A study of tornadoes in the area concluded that 100 mile (160 kilometer) per hour w constitute maximum forces to be expected at Fort St. Vrain (NRC 1991a).

Northeastern Colorado has moderate thunderstorm activity. The region near Fort averages 50 days a year in which thunder and lightning occur. The majority of thes thunderstorms are present from late spring through the summer (NRC 1991a).

3.3.2.7 Water Resources. The topography in the immediate vicinity of the site is

relatively flat and water use is primarily agricultural. Its distribution is throu irrigation ditches. The nearest major surface water features are the South Platte 0.5 mile (0.8 kilometer) east of the site, and the St. Vrain Creek, about 0.75 mile west of the site. Local surface water diversions from these rivers, which feed irr support agriculture, are somewhat closer, about 0.33 mile (0.5 kilometer) east and site, and about 0.4 mile (0.64 kilometer) to the north. The net local topography, the direction of surface runoff, slopes slightly to the northeast toward the South This trend is interrupted by the irrigation ditches. There are no liquid discharge storage facility (NRC 1991a).

3.3.2.8 Ecological Resources. Wildlife indigenous to the area include several species of

ducks and geese, the mourning dove, cottontail rabbit, fox squirrel, and to a lesse bobwhite quail, ring-necked pheasant, deer, and antelope. The most abundant fish s include the white sucker, carp, notropis, creek chub, and, to a lesser extent, seve perch (NRC 1991a).

With most of the land dominated by agriculture, natural vegetation is minimal. trees found along roads, in hedgerows, and around farm houses are cottonwood. Tree the river area are primarily cottonwoods, willows, and Russian olives. Typical gra found in river bottom areas include gnat heads, golden weed, snake weed, Smith gras grass, foxtail and big bluestem. The site does not have readily visible evidence o but is now overrun with plants which are typically indigenous to disturbed land; pl include Russian thistle, cocklebur, Canada thistle, dandelion, and poor-man's peppe (NRC 1991a).

The only threatened or endangered animal species known to occur within the area project are the bald eagle and the peregrine falcon. However, this land has not be as a critical habitat for these or any other species. The black-footed ferret, als be found as a transient within the region, but requires a permanent habitat which i prairie dogs. Prairie dogs are not present at the site (NRC 1991a).

3.3.2.9 Transportation. There are no airports within the immediate vicinity of the

Independent Spent Fuel Storage Installation site. Stapleton International is about kilometers) south of the site. County roads with their associated rights-of-way ar exclusion area boundary or provide access to the generating station (County Roads 2 1/2, respectively). A railroad spur connects the site to the Union Pacific Railroa located about 2 miles (3.2 kilometers) to the west (NRC 1991a).

3.3.2.10 Public Health and Safety. Results from an Independent Spent Fuel Storage

Installation Site Background Radiation Study, completed by Colorado State Universit 1990, including the mean integral exposure rate of 0.34 mR per day, were consistent acquired for the area during previous years of sampling by the Fort St. Vrain Radio Environmental Monitoring Program. With the exception of cesium-137, whose average activity concentration of 0.18 pCi/g is consistent with regional levels due to glob statistically significant concentrations of activation or fission products were det 1991a).

The design of the modular vault dry store system is such that its operation doe any water or other liquid discharges, generate any chemical, sanitary, or solid was any radioactive materials in solid, gaseous, or liquid form during normal operation radiological exposure pathway associated with the Independent Spent Fuel Storage In operation is direct irradiation of nearby residents and site workers. The highest nearest resident for any year is about 0.1 mrem. The highest collective dose commi year to the population within 5 miles (8 kilometers) of the Independent Spent Fuel Installation will not exceed 0.45 person-rem (NRC 1991a).

3.3.3 B&W Lynchburg

B&W Lynchburg maintains a large nuclear fuels research facility at its Mount At This site is about 925 acres (374 hectares) in area with the research facility with (1.6-hectare) fenced area. Numerous support facilities are located outside and adj fenced area. The research facility is in Campbell County, Virginia near the James approximately 4 miles (6.4 kilometers) east of the city of Lynchburg (NRC 1987).

Building A was constructed in 1956 and housed the Lynchburg pool reactor and th Experiment Facility. This facility has been decommissioned (NRC 1987).

Building B contains a hot cell facility with its associated operations area, ca transfer canal and storage pool, and various laboratories associated with the exami radioactive materials. It also houses a demineralizer for the cleanup of the pool (NRC 1987).

Building C was used as a plutonium fuels development laboratory and for researc development of processes for other nuclear fuels. It is undergoing decommissioning

Building J and its Annex are used for solid waste storage. High, intermediate, wastes may be stored here. Irradiated fuel wastes are being stored until they are DOE in accordance with the provisions in the Nuclear Waste Policy Act of 1982 (NRC

3.3.3.1 Land Use. Land use in Campbell and Amherst counties is dominated by farming

and forestry. Although the site lies in an agricultural region, very few of the im agricultural characteristics attributed to the region occur within 5 miles (8 kilom because of unfavorable terrain. The region is characterized by mixed land use cons areas of farmland (crop and pasture) interspersed within large tracts of forested a (NRC 1986).

3.3.3.2 Socioeconomics. The Lynchburg Research Center and the nearby City of

Lynchburg are centrally located within the area of Amherst, Appomattox, Bedford, an counties. The combined population of these counties and Lynchburg is about 180,000 (NRC 1986).

The Lynchburg area's commercial and industrial interests provide a large percen

employment in the four-county area. Although farming and forestry activities domin use in the region, they provide less than 1 percent of the economic activity and ve permanent employment. Other principal commercial, industrial, and population cente influence the four-county area or may be slightly influenced by B&W operations are Charlottesville, Richmond, and Danville (NRC 1986).

The Lynchburg Research Center has about 180 employees, and the other facilities B&W site employ about 2,200. The total employment on the B&W site is only about 3 of the 69,000 persons employed in the Lynchburg Standard Metropolitan Statistical A B&W operation is an important, although not critical, source of employment in the L region (NRC 1986).

3.3.3.3 Cultural Resources. A review of the Federal Register reveals that the only historic

site on the National Register of Historic Places located within 5 miles (8 kilomete facilities is the 19th-century Mt. Athos Plantation, which is across the road to th There are numerous historic places between 5 and 25 miles (8 kilometers and 40 kilo from the B&W site, particularly in Bedford County and Lynchburg to the west. The b known historic site is the Appomattox Court House National Historic Park, about 15 (24 kilometers) to the east (NRC 1986).

3.3.3.4 Aesthetic and Scenic Resources. The topography of the plant site is generally

rolling with gentle slopes. The nominal river elevation is 470 feet (143 meters) a level. The dominant topographic feature of the site is a hill located approximatel of the property, the crest of which rises to 693 feet (211 meters) above mean sea l includes a large area of relatively flat floodplain adjacent to the river. The hig vicinity of the site is the top of Mt. Athos, where the elevation is 890 feet (271 mean sea level (NRC 1986).

3.3.3.5 Geology. The James River Basin of Virginia includes portions of four

physiographic provinces characterized by distinct land forms and physical features. provinces, located west to east, are Valley and Ridge, Blue Ridge, Piedmont, and Co Western or inner Piedmont, where the B&W property lies, is an upland characterized scattered hills, some of mountainous dimensions, lying eastward from the foot of th (NRC 1986).

No important mineral resources have been identified at the B&W site, and U.S. G Survey topographic maps do not indicate any significant surface or underground mini within 5 miles (8 kilometers) of the site (NRC 1986).

The B&W site is located in a western part of the central Virginia cluster regio classified as Zone 2 on the Seismic Risk Map of the United States. This zone corre intensity of VII according to the Modified Mercalli scale, which implies building d extent of fallen chimneys and cracked walls. During the period 1758 through 1968, earthquakes with epicenters in Virginia were reported. The largest earthquake was a probable epicenter in Giles County, approximately 100 miles (160 kilometers) west site. A maximum intensity of VIII was estimated in the epicentral region, but an i V-VI was estimated at the plant site. The second largest earthquake was in 1875, w maximum epicentral intensity of VII more than 50 miles (80 kilometers) east or nort site. The estimated intensity at the site was V. No other quakes have been record intensities at the site greater than the 1875 or 1897 occurrences (NRC 1986).

3.3.3.6 Air Resources. The climate of the Lynchburg area is influenced by cold and dry

polar continental air masses in the winter and warm and humid gulf maritime air mas summer. Extremes in weather conditions in the area are rare. The mean temperature 56.7oF (13.7oC), with normal average temperatures ranging from 76.3oF (24.6oC) in J (3.6oC) in December. Rainfall amounts at Lynchburg can be expected to reach 40.3 i (102.4 centimeters) in any given year. The monthly rates are nearly uniform except higher rate during the summer months. Snowfall in the Lynchburg area generally occ the months of December and March. The mean yearly snowfall total is 19.4 inches (49.3 centimeters). Winds at Lynchburg are predominant from the southwest with a m

of 8 miles per hour (3.6 meters per second). Mean relative humidity values in Lync 7:00 am, 1:00 pm, and 7:00 pm are 78, 51, and 62 percent, respectively. Heavy fog less than 1,320 feet or 400 meters) can be expected to occur at the site on the ave per year (NRC 1986).

Severe weather at the Lynchburg Research Center is generally limited to thunder with a low probability of tornadoes. Climatological data show that the mean number thunderstorms occurring at Lynchburg is 22 per year. According to methods for esti tornado occurrence presented by Thom, the probability of a tornado's actually strik 3.0 x 10-4 per year, with a recurrence interval of 3,333 years (NRC 1986).

The B&W Lynchburg Research Center is located in the Central Virginia Air Qualit Control Region, where the air is classified by the Environmental Protection Agency than national standards" for total suspended particulates and sulfur dioxide. The Lynchburg also meets the national standards for total suspended particulates and su For carbon monoxide, nitrogen dioxide, ozone, and hydrocarbons, the Air Quality Con cannot be classified because data are not available (NRC 1986).

3.3.3.7 Water Resources. A relatively large forested floodplain exists between the

normal elevation of the James River and the estimated highest flood state at the si Lynchburg Research Center structures are located in the floodplain, plant operation impact floodplain features (NRC 1986).

The James River is formed about 96 miles (154 kilometers) upstream of the site confluence of the Jackson and Cowpasture Rivers. The James River flows generally s southeast from the Valley and Ridge Province to the Atlantic Ocean through the Hamp Roads and Chesapeake Bay. On the basis of records for two U.S. Geological Survey g stations, one about 20 miles (32 kilometers) upstream and the other about 21 miles (34 kilometers) downstream of the site, the annual average flow rate of the river a estimated to be about 3900 cubic feet per second (110 cubic meters per second). Th water surface elevation at the site at the average flow rate is approximately 470 f above mean sea level (NRC 1986).

Eleven great floods of the James River occurred at the plant site in 1771, 1795 1889, 1913, 1930, 1936, 1969, 1972, and 1985. The 1795 flood had the highest flood was 535 feet or 163 meters above mean sea level at Lynchburg and 494 feet (151 mete mean sea level at the site (estimated). The largest recent flood occurred in Novem had a flood state of 534 feet (163 meters) above mean sea level at Lynchburg (NRC 1

The Standard Project Flood determined by the U.S. Army Corps of Engineers for t River would produce a discharge rate of 10,705 m3/S (378,000 cfs) and a flood state (153 meters) above mean sea level at the site (NRC 1986).

Because the elevation of the plant floors at the Lynchburg Research Center is 5 (180 meters) above mean sea level, which is 95 feet (29 meters) above the maximum h flood state or 37 feet (26 meters) above the Standard Project Flood elevation, Jame would not affect the research and development facility at the Lynchburg Research Ce 1986).

Measurements in potable wells located in the river floodplain near the B&W Comm Nuclear Fuel Plant in the northeast corner of the site indicate that the groundwate ranges between 440 and 460 feet (134 and 140 meters) above mean sea level, which is (3 meters) below surface elevation at the annual average flow rate. Because of the impermeability of the silt and clay topsoils, neither the water in surface soils no has a major effect on the groundwater supply or quality. B&W obtains about 100,000 day (380 cubic meters per day) from the above-mentioned wells for drinking and indu An average of 19,300 gallons per day (73 cubic meters per day) is used at the Lynch Research Center. Continuous pumping tests on these wells indicates a plentiful sup groundwater. Therefore, it is not likely that the performance at nearby residentia affected by B&W's operations (NRC 1986).

3.3.3.8 Ecological Resources. Natural climax vegetation in the region is classified as

oak-hickory-pine (Quercus-Caray-pinus) forest. Dominants include white (Q. alba), (Q. stellata), hickory (Carya spp.), shortleaf pine (P. echinata) and loblolly pine common species include tulip poplar (Liriodendron tulipifera), sweetgum (Liquidamba styraciflua), dogwood (Cornus florida), and several other species of oak, hickory, (NRC 1986).

The great diversity of plants and vegetative communities in the site vicinity p

variety of habitats for wildlife. There are approximately 24 species of mammals, 1 birds, 19 species of reptiles, and 17 species of amphibians expected to occur in th area. Species in the vicinity of the site that are economically important include e.g., white-tailed deer (Odocoileus virginianus) and black bear (Ursus americanus), canadensis), red fox (Vulpes vulpes), and beaver (Castor canadensis); and mourning macroura) and several species of water fowl (NRC 1986).

The aquatic biota of the James River in the vicinity of the Lynchburg Research generally characteristic of that of a moderately polluted river. Examination of ph communities downstream of the site at Cartersville shows reasonably diverse communi consisting of green, yellow-green (diatoms) and blue-green algae during the late su Phytoplankton communities during the fall, winter, and early summer consisted almos a few species of yellow-green algae (NRC 1986).

Most of the fish in the James River in the vicinity of the Lynchburg Research C primarily members of the minnow, sucker, sunfish, perch, and catfish families. Spe families range from common to uncommon. There is no commercial fishery in the vici Lynchburg Research Center site (NRC 1986).

Federally and state-listed threatened and endangered animal species whose prese former geographic ranges include central Virginia and the B&W site are the bald eag (Haliaeetus leucocephalus), American peregrine falcon (Falco peregrinus), gray bat grisescens), Indiana bat (Myotis sodalis), Virginia big-eared bat (Plecotus townsen and eastern cougar (Felis concolor couguar). There have been no reports of these s observed on the site or its vicinity (NRC 1986).

There are no species of rare or endangered fish or mollusks known to occur in t River in the vicinity of the site (NRC 1986).

3.3.3.9 Transportation. The site is bounded on three sides by the James River and on

the fourth side by Virginia State Route 726. The site is serviced by a spur of the which runs through the B&W property. The site is also conveniently located for tru automobile access, because only about 2 miles (3.2 kilometers) from the plant, Stat connects with U.S. Highway 460, a major link between Roanoke and Richmond (NRC 1986

3.3.3.10 Public Health and Safety. The total-body dose rate for the vicinity of

Lynchburg is approximately 107 millirem per year. This dose rate includes 43 milli from cosmic rays, 45.6 millirem per year from terrestrial sources, and 18 millirem internal emitters (NRC 1986).

4. ENVIRONMENTAL CONSEQUENCES OF SPENT NUCLEAR

FUEL MANAGEMENT ACTIVITIES

This section presents the projected impacts of implementing the programmatic al for management of SNF for which DOE has accepted present or future responsibility. management activities evaluated in this section only include those actions identifi originating sites to be implemented should the No Action Alternative be adopted, as Section 2. SNF management activities planned independently of this EIS are address they are directly affected or altered as a result of the programmatic SNF alternati in this EIS. Only Alternative 1, No Action, has any potential for affecting some o addressed in this Appendix. Thus only the environmental consequences of SNF manage activities at originating sites under Alternative 1 will be discussed here. For th alternatives, the environmental consequences of SNF transportation from originating analyzed in Appendix I to Volume 1. The environmental consequences at the DOE faci receive the SNF originating from any facilities in this Appendix are addressed in A B, C and F.

4.1 No Action

4.1.1 DOE Experimental Reactors and Small-Quantity Storage

The DOE's reactors at the Brookhaven National Laboratory, Los Alamos National Laboratory, and Sandia National Laboratories would not be affected by the No Action Alternative through the year 2005. Between 2006 and 2035, however, implementation alternative might require modifications of SNF management activities at the reactor

4.1.1.1 Brookhaven National Laboratory. The High Flux Beam Reactor at the

Brookhaven National Laboratory is planned to continue to operate for the foreseeabl The presently planned installation of a storage rack in the existing wet storage fa 162 additional storage locations, will be depleted in 1998. It is expected that th the existing racks will be modified to provide additional storage capacity in the e SNF cannot be shipped at that time (Carelli 1993).

Fuel storage capacities at the Brookhaven National Laboratory High Flux Beam Re would be severely taxed if the No Action Alternative were selected. Selection of t Alternative could result in the eventual shutdown of the High Flux Beam Reactor as filling the existing SNF storage capacity. Implementation of the No Action Alterna expected to have no operational impact on the Brookhaven Medical Research Reactor (1993).

There is no safety analysis or technical specification limit on the number of e so the proposed addition of a new storage rack should be accompanied by a new criti analysis (DOE 1993c).

The fuel canal is unlined and there is no continuous and accurate way of measur detection. However, alarms for high and low water level are in the control room an level is regularly monitored. Records are maintained for canal water additions, an increased amounts of canal makeup water can be detected. The canal has been sealed evaporation about every 5 years to measure leakage, and no leakage problems have ev detected. Also, there are groundwater monitoring wells near the High Flux Beam Rea are sampled twice per year, and no significant amounts of radionuclides have ever b No known damaged fuel is presently stored in the fuel canal (DOE 1993c).

The fuel canal water monitoring program is adequate to control corrosion and to the release of fission products. In addition, corrosion surveillance coupon sample photographed and evaluated yearly since stored in the canal in 1977. These photogr shown no corrosion damage (DOE 1993c).

In view of the absence of any substantive difference in SNF management operatio attributable to the No Action Alternative, effluent releases and their associated d expected to be the same as those currently being experienced there.

Potential impacts on the Nassau/Suffolk Aquifer System as a result of SNF manag alternatives described in this EIS are expected to be small. If the fuel canal wer water impacts would be expected, but monitoring measures would mitigate impacts by early detection of leaks.

For the Brookhaven Medical Research Reactor, which has sufficient SNF storage c the No Action Alternative would cause no environmental consequences--other than tho have already been addressed and accepted under the siting and operation approval pr

4.1.1.2 Los Alamos National Laboratory. The Omega West Reactor at Los Alamos

National Laboratory is permanently shut down. It is being decommissioned. The SNF temporary storage at the Chemistry and Metallurgy Research complex. Although at pr stored fuel elements do not present a health or safety hazard, storage of fuel at t and Metallurgy Research complex presents a potential radiological hazard at that fa Los Alamos National Laboratory does not have the capability to store, handle or mon fuel for any extended length of time. The Rover casks contain no monitoring device storage of spent fuel is not addressed in the current Chemistry and Metallurgy Rese authorization. It is recommended that the fuel be relocated as soon as practical.

For the other Los Alamos National Laboratory facilities that have sufficient SN capacity, the No Action Alternative would cause no environmental consequences--othe those that have already been addressed and accepted under the siting and operation process.

4.1.1.3 Sandia National Laboratories. Each of the reactors at Sandia National

Laboratories is designed so that the uranium fuel source essentially lasts the desi reactor. Consequently, none of the reactors require periodic refueling or discharg Therefore, the No Action Alternative would cause no environmental consequences--oth those that have already been addressed and accepted under the siting and operationa process for these facilities at Sandia National Laboratories (DOE 1993d).

4.1.1.4 Argonne National Laboratory - East. Essentially all of the SNF at the Argonne

National Laboratory site in Illinois is contained in the Alpha-Gamma Hot Cell Facil Alpha-Gamma Hot Cell Facility is an operating hot cell where fuel development progr been conducted for 29 years. The SNF located there is a combination of material in the stored residues from past programs (DOE 1993d).

The condition of the stored SNF is generally good and would be an issue only if and chemical state dictates that it must be treated before it will be acceptable at interim storage site or a final repository. Likewise, the physical condition of th considering its 29-year age. The SNF is contained within the hot cell, which precl into the environment except under the most extremely low-probability events (DOE 19

4.1.2 Domestic Research Reactors

In Section 2.2.1.2, it was noted that SNF storage facilities at 34 domestic res would not be overloaded were the No Action Alternative (i.e., no off-site SNF trans be implemented. For those sites, the adoption of the No Action Alternative would p incremental impacts on the environment.

This conclusion is supported by NRC determinations in a number of licensing act related to requested increases in possession limits for U-235 in fuel at research r these licensing actions, the NRC has determined that there is no significant impact environment from normal operation or accidents associated with the increases in the limits for U-235 at those reactor sites. The possession or storage of fuel at the reactor sites is not considered by the NRC to be a significant activity as indicate following examples of their findings.

In 1993, the NRC performed a safety evaluation in response to the University of Columbia request for a temporary increase in the license possession limit for U-235 60 kilograms. In regard to potential accidents the NRC determined: "There are no accidents in this type of research reactor associated with the storage of spent fue with the Technical Specifications. The maximum hypothetical accident of complete f product release of four fuel plates in the reactor core is not affected by increasi stored fuel. Because the fuel will be stored in accordance with the Technical Spec accidents previously evaluated are not changed and no new or different kind of acci created. Therefore, the staff concludes that the temporary increase in the possess U-235 is acceptable."

In regard to environmental considerations of this possession increase, the NRC staff has determined that the amendment involves no significant increase in the amo significant change in the types, of any effluents that may be released offsite, and significant increase in individual or cumulative occupational radiation exposure. amendment meets the eligibility criteria for categorical exclusion set forth in 10 Pursuant to 10 CFR 51.22(b), no Environmental Impact Statement or Environmental Ass need be prepared in connection with the issuance of this amendment." (NRC 1993b)

In 1991, in performing a safety evaluation in response to an earlier University request for a temporary increase in the license possession limit for a larger amoun from 60 to 75 kilograms, the NRC reached the same determinations and conclusions as 1993 licensing action. (NRC 1991b)

In response to the request from the Massachusetts Institute of Technology reque to extend a temporary increase in the possession limit of U-235 of 41 kilograms unt 1994, the NRC performed an evaluation and made identically the same determination a quoted above for the University of Missouri license amendment. (NRC 1991d)

The NRC, in its Environmental Assessment for the Training and Research Reactor University of Lowell, stated: "Accidents ranging from the failure of experiments u core damage and fission product release considered possible result in doses that ar CFR Part 20 guidelines and are considered negligible with respect to the environmen

concludes that there will be no significant environmental impact associated with th research reactors or critical facilities designed to operate at power levels of 2 M that no environmental impact statements are required to be written for the issuance construction permits or operating licenses for such facilities." (NRC 1985b)

In the Environmental Impact Statement for the University of Texas, TRIGA Mark I reactor, it was stated: "Storage, processing and disposal of fuel elements is not significant activity of this facility." (NRC 1984)

Of the 11 domestic research reactors that are projected to exhaust their storag few facilities indicated that they might take measures to physically expand their S capacity within their existing structures beyond what had been planned. Only one f indicated that it might elect to create an 18.6-square-meter (200-square-foot) stor the existing structure. An addition of this small size would be expected to have a impact on the previously disturbed environment.

A small number of these facilities could request deferral of their directed con highly enriched uranium fuel to low enriched uranium fuel. The environmental conse such an action would derive from extending the risks of theft or diversion of highl uranium fuel which the U.S. Government has tried to reduce by mandating the convers 1993).

An unidentified number of the research reactors may elect to discontinue operat time during the next 40 years. Storage of the SNF onsite at a reactor facility tha decommissioning would interfere with the radiological surveys conducted to ensure t reactor site is returned to the pristine conditions that existed before the reactor

The consequences of premature shutdown of any of these reactors, attributable t implementation of the No Action Alternative, would include the loss of service whic were scheduled to provide. These consequences of implementing the No Action Altern could include, for example:

- Loss of education and training for some nuclear engineers and scientists
- Loss of trace analysis capability supporting solar cell material research, atmospheric pollutants, detection of trace metals in foods, and analysis of artifacts
- Loss of specific materials research capability relating to hydrogen in meta amorphous magnetic materials, and biomolecular polymers
- Loss of specific nuclear medicine and radiation therapy.

Any changes in radioactive (or other) releases or exposures to the public or to would be inconsequential. More detailed analyses of radiation exposures and other would be provided in site-specific NRC licensing documents before implementation of changes in these facilities that were made necessary by an SNF transportation morat

4.1.3 Nuclear Power Plant Spent Nuclear Fuel

4.1.3.1 West Valley Demonstration Project. It has been determined that continued use

of the SNF storage pool in the Fuel Receiving & Storage building at the West Valley Demonstration Project is not a viable option for extended periods of time. Therefo concepts for storing West Valley Demonstration Project SNF are being evaluated by t The options being considered at West Valley include dry storage, wet storage involv refurbishing of a portion of the existing spent fuel storage pool, and continued us facility.

Dry storage is projected to require a maximum area of 0.003 square kilometer (0 (i.e., a square plot of land about 54 meters [177 feet] on each side). This area wo actual storage facility, approach pads, and perimeter fence. The largest base pad any of the dry storage concepts would measure 9.1 by 15.2 meters (30 by 50 feet) an between 0.61 and 1.22 meters (2 and 4 feet) thick (WVDP 1993).

The wet storage concept and No Action Alternative assume the continued use (eit modified or as is) of the existing spent fuel storage pool. These options should ha measurable impact on the West Valley Demonstration Project site. The actions taken the spent fuel from the storage pool to the on-site dry storage facilities would no those taken to transfer this SNF to the INEL or any other DOE facility. Therefore, be no additional environmental impact resulting from these fuel transfer activities

Potential impacts on the Cattaraugus Creek Basin Aquifer System as a result of Management alternatives described in this EIS are expected to be small.

Keeping the SNF in dry storage on-site would result in both on-site and off-sit that would not occur if the fuel were shipped off-site once it was removed from the

Storing the fuel dry in sealed containers would not result in the production of rad or gaseous effluents or solid radioactive wastes. The source of the on-site and of doses is direct radiation from the dry spent fuel storage facility. Estimates have developed for these doses, because a storage concept has not been selected.

The 125 fuel assemblies in the Fuel Receiving and Storage Facility have been in over 20 years. Their total heat generation rate is less than 9 kilowatt and fissio inventory should have reached a near steady state condition. Conservative calculat analysis report estimate that failure of all 125 fuel assemblies would result in an 42 mrem and an on-site dose of 2.1 rem (DOE 1993c).

Doses and solid waste generation volumes resulting from implementation of the N Alternative would remain the same as the current operation at the West Valley Demon Project. The calculated annual effective dose equivalent resulting from the total including wet storage of SNF at the West Valley Demonstration Project are as follow 1994)

Maximum individual off-site dose from1.6 x 10-4 mrem/year
gaseous releases
Maximum individual off-site dose from1.1 x 10-2 mrem/year
liquid releases

4.1.3.2 Fort St. Vrain. The Fort St. Vrain facility has already constructed an

Independent Spent Fuel Storage Installation for interim storage (with a 40 year des the SNF from the Fort St. Vrain power plant. Onsite storage will have no additiona the Fort St. Vrain site (FSV 1990a). However, under this alternative, Public Servi Colorado would not achieve its goal of becoming free of radioactive materials by 19 option.

4.1.3.3 B&W Lynchburg Technology Center. The Lynchburg Technology Center

received the SNF between 1980 and 1987 as part of a "high-burnup" research program by the DOE Office of Nuclear Energy. The experiments were completed in 1989 and th program was officially terminated in 1992. Since that time, the Lynchburg Technolo has stored this fuel under contract to DOE (DOE 1993c).

The DOE-owned spent fuel rods that are stored in the spent fuel storage pool ar and in good condition. Water quality is also good and is maintained by passing thr particulate filters and resin beds. No chemistry controls have been needed. In ad not present in the pool and biological contamination has not been observed (DOE 199

There are no routine inspections of the condition of spent fuel rods that have sectioned and placed in dry storage. However, some of the fuel stored in this faci recently repackaged and moved; this fuel and its containers are known to be in good Other evidence that the integrity of spent fuel storage containers has been maintai condition is routine monitoring of groundwater, direct radiation, and smearable con of which indicate that leakage of radionuclides is not occurring (DOE 1993c).

Groundwater and other radionuclide monitoring have not indicated any radionucli releases from the SNF storage facilities at the B&W Lynchburg Technical Center. Th currently no reason to suspect that spent fuel storage containers will degrade in t a manner that would result in a release of fission products. This facility is rout and relicensed by the NRC every 5 years. Hence, any developing storage problems wo likely be dealt with and corrected under the direction of the NRC (DOE 1993c).

4.2 Decentralization

The Decentralization Alternative is similar to the No Action Alternative except off-site shipments would occur from university and domestic non-DOE research reacto Impacts of transportation are described in Appendix I to Volume 1. Some DOE facili be upgraded/replaced and additional on-site storage capacity would be required at s facilities. Essentially, there are no differences from the No Action Alternative, from transportation, facility upgrade, and new construction.

At Brookhaven National Laboratory High Flux Beam Reactor, some land disturbance be anticipated from the installation of additional SNF storage capacity, whether we However, any such disturbance is expected to occur in previously disturbed on-site

4.3 1992/1993 Planning Basis

The 1992/1993 Planning Basis Alternative would permit the shipment of the SNF c in storage or being generated at the originating sites. With the implementation of Planning Basis Alternative, as in past practice, SNF would continue to be shipped f originating sites to a DOE receiving site. The 1992/1993 Planning Basis Alternativ expected to have essentially no incremental impact on the originating sites. Impac transportation are described in detail in Appendix I to Volume 1. The alternative SNF by barge from Brookhaven National Laboratory is also described in Appendix I to 1.

4.4 Regionalization

The Regionalization Alternative would be the same as the 1992/1993 Planning Bas Alternative, except for the difference in destinations. Implementation of the Regi Alternative would permit the shipment of SNF from originating sites to regional DOE storage facilities. The Regionalization Alternative would be expected to have esse incremental impact on the originating sites. Impacts of transportation are describ Appendix I to Volume 1.

4.5 Centralization

The Centralization Alternative would be the same as the 1992/1993 Planning Basi Alternative, except for the difference in destinations. Implementation of the Cent Alternative would permit the shipment of SNF from originating sites to a central DO storage facility. The Centralization Alternative would be expected to have essenti incremental impact on the originating sites. Impacts of transportation are describ Appendix I to Volume 1.

5.0 CUMULATIVE IMPACTS

This section describes the cumulative environmental impacts of the alternatives generating and storing SNF at the originating sites addressed in this Appendix. Th on DOE SNF Alternative 1, No Action, under which all SNF would remain at the origin facility. For the individual originating facilities, the cumulative impact is defi the incremental impacts of SNF management under the No Action Alternative and the i of the other operations at the facility's reactor(s) or other activities involving materials. For the other alternatives, the SNF cumulative impact at the originatin essentially would end with the removal of the SNF from the site. The cumulative im intersite SNF transportation alternatives on transportation routes and affected com analyzed programmatically in Volume 1, Appendix I. The cumulative impacts at the D facilities receiving SNF are addressed in Appendixes A, B, C and F.

5.1 DOE Test and Experimental Reactors

Under the No Action Alternative, the cumulative environmental impacts at DOE te experimental reactors are derived from past environmental impacts as obtained from operating reports, and estimated future impacts based on extrapolation to the year impacts.

5.1.1 Brookhaven National Laboratory

It is expected that the High Flux Beam Reactor and Brookhaven Medical Research would continue to operate, for all SNF management alternatives except No Action. I storage were to be required on-site to accommodate High Flux Beam Reactor SNF throu current impacts would be somewhat increased by the impacts of building and operatin

additional facility. Although the nature of that facility has not been determined, impacts are expected to be negligibly small. Should the facility propose substanti appropriate NEPA documentation would be prepared in accordance with existing enviro regulations.

5.1.2 Los Alamos National Laboratory

Omega West Reactor at the Los Alamos National Laboratory is permanently shut do is being decommissioned. The spent fuel is in temporary dry storage at the Chemist Metallurgy Research complex, and resulting impacts are negligible. The spent fuel relocation. Cumulative impacts would not change under any alternative.

5.1.3 Sandia National Laboratories

The cumulative environmental impacts would not change from those currently expe at Sandia National Laboratories from the operation of the reactors and storage of s quantities of SNF.

5.1.4 Argonne National Laboratory - East

The cumulative environmental impacts would not change from those currently expe from the storage of small quantities of SNF.

5.2 Domestic Research Reactors

Under the No Action Alternative, the cumulative environmental impacts at domest research reactors are a composite of past environmental impacts as obtained from an operating reports, and estimated future impacts based on extrapolation to the year impacts. The following facility-specific cumulative environmental impacts have bee representative of all domestic research reactor facilities that could be affected b

5.2.1 National Institute of Standards and Technology

Implementation of the No Action Alternative would result in the shutdown of the Bureau of Standards Reactor in October 1996 due to the inability to store additiona environmental radiological impact of such action would be a reduction of radioactiv doses below those of full power operation. On-site SNF storage would meet existing design criteria. There would be no other change in the cumulative environmental im for the adverse socioeconomic impacts as a result of the loss of services and knowl reactor operations.

A scenario of continued operation, assuming timely reissuance of the operating including compliance with the National Environmental Policy Act, would bound the cu environmental impacts under any of the DOE-postulated SNF alternatives.

5.2.2 Massachusetts Institute of Technology

As with the National Institute of Standards and Technology, the Massachusetts I Technology research reactor would be expected to shut down in response to the No Ac Alternative because of limited SNF storage capacity. Thus, a scenario of continued assuming timely reissuance of the operating license, would bound the cumulative env impacts under any of the DOE-postulated SNF alternatives.

5.2.3 Conclusion

For all domestic research reactors, the SNF management alternatives, including Action Alternative, would not increase the cumulative impacts of the originating si current values. Some of the facilities could not be able to continue normal operat

No Action Alternative and could be forced to shut down due to the lack of SNF stora Reactors licensed by the U.S. Nuclear Regulatory Commission are not under DOE contr additional storage space could be constructed under the No Action Alternative. How for the negative socioeconomic impacts attributable to the loss of services and kno resulting from such shutdowns, other site-specific cumulative impacts would not be

5.3 Nuclear Power Plant Spent Nuclear Fuel

The implementation of any one of DOE's five SNF management alternatives would h additional environmental consequences beyond those already evaluated for the Fort S B&W Lynchburg facilities.

The situation is similar for the West Valley Demonstration Project, except that has entered into an agreement with the New York State Energy Research and Developme Authority which calls for the removal of SNF from the West Valley Demonstration Pro Implementation of the No Action and Decentralization Alternatives would result in S remaining at the West Valley Demonstration Project. If the fuel remains at the Wes Demonstration Project, the SNF may be managed in a new dry storage facility. Once in dry storage, there will be no releases of radioactive effluents and an indisting radiation exposure to the environs in excess of that which would occur were the SNF moved as scheduled, and in the payment of storage costs by DOE to the State of New

6.0 ADVERSE ENVIRONMENTAL EFFECTS

THAT CANNOT BE AVOIDED

Unavoidable adverse impacts addressed here are limited to those occurring as a DOE Alternative 1 (No Action) at the originating facilities discussed in this Appen alternatives consider normal shipment of SNF from the originating site, with only t routes and the receiving site possibly being subjected to unavoidable adverse impac transferred SNF. Any adverse impacts at the originating sites are thus precluded f transportation alternatives. Possible unavoidable adverse impacts on transportatio analyzed in Volume 1, Appendix I. Possible unavoidable adverse impacts at the DOE that receive SNF are addressed in Appendixes A, B, C and F.

6.1 DOE Test and Experimental Reactors

The adverse effects that may be unavoidable caused by implementation of the No Alternative would be associated with the possible premature, long-term shutdown of Flux Beam Reactor at Brookhaven National Laboratory. The consequences of this shut would be cessation of site specific activities involving unique experiments. These needed for understanding materials structures, biological processes, and the behavi conducting materials. Shutdown would also cause the loss of jobs associated with t experiments and supporting site activities.

6.2 Domestic Research Reactors

The adverse effects that may be unavoidable at domestic research reactors cause implementation of the No Action Alternative would be associated with the possible p long-term shutdown of several reactors. The consequences of these shutdowns, discu Section 4.1.2, would be cessation of site-specific research and education activitie in the loss of jobs associated with these activities at these sites.

6.3 Nuclear Power Plant Spent Nuclear Fuel

Implementation of the No Action Alternative could result in adverse consequence be unavoidable at West Valley Demonstration Project. Should this alternative be se adverse impact that may be unavoidable would be continued on-site and off-site radi exposures beyond the scheduled fuel removal date as a result of radioactive effluen direct radiation.

Since the Public Services Company of Colorado has already responded to the No A Alternative by licensing and constructing an independent spent nuclear fuel storage its Fort St. Vrain site, no additional consequences or additional adverse consequen incurred there.

7.0 IRREVERSIBLE AND IRRETRIEVABLE

COMMITMENTS OF RESOURCES

The assessment of the activities undertaken at the SNF originating sites as a c the implementation of all alternatives indicates that only minor irreversible and i commitments of resources would be required.

7.1 DOE Test and Experimental Reactors

If the Decentralization Alternative were to be implemented, the Brookhaven Nati Laboratory would expect to be required to identify some way to store the SNF genera High Flux Beam Reactor through the year 2035. Several scenarios are possible, but been decided upon at this time. One possible SNF management scenario is to install storage accommodations. Limited quantities of construction materials and fuel for equipment would be required if this scenario were selected.

Implementation of the No Action Alternative would not result in any irreversibl irretrievable commitments at the Los Alamos National Laboratory, Sandia National La or Argonne National Laboratory - East.

Implementation of any of the other proposed alternatives for SNF would not resu additional irreversible and irretrievable commitments of resources at the DOE test experimental reactors.

7.2 Domestic Research Reactors

There are no substantial new irreversible and irretrievable commitments of reso domestic research reactors with the implementation of any of the proposed SNF alter generating and storing SNF. If, under the No Action Alternative, any NRC-licensed should elect to modify its SNF storage capabilities, a site-specific license amendm required. If the storage facilities were expanded, there would be a commitment of materials and fuel to operate construction equipment. The other DOE SNF alternativ involve no commitment of resources at domestic research reactor facilities.

7.3 Nuclear Power Plant Spent Nuclear Fuel

Implementation of the Decentralization Alternative could result in irreversible irretrievable commitments of resources at the West Valley Demonstration Project sit this alternative be selected, this commitment of resources would result from the co materials and fuels used to provide alternative on-site SNF storage capability. Th these commitments cannot be quantified, however, until it is determined whether exi storage capacity would be modified or a new SNF storage facility would be construct type.

Implementation of any of the other proposed alternatives for SNF would not resu additional irreversible and irretrievable commitments of resources at the commercia facilities.

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APPENDIX F Nevada Test Site and Oak Ridge Reservation Spent Nuclear Fuel Management Programs

Department of Energy Programmatic
Spent Nuclear Fuel Management
and
Idaho National Engineering Laboratory
Environmental Restoration and
Waste Management Programs
Final Environmental Impact Statement
Volume 1
Appendix F
Nevada Test Site and Oak Ridge Reservation
Spent Nuclear Fuel Management Programs
April 1995

U.S. Department of Energy
Office of Environmental Management
Idaho Operations Office

1. APPENDIX F INTRODUCTION

This appendix addresses the interim storage of spent nuclear fuel (SNF) at two Department of Energy sites, the Nevada Test Site (NTS) and the Oak Ridge Reservatio These sites are being considered to provide a reasonable range of alternative setti future SNF management activities could be conducted. These locations are not curre involved in management of large quantities of SNF; NTS has none, and ORR has only s quantities. But NTS and ORR do offer experience and infrastructure for the handlin processing and storage of radioactive materials, and they do exemplify a broad spec environmental parameters. This broad spectrum of environmental parameters will pro perspective on whether and how such location attributes may relate to potential env impacts. Consideration of these two sites will permit a programmatic decision to b an assessment of the feasible options without bias to the current storage sites.

This appendix is divided into three parts. Part One is the Appendix F introduc Two contains chapters one through five for the NTS, as well as the NTS references i and acronyms and abbreviations in Chapter 7. Part Three contains chapters one thro the ORR, as well as the ORR references in chapter six and abbreviations and acronym Chapter 7. A Table of Contents, List of Figures, and List of Tables are included i and Three. This approach permitted the inclusion of both sites in one appendix whi maintaining chapter numbering consistent with Volume 1 and Appendices A, B, and C.

Currently, no SNF is stored at the NTS and only small quantities of SNF generat research reactors at ORR are stored there. In order to receive, handle, and store fuel from other DOE sites on an interim basis, new facilities would need to be cons

NTS and ORR. Since the basic facilities to receive and handle the spent fuel, as w safety-related and emergency containment, cleanup, and recanning facilities, are ap equivalent for all alternatives being considered, only the size of the storage faci each alternative, with the Centralization Alternative requiring the largest storage discussed in Chapter 3, only the Centralization Alternative for spent fuel storage NTS or ORR is analyzed quantitatively in this volume; the Regionalization Alternati evaluated qualitatively. The results of this appendix are then summarized in Volum

NEVADE TEST SITE

FIGURES

TABLES

#1. INTRODUCTION

This part assesses the impacts of construction and operation of proposed spent (SNF) facilities at the Nevada Test Site (NTS). The NTS is being evaluated for the because of the area available, the isolation of population centers, the apparently environmental parameters, previous U.S. Department of Energy activities involving r materials at the site, and the planned long-term government control of the site.

This part is organized as follows. Chapter 1 is the introduction, Chapter 2 se the area under analysis by providing an overview of the NTS and discussions of the Framework and SNF Management Program, and Chapter 3 explains the SNF alternatives b considered at the site.

Chapter 4 describes the human and natural environment that could be affected as of the introduction of an SNF facility at the NTS. Environmental parameters such a

resources, socioeconomics, biological resources and air quality are examples of tho characterized.

Chapter 5 enumerates the environmental consequences that might be anticipated, cumulative impacts, the unavoidable adverse impacts, the relationship between short and long-term productivity, the irreversible and irretrievable commitment of resour possible mitigation measures that might be anticipated if an SNF facility were buil Chapter 6 contains the references used to develop this part of the Environmental Im Statement. Chapter 7 contains the abbreviations and acronyms used in this Part.

2. NEVADA TEST SITE BACKGROUND

2.1 Overview

2.1.1 Site Description

The Nevada Test Site (NTS), located in the southeastern portion of Nevada, is o the U.S. Department of Energy (DOE) as the on-continent test site for nuclear weapo The site encompasses approximately 1,350 square miles (3,500 square kilometers). T surrounded on the north, east, and west by the Nellis Air Force Base (NAFB) Bombing Gunnery Range. Together with the Tonopah Test Range, these three properties provid 65-mile (24- to 104-kilometer) buffer zone between the test areas and public lands. of Land Management owns land on the southern and southwestern borders of the NTS. Vegas is approximately 65 miles (104 kilometers) from the southeast corner of the s (Figure 2.1-1) (DOE/NV 1991a; USAF et al. 1991).

The NTS is a large, open area, tightly controlled, with the infrastructure to c with hazardous and radioactive materials. Security at the NTS consists of security using four-wheel drives, patrolling the site. The perimeter of the site is not fen guards and electronic security measures are in place for secure areas. Approximate of the site is unused or is used as a buffer zone for ongoing programs or projects (DOE/NV 1991a; USAF et al. 1991).

The NTS is broken into numbered test areas to simplify the distribution, use, a resources (Figure 2.1-2). Area 22, the site's main entrance, is located on the sou the site and contains the Desert Rock airstrip. Area 23, adjacent to Area 22, cont Mercury base camp, which houses administrative operation and general support activi Offices for the DOE, the U.S. Department of Defense (DoD), Defense Nuclear Agency, Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL Sandia National Laboratories (SNL), and all supporting contractors of these organiz located in this area. Other facilities in this area include the cafeteria, recreat and housing. Area 5 (Frenchman Flat) was used in the past for nuclear testing. Ar

Figure 2.1-1. Nevada Test Site regional map. Figure 2.1-2. Nevada Test Site map

portion of the testing occurs. This facility provides control over and execution o detonations at the NTS. Also in Area 6 there is a new work camp which is used for and craft support. Other areas located on the NTS are the valley of the Yucca Flat and 9), the Rainier Mesa (Area 12), which is the center of DoD/Defense Nuclear Agen activities, and the Pahute Mesa (Areas 19 and 20) (DOE/NV 1991a; ERDA 1977; USAF et al. 1991). Area 5 will be housing the proposed spent nuclear fuel (SNF) fa Figure 2.1-2 shows the approximate location of the proposed SNF facility. The actu will be determined for site-specific environmental documentation.

2.1.2 Site History

Prior to 1951, the land which is now occupied by the NTS was used for mining an Primarily, mining was for low grades of copper, lead, silver, gold, mercury, and tu Although there were short periods of mining success at the site, the area was aband time. Grazing ended in 1955 when the Federal government acquired the water and gra of two ranches which were operating on what is now the NTS (ERDA 1977).

Since January 1951, the land now occupied by the NTS has been the primary locat nuclear weapons testing in the United States. Land was withdrawn from the NAFB Bom and Gunnery Range in 1952 to form the NTS. Subsequent withdrawals occurred in 1958 and 1962. A Memorandum of Understanding between NAFB and the NTS in 1967 allowed t

use of Pahute Mesa by the NTS (DOE/NV 1991a; USAF et al. 1991).

Most of the tests performed at the NTS in the 1950s were atmospheric tests. Af nuclear tests were carried out intermittently until a voluntary moratorium ended te October 1958. The first full-scale nuclear detonation occurred in 1957 in a sealed Testing resumed in September 1961 following the ending of the moratorium. Atmosphe testing ended in the summer of 1963 following the signing of the Limited Test Ban T 1962, all testing has occurred underground. Two methods have been used for undergr testing since 1963: vertical shafts (from the valley of Yucca Flat to the top of P horizontal tunnels (Rainer Mesa) (DOE/NV 1991a; ERDA 1977; USAF et al. 1991).

In addition to underground testing, between 1962 and 1968, earth-cratering test conducted as part of the Plowshare Program. This program explored peaceful means o nuclear explosives. Other tests which have occurred on the NTS have included the B Experiment (1960s) and the open air nuclear reactor, nuclear engine, and nuclear fu (1959-1973). Much of the nuclear testing has been conducted on the NTS by the LANL SNL and, through the Defense Nuclear Agency, the DoD. Non-nuclear testing has incl hazardous material spills. Other activities which occur on the NTS are the storage of low-level radioactive wastes and mixed wastes (DOE/NV 1991a; ERDA 1977; USAF et al. 1991).

As part of DOE's program to establish a national repository for high-level radi Lawrence Livermore National Laboratory conducted an evaluation of the effects of ra heat from radioactive decay on granite rock formations. The project, known as Spen Climax, stored 11 spent fuel elements from the Florida Power & Light Company and 6 heat simulators in specially designed and constructed holes in the Climax tunnel, l northeastern corner of the NTS in Area 15. The SNF, in hermetically sealed caniste emplaced in the granite formation, stored for approximately 3 years, retrieved, and transferred, in 1986, to INEL for further testing (DOE/NV 1983, 1986a).

2.1.3 Nevada Operations Office Mission

The missions of the NTS and/or the DOE Nevada Operations Office include:

- Maintaining the capability to conduct underground nuclear weapons tests.
- Conducting all programs related to nuclear emergencies and threats.
- Supporting arms control, treaty verification, and non/counter proliferation weapons technology.
- Supporting research activities as part of being designated a National Envir Research Park.
- Conducting tests for the Liquefied Gaseous Fuels Spill Testing Program.
- Supporting studies in alternate energy sources and environmental management research and development, and testing.
- Ensuring that all operations are conducted in compliance with all environme safety, and health laws, regulations, standards, agreements, and DOE Orders (DOE/NV 1993b, 1992a, 1991a; ERDA 1977).

2.1.4 Nevada Test Site Management

The DOE Nevada Operations Office is currently administering NTS operations. Th has multiple contractor support. The major support contractors are Reynolds Electr Engineering Co., Inc., the prime contractor; EG&G Energy Measurements, Inc., the el and instrumentation support contractor; Raytheon Services Nevada, the architect-eng support contractor; and Wackenhut Services, Inc., the site security contractor.

2.1.5 Yucca Mountain Project

The DOE Office of Civilian Waste Management is conducting a program for siting nation's first geologic repository for spent nuclear fuel and other high-level radi The Yucca Mountain Site has been designated by the U.S. Congress as a candidate sit Although Yucca Mountain is located outside the western boundary of the NTS, a conti portion of the NTS has been assigned as part of the potential repository site. Acc is accomplished through the NTS and Yucca Mountain Project field offices and suppor are located in Area 25 (DOE/NV 1993b). Currently, Yucca Mountain is being characte study its suitability as a geological repository. The characterization study inclu

borings and analyses of meteorological, geological, hydrological, geochemical, eros and socioeconomics conditions. Upon completion of the characterization study, the may recommend Yucca Mountain to the U.S. President as viable site for a repository (DOE 1988b).

2.2 Regulatory Framework

The National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321-4347, as a provides Federal agency decision makers with a process to systematically consider t environmental consequences of agency decisions. The DOE has prepared this environm impact statement (EIS) in conformance with the requirements of this Act to evaluate potential impacts of programmatic decisions on the management of SNF. This EIS wil the necessary background, data, and analyses to help decision makers understand the environmental consequences of each alternative.

On October 22, 1990, the DOE published a Notice of Intent in the Federal Regist (FR 1990a) announcing its intent to prepare a programmatic EIS addressing environme restoration and waste management (including SNF management) activities across the e Complex. On October 5, 1992, the DOE published a Notice of Intent in the Federal R (FR 1992) announcing its intent to prepare an EIS addressing environmental restorat waste management and SNF activities at the Idaho National Engineering Laboratory. further programmatic discussion of this topic, see Volume 1.

Significant Federal and state environmental and nuclear materials management la applicable to the NTS. The Federal laws are listed in Volume 1, Section 7.3. The Nevada laws are listed alphabetically below:

- Air Pollution Control Law (Title 40 Chapter 445)
- Air Quality Regulations (Title 40 Chapter 445)
- Disposal of Hazardous Waste (Title 40 Chapter 444)
- Disposal of Radioactive Material (Title 40 Chapter 459)
- Facilities for the Management of Hazardous Waste (Title 40 Chapter 444)
- Regulation of Highly Hazardous Substances (Title 40 Chapter 459)
- Solid Waste Disposal Act (Title 40 Chapter 444)
- Storage Tanks (Title 40 Chapter 459)
- Underground Injection Control (Title 40 Chapter 445)
- Water Pollution Control Law (Title 40 Chapter 445)
- Water Pollution Regulations (Title 40 Chapter 445)

2.3 Spent Nuclear Fuel Management Program

Currently, spent nuclear fuel is not generated, received, reprocessed, or store therefore, a SNF management program does not currently exist for activities at the (DOE 1993). There are no current or foreseeable environmental, safety, or health v at the NTS associated with SNF (DOE 1993). Selection of the No-Action Alternative adversely affect the operations or any planned facility modifications at the NTS.

3. SPENT NUCLEAR FUEL ALTERNATIVES

3.1 Description of Management Alternatives

This chapter describes the spent nuclear fuel (SNF) management alternatives eva the U.S. Department of Energy (DOE) for Appendix F that are applicable to the Nevad Site (NTS). DOE did not consider the Nevada Test Site to be a preferred site for t management of spent nuclear fuel in the Draft EIS because of the State's current ro site for the Yucca Mountain Site Characterization Project. DOE's identification of alternatives also indicates that DOE does not consider the Nevada Test Site as a pr for spent nuclear fuel management in the Final EIS. For the purposes of conducting NEPA analysis, the NTS provides a contrast to other potential sites because it repr that has no existing SNF management infrastructure. The NTS does not currently gen store any SNF. Hence, of the five alternatives discussed in this Programmatic Envi Impact Statement (EIS), only two, Regionalization and Centralization, are applicabl The other three alternatives -- No Action, Decentralization, and the 1992/1993 Plan

are not applicable to the NTS since they affect or involve only sites which current store SNF.

3.1.1 Alternative 1 - No Action

The No Action Alternative is restricted to the minimum actions necessary for th safe and secure management of SNF. As defined, this alternative stipulates no SNF or from DOE facilities. The NTS does not currently generate or store any SNF and w receive any SNF under this alternative. Therefore, this alternative is not applica and is not analyzed or discussed further in this or subsequent chapters for the NTS

3.1.2 Alternative 2 - Decentralization

Decentralization involves storage of SNF at or close to generation sites, with shipments to the Idaho National Engineering Laboratory (INEL) and Savannah River Si as necessary to permit continued operation. Since the NTS does not generate or sto and would not receive any SNF under this alternative, it is not applicable to the N analyzed or discussed further in this or subsequent chapters for the NTS.

3.1.3 Alternative 3 - 1992/1993 Planning Basis

The 1992/1993 Planning Basis Alternative is DOE's documented 1992/1993 plan for management of DOE and Naval SNF. Since the NTS does not generate or store any SNF would not receive any SNF under this alternative, it is not applicable to the NTS a analyzed or discussed further in this or subsequent chapters for the NTS.

3.1.4 Alternative 4 - Regionalization

3.1.4.1 Overview. The Regionalization Alternative consists of two subalternatives.

Subalternative A would distribute existing and new SNF between the Hanford Site, IN SRS by SNF type. Under Subalternative B, SNF would be distributed to either an eas western regional site based on geographical location. SNF east of the Mississippi shipped to the eastern region site (i.e., SRS or Oak Ridge Reservation (ORR)). SNF Mississippi River would be shipped to the western regional site (i.e., Hanford, INE Additionally, all Naval SNF would be shipped to only one of the sites, but not both would be the alternative to the SRS as the eastern regional site, and the NTS would alternative to both the Hanford Site and INEL as the western regional site.

3.1.4.2 Regionalization Subalternative B. The following fuels would be transported to

the NTS for storage under the Regionalization Subalternative B:

- Naval-type SNF (if selected)
  - All, including from the INEL, shipyards, and prototypes
- Hanford Production SNF
  - From western sites including the Hanford Site
- Graphite SNF
  - From western sites including the INEL and Public Service of Colorado
- DOE-Owned Commercial SNF
  - From western sites including the Hanford and INEL
- Experimental - Stainless steel SNF
  - From western sites including the Hanford, INEL, Foreign Research Reacto non-DOE domestic research reactors
- Experimental - Zirconium SNF
  - From western sites including the INEL
- Experimental - Other
  - From western sites.
- SRS Production and Aluminum SNF
  - From western sites including INEL, Los Alamos National Laboratory (LANL

Foreign Research Reactors, and non-DOE domestic research reactors

All SNF presently in storage at DOE facilities would arrive at the NTS stabiliz canned to the extent necessary for safe transportation. However, this SNF might ne uncanned, stabilized, prepared, and recanned at the NTS to ensure safe interim stor non-DOE domestic, Foreign Research Reactors, and Naval SNF would be shipped in the necessary for safe transportation but not necessarily canned. This fuel would be s prepared, and canned at the NTS to ensure safe interim storage. All fuel would be minimum of 120 days prior to shipping and 5 years before being placed in dry storag Additionally, if the NTS is selected for the Expended Core Facility, Naval SNF woul examined at the NTS before being turned over for interim storage management.

The NTS currently has no facilities that are suitable for receiving, canning, s supporting the research activities necessary for the safe management of SNF. As a SNF management complex would be built at the NTS under the Regionalization Subalternative B. The SNF management complex would include the following:

- SNF receiving and canning facility
- Technology development facility
- Interim dry storage area
- Expended Core Facility similar to the one at the INEL (if selected for Nava Receipt).

The SNF receiving and canning facility would receive SNF cask shipments from of prepare the SNF for dry storage. A pool storage area would be included in this fac cooling SNF before it is placed into dry storage, as necessary. The technology dev facility would investigate the applicability of dry storage technologies and pilot development for disposal of the various types of SNF. The interim dry storage area consist of passive storage modules designed to safely store the SNF for 40 years. selected for Naval fuel receipt, Naval SNF would be examined at the Expended Core F prior to being turned over for interim storage management.

The SNF management complex which would be built at the NTS under the Regionaliz Alternative would have the same components as that built under the Centralization A However, the dry storage component would be somewhat smaller due to the smaller SNF inventory that would be transported to the NTS under the Regionalization Alternativ other components of the SNF management complex would be the same general size as th built under the Centralization Alternative. This is because the inventories of new which would be sent to the NTS under the Regionalization and Centralization Alterna be very similar. Additionally, since the major portion of the potential radiologic releases and waste generation rates are associated with these components, the Regio Alternative will not be analyzed separately. This alternative will be compared to Centralization Alternative in a semiquantitative manner.

If the NTS is not chosen as the western regional site, the Regionalization Alte not be applicable to the NTS.

3.1.5 Alternative 5 - Centralization

3.1.5.1 Overview. Under Centralization, all existing and new SNF would be shipped to

one site. There are five Centralization options considered in this PEIS; Option A Option B - INEL, Option C - SRS, Option D - ORR, Option E - NTS. If the NTS was ch the centralization site, all SNF currently stored at the HS, INEL, SRS, ORR, and ot currently storing DOE fuel would be transferred to the NTS.

3.1.5.2 Centralization Alternative Option E. The following fuels would be transported to

the NTS for storage under the Centralization Alternative Option E:

- Naval-type SNF
  - From the INEL and shipyards
- Hanford Production SNF
  - From the Hanford Site
- Graphite SNF
  - From the INEL and Public Service of Colorado
- DOE-Owned Commercial SNF
  - From Hanford, INEL, West Valley Demonstration Project, and B&W Lynchbur
- Experimental - Stainless Steel SNF

  - From Hanford, INEL, SRS, FRR, and non-DOE domestic research reactors
- Experimental - Zirconium SNF
  - From the INEL and SRS
- Experimental - Other
  - From the Oak Ridge National Laboratory (ORNL)
- SRS Production and Aluminum SNF
  - From the INEL, SRS, ORNL, LANL, Brookhaven National Laboratory, Foreign Research Reactors, and non-DOE domestic research reactors.

All SNF presently in storage at DOE facilities would arrive at the NTS stabiliz canned to the extent necessary for safe transportation. However, this SNF may need uncanned, stabilized, prepared, and recanned at the NTS to ensure safe interim stor non-DOE domestic research reactor, Foreign Research Reactor, and Naval SNF would be shipped in a state necessary for safe transportation but not necessarily canned. T be stabilized, prepared, and canned at the NTS to ensure safe interim storage. All cooled for a minimum of 120 days prior to shipping and 5 years before being placed storage. Additionally, Naval SNF would be examined at the NTS before being turned interim storage management.

The NTS currently has no facilities that are suitable for receiving, canning, s supporting the research activities necessary for the safe management of SNF. As a SNF management complex would be built at the NTS under the Centralization Alternati Option E. The SNF management complex would include the following:

- SNF receiving and canning facility
- Technology development facility
- Interim dry storage area
- Expended Core Facility similar to the one at the INEL.

The SNF receiving and canning facility would receive SNF cask shipments from of prepare the SNF for dry storage. A pool storage area would be included in this fac cooling SNF before it is placed into dry storage, as necessary. The technology dev facility would investigate the applicability of dry storage technologies and pilot development for disposal of the various types of SNF. The interim dry storage area consist of passive storage modules designed to safely store the SNF for 40 years. would be examined at a new Expended Core Facility constructed at the NTS prior to b turned over for interim storage management.

The SNF management complex which would be built at the NTS under the Centraliza Alternative would have the same components as those built under the Regionalization Alternative. However, the dry storage component would be somewhat larger under the Centralization Alternative due to the somewhat greater SNF inventory that would be to the NTS under this alternative. The other components of the SNF management comp would be the same general size as those built under the Regionalization Alternative because the inventories of new uncanned fuel which would be sent to the NTS under t Regionalization and Centralization Alternatives would be very similar. Additionall portion of the potential radiological and chemical releases and waste generation ra associated with these components, and would not be significantly different for the alternatives. Therefore, this alternative will be used as the basis for a semiquan comparison with the Regionalization Alternative.

If the NTS is not chosen as the centralization site, the Centralization Alterna be applicable to the NTS.

3.2 Comparison of Alternatives

Table 3.2-1 shows a comparison of the alternatives. The Regionalization Altern column does not include the requirements of the Naval Expended Core Facility, altho facility may be constructed at the site under this alternative. The Centralization column does include the requirements of the Naval Expended Core Facility, which are in Volume 1, Appendix D, since this facility will be built at the site under this a

Table 3.2-1. Comparison of alternatives for the NTS.

Parameter
Land for new facilities (acres)
Site area (acres)
Percent of site area
SNF-related employmentb

Baseline site employment
Percent of baseline site employment
Estimated cancer fatalities in 80-km population per year, SNF management operationsc
Estimated cancer fatalities in 80-km population per year, other site operations
Estimated probability of cancer fatalities in a maximally exposed individual per year, SNF management operationsc
Estimated probability of cancer fatalities in a maximally exposed individual per year, other site operations
Estimated probability of cancer fatality in average worker per year, SNF management operationsc
Estimated maximum probability of cancer fatality in average worker per year, other site operations
Water use (million gallons) per year, SNF management
Baseline water use (million gallons) per year, site operations
Percent of baseline site water use
Electricity use (megawatt-hours) per year, SNF management
Baseline electricity use (megawatt-hours) per year, site operations
Percent of baseline site electricity use
Sewage discharge (million gallons) per year, SNF management
Baseline sewage discharge (million gallons) per year, site operations
Parameter

Percent of baseline site sewage discharge
High-level waste (cubic meters) per year, SNF management
Transuranic waste (cubic meters), SNF management
Mixed waste (cubic meters), SNF management
Low-level waste (cubic meters), SNF management
Estimated maximum cancer fatalities in 80-km population from maximum risk accident
Frequency of occurrence (number per year)d
Estimated maximum risk of cancer fatalities in 80-km population from maximum risk accident (cancer fatalities per year)d
Estimated maximum worker cancer fatalities from maximum risk accidentd
Frequency of occurrence (number per year)d
Estimated maximum risk of worker cancer fatalities from maximum risk accident (cancer fatalities per year)d

a. Centralization Option includes the Naval Expended Core Facility results from Vo
b. Annual Average SNF direct construction and operation jobs over the 10-year peri
c. Excludes baseline site operations.
d. Centralization Option is the same as the Regionalization Option for the SNF Man include the Naval Expended Core Facility accident analyses results from Volume 1, A

4. AFFECTED ENVIRONMENT

4.1 Overview

This chapter describes the existing environmental conditions in areas potential a programmatic decision to site spent nuclear fuel (SNF) facilities at the Nevada T under the Centralization and Regionalization Alternatives. Topics were selected fo based upon their potential to be affected by the alternatives. Each topic is addre detail necessary to serve as a baseline for assessment of potential environmental c Chapter 5.

4.2 Land Use

The NTS occupies an area of approximately 1,350 square miles (3,500 square kilo southern Nevada, in a sparsely populated desert area approximately 65 miles (104 ki

northwest of Las Vegas. The NTS is almost entirely surrounded by other federally o which buffer it from lands open to the public. The NTS is bordered by the Nellis A (NAFB) Bombing and Gunnery Range on the north, east, and west, and by Bureau of Lan Management (BLM) lands on the south and southwest (DOE/NV 1993a,b).

Existing land use on the NTS falls into four general categories: Testing Areas Buffer/Reserved Areas; Industrial/Research Areas; and Waste Management Areas. Acco the latest NTS land use map (Figure 4.2-1), approximately 50 percent of the land on buffer/reserved area for ongoing programs or projects (DOE/NV 1993a).

Land bordering the site to the north, east, and west is located on the NAFB Bom Gunnery Range and is primarily vacant, unused, or used for a buffer zone. Land bor site to the south and southwest is owned by the BLM and is used for recreation, gra management, or wildlife management (DOE/NV 1993a,b).

The NTS is located in an area of sparsely vegetated desert. Beyond the federal lands which surround the NTS, principal land uses in Nye County in the vicinity of Figure 4.2-1. Land use at the Nevada Test Site. include mining, grazing, agricult land uses occur beyond the immediate vicinity of the NTS, in fertile valley regions Owens and San Joaquin to the west of the site, the Virgin River to the east of the Pahrump to the south of the site, the Moapa River to the southeast of the site, and Alamo to the northeast of the site (DOE/NV 1993b).

Clark County, to the southeast of the NTS, consists of approximately 7900 squar (20,220 square kilometers) of which about 95 percent is owned by the federal govern (ULI 1992). Primary land uses on these federal lands include grazing, mining, and The remaining 5 percent of the county supports residential, state and local governm industrial, and retail land uses (Clark County Regional Transportation Commission 1

Currently, Nye County does not have a zoning ordinance; therefore, no zoning cl exists for NTS lands. The NTS is required to comply with State of Nevada regulatio pollution, safety, and transportation, and with Nye County traffic regulations and (DOE/NV 1993b). Of the total area within Nye County, only a small number of isolat are under private ownership and therefore subject to general plan guidelines (NEEDA

Numerous national, state, and local public recreation areas exist within the NT (Figure 2.1-1). Outdoor recreational areas include the Death Valley National Monum 12 miles (19 kilometers) to the west/southwest, and the Desert National Wildlife Ra approximately 25 miles (40 kilometers) east. (Portions of the Desert National Wild located within NAFB Bombing and Gunnery Range and are as close as 2 miles (3 kilome the NTS). State parks near the site include; the Red Rock Canyon Recreation Lands, approximately 40 miles (64 kilometers) to the southeast; Spring Mountain Ranch Stat approximately 50 miles (80 kilometers) southeast; and the Floyd R. Lamb State Park, approximately 45 miles (72 kilometers) southeast (BLM 1990).

Other recreational areas include numerous campsites, picnic areas, and sports g of the site in the Toiyabe National Forest, approximately 25 miles (40 kilometers) numerous camping and fishing sites north of the site which are used during the spri and fall months (DOE/NV 1993a,b,c).

The NTS is a controlled area with public access limited to through traffic on U and on Lathrop Wells Road (DOE/NV 1993b).

The proposed SNF site is in the northeast portion of Area 5, located in the sou part of the NTS. This area is currently designated as the Low-Level Waste Facility Area and Buffer/Reserved Area land use categories. This area was also designated a Nuclear Test Area in the latest NTS Future Land Use Plan (DOE/NV 1993a).

To the east of Area 5, the NTS is bordered by the NAFB Bombing and Gunnery Rang which provides a buffer zone of approximately 50 miles (80 kilometers) between the lands open to the public. Beyond the NAFB Bombing and Gunnery range land, land use east of the NTS are primarily mining, grazing, and agriculture (BLM 1990; DOE/NV 19

There are no onsite areas that are subject to Native American Treaty rights or prime or unique farmland.

4.3 Socioeconomics

4.3.1 Region of Influence

The socioeconomic information presented in this Programmatic Environmental Impa Statement (PEIS) discusses the baseline conditions in a Region of Influence compris

and Clark Counties, Nevada. This is the region potentially affected by the princip indirect socioeconomic effects of actions on the NTS. This Region of Influence inc current residential distribution of the U.S. Department of Energy (DOE) and contrac personnel employed by the NTS, the probable location of offsite contractor operatio probable location of labor and capital supporting indirect economic activity linked

The residential distribution of most of the DOE and contractor personnel employ NTS reflects existing commuting patterns and attractiveness of area communities. A NTS worker residential distributions in 1988 revealed that 86 percent lived in Clar 10 percent in Nye County (DOE 1988a). In Clark County, most NTS employees reside i Las Vegas vicinity.

The two-county Region of Influence includes several communities located within time of approximately 1 hour from the NTS, including Boulder City and the Las Vegas (includes the "incorporated places" of Henderson, Las Vegas, and North Las Vegas; a "census-designated places" of East Las Vegas, Enterprise, NAFB Bombing and Gunnery Paradise, Spring Valley, Sunrise Manor and Winchester) in Clark County, and Pahrump Beatty in Nye County (DOE/NV 1993a,b).

4.3.2 Regional Economic Activity and Population

Regional economic linkage supporting production activity at the NTS occurs prim Clark County, where most of the offsite supporting contractors and the labor and ca supporting indirect economic activity linked to the NTS are located.

4.3.2.1 Clark County (Las Vegas Metropolitan Statistical Area(1)). Clark County is

composed of five incorporated cities (Las Vegas, Henderson, North Las Vegas, Boulde Mesquite) and large expanses of unincorporated land, some of which are experiencing growth. The area experiencing the majority of the county's development is the Las (ULI 1992). In addition, 95 percent of the total area within the county is owned b government and includes several state parks, vast stretches of desert, and military

Economic conditions in southern Nevada since the mid-1980s have grown continuou Economic growth has accelerated relative to national trends due to an expansion in gaming markets, relocation of retirees to southern Nevada, expansion of local infra additional unplanned investment to house new families in the region. The overall l growth pattern is forecasted to gradually change the current robust expansion to mo

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1. At the time of the 1990 census, CLark County and the Las Vegas Metropolitan Statistical Area were synonymous. The Census Bureau redifined the Las Vegas Metropolitan Statistical Area to include Mohave County, Arizona. However, the numbers provided here reflect the 1990 census definition.

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growth conditions, as seen in the United States (The Center for Business and Economic Research 1992).

The economy in the Las Vegas Metropolitan Statistical Area is driven by growth hotel and gaming industry. Because of its orientation toward tourism and conventio economy is highly service oriented. Service employment in the Las Vegas area is su higher than the relative national share, accounting for nearly 45 percent of total with hotels and gaming accounting for approximately 30 percent of the service facto employment accounts for 21 percent, and government and construction each account fo additional 10 percent (ULI 1992). Construction employment has increased over 130 p since 1980, with 32,000 jobs in that sector in 1993 particularly due to the buildin of a number of casinos in Clark County (DOE/NV 1993a). The industrial market has a induced growth in the construction sector, causing a 50 percent increase in new con activity between 1990 and 1992. Growth in the industrial market is expected to con demand outpacing new construction (ULI 1992). Manufacturing employment is increasi steadily (7 percent from 1992 to 1993); however, this sector comprises only a 2.8 p total employment (DOE/NV 1993a), still well below the national average.

Between 1980 and 1990, Clark County added an average of 15,000 jobs per year. end 1991 another 19,000 jobs had been added to the employment base for 1990, for a 388,000 jobs (ULI 1992). In September 1992, employment in the Las Vegas area reach 399,900. Despite the national recession during 1990-1992, the number of existing j Vegas area increased rapidly, averaging an 8.1 percent gain during that period (DOE

The number of existing jobs in the Las Vegas area is projected to continue incr

the next several years. The State of Nevada Employment Security Research Departmen estimated there would be a total of 125,190 new jobs in the Las Vegas area between 1996, an increase of approximately 6 percent annually (DOE/NV 1993a).

The unemployment rate reached a low of 4.9 percent in 1990 and increased to 7.5 as of June 1993 (DOE/NV 1993a). The increase in unemployment reflected the fact th in-migration of labor exceeded the growth in employment opportunities. However, th unemployment level is expected to decrease with new hotel, gaming, and amusement pr opening at the end of 1993 (DOE/NV 1993a).

Most of the population in the Las Vegas Metropolitan Statistical Area is center Las Vegas Valley, with six population groupings in the area: the Las Vegas Valley, Indian Springs, Laughlin, Mesquite, and the Moapa Valley (DOE/NV 1993b). In 1990, population of the metropolitan statistical area totaled 735,000, growing at a rate annually from 1980 (ULI 1992). This rate of growth, however, is lower than that ne the 1980s. The population of the metropolitan statistical area was estimated at ov of August 1993, an increase of nearly 8 percent annually since 1990 (DOE/NV 1993b).

4.3.2.2 Nye County. The employment level in Nye County (11,310 jobs) is low relative

to Clark County, and includes opportunities in the services, mining, and government (DOE/NV 1993b).

Nye County is sparsely populated, with the two largest population groupings bei unincorporated communities of Pahrump and Tonopah. The populations of Pahrump and Tonopah in 1990 were 7,424 and 3,616 (62 percent and 20 percent of the county total respectively (DOE/NV 1993b).

Tourist (and business traveller) activity is an important part of the Nye Count communities along U.S. Route 95; however, in each community, mining is the major, e dominant, economic force.

In the 1970s and 1980s, nuclear weapons testing at the NTS dominated the Nye Co economy when described in terms of employment by place of work. Most of the NTS wo commutes to Mercury or forward areas from the Las Vegas Valley, and most food and o services are provided at federally subsidized facilities onsite. However, some Nye businesses do provide NTS support services. In the context of the Yucca Mountain r oversight program, Nye County and DOE have engaged in efforts that could lead to gr employment and procurement opportunities for Nye County residents and businesses (NEEDA 1993).

4.3.2.3 Nevada Test Site. The NTS work force supports engineering design,

construction, and operation of the site and includes people employed by DOE and peo employed by DOE contractors. The total NTS work force in 1993 included nearly 4,00 located at the NTS and an additional 5,000 jobs in the Nevada Operations Office (DOE/NV 1993a). As of January 1994, the work force totaled 8,563 (3,286 on NTS, 3, Las Vegas, and 1,472 in the rest of Nevada or other areas). There is currently no employment at NTS (DOE/NV 1994a).

4.3.2.4 Aggregate Regional Economic and Demographic Baseline. For the purposes of

establishing a regional baseline to assess potential impacts for the programmatic a Section 5.3, regional economic and demographic data for Clark and Nye counties were aggregated to form one region (Table 4.3-1).

The total population of this Region of Influence is projected to be 998,093 per and to grow at an annual average rate of 2.7 percent, reaching 1,281,666 persons in labor force of the Region of Influence is projected to grow at an annual average ra percent, reaching 792,309 persons in 2004. The total employment in the Region of I projected to grow at an annual average rate of approximately 3.1 percent from 552,4 1995 to 734,589 jobs in 2004.

4.3.3 Public Service, Education and Training, and Housing Infrastructure

4.3.3.1 Police and Fire. The NTS's fire protection capacity is structured to accommodate

current mission requirements, with a self-contained firefighting department respons suppression and prevention. Other services include rescue, hazardous material resp of fire personnel, fire prevention inspections, installation of all fire extinguish fire prevention awareness programs. In addition, the DOE has signed an agreement w Nye County Fire Department will assist the Clark County Fire Department in case of emergency at the NTS (DOE/NV 1993a).

The Las Vegas Fire Department is spending $9.7 million to build three new fire the northwest area of the city to support growing public service demand in this are

Table 4.3-1. Aggregate regional economic and demographic indicators for the NTS.

Years	Regional employment	Regional labor force	Regional population
1995	552,439	595,851	998,093
1996	573,279	618,329	1,033,234
1997	594,916	691,666	1,069,422
1998	617,450	665,968	1,107,037
1999	640,822	691,175	1,145,711
2000	665,060	717,317	1,185,766
2001	681,956	735,538	1,209,316
2002	699,258	754,197	1,233,372
2003	716,971	773,299	1,257,672
2004	734,589	792,309	1,281,666
2005	752,356	811,483	1,305,461
Average Annual Growth Rate	3.1%	3.1%	2.7%

a. Sources: Nye County Board of Commissioners (1993); The Center for Business and Economic Research (1992).

Note: Aggregate region includes Clark and Nye Counties. Labor force projection developed for this study.

County Fire Department plans to add two new fire departments within the next 5 year a mutual agreement between the Clark County Fire Department and all surrounding are departments to assist in any fire emergency when necessary (DOE/NV 1993a).

Law enforcement at the NTS is provided by the Nye County Sheriff. Security enf established to accommodate the requirements of NTS's mission, is the responsibility contractor. Regional law enforcement services are provided principally by the Las Metropolitan Police Department. Las Vegas ranks fourth nationally in metropolitan areas in police per capita, with 1 per 277 population (DOE/NV 1993a).

4.3.3.2 Health Care. The NTS has a self-contained medical center that provides limited

emergency treatment. Health care in the Las Vegas metropolitan area is provided th full-service hospitals, with 3.44 hospital beds per 1,000 population. A major prop facility is scheduled to open in 1994 to accommodate demand (DOE/NV 1993a).

4.3.3.3 Education and Training. The Clark County School District provides education

services for the families of the majority of the employees who work at the NTS. En the Clark County School District was approximately 122,000 student in 1992 and was be 136,000 students in 1993. An average student/teacher ratio of 22.32 is reported elementary school grades K-6; the student/teacher ratio is not reported for other g (DOE/NV 1993a).

Higher education and training resources provided by the NTS include the support by the DOE Contractor Education and Training Departments, with technical training i such as Radiation Protection Training, Radiological Response Training, Environmenta Health Training (which includes Hazardous Waste, Site Operation, and Emergency Resp support NTS's mission. In addition, there are a number of vocational, training, an education institutions in the Las Vegas metropolitan area (DOE/NV 1993a).

Since 1990, southern Nevada has experienced tremendous growth in school enrollm accommodate the influx of students, the school district was able to negotiate the l in Nevada history along with regular allocations from the Nevada legislature (DOE/N

4.3.3.4 Housing. Between 1980 and 1990, the number of housing units in Clark County

increased by 84 percent, from approximately 174,000 to approximately 320,500. The market continues to flourish, as the demand for new housing has consistently exceed (ULI 1992). The increase in demand is attributable to the influx of retirees and o population.

Residential building permits, which peaked in 1988 at 26,400 units, declined to in 1991. Between 1991 and 1995, the number of permits issued is expected to averag units per year (ULI 1992). Demand is projected to outpace supply over the next 5 y the strong projections for population and employment (ULI 1992).

4.4 Cultural Resources

4.4.1 Archaeological Sites and Historic Structures

For approximately 12,000 years, people have inhabited the lands now comprising site. The availability of surface water was the primary determinant governing the human occupation on these lands. On what is now the NTS, access to surface water w springs located in canyons and at the bases of mountains and mesas. Therefore, the little evidence of human occupation in valleys or playas where surface water source unavailable, including the Frenchman Flat area where the proposed SNF site would be (DOE/NV 1993b).

Three cultural resource surveys were conducted in the vicinity of the proposed archaeological sites were recorded but neither was considered potentially eligible the National Register of Historic Places (DRI 1991, 1989, 1987). As a result, no p historic resources are expected to be located on the proposed SNF site.

4.4.2 Native American Resources

The Southern Paiute and Shoshone Native American tribes are known to have inhab southern Nevada including parts of what is now the NTS. These tribes are known to with sites located in the northern portions of NTS including the Pahute and Rainier However, no known Native American resources are located within the proposed SNF sit (DRI 1986a).

4.4.3 Paleontological Resources

The NTS is characterized by alluvium-filled, topographically closed valleys sur ranges composed of Paleozoic sedimentary rocks and Tertiary volcanic tuffs and lava igneous rocks do not contain fossils, the deposits might contain late Pleistocene t vertebrate fossils (Sandia National Laboratories 1982).

4.5 Aesthetics and Scenic Resources

Visual or scenic resources comprise the natural and manmade features that give environment its aesthetic qualities. These features form the overall impression th receives of an area or its landscape character.

Scenic resources at the NTS are set in a landscape which is a transition area b Mojave Desert and the Great Basin, with vegetation ranging from grasses and creosot the lower elevations to juniper, pinyon pine and sagebrush in elevations above 5,00 (1,524 meters) (DOE/NV 1993b). The topography of the NTS consists of a series of m ranges arranged in a north-south orientation separated by broad valleys (DOE/NV 199 topography is also characterized by the presence of numerous craters produced by pa testing at the NTS. Of the three principal valleys located within the NTS, Frenchm surrounds the proposed location of the SNF site (BLM 1990). Access to the NTS is Route 95, which runs in an east-west direction along the south side of the NTS at M (BLM 1990). The Mercury Highway, which runs north from the Mercury Base Camp, is a restricted access road that is not available for public access (Figure 2.1-2).

The proposed SNF site at the NTS is set along the east side of the Mercury High Area 5, within the Frenchman Flat. The proposed SNF site is located in the vicinit existing Radioactive Waste Management Site. The land cover in this area is typical vegetation.

The viewshed surrounding the NTS consists of unpopulated to sparsely populated and rural lands. Since the NTS is surrounded to the east, north and west by the NA and Gunnery Range and to the south by lands controlled by the BLM, the only public the interior of the NTS are from U.S. Route 95. Since the southern boundary of the ringed by various mountain ranges, including the Spector Range, Striped Hills, Red and the Spotted Range, views to the interior of the site are generally limited to t Valley and the Mercury Base Camp (BLM 1990).

Low sensitivity exists when the public can be expected to have little or no con changes in the landscape. Little value may be ascribed to the views, or they may b others in the area. In general, due to the mixture of industrial uses, open desert access, the NTS could be classified as having low visual sensitivity.

4.6 Geologic Resources

This section provides a description of the general geology, geologic resources, and volcanic hazards at the NTS and surrounding area. This section also describes impacts to the geology and geologic resources that have resulted from past and pres conducted at the NTS.

4.6.1 General Geology

As shown on Figure 4.6-1, the NTS is located east and north of the Walker Lane-Valley Shear Zone (Eckel 1968). Walker Lane is a northwest-trending belt of right-that disrupts the regional structural grain in the southwestern part of the Great B California-Nevada border. The Las Vegas Valley shear zone is a concealed zone of r faulting along the north side of the Las Vegas Valley (DOE 1988b). Whether the Wal Las Vegas Valley Shear Zone comprises a continuous single fault or two faults is de Most geologists consider it to be a single fault system, which in the NTS area is b

Figure 4.6-1. Location of Nevada Test Site in relation to regional fault zones. t

Section of the Basin and Range Physiographic Province. The local geology of the NT characterized by mountain ranges composed of Precambrian and Paleozoic sedimentary and Tertiary volcanic tuffs and lavas that surround alluvium-filled, topographicall A generalized stratigraphic column of the area is shown on Figure 4.6-2 (Sandia Nat Laboratory 1982). Figure 4.6-2 also shows the six aquifers and four aquitards of t (see Section 4.8). A schematic cross section illustrating NTS geology is shown on (DOE 1986). A geologic map of the NTS is shown as Figure 4.6-4 (DOE/NV 1993b).

The sedimentary rocks are complexly folded and faulted and are comprised mainly carbonates (dolomite and limestone) in the upper and lower parts of the column and (shale and sandstone) in the middle section. Above the approximately 4,000 meters of Precambrian to Cambrian clastic deposits are approximately 4,300 meters (14,000 Cambrian through Devonian carbonates, 2,400 meters (8,000 feet) of Mississippian sh sandstones, and 900 meters (3,000 feet) of Pennsylvanian to Permian limestones (San Laboratory 1982).

The volcanic rocks in the NTS area are predominantly Tertiary tuffs that are hi Although there are minor amounts of Tertiary basalts and a few scattered Mesozoic g plutons in the area (Sandia National Laboratory 1982), the Tertiary tuffs comprise 70 percent of the rocks exposed at the surface (Eckel 1968).

The valleys formed between steeply dipping faults that have become filled with comprise approximately 30 percent of the area (Eckel 1968). This generally unconso alluvium is derived from erosion of nearby hills composed of Tertiary and Paleozoic ranges in thickness from 600 to 900 meters (2,000 to 3,000 feet) (DOE/NV 1992c). S are cemented by calcium carbonate (caliche) and/or clays. The alluvial materials a sorted and finer grained toward the center of the basins. The sediments in the pla floored undrained desert basins that, at times, become shallow lakes) consist of ve lacustrine deposits up to several tens of meters (feet) thick. Near the range fron generally composed of angular rubble, with individual clasts commonly a foot or mor diameter surrounded by a matrix of silt, sand, and gravel (Sandia National Laborato

Figure 4.6-2. Stratigraphic column of the Nevada Test Site. Figure 4.6-3. Schem

mostly between 10 and 20 degrees), normal faults (faults with downward displacement of the rock that lies above the fault), and strike-slip faults (nearly vertical fau shear zones) (DOE/NV 1992c). The faults located at NTS are shown on Figure 4.6-5 (DOE/NV 1993b). Thrust faulting in the NTS area occurs as three major thrust fault total displacement along this fault system ranging from 40 to 48 kilometers (25 to Normal faults in the NTS area exist in both ranges and valleys and generally strike northwest, while a set of younger and potentially active faults strike north. The structure to the NTS is the Walker Lane-Las Vegas Valley Shear Zone (see Figure 4.6 Estimates of horizontal displacement along this shear zone range from 40 to 160 kil (25 to 100 miles) (Sandia National Laboratory 1982).

At the NTS, recent displacement has occurred along several faults as a conseque underground nuclear explosions. This displacement is not attributable to naturally seismic activity. Fault displacements are thought to have occurred as a result of produced by the explosion, the vibrations produced by the explosions, or a combinat (Eckel 1968).

Faults are designated as capable if they have exhibited movement at or near the surface at least once within the past 35,000 years or movement of a recurring natur past 500,000 years (CFR 1993a). Almost all of the natural fault movement in the NT occurred several million years ago. However, movement along Yucca Fault, a north-s striking fault known in the northeast portion of the NTS (see Figure 4.6-5), is bel occurred sometime during the last tens of thousands to 250,000 years (Leedom 1994; Sandia National Laboratory 1982). Given the broad range of time during which displ along Yucca Fault is believed to have occurred, Yucca Fault may or may not be an NR fault (Leedom 1994).

4.6.2 Geologic Resources

Gold, tungsten, and molybdenum may exist in carbonate rocks near igneous intrus regional thrust faults, or other faults at the NTS. In other areas, these deposits

Figure 4.6-5. Approximate location of proposed facility in relation to major faul

the NTS is assessed as having only a low to moderate potential for the occurrence o skarn (contact metamorphic rock rich in iron) deposits and/or polymetallic replacem and very low potential for the discovery of gold in these types of rocks. Magnetit in rocks at the NTS, but they are not extensive and have very low resource potentia 4.6-6 shows the possible location of the SNF storage facility in relation to the ty associated with geologic resources as well as to locations of mining districts (USA

Gold and silver may exist at NTS in Tertiary volcanic rocks or in sedimentary r volcanic or intrusive centers. Based on limited information, however, NTS is asses low to moderate potential for the development of precious metal deposits in these r estimated that one small to medium-sized precious metals deposit might have been de within the NTS had the area remained open to mineral development (USAF et al. 1991)

Much of the alluvial areas along the lower flanks of the ranges within the NTS and gravel reserves. These materials, however, do not have any unique value over s material occurring in other areas throughout southern Nevada (USAF et al. 1991).

Zeolitized rocks (various hydrous silicates occurring as secondary minerals in lavas) underlie most of the volcanic rocks and the alluvial basins at the NTS. Cli mordenite, either alone or in mixtures, are the most common zeolites in these depos ferrierite, chabazite, and analcime also occur. Zeolite deposits in Nevada that ha developed for exploitation are lakebed deposits that have been altered to zeolites water-saturated conditions. Zeolites are used in water softeners, detergent builde catalysts. Very little information is available on the tonnage and grade of these widespread occurrence of zeolite deposits, however, requires that the deposits at N assigned a low to moderate potential for development (USAF et al. 1991).

Barite is also known to occur at the NTS. The barite occurs in veins associate and mercury, antimony, and lead mineralization. These veins cut Devonian carbonate However, the barite veins at the NTS are small and impure, and do not represent a p barite resource (USAF et al. 1991).

Figure 4.6-6. Geologic terrains and mining districts of the Nevada Test Site. Flu

bodies within Paleozoic sedimentary rock. However, little is known about this occu therefore, the NTS is assumed to have a very low to moderate potential for the deve fluorite resources (USAF et al. 1991).

4.6.3 Seismic and Volcanic Hazards

The NTS lies on the southern margin of the Southern Nevada East-West Seismic Be belt connects the north-trending Nevada Seismic Belt, about 160 kilometers (100 mil the site with the north-trending Intermountain Seismic Belt about 240 kilometers (1 the east. The location of these seismic belts are shown on Figure 4.6-7. The pat earthquakes in the western United States is marked by relatively brief episodes of in areas that may have been relatively inactive for hundreds and perhaps thousands (DOE 1986).

The southern Nevada region is generally characterized as an area of moderate se activity (DOE/NV 1993b). The proposed SNF management site is located on the easter a region considered to have a moderate seismic-activity level. Earthquakes in sout and the California desert have registered on the NTS seismic network.

Prior to the installation of a seismic network within a 160-kilometer (100-mile site in 1978 and 1979, 12 earthquakes (including one series of earthquakes) with Ri magnitudes (M) of equal to or greater than 6.5 were reported within a 400-kilometer radius of the site (DOE/NV 1994b). One of the largest and nearest of the earthquak to NTS was the 1872 Owens Valley shock (M = 8.25), located approximately 150 kilome miles) from the site. Figure 4.6-8 shows the location of the pre-network earthquak greater than or equal to 5 that have occurred near the NTS (DOE 1988b). Recorded s activity prior to 1978 in the vicinity of the NTS also includes two earthquakes wit and M equals 4.5 near Massachusetts Mountain (located just north of the proposed SN site) and in Frenchman Flat (located in the southeast corner of the NTS, an area th the proposed SNF storage site) (DOE/NV 1994b).

Figure 4.6-7. Location of the NTS in relation to the Nevada Seismic Belt, the Int

Figure 4.6-8. Historical Seismicity of the Southern Great Basin from 1868 through

Between 1978 and 1981, no earthquakes with magnitudes greater than 4.3 were rec Since 1981, a magnitude 5.6 earthquake was recorded near Little Skull Mountain (loc the southwest corner of the NTS) in 1992 at a depth of 12 kilometers (7.5 miles). magnitude 3.5 earthquake was recorded southeast of the town of Mercury on the NTS (DOE/NV 1994b). However, there is some uncertainty in the seismic sources for many recorded by the seismic monitoring network in the area, because underground nuclear surface drilling, and explosions to support geophysical investigations may produce signals (DOE 1986).

The most probable source for seismic activity within the area where the SNF sto would be located is the Cane Spring Fault (see Figure 4.6-5). This fault is though source of the magnitude 4.3 Massachusetts Mountain earthquake discussed above. The maximum credible earthquake associated with the Cane Springs Fault is expected to b magnitude earthquake of 6.7. The recurrence interval for this magnitude earthquake at 10,000 to 30,000 years (DOE/NV 1993a).

Predictions of future seismicity and faulting, however, are complicated by a nu factors. Because the recurrence interval for large earthquakes on a Basin and Rang be thousands of years, epicenter maps of historic earthquakes or evidence of Holoce alone may not be reliable indicators of future or long-term seismicity. Another co that when long fault zones in normal fault regimes fail, they may break along segme than along the entire length. Large (M greater than 7) earthquakes in the western tend to be followed by aftershocks lasting about a century and then seismic activit low level for centuries or thousands of years. Based on this concept, recurrence e on historic or current earthquake distributions may not be directly applicable to t identifying the most likely locations of future large earthquakes (DOE 1986).

From the historical seismicity of the southern Great Basin (two earthquakes of and length of active faults, a maximum magnitude of M equals 7 to 8 is inferred for in the Yucca Mountain region. Estimates of recurrence intervals for major earthqua region (M is greater than or equal to 7) are on the order of 25,000 years; for magn greater than or equal to 6, recurrence intervals are on the order of 2,500 years; a magnitudes of greater than or equal to 5, recurrence intervals are on the order of (DOE 1986).

Ground motion acceleration resulting from earthquakes may cause damage to build other structures. Ground motion acceleration is represented by the unit (g), which acceleration due to the force of the earth's gravitational field and is approximate 986 centimeters per square second (DOE/NV 1993a). A maximum horizontal ground surf acceleration of 0.34g at the NTS is estimated to result from an earthquake that cou every 2,000 years (DOE 1994). The seismic hazard information presented in this EIS general seismic hazard comparisons across DOE sites. Potential seismic hazards for new facilities should be evaluated on a facility specific basis consistent with DOE

standards and site specific procedures.

The Massachusetts Mountain earthquake associated with the Cane Spring Fault (th probable source for seismic activity in the area of the proposed SNF storage facili above occurred on August 5, 1971 and produced a peak ground motion acceleration of The maximum credible earthquake associated with the Cane Spring Fault is expected t a peak acceleration of 0.67 g (DOE/NV 1993a).

Volcanic activity in the area is evident in the geologic record by the presence tuffs and scattered granitic plutons deposited during the Tertiary period and basal during the late Pliocene and Pleistocene epochs (DOE 1988b).

The potential for renewed silicic volcanism is suggested by the youngest (7- to old) major silicic volcanic center in the area, the Black mountain center, located northwest corner of the NTS. However, the occurrence of silicic volcanism near the the next 10,000 years is considered unlikely due to: no silicic volcanism in the s Great Basin during at least the past 6 million years, the decrease of silicic volca the central and southern parts of the Great Basin during the past 10 million years, restriction of silicic volcanism to the margins of the Great Basin during the Quate 2 million years). If silicic volcanism were to occur, the most likely effect at NT deposition of air-fall tuff from eruptions of silicic centers near the western marg Basin, as happened at least twice during the Pleistocene. Such volcanism could res deposition of fine-grained volcanic ash in layers ranging from a few millimeters to centimeters thick (DOE 1988b).

The possibility of future basaltic volcanism near the NTS is suggested by Quate volcanism, notably in the Crater Flat basalt field, just west of the southwest corn However, future basaltic eruptions would likely be small and short-lived judging fr Quaternary record of basaltic volcanism due to: magma volumes for eruptions in the the NTS during the past 8 million years being generally less than 1.0 x 108 cubic m cubic feet), and of short duration; a low rate of magma generation in the south-cen Basin during the late Cenozoic as reflected by the small-volume, basalt eruptive cy region; and the lack of geologic or geochemical patterns indicating that the rates the southern Great Basin are increasing, that such rates might increase in the futu basaltic activity could evolve into more voluminous types of basalt fields. The pr penetration of a repository at Yucca Mountain by basaltic volcanism was calculated studies of volcanic deposits in the vicinity. According to these calculations, the is estimated as 3.3 x 10-10 to 4.7 x 10-8 (DOE 1988b).

4.7 Air Resources

Because the transport of airborne effluents is affected by meteorological condi climatology at the NTS is discussed in this section. A summary of air monitoring n then included. Finally, the most recent air quality data available are presented.

4.7.1 Climatology

The climate at the NTS and the surrounding region is characterized by high sola limited precipitation, low relative humidity, and large diurnal temperature ranges. elevations have a climate typical of the Great Basin.

NTS is situated at the edge of the Mojave Desert, and the arid climate is typic Great Basin. The Sierra Nevada Mountains of California and the series of mountains 1,830 meters (6,000 feet) in height immediately west and north of the NTS have a ma influence on the climate. The prevailing upper level winds are from the west; most moisture associated with Pacific Ocean storms falls on the western slopes of the Si East of the Sierra Nevada, at locations such as the NTS, very little precipitation

The Weather Services Office at the NTS monitors meteorological data from numero observation sites within and in the vicinity of the NTS. The nearest National Weat full-time meteorological monitoring station is at McCarran International Airport, L

At Area 6 of the NTS, the average daily maximum/minimum temperatures during the month of January are 10.6yC/-6.1yC (51yF/21yF). The average daily maximum/minimum temperatures are 35.6yC/13.9yC (96yF/57yF) in July. At Las Vegas, the coldest temp record is -13.3yC (8yF) and the warmest temperature on record is 46.7yC (116yF).

The average annual precipitation at Area 6 is 15 centimeters (6 inches). Preci amounts for each month are generally less than 1.3 centimeters (0.5 inch). At Las greatest precipitation recorded in a 24-hour period is 6.6 centimeters (2.59 inches

of 14 thunderstorm days occur each year, with maximum occurrence in July and August Thunderstorms occasionally become severe. Tornadoes are extremely rare in Nevada. average relative humidity at 4 AM in Las Vegas is 40 percent. The average relative 4 PM is 20 percent.

Low-level surface winds at the NTS are influenced by the large-scale weather pa interacting with the mountain ranges, which generally run from north to south. Pre winds are from the south during the summer and north during the winter. The genera downward slope in the terrain from north to south across the NTS results in a diurn reversal from the south during the day to the north during the night. At Area 6, t annual wind speed is 11 kilometers per hour (7 miles per hour). Occasionally, stro associated with storms will exceed 82 kilometers per hour (50 miles per hour). The most common in the spring. At Las Vegas, the peak wind gust on record is 145 kilom hour (90 miles per hour). Strong winds interacting with dry soil conditions are re occasional duststorms or sandstorms.

Wind direction and speed are major factors in planning and conducting nuclear t atmospheric transport is the primary potential route of contamination to onsite wor offsite populations. Figure 4.7-1 presents 10-meter (33-feet) wind roses for the N wind rose presents the frequency distribution of wind directions at a particular lo wind roses indicate that there are differences in prevailing wind directions across Mountain slopes and valleys are major determinants in these localized variations (DOE/NV 1993c; National Climatic Data Center 1991).

Atmospheric dispersion improves as the wind speed increases, conditions become unstable, and the depth of the mixing height increases. The transport and dispersi material are direct functions of air movement. Transport directions and speeds are the general patterns of air flow (and by the nature of the terrain), whereas the di airborne material is governed by small-scale, random eddying of the atmosphere (i.e turbulence). Turbulence is indicated by atmospheric stability classification. Dat Desert Rock for calendar year 1990 indicated that atmospheric conditions were unsta Stability Classes A through C) approximately 25 percent of the time, neutral (Class approximately 37 percent of the time, and stable (Classes E through G) approximatel of the time for that year.

4.7.2 Air Monitoring Networks

4.7.2.1 Radiological Monitoring Network. DOE Order 5400.1, General Environmental

Protection Program, established the onsite environmental protection program require authorities, and responsibilities for DOE operations. At the NTS, radiological eff originate from tunnels, underground test sites, and facilities where materials are stored, or discharged. Airborne radiological effluents at the NTS have the greates reaching the public. There are two radiological monitoring programs for potential radioactive effluents associated with the NTS, one onsite and the other offsite (DO Figure 4.7-1. 1990 10-meter (33 foot) wind rose patterns for the NTS. The onsite particulates and reactive gases; 17 samplers collecting atmospheric moisture for tr 10 samplers collecting air samples for noble gas analysis; 63 water sampling locati wells, springs, reservoirs, and ponds onsite; and 187 locations where thermolumines dosimeters are positioned for measurement of external gamma exposures (DOE/NV 1993c

The offsite radiological monitoring program is conducted around the NTS by the Environmental Protection Agency's (EPA's) Environmental Monitoring Systems Laborato Vegas, under an interagency agreement. This program consists of several extensive environmental sampling, radiation detection, and dosimetry networks. In 1992, the Surveillance Network was made up of 30 continuously operating sampling locations su the NTS and 77 standby stations (operating one week each quarter) in all states wes Mississippi River. During 1992, no airborne radioactivity related to current nucle NTS was detected on any sample from this network (DOE/NV 1993c).

4.7.2.2 Nonradiological Monitoring Network. Nonradiological environmental monitoring

of NTS operations involved only onsite monitoring because there were no nonradiolog hazardous material discharges offsite.

4.7.3 Air Releases

4.7.3.1 Radiological. The majority of radioactive effluents at NTS in 1992 originated

from underground nuclear tests designed and conducted by two national laboratories Defense Nuclear Agency. The Los Alamos National Laboratory of Los Alamos, New Mexi and the Lawrence Livermore National Laboratory of Livermore, California conducted t support of DOE nuclear testing program objectives. Sandia National Laboratories of Albuquerque, New Mexico supported tests conducted by the Defense Nuclear Agency, wh uses the NTS as a nuclear testing facility under an agreement with DOE (DOE/NV 1993

The presence of plutonium as an airborne, radioactive effluent at NTS in 1992 i due to previous atmospheric tests and tests in which nuclear devices were detonated explosives (called "safety shots"). These latter tests spread low-fired plutonium northeastern areas of the NTS. Three decades after the conclusion of the atmospher program, higher than normal levels of plutonium in the air are still detected in se Because of operational activities and vehicular traffic in Area 3 some of the pluto airborne and elevated levels of plutonium have been detected in Area 3 for several (DOE/NV 1993c).

Six underground nuclear tests were conducted at the NTS during 1992. A list of and a summary of environmental monitoring observations for each of these are provid Table 4.7-1.

Air emissions from nuclear testing operations consisted primarily of radioactiv and tritium released during posttest drillback, mineback, or sampling operations fo **the 1992 underground nuclear tests.** None of the tests resulted in a prompt release (release of radioactive materials within 60 minutes of the nuclear test). Onsite r support included monitoring emissions during the six nuclear tests. Testing includ recording, evaluating, and reporting radiological conditions prior to, during, and period after each test with provisions for aerial monitoring teams to detect airbor (DOE/NV 1993c).

Following each test, when control of the test area was released by the DOE Cont survey personnel obtained radiation measurements using portable detection instrumen the postevent drillback and mining activities, continuous environmental surveillanc maintained in the work area. For containment of radioactive releases to the atmosp drillback, systems were employed to trap radioactive particles.

Radioactive waste management sites are located in Areas 3 and 5. These sites s DOE defense waste disposal sites (DOE/NV 1993c).

NTS airborne radionuclide emissions for 1992 are presented in Table 4.7-2.

4.7.3.2 Nonradiological. Air emissions from the NTS originate from concrete batch

plants, aggregate crushing and processing, surface disturbance, fire training exerc

Table 4.7-1. Nuclear test release summary - 1992 at the NTS Site.

Event name	Test org.	Hole/ area no.	Location	Date/ time of event	Prompt release?	Telemetry measurement Start	Sto
Junction	LANL	U19bg Area 19	Pahute Mesa	03/26/92 0830 hrs	No	03/26/92 0830 hrs	03/ 083
Diamond Fortune	DNA	U12p.05 Area 12	Rainier Mesa	04/30/92 0930 hrs	No	04/30/92 0930 hrs	05/ 140
Victoria	LANL	U3kv Area 3	Yucca Basin	06/19/92 0945 hrs	No	06/19/92 0945 hrs	06/ 150
Galena	LLNL	U9cv Area 9	Yucca Basin	06/23/92 0800 hrs	No	06/23/92 0800 hrs	06/ 220
Hunters Trophy	DNA	U12n.24 Area 12	Rainier Mesa	09/18/92 1000 hrs	No	09/18/92 1001 hrs	09/ 130

Divider	LANL	U3ml Area 3	Yucca Basin	09/23/92 0804 hrs	No	09/23/92 0804 hrs	09/ 094
Distant Zenith	DNA	U12p.04 Area 12	Rainier Mesa	09/19/91 0930 hrs	No	1992 releases included: 1.	

a. Source: DOE/NV 1993c.

Table 4.7-2. Airborne radionuclide emissions for 1992 at the NTS.

Event or facility name (airborne releases)	Curies Tritiumb	Argon-37c	Argon-39	Krypton-85	Xenon-127d	X
Area 3, DIVIDER						
Area 3f						
Area 5, RWMSf	6 x 10-1					
Area 6g						
Area 12,						
N Tunnel	4.9 x 10-2	7.9 x 10-1	8.1 x 10-5	1.3 x 10-2	5.7 x 10-6	2
P Tunnel	3.6 x 10-1	2.1 x 10-0		1.3 x 10-0		
Area 19 and 20, Pahute Mesad				2.8 x 10+2		
Total	1.0 x 10-0	2.9 x 10-0	8.1 x 10-5	2.8 x 10+2	5.7 x 10-6	2

a. Source: DOE/NV 1993c.

b. Total includes 4.9 x 10-2 Ci of molecular HT from Hunter's Trophy. Remainder i

c. Ar-37 with 35 day half-life not in GENII. Decays to stable Cy-37.

d. Xe-127 with 36.4 day half-life not in GENII. Decays to stable I-127.

e. Xe-127m with 8 day half-life not in GENII. Decays to stable Xe-129.

f. Calculated from air sampler data.

g. Assumes all radioactivity on Anti-C clothing is I-131 and all becomes airborne
vehicle operations, boilers, and fuel storage. The concrete batch plants, aggregat processing facilities, and surface disturbance activities are sources of particulat activities are largely intermittent and occur in support of specific testing progra Fire training exercises consist of periodic open burning in designated areas with a materials conducted by fire and emergency personnel several times per year. Motor operations and boilers are the largest sources of air pollutants at the NTS; motor consume gasoline, while boilers, construction equipment, and other diesel engines c fuel. A continuous, nonradiological air monitoring network is not in place at the (USAF et al. 1991). Table 4.7-3 presents the maximum allowable nonradiological emi for those NTS sources which require permits.

4.7.4 Air Quality

4.7.4.1 Radiological. Onsite surveillance of airborne particulates, noble gases, and

tritiated water vapor indicated onsite concentrations that were generally not stati from background concentrations. External gamma exposure monitoring in 1992 indicat the gamma environment within the NTS remained consistent with that of previous year gamma monitoring stations displayed expected results, ranging from the background l predominant throughout the NTS to the types of exposure rates associated with known contaminated zones and radiological material storage facilities. Results of 1992 o

environmental surveillance indicated no NTS-related radioactivity was detected at a sampling station, and there were no apparent net exposures detectable by the offsit network (DOE/NV 1993c).

The GENII environmental transport and dose assessment model (PNL 1988) was used calculate the effective dose equivalents (EDE) resulting from the airborne radionuc presented in Table 4.7-2. These results are summarized in Table 4.7-4. The maximu the NTS boundary is 1.1 x 10-2 millirem. This is 1.1 x 10-1 percent of the corresp Emissions Standard for Hazardous Air Pollutants. The collective EDEs to the estima population of 15,100 persons within 80 kilometers (50 miles) of the proposed SNF fa 10-3 person-rem, which is 1.2 x 10-4 percent of the natural background radiation do population. Background radiation doses are presented in Figure 4.7-2.

Table 4.7-3. Total nonradiological emission rates at NTS for permitted sources.

Pollutant	Emission rate (g/s)
Carbon monoxide	b
Nitrogen dioxide	b
Particulate matter (PM10)	2.8
Sulfur dioxide	4.5
Lead	b

a. Source: Engineering Science, Inc. (1990).

b. No pollutant sources indicated.

Table 4.7-4. Summary of effective dose equivalents to the public from NTS operatio during 1992.

	Maximally exposed individual doseb	Collective dose to the population within 80 km of NTS sourcesc
Dose	1.1 x 10-2 mrem	5.2 x 10-3 person-rem
NESHAP standard	10 mrem per year	--
Percentage of NESHAP	1.1 x 10-1	--
Natural background dose	278 mrem per year	4190 person-rem per year
Percentage of natural background dose	4.0 x 10-3	1.2 x 10-4

a. Sources: 1992 Radionuclide emissions from DOE/NV 1993c GENII Model (PNL 1988) used to predict EDE. Natural background dose from DOE/NV 1993c.

b. The maximum boundary dose is to the hypothetical individual who remains in the continuously during the year at the NTS boundary.

c. Based on an estimated population of 15,100 persons within 80 km of the proposed facility in 1995.

Figure 4.7-2. Sources of radiation exposure, unrelated to NTS operations, to indi

4.7.4.2 Nonradiological. Air quality rules and regulations applicable to the NTS are

governed by the Clean Air Act, the Nevada Revised Statutes, and the Nevada Administ Code. The EPA administers the Federal regulations developed to implement the Clean and the Nevada Department of Conservation and Natural Resources is responsible for the Federal and state regulations. Air quality in a given location is described as concentration of various pollutants in the atmosphere, generally expressed in units per cubic meter (-g/m3).

The Clean Air Act directed the EPA to set National Ambient Air Quality Standard (NAAQS) for those pollutants, termed criteria pollutants, that pose the greatest th quality in the United States. The six criteria pollutants are ozone, carbon monoxi dioxide, lead, nitrogen dioxide, and particulate matter with an aerodynamic particl than or equal to 10 microns, referred to as PM10. The Clean Air Act Amendments aut the EPA to designate geographic regions not in compliance with NAAQS as nonattainme areas. The NTS is located within the Nevada Air Quality Control Region 147, which

attainment with respect to the NAAQS for the criteria pollutants (CFR 1993b; Engine Science, Inc. 1990). The nearest nonattainment areas to the Nevada Test Site Spent Fuel site are in Clark County, which includes an area in the Las Vegas planning are designated serious for PM10 and an area in Las Vegas that is designated moderate fo monoxide (CFR 1993b).

Under the Clean Air Act, clean air areas are divided into classes. National pa wilderness areas receive mandatory Class I protection. Very little pollution incre Class I areas. The only Class I area in Nevada, the Jarbridge Wilderness Area, is approximately 480 kilometers (300 miles) from the NTS, in the northwest corner of N nearest Class I areas to the NTS are the Grand Canyon National Park, approximately kilometers (171 miles) to the southeast, and Sequoia National Park approximately 17 (109 miles) to the west-southwest. The NTS is located in a Class II area, as are m across the country.

In addition to the criteria pollutants which are regulated under the National A Quality Standards and under various emission standards, hazardous air pollutants ar Title III of the Clean Air Act Amendments of 1990 directed the EPA to determine max available control technologies which would be used as the basis for emission limits hazardous air pollutants.

Engineering Science, Inc. of Pasadena, California conducted an air quality stud in 1990. The study examined air quality compliance of the NTS with applicable Fede state air quality standards. The study encompassed an air emissions inventory, amb monitoring, and air pollution source testing at various sources. Based on the data the ambient air monitoring stations established for the study, air quality at the N applicable Federal and state standards. The results of background monitoring perfo Engineering Science, Inc. are summarized in Table 4.7-5. This is the most recent analysis of NTS ambient air quality.

Air dispersion modeling was performed to determine the maximum concentrations o criteria pollutants. These results are also summarized in Table 4.7-5. The "total maximum concentrations" in Table 4.7-5 would result if all permitted sources at the operated at the maximum allowable capacity. All pollutant concentrations from this scenario of existing emissions at the NTS are below applicable regulations.

4.8 Water Resources

This section provides a description of the surface water and groundwater at the surrounding area. The section also describes the existing impacts to surface water groundwater that have resulted from past and present operations at the NTS.

4.8.1 Surface Water

The drainage basins and the generalized directions of surface water flow near t shown in Figure 4.8-1 (USAF et al. 1991). The boundary lines of the drainage basin principally along topographic divides (DOE 1988b). Figure 4.8-1 also shows other s features.

Table 4.7-5. Comparison of baseline concentrations with most stringent applicable

Criteria pollutant	Averaging time	Most stringent regulation or guideline (-g/m3)	Maximum background concentration (-g/m3)	M e s c (
Carbon monoxide	8-hour	10,000	2,290	b
	1-hour	40,000	2,748	b
Nitrogen dioxide	Annual	100	c	b
Lead	Calendar quarter	1.5	c	b
Particulate matter (PM10)d	Annual	50	c	0
	24-hour	150	78.3	6
Sulfur dioxide	Annual	80	c	1
	24-hour	365	39.3	1
	3-hour	1,300	65.4	1
Hazardous air pollutants				
b	b	b	b	

a. Sources: Maximum background concentration provided by Engineering Science, Inc contribution computed by Halliburton NUS.

b. No sources indicated.

c. Not measured.

d. All suspended particulate matter is assumed to be PM10.

Figure 4.8-1. NTS hydrologic basins and surface drainage direction. Almost all st data have been collected. The average annual runoff within the hydrographic areas Valley Basin in Nye County was estimated at less than 164 million gallons (620,000 per area (DOE 1988b).

The ephemeral character of streamflow has also limited the onsite monitoring of water quality. Water samples were, however, collected from the main channel of For and two of its principal tributaries (Drill Hole Wash and Busted Butte Wash) during runoff and flooding in 1984. Due to unknown factors such as compositional variabil any quantitative interpretation is unwarranted (DOE 1988b).

Throughout the NTS, perennial surface water originates solely from springs, and restricted to source pools at some large springs. Because of the extreme aridity o most of the spring discharge travels a short distance before evaporating or infiltr the ground (DOE 1986). Thus, dry washes may be the principal sources of potential groundwater recharge inputs in the area (DOE 1988b). In addition, playas on NTS, i Frenchman Lake located in Area 5 and Yucca Lake to the northwest of Area 5, may ret standing water for hours to weeks following intense precipitation events. These pl the only natural surface water features in the vicinity of Frenchman and Yucca Flat direction of movement of water accumulated in playas is generally upward due to hig evapotranspiration (DOE/OFE 1994). However, accumulated runoff in Frenchman Lake a Yucca Lake reportedly serves to recharge the valley fill aquifer (DOE 1988b).

Despite the arid climate, which includes high annual average potential evaporat average annual precipitation, and infrequent storms, surface runoff does occur. Ru from storms that occur most commonly in winter and occasionally in autumn and sprin from localized thunderstorms that occur mostly during the summer (DOE 1988b). The ephemeral streams resulting from heavy precipitation fill the normally dry washes. may occur where the water exceeds the capacity of the channels. In contrast to the terminal playas may retain standing water for days or weeks after severe storms (DO Playas in Kawich Valley and Gold Flat collect and dissipate the runoff from the nor Pahute Mesa (ERDA 1977). Summer floods usually do not accumulate to cause regional but their intensive character renders them potentially destructive over limited are (DOE 1988b).

The western half and southernmost part of the NTS have channel systems which ca runoff beyond NTS boundaries during infrequent, very intense storms. Fortymile Can largest of these systems, originating on Pahute Mesa in the northwestern part of th draining into the normally dry Amargosa River channel about 20 miles (32 kilometers of the NTS. Within the NTS, Fortymile Canyon and its tributaries are restricted to canyons. Flood-prone areas surround Fortymile Wash, a major tributary within Forty Canyon. The other major NTS tributaries to the Amargosa River are Tonopah Wash, wh southwesterly from Jackass Divide in the south-central part of the NTS into the Ama near Amargosa Valley, and Rock Valley, which drains from the southernmost part of t westward and then southward to Ash Meadows in the east-central portion of the Amarg Desert (ERDA 1977).

The Amargosa River originates in Oasis Valley and continues southeastward throu Amargosa Desert past Death Valley Junction, then southward another 45 miles (82 kil where it turns northwestward and terminates in Death Valley. The river carries flo following cloudbursts or intense storms but is normally dry, except for a few short contain water from springs (DOE 1988b).

Two watersheds, Fortymile Canyon and Jackass Flats, have the potential of endan offsite public health and safety due to flooding. Regional peak-flood flow equatio southern Nevada area indicate that the 100-year peak flow from the Fortymile Canyon is approximately 13,000 cubic feet (370 cubic meters) per second and 8,200 cubic fe meters) per second from the Jackass Flats drainage (USAF et al. 1991).

In summary, the potential exists for sheet flow and channelized flow through ep washes from intense precipitation events to cause localized flooding throughout the

however, no comprehensive floodplain analysis has been conducted on the NTS to deli 100- and 500-year floodplains associated with NTS drainages. No flood studies are have been conducted for the proposed SNF facility in Area 5; a flood assessment was for the Radioactive Waste Management Site in NTS Area 5 on Frenchman Flat, located southwest of the proposed SNF Site. This study determined that the southwest corne Radioactive Waste Management Site is located in Federal Emergency Management Agency AO (100-year flood zone with depths between 1 and 3 feet [0.3 and 0.9 meter]) of th Wash Alluvial Fan. The remainder of the Radioactive Waste Management Site is locat Zone X of the Halfpint Alluvial Fan (100-year flood zone with depths less than 1 fo [0.3 meter]). Areas to the north, south, and east of the Radioactive Waste Managem in Zone X or Zone AO (DOE/NV 1993d). These suggest that the proposed SNF facility may encompass areas in Zone X and/or areas in Zone AO associated with the Halfpint Fan. Probable maximum flood analyses are known to have been performed only for are vicinity of Yucca Mountain to aid in flood protection design for Yucca Mountain fac (DOE 1988b).

Underground nuclear testing has resulted in the release of radioactive material surface. There is the potential for 100-year floods to transport these contaminant boundaries of the NTS. Quantitative estimates of this potential cannot be determin additional studies (USAF et al. 1991).

There are no National Pollutant Discharge Elimination System (NPDES) permits fo NTS, as there are no wastewater discharges to onsite or offsite surface water. NTS wastewaters are discharged to sewage lagoons or to septic tank/leach field systems. wastewater discharges at NTS are conducted in accordance with permits issued by the Nevada (DOE/NV 1993c).

4.8.2 Groundwater

Generally, the hydrogeology at the NTS is characterized by great depths to the table and slow velocity of movement of water in the saturated and unsaturated zones (DOE/NV 1992c). Depth to groundwater varies from about 660 feet (200 meters) benea valleys in the southern part of the NTS to more than 1,640 feet (500 meters) beneat Mesa. The depth of the water table below Area 5 is approximately 800 feet (244 met land surface (DOE/NV 1993c). Locally, there are perched water tables at shallow de (USAF et al. 1991). Perched aquifers have been reported at depths of 70 feet (21 me the southwestern part of Frenchman Flat (RSN 1993). In the eastern portions of the water table occurs generally in the alluvium and volcanic rocks above the regional (DOE/NV 1993c).

The NTS lies within the Death Valley Groundwater System, which is a large and d area encompassing southern Nevada and adjacent parts of California composed of many mountain ranges and topographic basins that are hydraulically connected at depth. groundwater within the system travels toward Death Valley, although much of it disc before reaching it. Groundwater in the Death Valley system does not enter neighbor groundwater systems (DOE 1986). The Death Valley Groundwater System is divided int groundwater subbasins. The boundaries of these subbasins have been estimated from potentiometric levels, geologic controls of subsurface flow, discharge areas, and i paths (DOE 1988b). As shown in Figure 4.8-2, the three groundwater subbasins of th beneath the NTS are Ash Meadows, Alkali Flat Furnace Creek Ranch, and Oasis Valley. Groundwater beneath the eastern part of the NTS is in the Ash Meadows Subbasin. Mo western NTS is in the Alkali Flat Furnace Creek Ranch Subbasin. Groundwater beneat northwestern corner of the NTS occurs in the Oasis Valley Subbasin (DOE/NV 1993c, 1

Six major aquifers occur in the area. In decreasing order of age of the geolog which they are found, they are: Cambrian through Devonian lower carbonate aquifer, Pennsylvanian and Permian upper carbonate aquifer, Tertiary bedded tuff aquifer, Te welded tuff aquifer, Tertiary lava flow aquifer, and Tertiary and Quaternary valley (Eckel 1968) (see Figure 4.6-2). The hydrologic and geologic properties of these a (see the Yucca Mountain Site Characterization Plan [DOE 1988b] for a thorough descr the hydraulic properties of the major hydrostratigraphic units based on studies at Mountain). For example, the carbonate aquifers and the welded tuff aquifer store a water chiefly along fractures. In contrast, the valley fill aquifer stores and tra through interstitial openings. Additionally, in places in the lower carbonate aqui flow is diverted laterally and vertically because of fault displacements that have lower carbonate aquifer against less permeable rocks. Where the flow is blocked, i the water table with the land surface causes springs (DOE 1986).

Figure 4.8-2. Groundwater hydrologic units, hydrgraphic areas, and well locations

The lower carbonate and valley fill (alluvial) aquifers are the main sources of gro in the eastern part of the NTS (DOE 1986). Groundwater withdrawals in the area of proposed SNF management facilities are principally from the valley fill aquifer of Flat hydrographic area (DOE 1988b). The other four units in the area have relative permeabilities that tend to retard the flow of groundwater. These units are called (DOE 1986). In decreasing order of age of the geologic units that form them, these are: Precambrian through lower Cambrian lower clastic aquitard, Devonian through Mississippian upper clastic aquitard, Tertiary tuff aquitard, and Tertiary lava flo (Eckel 1968) (see Figure 4.6-2).

Figure 4.8-3 is a regional groundwater potentiometric surface map of the NTS (DOE/NV 1993d). The map does not show perched groundwater. However, perched groundwater does occur at NTS, principally associated with the aquitards underlying (Eckel 1968).

In general, regional groundwater flow is from the north and northeast toward th discharge area near Ash Meadows in the Amargosa Desert (see Figure 4.8-2 and 4.8-3) western portions of the area, the regional flow is from the northwest to the south (DRI 1986b). Deep regional movement of groundwater south of the NTS occurs chiefly the lower carbonate aquifer. Because of geologic structure, flow paths in the lowe aquifer are complex and poorly defined. Groundwater from the Ash Meadow Subbasin s the water entering Devil's Hole, which supports the only known population of the De pupfish, a federally listed endangered species. The decline of the species has bee low water levels caused by decreasing groundwater levels (ERDA 1977).

Groundwater recharge to the Ash Meadows Subbasin occurs primarily from precipit over the mountainous areas in the northern, eastern, and southern portions of the b (DOE 1988b). As mentioned above, this recharge generally travels vertically throug zone (unsaturated zone) and the overlying aquifers to the underlying carbonate aqui Specifically, in the eastern half of the NTS, groundwater flows toward the major va deflecting downward to join the regional flow in the carbonate aquifers. Beneath Y Frenchman flats, vertical flow through the underlying volcanic rocks is impeded by

Figure 4.8-3. NTS regional potentiometric surface map.

zeolitized tuffs, resultin Vertical flow in the uppermost portions of the vadose zone in the area of Frenchman generally upward toward the surface, due to an evapotranspiration rate which is 15 than precipitation (DOE/OFE 1994). Site characterization data for Area 5 indicate vertical flow direction in the vadose zone is upward from 0 to 250 feet (0 to 75 me land surface. In the next interval (250 to 600 feet [75 to 180 meters]), a downwar 10 feet/1,000 years (3 meters/1,000 years) has been calculated. At a depth of 600 (180 to 250 meters), a zone of equilibrium (a zone of no vertical movement) is pres water table (Johnejack et al. 1994).

Analyses have also been conducted in order to determine the travel time of wate vicinity of Area 5 and Frenchman Flat to the regional water table. Modeling studie Radioactive Waste Management Site at Area 5 indicate that the travel time from the the water table is on the order of thousands of years (DOE/NV 1993c). Specifically time from Area 5 to the regional water table is estimated to range from 19,000 to m 113,000 years (USAF et al. 1991). The Yucca Mountain Site Characterization Plan (D describes in detail the hydraulic properties of the various units comprising the un based on studies at Yucca Mountain.

Three types of groundwater chemistry exist at the NTS and in its vicinity: (1) potassium bicarbonate, which generally occurs in the tuff and valley fill aquifers of tuff detritus; (2) calcium and magnesium bicarbonate, which generally occurs in and the valley fill aquifers composed chiefly of carbonate detritus; and (3) mixed, defined as having the chemical characteristics of both type 1 and type 2 (DOE 1986)

The hydrogeologic units which supply potable water to the NTS have been classif Class IIA (currently a source of drinking water) and IIB (potentially a source of d in accordance with the EPA's guidelines for groundwater classification (DOE/NV 1993 aquifers at the NTS have been designated as sole source aquifers.

In general, the quality of NTS groundwater is suitable for most purposes and ge meets EPA secondary standards for major cations and anions and the primary standard deleterious constituents. Specifically, groundwater in the Ash Meadows Subbasin ha dissolved solids concentration ranging between 275 and 450 milligrams per liter (mg (DOE/NV 1993a). Summary groundwater quality data for the period 1957 to 1990 for W 5c, Well UE5c, and Army Well 1 which serve Area 5 reveal a pH range of 7.6 to 8.7; (2.4 to 44.0 mg/L); sodium (38.1 to 129.0 mg/L); chloride (9.1 to 23.2 mg/L); sulfa mg/L); and silica (0 to 55.1 mg/L) (DRI 1993).

Contamination by radionuclides occurs below the water table as well as in the u zone above it. This contamination is a result of underground nuclear testing. A p environmental survey of the NTS also identified a number of potential sources of gr contamination. These included wastewater discharges, hazardous- or mixed-waste dis solid waste landfills and trenches receiving potentially hazardous waste, and over waste spill or release sites (USAF et al. 1991).

Underground nuclear testing has primarily occurred in the areas of Yucca Flat, Flat, Pahute Mesa, Rainier Mesa, and Shoshone Mountain. Nuclear detonations at or water table have resulted in groundwater contamination. The principal confirmed or contaminants from these tests include various radionuclides (primarily tritium) and A number of NTS waste disposal and testing facilities, including injection wells, l various waste storage facilities or disposal sites, have caused contamination of th Contaminants of concern include radionuclides, organic compounds, heavy metals (pri lead), and hydrocarbons as well as various residues from plastics, drilling muds, a (DOE/NV 1993e). Figure 4.8-4 depicts the areas with known or suspected groundwater vadose zone contamination. Groundwater contamination characterization activities a progress at NTS; at present, no contaminant plume maps are available, and available groundwater quality data are not useful for the purposes of site-wide characterizat comparison with established criteria.

Groundwater contamination could be transported toward the NTS boundary by one o regional groundwater flow systems. Groundwater flow velocities in these systems ra 6 and 600 feet (1.8 and 183 meters) per year. Because of sorption, however, most n (other than tritium) would move at a much slower rate. The groundwater travel time

Figure 4.8-4. Areas of potential groundwater contamination at the NTS.

NTS to the approximately 300 years. Radioactive decay during this time, coupled with dilution should reduce radioactivity concentrations to well below regulatory limits (USAF et Thus, there are no effects on public health and safety, nor are any expected in the future.

The NTS derives its complete water supply from the groundwater aquifers underly site. Water supply has been developed and is managed on the basis of five service support the different NTS operating areas. Given the wastewater disposal practices and the depth to the groundwater system, it is reasonable to assume that all of the on the NTS is consumed (USAF et al. 1991). Recent annual water use at the NTS has substantially from the 1980's. In 1989, NTS annual water withdrawal was 1.117 bill (4.22 million cubic meters) (Leppert 1993). In 1992, NTS annual water withdrawal w billion gallons (2.25 million cubic meters) (Leppert 1993).

In 1993, 14 wells were utilized for the NTS water supply (DOE/NV 1994c). A sma of the NTS receives its water from 5 onsite wells drilled in the Alkali Flat-Furnac Subbasin (DOE 1988b). Most of the NTS receives its water from 9 onsite wells drill Ash Meadows Subbasin, which encompasses Area 5 (DOE/NV 1994c). These 9 wells have combined production capacity of 1,813 billion gallons per year (6.86 million cubic year) (DOE/NV 1993a).

Area 5, which encompasses the proposed SNF facility site, is located within NTS service area C. Wells 5b, 5c, and UE5c serve the fire protection, construction, an needs of Area 5 facilities (DOE/NV 1993b). Wells 5b and 5c are completed in alluvi (valley fill aquifer) with total completion depths of 900 and 1,200 feet (274 and 3 below land surface, respectively. Well UE5c is completed in volcanic rock (exact a unknown) with a total depth of 2,682 feet (817 meters) below land surface (DOE 1988 DOE/NV 1993b; DRI 1993).

Groundwater for construction and operation of the SNF management facilities wou be drawn from the Frenchman Flat hydrographic area of the Ash Meadows Subbasin. Mu the land within the Ash Meadows Subbasin is under Federal jurisdiction and has been from the public domain (DOE 1988b). Little of the total groundwater of the subbasi privately appropriated or used.

The perennial yield of the Ash Meadows Subbasin greatly exceeds water withdrawa DOE and all other users. For more than thirty years water withdrawals from the Fre Flat hydrographic area had exceeded the estimated precipitation recharge for that a (DOE 1988b). This study also indicates that withdrawals have caused no decline in water level (DOE 1988b). However, it should be noted that numerous conditions on t preclude the accurate measurement of static water levels (Winograd 1970). Because hydrogeologic complexities, regional groundwater flow at the NTS is not constrained hydrographic basins which are defined by local topography (USAF et al. 1991). Ther potential groundwater overdrafts in the Frenchman Flat basin indicated by previous estimates are likely made up by untapped groundwater from neighboring hydrographic

Water in southern Nevada (excluding the Las Vegas area) is used chiefly for irr to a lesser extent for livestock, municipal needs, and domestic supplies. Almost a water is pumped from the ground, although some springs supply water to establishmen Death Valley and other areas south of the NTS. Springs in Oasis Valley near Beatty a significant source of water for public and domestic needs and for irrigation (DOE City of Las Vegas obtains approximately 80 percent of its water from the Colorado R remaining 20 percent is withdrawn from groundwater sources. There are no plans to water supply sources in the near future. (Las Vegas Valley Water District 1994).

The principal water users in the area closest to the NTS are in the Amargosa De around the Town of Amargosa Valley and in the Pahrump Valley. Aquifers in the Pahr Valley could support up to about 16,900 residents with no decline in usable storage local effects, such as land subsidence and well interference, could result from sus development. The mining industry in southern Nevada also uses a small amount of wa processing. Water for this purpose is supplied from nearby shallow wells or trucke nearby towns. Many of the mines currently recycle process water, which reduces the demand (DOE 1986).

The volume of groundwater underlying the NTS (as well as the estimated volume o contaminated groundwater) that has been removed from direct access to the general p rather large. The impaired groundwater will likely remain unusable for an extended significance of the loss of access to the NTS groundwater is diminished by the fact access were provided, the water underlying portions of the NTS might not be usable purposes (USAF et al. 1991).

4.9 Ecological Resources

NTS lies within the transition area between the Mojave Desert and the Great Bas result, flora and fauna characteristics of both occur on the NTS. The NTS covers a square kilometers (1,350 square miles) of which only 0.55 percent is developed (DOE

NTS has completed numerous studies on the effects of nuclear testing on the eco area, and an extensive bibliography of these studies has been prepared (ERDA 1976). summary, studies (including ongoing surveys) have shown that there may be a correla between radioactive testing and the decline of vegetation present in an area. As a may not have the necessary vegetation for food and cover, thus changing the fauna d those areas (USAF et al. 1991).

The following section describes the ecological resources at the NTS, including resources, wetlands, aquatic ecology, and threatened and endangered species. Infor presented on special status species other than threatened and endangered species su Federal Candidate and state-listed species.

4.9.1 Terrestrial Resources

Plant communities on the NTS have been classified according to the dominant shr Approximately 700 taxa, representing about 70 families, have been identified on the (ERDA 1976; DOE/NV 1993b, 1991b). Figure 4.9-1 presents the general plant communit identified there.

Figure 4.9-1. Plant communites on Nevada Test Site. The Mojave Desert is located 5,000 feet). The dominant plant community is creosote bush (Larrea tridentata). A this community occurs are located within much of the southern portion of the NTS, i Jackass Flats and Frenchman Flat (DOE/NV 1991b, 1986b; ERDA 1976; FWS 1992).

The transitional zone between the Mojave Desert and the Great Basin occurs at e between 1,219 and 1,524 meters (4,000 and 5,000 feet). The dominant plant communit associated with the transition zone are: blackbrush (Coleogyne ramosissma), desert pallidum), and hopsage (Grayia spinosa). In general, these communities are found i bajadas and in closed basins within Jackass Flats and Yucca Flat (DOE/NV 1991b, 198 ERDA 1976).

The Great Basin is located within the northern two-thirds of NTS at elevations meters (5,000 feet). The dominant plant communities are big sagebrush (Artemisia t and black sagebrush (Artemisia nova), saltbush (Atriplex canescens), and desert tho shockleyi). In areas with elevations above 1,830 meters (6,000 feet), collectively mountains, hills, and mesas, the dominant plant communities are singleleaf pinyon (monophylla) and Utah juniper (Juniperus osteosperma). In general, these communitie at Thirsty Canyon, Yucca Playa, Rainier Mesa, and Yucca Mountain (DOE/NV 1991b, 198

ERDA 1976).

There is a recent trend of nonnative plant species establishing themselves in a disturbance at the NTS. Cheatgrass (Bromus tectorum), an annual grass, occurs at e above 1,524 meters (5,000 feet). Downey chess (Bromus rubens), another annual gras becoming established in the mid-elevations. Russian thistle (Salsola iberica and S appears in areas where the native vegetation has been removed and the soil composit changed (DOE/NV 1991b, 1988; ERDA 1976).

Like vegetation, animals on the NTS are representative of both the Mojave Deser Great Basin and the associated transition zone. There are over 30 species of reptil amphibians, 190 species of birds, and 50 species of mammals on the NTS (DOE/NV 1993 ERDA 1976). Many animals utilize man-made reservoirs and natural springs and seeps NTS. Sewage ponds have also become an important resource for wildlife.

Reptiles and amphibians on the NTS include 1 species of desert tortoise, 14 spe lizards, and 17 species of snakes. In addition, the NTS is within the range of the spadefoot toad (Scaphiopus intermontanus), but this amphibian has not been identifi NTS (DOE/NV 1993b; ERDA 1976; Medica 1990).

Birds on the NTS are often migratory and seasonal residents. The most widely d species include the black-throated sparrow (Amphispiza bilineata), house finch (Car mexicanus), red-tailed hawk (Buteo jamaicensis), common raven (Corvus corax), logge (Lanius ludovicianus), mockingbird (Mimus polyglottos), ash-throated flycatcher (My cinerascens), and mourning dove (Zenaida macroura) (DOE/NV 1993b; ERDA 1976; Greger 1991).

The most abundant group of mammals on the NTS are rodents. Carnivores include (Canis latrans), kit fox (Vulpes macrotis), badger (Taxidea taxus), bobcat (Lynx ru lion (Felis concolor), and long-tailed weasel (Mustella frenata). Large mammals on the mule deer (Odocoileus hemionus), pronghorn (Antilocapra americana), desert big (Ovis canadensis), and wild horse (Equus caballus). Hunting, grazing, and fishing on the NTS (DOE/NV 1993b, 1986b; ERDA 1976; Medica and Saethre 1990).

In general, the portion of Frenchman Flat in Area 5 (i.e., north and east of Me Highway) within which the proposed SNF facility would be located is within the creo community. This plant community is characteristic of the Mojave Desert. Pre-activ completed for the Radioactive Waste Management Site, which is in the general area o proposed SNF facility, found the dominant vegetation to include creosote bush, spin white bursage, desert thorn, and Nevada joint-fir (Ephreda nevadensis) (EG&G 1993, 1990, 1989).

The distribution of animals within the portion of Area 5 being considered for t SNF facility is not as well documented as for the rest of the NTS. However, specie within 5 kilometers (3.1 miles) of the Liquefied Gaseous Fuels Spill Test Facility reptiles, 17 bird species, and 14 mammals (Hunter et al. 1991). The Liquified Gase Spill Test Facility is located within similar habitat approximately 7.6 kilometers of the proposed facility. There are no water sources located within the portion of considered for the proposed SNF facility.

4.9.2 Wetlands

There are several natural springs on the NTS that feed flowing streams (Greger Romney nda). Some of these extend for 91 meters (300 feet) before infiltration and cause them to dry up. Vegetation along these channels consists of willow (Salix sp (Tamarix sp.). Reservoirs on the site which are fed by groundwater from wells have wetland vegetation such as tamarisk, cattail (Typha sp.), and bulrushes (Scirpus sp (Elle 1992). A wetland delineation, as defined by the 1987 U.S. Army Corps of Engi wetlands Delineation Manual (U.S. COE 1987), has not been performed for any of thes (DOE/NV 1993b; Elle 1992), and National Wetlands Inventory maps are not available f NTS.

The portion of Area 5 under consideration for the SNF facility does not have an springs, seeps, or wetland vegetation (DOE/NV 1993b; Greger and Romney nda).

4.9.3 Aquatic Resources

Potential aquatic habitat on the NTS includes surface drainages, playas, man-ma reservoirs, and springs. Permanent surface water sources are limited to a few smal

There are two dry lake beds (playas) located in the eastern (Yucca Flat) and so

(Frenchman Flat) portions of the NTS. Runoff from the eastern half of the NTS flow surface drainages to onsite playas and can collect for a few days to a few months. areas of the NTS drain offsite via arroyos and dry stream beds that carry water onl intense or persistent rainstorms. These surface drainages and playas are unable to permanent fish populations (ERDA 1976; Greger and Romney nda).

Reservoirs resulting from discharge of well water located on the NTS support th introduced species of fish: bluegill (Lepomis macrochirus), goldfish (Carassius au golden shiner (Notemigonus crysoleucas). Springs located throughout the site do no populations (Elle 1992). There are no springs, seeps, or other permanent water bod proposed SNF Site; however Cane Spring is located in Area 5, southwest of the propo Site (Greger and Romney nda).

4.9.4 Threatened and Endangered Species

Table 4.9-1 presents a list of federally and state-listed species that may be f vicinity of NTS.

There are no known plants which have been listed as threatened or endangered un Endangered Species Act (16 USC 1531-1534) on NTS. However, the U.S. Fish and Wildl Service has identified candidate species for listing, 11 of which may occur on or i the NTS. Ten of these are Candidate Category 2 species, meaning that information i that they may be appropriate for listing as endangered or threatened but more infor needed. One species, the Beatley milk-vetch, is a Candidate Category 1 species (DOE/NV 1993b, 1991c; EG&G 1993; USAF et al. 1991). This species has been identifi Pahute Mesa (Hunter et al. 1988). A Candidate Category 1 species is one for which substantial information indicating that it is appropriate for listing as endangered Four Candidate Category 2 species (camissona, black wooly-pod, cymopterus, and Beat phacelia) have been identified in Frenchman Flat, although none of these was identi surveys conducted near the proposed SNF facility site (EG&G 1993; Tetratech 1993).

Two listed reptile species on or in the vicinity of NTS are of concern. The ch Federal Candidate Category 2 species which may occur on NTS. The desert tortoise i federally listed threatened species known to occur on NTS (DOE/NV 1993b; EG&G 1993) the desert tortoise and the chuckwalla are listed as reptile species of Frenchman F (DOE/NV 1986b).

Table 4.9-1. Federally and state-listed threatened, endangered, and other special that may be found in the vicinity of the Nevada Test Site.

Common name	Scientific name	Statusb Fed.
	Plants	
Amargosa penstemon	Penstemon fruticiformis ssp. amargosae	C2
Beardtonguec	Penstemon pahutensis	C2
Beatley milkvetchc	Astragalus beatleyae	C1
Beatley phaceliac	Phacelia beatleyae	C2
Black wooly-podc	Astragalus funerus	C2
Camissoniac	Camissonia megalantha	C2
Cymopterusc	Cymopterus ripleyi var. saniculoides	C2
Green-gentianc	Frasera pahutensis	C2
Kingston bedstrawc	Galium hilendiae ssp. kingstonense	C2
Mojave fishhook cactusc	Sclerocactus polyancistrus	NL
White bear desert-poppyc	Arctomecon merriamii	C2
	Birds	
Bald eagled	Haliaeetus leucoephalus	E
Golden eaglec	Aquila chrysaetos	NL
Ferruginous hawkc	Buteo regalis	C2
Loggerhead shrikec	Lanius ludovicianus	C2
Mountain ploverc	Charadrius montanus	C2
Peregrine falcond,e	Falco peregrinus	E
Western least bittern	Ixobrychus exilis hesperis	C2
Western snowy ploverc	Charadrius alexandrinus nivosus	C2
White-faced ibisc	Plegadis chihi	C2
	Reptiles	
Chuckwalla	Sauromalus obesus	C2
Desert tortoisec	Gopherus agassizit	T

	Mammals	
Spotted bat	Euderma maculatum	C2
Pygmy rabbit	Branchylqus idahoensis	C2
	Fish	
Devils Hole pupfishd,f	Cyprinodon diabolis	E

a. Sources: CFR (1993c,d); ERDA (1976); EG&G (1993); DOE/NV (1986b); FR (1991, 19 Hunter et al. (1988); NV DCNR (1992); Tetratech (1993).

b. Status codes:
C1 Federal candidate - Category 1 (probably appropriate to list)
C2 Federal candidate - Category 2 (possibly appropriate to list more study requi
CE State critically endangered by authority of NRS 527.270 (State Division of Fo
CY State protected by authority of NRS 527.60-.120 under the Nevada Cacti and Yucc
E Endangered
NL Not listed
T Threatened
P State protected by NAC 503.050

c. Species recorded on the NTS.

d. U.S. Fish and Wildlife Service Recovery Plan exists for this species.

e. Peregrine falcon seen on the NTS; however not identified to subspecies level.

f. Only known location of this species is outside the NTS 24 miles (39 km) southwe included here due to potential offsite groundwater impacts.

Note: Nevada Department of Wildlife utilizes the Federal threatened and endangered

The distribution and abundance of the desert tortoise have been extensively res latest research for the NTS as a whole was completed in 1991 (DOE/NV 1991c). A bio opinion from the U.S. Fish and Wildlife Service was completed in 1992 for NTS activ planned for 1992 through 1995 (FWS 1992). The desert tortoise is known to exist in southern portion of the NTS, but its abundance on the NTS is considered to be very (DOE/NV 1991c). The northern extent of its range is from Massachusetts Mountain th Control Point Hills and Mid Valley to Topopah Valley and west to the NTS boundary (DOE/NV 1991c).

Two bird species which could occur on or within the vicinity of NTS are federal endangered species. These are the American peregrine falcon and the bald eagle. T American peregrine falcon has been sighted on the NTS in the past but not recently (DOE/NV 1991c; ERDA 1976). Bald eagles may also occur on the NTS, but sightings ha been reported in recent literature (DOE/NV 1986b; EG&G 1993; ERDA 1976; Hunter et al. 1991). Six other bird species, all of which are Federal Candidate Ca species, are known to occur on or within the vicinity of NTS (DOE/NV 1991c; EG&G 19 Recent surveys of Area 5 (which contains the proposed SNF Site) have not identified these species (DOE/NV 1986b; EG&G 1993, 1991, 1990, 1989). However, birds listed a common to Frenchman Flat include the golden eagle and loggerhead shrike (DOE/NV 198 Tetratech 1993).

There are two Federal Candidate Category 2 mammal species identified as potenti occurring in the vicinity of the NTS. Neither the spotted bat nor the pygmy rabbit observed during recent pre-activity surveys for the area (EG&G 1993; USAF 1993). T also not listed as mammals occurring in Frenchman Flat (DOE/NV 1986b; Tetratech 199

There are no known fish species indigenous to the NTS. However, it is importan that the only known location of the Devils Hole pupfish, a federally listed endange approximately 39 kilometers (24 miles) southwest of the NTS. The decline of this s been attributed to low water levels caused by decreasing groundwater levels (ERDA 1 USAF et al. 1991).

Pre-activity surveys for threatened and endangered species have recently been c for the Radioactive Waste Management Site located in Area 5 near the proposed SNF f The primary purpose of these surveys was to identify live tortoise, scat, burrows, Although these surveys have found few tortoise or their sign, each new activity on undergo pre-activity surveys for the desert tortoise (DOE/NV 1991c; EG&G 1993, 1991 addition, these surveys look for other listed species. Recent surveys have not ide

listed or candidate species in the portion of Area 5 surrounding the Radioactive Wa Management Site, which is near the proposed SNF Site (EG&G 1993, 1991).

4.10 Noise

The major noise sources at the NTS occur primarily in developed operational are include various facilities, equipment and machines (e.g., cooling towers, transform pumps, boilers, steam vents, paging systems, construction and materials-handling eq vehicles), aircraft operations, and testing. No NTS environmental noise survey dat At the NTS boundary, away from most facilities, noise from most sources is barely d from background noise levels. Some disturbance of wildlife activities might occur as a result of operational activities and construction activities.

Existing NTS-related noise sources of importance to the public are those from transportation of people and materials to and from the NTS. These sources include buses, private vehicles, helicopters, and airplanes. In addition, some air cargo a via commercial air transport through the McCarren International Airport in Las Vega attributed to the NTS operations.

The State of Nevada and Nye County have not established any regulations that sp acceptable community noise levels with the exception of prohibitions on nuisance no

During a normal week, about 3,300 employees travel to the NTS each day. Most e commute using the contracted bus service and a small portion commute in government vehicles. Both government-owned and private trucks pick up and deliver materials a Most of the private vehicles, buses, and trucks travel to and from the site each da Route 95. The contribution of the NTS operations to traffic volumes along U.S. Rou especially during peak traffic periods, affects noise levels at residences along th

4.11 Traffic and Transportation

Traffic congestion is measured by level of service. Level of Service A represe of traffic. Level of Service B is in the range of stable flow, but the presence of traffic stream begins to be noticeable. Level of Service C is in the range of stab marks the beginning of the range of flow in which the operation of individual users significantly affected by interactions with others in the traffic stream. Level of represents high-density but stable flow. Level of Service E represents operating c near the capacity level. Level of Service F is used to define forced or breakdown traffic. The calculated Level of Service are for discrete locations along a segmen Service will most likely be worse in urban areas and better in rural areas along wi

The Region of Influence for the following analysis includes site roads and regi Nye and Clark counties.

Vehicular access to the NTS is provided by U.S. Route 95 to the south, with off to the northeast provided via Nevada State Route 375. Baseline traffic along segme access to the NTS contributes to differing service level conditions. Nevada State U.S. Route 95 are projected to remain at Level of Service A. No major improvements presently scheduled for those segments providing immediate access to the NTS (NDOT Regional roads and local roads providing access to NTS are presented in Figures 2.1 respectively.

Future background traffic (defined as all future traffic not attributable to th facilities) is projected to contribute to differing service-level conditions for lo The year 2001 was selected for analysis because that is when the impacts from the p facilities would be highest. All local and regional roads are projected to operate Service A.

The Level of Service was calculated using average daily traffic counts (NDOT 19 standard parameters (ITE 1991; Rand McNally 1993; TRB 1985).

The public transit serves the heavily populated regions of Clark County. Contr to the NTS. There is no public transportation system serving the NTS; however, app 70 buses a day transport employees to and from the site. The nearest major railroa Union Pacific, located approximately 50 miles (80 kilometers) east of the NTS. A 9 (15-kilometer) standard-gauge railroad serves Area 25 of the NTS but does not conne Union Pacific (ERDA 1977). No navigable waterways within the Region of Influence a capable of accommodating waterborne transportation of material shipments to the NTS

McCarran International Airport in Las Vegas provides jet air passenger and carg from both national and local carriers. It is outside the Region of Influence. Sma

airports are located throughout the Region of Influence. Desert Rock Airstrip, the airport, is located near Mercury.

4.12 Occupational and Public Health and Safety

Health impacts to the public from activities on the NTS are minimal as a result administrative and design controls to minimize releases of pollutants to the enviro achieve compliance with permit requirements, e.g., air emissions and National Pollu Discharge Elimination System permit requirements. The effectiveness of these contr verified through the use of monitoring and inspections. Health impacts to the publ during normal operations at the NTS via inhalation of air containing radioactive an pollutants released to the atmosphere, immersion in this air, and ingestion of food by these pollutants. Risks to public health from other possible pathways such as e contaminated soil are low relative to these pathways.

Health impacts to NTS workers during normal operations may include those from i of the workplace atmosphere, consumption of potable water, direct exposure, and pos contact with hazardous materials associated with work assignments. The potential f impacts varies from facility to facility and from worker to worker, and available i sufficient to allow a meaningful estimation and summation of these impacts. Howeve are protected from hazards specific to the workplace through appropriate training, equipment, monitoring, and management controls. NTS workers are also protected by occupational standards that limit atmospheric and drinking water concentrations of hazardous chemicals and that also limit radiation exposure. Monitoring ensures tha standards are not exceeded. Additionally, DOE requirements (DOE Order 3790.1B) ens conditions in the workplace are as free as possible from recognized hazards that ca likely to cause illness or physical harm. Therefore, worker health conditions at t expected to be substantially better than required by standards.

Health effects from radiation are presented here as the risk of fatal cancer. the ratio of the health risk estimator (risk of fatal cancer per rem of exposure). estimator for exposures to the public is 5.0 x 10-4 for fatal cancers. The corresp for exposures to workers is 4.0 x 10-4.

The DOE Nevada Field Office published a Waste Minimization and Pollution Preven Awareness Plan in June 1991 to reduce the quantity and toxicity of hazardous, mixed radioactive wastes generated at DOE/NV facilities. The plan is designed to reduce pollutant releases to the environment and thus increase the protection of employees public. All DOE/NV contractors and NTS users that exceed the EPA criteria for smal generators are establishing their own waste minimization and pollution prevention a programs that are implemented by the DOE/NV plan. Contractor programs ensure that minimization activities are in accordance with Federal, state, and local environmen regulations, and DOE Orders (DOE/NV 1993c).

Additional goals include the promotion and use of nonhazardous materials, estab a baseline of waste generation data, calculations of annual reductions of wastes ge implementation of recycling programs. Goals also include incorporation of waste mi concepts and technologies in planning and design of new processes and facilities, a of existing facilities. A waste minimization task force composed of representative contractor and NTS user has been established to coordinate DOE/NV waste minimizatio pollution awareness activities (DOE/NV 1993c).

4.12.1 Doses

4.12.1.1 Radiological Doses. Every individual is affected by natural and other

background radiation. The major sources of background radiation exposure to indivi vicinity of the NTS are shown in Figure 4.7-2. All annual doses to individuals fro radiation are expected to remain constant over time.

Releases of radionuclides to the environment from NTS operations provide anothe of radiation exposure to people in the vicinity of the NTS. Table 4.7-2 summarizes radionuclides and quantities released in curies during baseline NTS operations. Th committed doses to the public resulting from these release are given in Table 4.7-4 to those from natural background radiation, these doses are very small. The doses than 1 percent of the most restrictive standard given in DOE Order 5400.5.

Workers at the NTS receive the same dose as the general population from backgro

radiation but also receive an additional dose from working in the facilities. The average and maximally exposed workers due to operation in 1991 (assumed representat 1995 operations), were approximately 5 and 500 millirem, respectively; the total do workers was about 4 person-rem (DOE/NV 1992c). The maximum dose is well within the of 5,000 millirem per year specified in DOE Order 5480.11 and in 10 CFR 835.

4.12.1.2 Nonradiological Doses. Every individual is also affected by background

concentration of nonradiological pollutants. The maximum background concentrations criteria pollutants which have been measured is provided in Table 4.7-5. The maxim DOE site contribution concentration was then computed, as discussed in Section 4.7.

4.12.2 Health Effects

4.12.2.1 Radiological. The fatal cancer risk to the maximally exposed member of the

public due to the radiological emissions from NTS baseline operations in 1995 would 5.5 x 10-9. The same risk estimator projects 2.6 x 10-6 excess fatal cancer to the 80 kilometers (50 miles) of the NTS. These values would be approximately 2.2 x 10- 1 x 10-4, respectively, during the 40 years of SNF facility operations.

Because of the different age distribution of a working population, the health r for workers are somewhat lower than for members of the general public. As a result baseline operations at the NTS, these estimators predict a fatal cancer risk of 2.0 maximally exposed worker, and 1.6 x 10-3 excess fatal cancer among all workers. Th by an average worker would be 2.0 x 10-6. Over the 40-year operating life of the p facility, and assuming a particular worker during this time, these values would be 6.4 x 10-2, and 8.0 x 10-5, respectively.

4.12.2.2 Nonradiological. As discussed in Section 4.7, the maximum existing DOE site

contribution of criteria nonradiological air pollutants were computed. In Table 4. existing maximum concentration (which adds the maximum existing DOE site contributi maximum background concentration) is presented. The total existing maximum concent values represent the highest concentrations to which members of the public would be In every case where information was available, the highest concentration was less t applicable health-based standard.

4.12.2.3 Health Effects Studies. The epidemiologic studies concerning the NTS have

concentrated on the health effects in soldiers and children associated with nuclear than on plant emissions (Beck and Krey 1983; Bross and Bross 1987; Caldwell et al. Lyon et al. 1979; Rallison et al. 1990; and others). The results regarding the obs incidence and deaths in exposed children are contradictory, with some studies repor excess and others reporting no excess. The validity of the analytical methods used some of these studies are subject to various opinions. For soldiers, the results r leukemia and polycythemia vera differed between two studies relating to nuclear tes but reanalyses showed leukemia, respiratory, and other cancers to be associated onl exposure to higher doses, e.g., more than 300 millirem for leukemia cases.

In March 1990, the Secretary of Energy announced that DOE would turn over respo for analytical epidemiologic research on long-term health effects on workers at DOE and surrounding communities to the Department of Health and Human Services and dire that worker health and exposure data be released. A Memorandum of Agreement with t Department of Health and Human Services was signed in January 1991. The Department Health and Human Services is now conducting the ongoing health effects research pro develop a data base on workers, DOE has initiated an Epidemiologic Surveillance Pro Health-Related Records Inventory.

4.13 Utilities and Energy

4.13.1 Water Consumption

There are 14 active wells which supply water to the NTS. Figure 4.8-2 in Sectio the location of these wells. These 14 wells combined had a capacity of 387 liters (6,139 gallons per minute) in 1993 (DOE/NV 1993a). From 1988 to 1993, water use at varied from a high of 134 liters per second (2,125 gallons per minute) in 1989 to a 60 liters per second (949 gallons per minute) in 1993 (DOE/NV 1994c; Leppert 1993). usage projections to 1995 are unavailable; however, significant changes in the wate level are not anticipated.

There are also a number of deactivated wells located on the NTS. These wells c additional water supply capacity if they were reactivated (Leppert 1993). It has b that the activation of these wells could increase the available water supply by 85 (1,342 gallons per minute). Other methods to increase production of water could in increasing pump sizes or installing new wells (DOE/NV 1993a).

The proposed SNF site would be located in Area 5. There are four wells located two of which supply potable water. These two wells have a capacity of 38 liters pe (595 gallons per minute) (DOE/NV 1994c; 1993b). A third well in the area is curren used to supply water for construction activities. The fourth well has been deactiv (DOE/NV 1993b). In 1993, Area 5 used approximately 12 liters per second (191 gallon minute) of water, including the well used for construction purposes. Water usage f not expected to change substantially from 1993 to 1995 (DOE/NV 1994c; Leppert 1994)

4.13.2 Electrical Consumption

The NTS obtains electrical power from the Nevada Power Company and Valley Elect Association. Each company provides an independent 138 kilovolt transmission line t The capacity of these transmission lines, with scheduled upgrades, is approximately megavolt-amperes. The local utilities' 138 kilovolt transmission grids have adequ within a 80-kilometer (50-mile) radius of the NTS to serve an additional 75 megavol load. In addition, the local utilities' proposed expansion of their existing 230 k systems would make capacity in excess of 200 megavolt-amperes available within an 8 (50-mile) radius (DOE/NV 1993a).

From 1989 to 1993, the annual consumption of electricity ranged from a high of megawatt hours in 1989 to a low of 144,521.5 megawatt hours in 1993. The peak dem from a high of 38.4 megavolt-amperes in 1989 to a low of 30.9 megavolt-amperes in 1 (Leppert 1993; Thornton 1994). In 1995, the annual consumption of electricity is p 176,440 megawatt hours, with a peak demand of 39.5 megavolt-amperes. The instituti energy management practices can regulate the peak demands of various NTS activities the maximum peak capacity is not exceeded. The predicted increase in overall elect for 1995 is attributable to the increased requirements for the Yucca Mountain Site Characterization Project; the usage for the rest of the NTS is predicted to continu trend (Thornton 1994).

The Frenchman Flat Substation, located in Area 5, has a capacity of 12.5 megavo (Thornton 1994). A 34.5 kilovolt line from this substation feeds the loads at Area Tweezer facility, and the east side of the test areas used by LANL (DOE/NV 1993b). the peak demand on the substation was 5.2 megavolt-amperes. This demand is not ant change substantially from 1993 to 1995 (Thorton 1994).

4.13.3 Fuel Consumption

The majority of the energy used at the NTS is provided by electricity, but dies fuel oil are used to provide heat in some facilities and backup power.

4.13.4 Wastewater Disposal

Currently, there are no wastewater disposal facilities in Area 5. Septic syste parts of the NTS for sanitary wastewater disposal. These septic systems discharge percolation/evaporation stabilization ponds. These ponds, however, are only used f disposal of wastewater not generated by any manufacturing processes.

4.14 Materials and Waste Management

The operations conducted at the NTS have resulted in generation of low-level ra waste, hazardous waste, mixed waste (radioactive and hazardous combined), and sanit (nonhazardous, nonradioactive solid waste). In addition, the NTS stores mixed tran received from Lawrence Livermore National Laboratory. This section discusses the t storage, and disposal of waste at the NTS.

DOE currently operates two disposal facilities in Areas 3 and 5 at the NTS for radioactive waste generated by DOE defense facilities. The Area 5 Radioactive Wast Management Site also serves as a interim storage area for LLNL transuranic wastes w shipped to the Waste Isolation Pilot Plant in New Mexico for final disposal. The A also accepts mixed waste, which contains both low-level radioactive waste and hazar only if the waste was generated on the NTS.

All hazardous wastes generated at the NTS are disposed of offsite at commercial approved and permitted by the EPA. Hazardous wastes are temporarily stored at the full compliance with Federal, state, and local requirements.

Mixed waste disposal facilities are presently operating under interim status, p completion of the Resource Conservation and Recovery Act (RCRA) permitting process. Operation of the low-level radioactive waste and mixed waste disposal sites and the transuranic waste storage site are supported by an environmental monitoring program indicates waste is being safely contained in the near-surface environment in which The radioactive and mixed-waste disposal facilities are mainly shallow land burial Figure 4.14-1 shows the location of the waste management facilities at the NTS (DOE 1992b).

The DOE Nevada Operations Office developed and implemented a Waste Minimization and Pollution Prevention Awareness Plan to reduce the quantity and toxicity of haza and radioactive wastes generated at the NTS. The plan is designed to reduce the po pollutant releases to the environment. The objectives of the waste minimization an program are to:

- Identify processes generating waste streams
- Characterize and track each waste stream
- Identify, evaluate, and implement applicable waste minimization technologie
- Set numerical goals and schedules after the initial assessment of technolog economic feasibility
- Establish an employee pollution prevention awareness and training program.

Additional goals include the promotion and use of nonhazardous materials, estab a baseline of waste generation data, calculations of annual reductions of wastes ge implementation of recycling programs, and incorporation of waste minimization conce technologies in planning and design of new processes and facilities and in upgrades facilities.

The NTS manages the following waste categories: mixed transuranic waste, mixed waste, low-level waste, hazardous waste, sanitary waste, and nonhazardous waste. T not currently manage high-level waste or SNF. The NTS waste management activities onsite treatment, onsite storage, onsite disposal, and preparation for appropriate Additionally, the NTS uses and manages an onsite inventory of hazardous materials,
<u>Figure 4.14-1. Existing treatment, storage, and disposal units at the NTS.</u> some m onsite generated waste management and waste shipment, receipt, and disposal, respec

Waste generation rates presented for each of the waste categories for the NTS r 1993 waste generation rates unless otherwise stated and are assumed representative baseline year. Table 4.14-1 presents the baseline waste management for 1995 for th categories currently managed at the NTS. In addition, the table presents available storage capacity and waste disposition.

4.14.1 Transuranic Waste

Transuranic waste from the Rocky Flats Plant and mixed-transuranic waste from L stored at the NTS at the transuranic waste storage cell located in Area 5 Radioacti Management Site. The transuranic waste has been characterized and repackaged, and mixed-transuranic waste has been placed in a RCRA-permitted storage area consisting 55-gallon drums and steel boxes stored on wooden pallets fixed upon a curbed asphal Approximately 204,663 kilograms (451,201 pounds) with a total volume of 612 cubic m

cubic yards) of transuranic waste are stored at the NTS (DOE/NV 1994d). The NTS ex additional transuranic or mixed-transuranic wastes to be stored at this unit.

4.14.2 Mixed Low-Level Wastes

The Area 5 Radioactive Waste Management Site contains Pit 3, which is an active low-level waste management unit. Pit 3 is the only active landfill cell within the Radioactive Waste Management Site for which a RCRA permit is being sought. Pit 3 i unlined, trapezoidal shaped pit occupying 3.42 x 104 square meters (8.46 acres) wit capacity of 1.29 x 105 cubic meters (1.69 x 105 cubic yards). The estimated dispos mixed low-level waste remaining at this facility is 9.03 x 104 cubic meters (1.19 x (DOE/NV 1992b).

A RCRA permit is being sought for a proposed Mixed Waste Disposal Unit in the a immediately north of Pit 3 in the Area 5 Radioactive Waste Management Site. This M

Figure 4.14-2. Flow diagram for waste generation at the NTS. Figure 4.14-3. Flo

Waste type	Volume generated or disposed of (m3)	Available disposal space (m3)	Disposition
Transuranic waste and mixed-transuranic waste	0	8,296	Interim onsi storage
Low-level waste	10,845	438,359	Onsite dispo
Mixed low-level waste	0	90,240	Onsite dispo
Hazardous waste	252	91	90-day pad
Sanitary waste	1.1 x 104b	c	Onsite dispo

a. Sources: DOE/NV (1994d, 1992c).

b. 1992 data.

c. Current disposal space adequate.

Waste Disposal Unit would occupy 2.1 x 105 square meters (52 acres) and consist of cells. The estimated disposal space for mixed waste in this proposed unit is appro 105 cubic meters (1.58 x 105 cubic yards) (DOE/NV 1992b).

In May 1990, mixed waste disposal operations ceased due to EPA issuance of the Disposal Restrictions of RCRA. Active mixed waste disposal operations will commenc interim status in Pit 3 upon completion of NEPA documentation and an approved Waste Analysis Plan (DOE/NV 1993c). No mixed low-level waste has been received, generate disposed of at the NTS since 1991 (DOE/NV 1994d, 1993c,f).

4.14.3 Low-Level Waste

Two low-level waste disposal facilities are in operation at the NTS: Area 5 Rad Waste Management Site and the Area 3 Radioactive Waste Management Site (DOE/NV 1992 The Area 5 Radioactive Waste Management Site receives low-level waste generated at and other DOE facilities and occupies approximately 2.9 square kilometers (730 acre The waste is disposed of in large-diameter shafts, trenches, and shallow pits. The low-level waste disposed of at the Area 5 Radioactive Waste Management Site between 1991 was 3.96 x 105 cubic meters (5.8 x 105 cubic yards). Average annual low-level for this period was 1.3 x 104 cubic meters (1.7 x 104 cubic yards). During 1993, a x 104 cubic meters (1.4 x 104 cubic yards) of low-level waste was disposed of at th (DOE/NV 1994d).

4.14.4 Hazardous Waste

The primary facilities that generate or manage nonradioactive hazardous wastes or store nonradioactive hazardous materials are the Liquified Gaseous Fuels Spill T the Hazardous Waste Accumulation Site, the tunneling facilities and operations, and underground storage tanks.

The Liquified Gaseous Fuels Spill Test Facility is located on Frenchman Lake in This location provides a remote, environmentally acceptable setting for atmospheric

hazardous materials and toxic substances for investigative purposes. The facility tank farm, spill area, wind tunnel, and pads for conducting small volume spill test also includes a control building that houses data acquisition and recording instrum command and control computer, and support personnel. A total of 17 spill tests wer at the facility in Area 5. Discharges from the test facility occur at a controlled a measured volume of hazardous test fluid released on a surface especially prepared test requirements. Personnel monitor and record operating data, close-in and downw meteorological data, and downwind gaseous concentration levels. Spills involving h acid were conducted in 1991 and the results monitored (DOE/NV 1992c).

The Hazardous Waste Accumulation Site consists of an impervious concrete pad wi centimeter (6-inch) curbs to contain spillage and to protect the pad from precipita runoff; a separate curbed area is provided for noncompatible wastes. A roof protec from rain and weathering effects; there is also a fire detection system (DOE/NV 199 operating entity at NTS is a potential satellite accumulation area for hazardous wa satellite accumulation area is allowed to accumulate up to 208.2 liters (55 gallons waste or 0.95 liter (1 quart) of acutely hazardous waste. Within 3 days of reachin quantities, the waste is transferred to the Hazardous Waste Accumulation Site. If unknown or if an offsite treatment, storage and disposal facility wishes to confirm a waste stream, samples are collected for characterization (DOE/NV 1992d).

When the waste containers are transferred to the Hazardous Waste Accumulation S are checked for proper labeling and an accumulation date is assigned to each contai EPA-permitted treatment, storage, and disposal facility is contacted prior to the 9 limit to collect and remove the accumulated wastes from the NTS (DOE/NV 1992d).

Nuclear devices were tested in horizontal tunnels mined into Rainer Mesa at the tests were conducted in zeolitized volcanic tuffs, which act as a perching layer fo infiltrating from the mesa surface. During normal tunneling operations, fractures water are intercepted creating artificial springs in the tunnels. Periodically, th radionuclides from previous underground nuclear tests and are drained out of the tu evaporation ponds or washes. Tunneling and related operations also may have releas compounds and heavy metals to the tunnel effluent. Presently, sampling of the tunn being conducted to characterize the effluent. The objectives of the project includ types and concentrations of radionuclides, metals, and organic compounds in the eff U12t, U12e, and U12n tunnels. Variations of discharge volumes and chemical contami time are also being examined (DOE/NV 1992c).

There is a site-wide inventory of 115 underground storage tanks at the NTS. Th 24 underground storage tanks containing petroleum products that were removed, close or temporarily taken out of service in 1991 in accordance with state statutes as we underground storage tanks which were temporarily closed in 1991 while awaiting upgr (DOE/NV 1992c).

As part of the 1991 underground storage tank activities, all tanks to be upgrad samples taken from the tank ends to identify any soil contamination prior to redesi construction. To date, overfill releases from underground storage tanks located at 12, and 23 gasoline stations were observed and necessitated additional soil samplin underground storage tanks that were planned to be upgraded (except a tank containin material) were also pressure tested for leaks. All tanks passed the test limit of (0.2 gallon per hour) (DOE/NV 1992c).

Numerous underground storage tanks have been identified throughout the site as "Undetermined Activity Status." The contents of some of these underground storage classified as "H?" which indicates that the contents are presumed to be hazardous.

The types of possible wastes found on the surface of the NTS include radionucli compounds, metals, hydrocarbons, and residues from plastic, epoxy, and drilling mud petroleum production related and therefore considered hazardous under Subtitle C of A wide variety of surface facilities, such as injection wells, leach fields, sumps, facilities, tunnel ponds and muck piles, and storage tanks, may have contaminated t and the shallow unsaturated zone of the NTS. Because of the great depths to ground the arid climate, it is assumed that the potential for mobilization of surface and subsurface contamination is minimal. However, contaminants entering carbonate bedr Rainier Mesa tunnel ponds, contaminated wastes injected into deep wells, and wastes into subsurface craters have the potential to reach the regional water table. Pilo be installed during 1992 to support the RCRA permitting process (DOE/NV 1992c).

Annual generation or disposal of hazardous waste at the NTS was approximately 2 meters (329.6 cubic yards) during 1993. Available storage space on the 90-day pad approximately 91 cubic meters (119 cubic yards) (DOE/NV 1994d).

4.14.5 Sanitary Waste

Sanitary wastes are expected to be generated at the current rates for several y future, then decline assuming the present moratorium on underground weapons testing sanitary wastes are disposed of in septic tanks/leach fields, sumps, or in ponds, a wastes are disposed of in landfills at various locations on the site. The NTS curr 13 sewage discharge permits: Area 2, Area 6 (5), Area 22, Area 23, Area 25 (4), and (DOE/NV 1993c). Approximately 9.1 x 103 cubic meters (11,902 cubic yards) of sanit were generated at the NTS during 1991 and 1.1 x 104 cubic meters (14,388 cubic yard 1992 (DOE/NV 1993c). Sufficient disposal space is available at the NTS for current

4.14.6 Hazardous Materials

Polychlorinated biphenyls, pesticides, and asbestos have been or currently are the NTS. These wastes and materials are managed in addition to the approximately 9 kilograms (100 tons) of RCRA-regulated nonradioactive hazardous wastes generated an the NTS, the approximately 218,000 kilograms (240 tons) of non-RCRA-regulated hazar waste generated annually at the NTS, and the wastes and materials managed at the fa discussed previously.

By the end of 1991, all known polychlorinated biphenyl transformers and other e equipment had been either reclassified or appropriately disposed of, and three poly biphenyl-contaminated transformers and regulators were under the 90-day period for reclassification. Successful reclassification of these three polychlorinated biphe transformers will complete the reclassification or disposal of all known polychlori and polychlorinated biphenyl contaminated transformers at the NTS (DOE/NV 1992c).

No unusual environmental activities relating to the Federal Insecticide, Fungic Rodenticide Act occurred in 1991 at the NTS. Pesticides are stored in an approved facility located in Area 23. Pesticide usage includes insecticides, herbicides, an Insecticides are applied twice a month at the food service areas, herbicides are ap year, and all other pesticides are applied on an as-requested basis. General-use p used for most applications, although restricted-use herbicides and rodenticides are occasion (DOE/NV 1992c).

The Area 11 Explosive Ordnance Disposal Facility is a thermal treatment unit fo of conventional explosives. Explosives detonated at the facility include Defense N materials and waste explosives from Reynolds Electrical and Engineering Co., Inc. t operations, the Wackenhut Firing Range (used by the NTS security force), and the re national laboratories. No radioactive or radioactive-contaminated materials are ac detonated at the Area 11 Explosive Ordnance Disposal unit.

The unit encompasses approximately 0.08 square kilometer (20 acres) of land loc between Frenchman Flat and Yucca Flat, with four graded areas. Only one of these g areas is used for detonation. Magazines are used to store detonation materials and explosives. Approximately 80 to 90 percent of the explosives detonated at the Expl Ordnance Disposal unit during the past 10 to 12 years have been water-gel explosive the primary waste was gelatin-based dynamite. Other explosives detonated include s amounts of trinitrotoluene (TNT), RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) pel arms ammunition (from past military operations at NTS), and black powder (DOE/NV 19

4.14.7 Non-hazardous Waste

Solid wastes are regulated through State of Nevada regulations NAC 444 and Fede regulations 40 CFR 241, 257, and 258. Solid wastes generated include used petroleu uncontaminated tunnel muck, drilling fluids, cement and grout wastes, construction sludge from wastewater lagoons, septic tank and chemical toilet sludge, and animal The NTS has several sanitary landfills and construction landfills in operation; sev have been closed or abandoned (DOE 1990).

Some wastes not regulated under RCRA will be stored at the Hazardous Waste Accumulation Site. These nonregulated wastes are shipped offsite along with the RC to a treatment, storage, and disposal facility. Only non-RCRA hazardous wastes tha disposed of at the NTS landfill will be stored at the Hazardous Waste Accumulation offsite shipment. Any drum containing nonregulated wastes will carry a label so sp

contents of the drum will be entered on a space provided on the label. Wastes in t include but are not limited to epoxies, photochemicals, spent antifreeze, and oils that do not carry EPA codes.

Recycling of paper, metals, glass, plastics, and cardboard has already resulted decrease in quantities of waste and is expected to result in significant decreases years (DOE/NV 1992b).

5. ENVIRONMENTAL CONSEQUENCES

5.1 Overview

This chapter describes the potential environmental consequences from the constr operation of spent nuclear fuel (SNF) facilities at the Nevada Test Site (NTS) unde Centralization and Regionalization Alternatives. Potential environmental consequen assessed to the extent necessary to support a programmatic decision concerning the proposed SNF facilities. More detailed considerations of potential environmental c would be performed as necessary prior to initiating construction or operation of th

5.2 Land Use

5.2.1 Centralization Alternative

Construction and operation of SNF facilities under this alternative would requi disturbance of approximately 90 acres (0.36 square kilometer), including buffer are proposed SNF site for program activities would be consistent with existing nearby l land use policies and plans. The current land use designations for this area are L Facility Management and Buffer/Reserved Area. Use of this area for program activit also be consistent with future land use plans (DOE/NV 1993a).

Use of the proposed site for the construction and operation of SNF facilities c irreversible or irretrievable land use impacts in those areas currently under Buffe However, the placement of SNF facilities at this location would be consistent with draft future land use plan, which designates this portion of Area 5 as a Non-Nuclea (DOE/NV 1993a). Therefore, no mitigation measures are proposed.

5.2.2 Regionalization Alternative

As under the Centralization Alternative, use of the proposed site for construct operation of SNF facilities under the Regionalization Alternative would be consiste existing land uses and with all applicable land use policies and plans. Impacts wo character to those described for the Centralization Alternative, except that there reduced land requirements under this alternative.

5.3 Socioeconomics

Socioeconomics as addressed in this Programmatic Environmental Impact Statement encompasses the interaction of economic, demographic, and social conditions. Econo consequences (e.g., capital requirements to support SNF research and development ac affect business activities, market structures, procurement methods, and disseminati commodities within and between regions. Demographic consequences (e.g., in-migrati specialized human resources to support the SNF Management Program) affect size, dis and composition of the population, labor force, and the housing market in the regio consequences (e.g., capacity modifications of public infrastructure to support SNF the overall quality of life enjoyed by the residents of a community (Murdock and Le These conditions are potentially affected either directly or indirectly by actions the U.S. Department of Energy (DOE) SNF Management Program.

The importance of actions is relative to the affected region. A region can be dynamic socioeconomic system, where physical and human resources, technology, socia economic institutions, and natural resources interrelate to create new products, pr

services to meet consumer demands. The measure of a region's ability to support th depends on its ability to respond to changing economic, demographic, and social con

Potential socioeconomic effects are addressed only to the extent that they are with the natural or physical environment. Direct effects include those impacts tha the action and occur at the same time and place. Indirect effects include those im by the action that are later in time or farther removed in distance but still are r foreseeable (i.e., offsite) (CFR 1993e). Direct and indirect effects are presented from 1995 through 2005, and qualitatively through 2035.

Socioeconomic effects are quantified for regional economic activity and populat potential socioeconomic impacts to individual communities, such as public infrastru housing, are discussed qualitatively to address programmatic issues.

Economic impact projections include direct and indirect jobs. Direct jobs are needed to construct or support the operation of the SNF management complex at the N Indirect jobs are created throughout the regional economy within the Region of Infl result of procurement for materials, services, and other commodities, and induced e consumer spending. These direct and indirect impacts reflect both construction and phase demands, which may occur concurrently or independently throughout the project period. Indirect jobs were projected using parameters from the U.S. Bureau of Econ Analysis Regional Input-Output Modeling System.

Two scenarios were analyzed to account for two potential distributions of the S construction efforts. The construction effort consists of fabricating various stru its own construction labor need and a duration of either three or five years. The accelerates the construction labor requirements into the first two years of constru Average Scenario averages the labor requirements of a structure for the duration of The total construction effort for all structures, in labor years, is the same for e Therefore, for structures with a three year construction duration, the Peak Scenari labor needs for the first two years and then a substantial reduction for the third Average Scenario has a constant labor requirement for the three years. Likewise, f with a five year construction duration, the Peak Scenario has a high labor need for years, then a lower need for the remaining three years, while the Average Scenario constant requirement for all five years. Because the total construction labor year structure is the same for both scenarios, the Average Scenario will have a lower re than the Peak Scenario in the first two years, then will have a higher requirement Scenario in the remaining construction years.

Regional population projections reflect the potential change in population resu increase in regional economic activity. Detailed assumptions regarding in-migratio with the SNF Management Program were not developed, given the programmatic scope of analysis. Potential in-migration effects resulting from direct job creation are pr qualitatively where appropriate.

5.3.1 Centralization Alternative

The upper and lower bounds of construction and operation-related jobs generated facilities for both scenarios under the Centralization Alternative from 1995 to 200 in Figure 5.3-1 and tabulated in Table 5.3-1. In its initial phase, the Centraliza may create 54 jobs (25 direct, 29 indirect) over a 5-year period beginning in 1995 through the year 1999 to support project planning, engineering design, personnel op training, and environmental permitting and compliance. Construction is expected to year 2000, requiring a total of 4,351 direct jobs (5,041 indirect jobs). In that y Peak Scenario requires 1,587 construction laborers, while the Average Scenario need There is no operational labor required for this time period. In 2002, after two ye construction, the Peak Scenario decreases its construction labor requirements to 92 while the Average Scenario maintains its 1,346 laborers. Additionally, 300 operati are needed, raising the total of SNF workers to 1,228 for the Peak Scenario and 1,6 Average Scenario. By 2003, the buildings with three year construction durations ha completed; therefore, both the Peak and Average Scenario construction labor require decline to 125 and 157, respectively. Operation labor requirements remain at 300 w Total SNF labor requirements are 425 workers for the Peak Scenario and 457 for the Scenario. In 2004, construction labor needs for both scenarios remains at their pr but operational personnel increase. Total SNF labor requirements are 612 workers i Scenario and 644 workers in the Average Scenario. By 2005, all construction has be and operational personnel have increased to the full staff labor requirement of 800

The Peak Scenario reaches its maximum construction labor with 1,587 direct jobs

total jobs created) over a 2-year period from years 2000 through 2001. The Average would have its maximum construction labor with 1.346 direct jobs (2,906 total jobs

Figure 5.3-1. Total employment effects, NTS centralization alternative. Table 5.3

Years	Time period 1995 - 1999	2000, 2001	2002	2003	2004	2005 +
			Operations			
Direct jobs	25	0	300	300	487	800
Indirect jobs	29	0	344	344	559	918
Total jobs	54	0	644	644	1,046	1,718
			Construction			
Direct jobs						
Peak	0	1,587	928	125	125	0
Average	0	1,346	1,346	157	157	0
Indirect jobs						
Peak	0	1,839	1,076	145	145	0
Average	0	1,560	1,560	182	182	0
Total jobs						
Peak	0	3,426	2,004	270	270	0
Average	0	2,906	2,906	339	339	0
			Total			
Direct jobs						
Peak	25	1,587	1,228	425	612	800
Average	25	1,346	1,646	457	644	800
Indirect jobs						
Peak	29	1,839	1,420	489	704	918
Average	29	1,560	1,904	526	741	918
Total jobs						
Peak	54	3,426	2,648	914	1,316	1,718
Average	54	2,906	3,550	983	1,385	1,718
			Population Change			
Peak	91	5,664	(1,084)	(2,379)	547	540
Average	91	4,804	896	(3,522)	547	447

3-year period from years 2000 through 2002. Operation requirements would be minor when engineering and administrative services are assumed to be in demand to accommo project requirements. Ancillary SNF complex operations, such as utilities and rese development activities, are assumed to begin in 2004, taper off into 2005, and rema constant through 2035. The maximum total SNF management direct jobs under either construction scenario would occur in 2002 with 1,346 construction jobs for the Aver and 300 operation jobs. Implementation of the Centralization Alternative would in projected average annual rate of growth rate for both regional population and emplo 1995 through 2005 by 0.02 percent.

Regional businesses and the work force would benefit from increased competition contract procurement and jobs. Most of this activity is anticipated to be captured County, with a smaller share occurring in Nye County. However, the impact to the r economy represents only a portion of the total economic activity generated by the C Alternative. For instance, purchases of specialized materials and technology acqui occur even outside the State of Nevada. It has been estimated that about 50 percen NTS expenditures occur within the State of Nevada (Nye County Board of Commissioner This leakage would result in the associated economic benefits accruing outside of t economy.

Most of the population change in the Region of Influence above the baseline for be due to in-migration of labor and households to support SNF management activity a It is likely that most of the SNF operation work force would be supplied by SNF per relocating from DOE sites where SNF inventories were stored before shipment to the they are familiar with the processes, technologies, and research. Other demands fo jobs not related to SNF management would be accommodated by the regional labor mark The regional labor market could accommodate most of the construction requirements, exception of very specialized tasks. Construction employment in Clark County is tw the national average. As the population continues to grow, demand on public infras grows as well. These projects will result in continued growth in construction acti (Las Vegas Review Journal et al. 1993).

To assess potential population and housing impacts, an in-migration rate per jo estimated using a ratio between projected employment and population figures (Table

This ratio was applied to the number of total (direct and indirect) jobs created by management activities at the NTS, resulting in the total estimated number of person into the Region of Influence per job created (Table 5.3-1).

With initial operation in 1995 under the both scenarios (Table 5.3-1) a total o could migrate into the Region of Influence. The number of persons coming in would largest for the years 2000 through 2001, (5,664 in-migrants for the Peak Scenario a the Average Scenario) the period when construction starts. In the final phases of people would migrate out of the Region of Influence. However, the number of in-mig would increase in the years 2004 and 2005, as more of the SNF management operations After 2005, in-migration due to SNF management activities would cease, since SNF ma activities would not create any more jobs.

Construction of the SNF complex could result in a temporary increase in housing Nye County. The demand for both the rental market and short-term lodging could inc The demands on housing would fluctuate over time, based on the various construction peak employment levels, the level of local sub-contracting, and any decision by a c develop temporary housing arrangements near the job site. Within Nye County, the c of Tonopah and Beatty would probably experience the most impacts related to housing Both communities support fairly large inventories of temporary housing. While such are favorable for local lodging operators and landlords, they could compete with to demands (Nye County Board of Commissioners 1992).

Overall socioeconomic impacts to Clark County could be absorbed within the proj expansion of the county's economy, local infrastructure, public service, and real e development.

5.3.2 Regionalization Alternative

Socioeconomic impacts resulting from the Regionalization Alternative are expect similar to those for the Centralization Alternative. The construction and operatio each alternative would be the same; therefore, the same issues identified for the C Alternative would apply. Labor requirements might be reduced slightly for the Regi Alternative. Although the volume of SNF stored would be less for the Regionalizati Alternative, an economy of scale occurs for both alternatives, so that differences capital between the two alternatives would be minimized.

5.3.3 Mitigation Measures

5.3.3.1 Coordination with Local Jurisdictions. To reduce construction- and operation-

related impacts, possible coordination with local communities could address potenti from increased labor and capital requirements. The knowledge of the extent and eff growth due to SNF management activities could greatly enhance the ability of affect jurisdictions to plan effectively. Effective planning would address changes in lev housing, infrastructure, utilities, transportation, and public services and finance

5.3.3.2 Enhance Labor Force Availability. To alleviate potential impacts associated with

the in-migration of labor, local labor force availability could be increased throug employment training and referral systems currently provided by the NTS. The goal o systems would be to reduce the potential for in-migration of labor to support SNF m activities.

5.4 Cultural Resources

5.4.1 Centralization Alternative

Under the Centralization Alternative, the construction of SNF facilities is not require the disturbance of more than 90 acres (0.36 square kilometer) on the NTS. known historical, archeological, paleontological, or Native American traditional si proposed area or its vicinity. Therefore, no impacts to cultural resources are exp

ground disturbance, noise, or air emissions during construction and operation of th facilities. Consultation with the Nevada State Historic Preservation Office (SHPO) project implementation is required under Section 106 of the National Historic Prese of 1966. The SHPO may recommend that further archaeological studies be conducted throughout the construction area to verify that there are no archaeological sites s disturbance.

5.4.2 Regionalization Alternative

Under the Regionalization Alternative, the location of the SNF facilities would same but could be reduced in area. As with the Centralization Alternative, impacts anticipated.

5.5 Aesthetics and Scenic Resources

5.5.1 Centralization Alternative

The proposed SNF facilities under the Centralization Alternative, when fully co and under operation, would consist of a series of industrial buildings set within a on the proposed 90-acre (0.36 square-kilometer) site. The facility would have the industrial buildings ranging in height from one to three stories. The maximum heig buildings contained within the site would not exceed 42 feet (13 meters) above grou proposed SNF site is located within a valley over 10 miles (16 kilometers) from U.S separated by intervening hills and mountains, including Red Mountain, the Spotted R Specter Range, Hampel Hill and Skull Mountain. The site would not be visible from outside the NTS or the Nellis Air Force Base Bombing and Gunnery Range. Therefore, to aesthetics and scenic resources are not anticipated.

5.5.2 Regionalization Alternative

Under the Regionalization Alternative, proposed SNF facilities could be reduced and intensity of operations from the Centralization Alternative. Environmental eff aesthetics and scenic resources could also be less than that of the Centralization

5.6 Geologic Resources

This section describes any incremental or additional impacts on geology and geo resources that would result from the construction and operation of the new faciliti with the storage of SNF at the NTS. Seismic and volcanic hazards are discussed in

5.6.1 Centralization Alternative

As discussed in Section 4.6.2, precious metal deposits may exist in certain car and volcanic or sedimentary rocks at the NTS. Figure 4.6-5 shows the proposed SNF relation to these types of geologic terranes as well as to the locations of mining Although the proposed SNF facilities would not be located within a mining district, situated on Tertiary volcanic or sedimentary rocks near volcanic or intrusive cente geologic terrane where small to medium-size precious metal deposits could be develo However, because the NTS would likely remain closed to mining operations, the impac precious metal deposits that might exist at the NTS would not change if the propose facility were to be sited there.

In addition, destruction of unique geologic features are not expected to occur construction and operation of a new SNF storage facility nor are mass movement and and sediment runoff from land disturbances.

5.6.2 Regionalization Alternative

Impacts to geology and geological resources under the Regionalization Alternati generally be as described for the Centralization Alternative.

5.7 Air Resources

Both radiological and nonradiological air emissions impacts from the proposed S are discussed in this section.

5.7.1 Centralization Alternative

5.7.1.1 Emissions.

5.7.1.1.1 Radiological Emissions-There would be no radiological emissions from

construction of the proposed SNF facilities.
The total annual airborne radionuclide releases from
operation of the proposed SNF facilities are provided in Table 5.7-1.

5.7.1.1.2 Nonradiological Emissions-During construction of the proposed SNF

facilities, short-term emissions, such as fugitive dust and heavy equipment exhaust would be temporary and only affect receptors close to construction areas.
Fugitive dust
emissions would be minimized by curtailing soil-disturbing activities during high w operation of the proposed SNF facilities, criteria and hazardous air pollutants wou The total annual emissions from all modules associated with the proposed SNF facili listed in Table 5.7-2.

5.7.1.2 Air Quality.

5.7.1.2.1 Radiological-The GENII environmental transport and dose assessment

model (PNL 1988) was used with 1990 meteorological data from Desert Rock Army Airfi determine effective dose equivalents from the radiological emissions listed in Tabl 7-1. A
population of 15,100 persons was estimated to be within 50 miles (80 kilometers) of SNF facilities. It was also assumed that 1995 operations at the NTS would result i baseline radiological emissions as the 1992 operations at the NTS. The most recent comprehensive radiological emissions report at the NTS was based on 1992 operations

Table 5.7-1. Annual airborne radionuclide emission source terms for proposed NTS SNF facility operational phase.

Isotope	Release rate (Ci/yr)b,c
Tritium	7.9 x 10-1
Carbon-14	1.2 x 100
Manganese-54	2.2 x 10-8
Cobalt-60	4.2 x 10-8
Krypton-85	1.0 x 104
Strontium-90	3.3 x 10-6
Yttrium-90	2.0 x 10-6
Ruthenium-106	1.1 x 10-5
Antimony-125	3.4 x 10-4
Iodine-129	1.0 x 10-1
Cesium-134	6.2 x 10-8
Cesium-137	4.8 x 10-5

a. Source: Johnson (1994).

b. 2.0 x 10-6 Ci/yr of Barium-137m, from Wet Storage, is not in GENII. Barium-137m, with a half-life of 2.55 min, decays to Barium-137, which is stable.

c. 7.5 x 10-8 Ci/yr of Thallium-208, from Wet Storage, is not in GENII. Thallium-208, with a half-life of 3.10 min, decays to Lead-208, which is stable.

Table 5.7-2. Total annual nonradioactive emissions for the SNF storage facility at

Criteria pollutants	Release rate (kg/yr)
Carbon monoxide	1.7 x 103
Particulate matter (PM10)b	1.0 x 10-3
Nitrogen oxides	5.5 x 103
Sulfur dioxide	1.3 x 102
Lead	5.0 x 10-9

Hazardous air pollutants	Release rate (kg/yr)
Selenium compounds	1.6 x 10-4
Mercury compounds	5.1 x 10-1
Chlorine	3.5 x 103
Hydrogen fluoride	1.6 x 101
Cadmium compounds	2.9 x 10-7
Cobalt, chrome, antimony, and nickel compounds	2.0 x 10-10

a. Source: Johnson (1994).

b. All suspended particulate matter is assumed to be PM10.

Table 5.7-3 summarizes the sum of the baseline and the incremental contribution proposed SNF facilities to the effective dose equivalents of the maximum site bound and, collectively, to the population within 50 miles (80 kilometers) of the propose These combined effective dose equivalents for operation of the proposed SNF facilit less than 1 percent of the National Emissions Standards for Hazardous Air Pollutant standard and less than 1 percent of the natural background radiation.

5.7.1.2.2 Nonradiological-The Industrial Source Complex Short Term air

dispersion model (EPA 1992) was used with 1990 meteorological data from Desert Rock Airfield to determine pollutant concentrations resulting from the Centralization Al nonradiological emissions listed in Table 5.
7-2. A maximum emissions baseline was established to characterize conditions that could result if all sources operated to the maximum ex by permit conditions. It was also assumed that 1995 operations at the NTS would re same baseline nonradiological emissions as the 1990 operations at the NTS. The mos comprehensive nonradiological emissions report at the NTS was based on 1990 operati results of modeling are in Table 5.7-4, where a comparison of the existing DOE site concentration is compared to the existing DOE site contribution concentration plus SNF contribution. The increases in pollutant concentrations from operation of the SNF facilities would be negligible in magnitude. The concentrations of pollutants with the inclusion of the proposed SNF facilities would remain within regulatory gu

The calculated atmospheric maximum concentrations at the site boundary and offs proposed SNF facilities are presented in Table 5.7-5. The maximum concentrations a boundary reflect exposure to a maximally exposed individual, whereas the maximum on concentrations reflect exposure to a worker.

5.7.2 Regionalization Alternative

As with the Centralization Alternative, construction of the proposed SNF facili Regionalization Alternative would not result in radiological air emissions, but cou minor, temporary emissions of fugitive dust. These emissions could be slightly les the Centralization Alternative, since the extent of construction disturbance would

Table 5.7-3. Summary of effective dose equivalents to the public from proposed SNF facility plus 1995 baseline operations at NTS.

	Maximally exposed individual doseb	Collective dose to population within 80 km of NTS sources
Dose	1.3 x 10-1 mrem per yearc	8.7 x 10-2 person-remd
NESHAP standard	10 mrem per year	--
Percentage of NESHAP standard	1.3	--
Natural background dose	278 mrem per year	4190 person-rem per year
Percentage of natural backgroun dose	4.7 x 10-2	2.1 x 10-3

a. Effective dose equivalents computed using GENII (PNL 1988).

b. The maximum boundary dose is to the hypothetical individual who remains in the continuously during the year at the NTS boundary.

c. The SNF facility contributes 1.2 x 10-1 millirem to this dose.

d. The SNF facility contributes 8.2 x 10-2 person-rem to this dose.

Table 5.7-4. Comparison of baseline concentrations with most stringent applicable for proposed SNF facility plus current operations.

Criteria pollutant	Averaging time	Most stringent regulation or guidelined (-g/m3)	Maximum background concentration (-g/m3)	Total existing maximum concentratione (-g/m3)	Total maxim conce (-g/m
Carbon dioxide	8-hour	10,000	2,290	2,290	2290.
	1-hour	40,000	2,748	2,748b	2754.
Nitrogen dioxide	Annual	100	a	b	0.20
Lead	Calendar quarter	1.5	a	b	3.7 x
Particulate matt (PM10)c	Annual	50	a	0.43	0.43
	24-hour	150	78.3	84.9	84.9
Sulfur dioxide	Annual	80	a	1.1	1.1
	24-hour	365	39.3	55.2	55.2
	3-hour	1,300	65.4	170.3	170.3
Hazardous air pollutants					
Selenium	8-hour	4.8	a	b	2.18
Mercury compounds	8-hour	0.2	a	b	2.18
Chlorine compounds	8-hour	71.4	a	b	1.52
Hydrogen fluorid	8-hour	59.5	a	b	3.70
Cadmium compounds	8-hour	1.2	a	b	1.81
Cobalt, chromium antimony, and nickel compoundsg	8-hour	1.2	a	b	5.5 x

a. Not measured.

b. No sources indicated.

c. All suspended particulate matter is assumed to be PM10.

d. Criteria pollutant regulations are National Ambient Air Quality Standards. Haz pollutant regulations are Nevada Ambient Air Quality Standards.

e. Includes background concentration plus existing DOE facilities impact concentra baseline concentration.

f. Includes background concentration plus existing DOE facilities impact concentra facilities impact concentration.

g. Individual emission rates were not specified for each of cobalt, chrome, antimo compounds. Only a total emission rate for all four was provided. Therefore, the m standard for any of the four compounds, 1.2 -g/m3 for cobalt, was used.

Table 5.7-5. Calculated annual maximum concentrations for hazardous air pollutants onsite and offsite.

Hazardous air pollutant	Maximum annual average concentration onsite (-g/m3)	Maximum annual average concentration offsite
Selenium compounds	6.03 x 10-8	1.20 x 10-8
Mercury compounds	6.03 x 10-4	1.20 x 10-4
Chlorine compounds	4.2 x 10-1	8 x 10-2
Hydrogen fluoride	1.02 x 10-3	2.04 x 10-4
Cadmium compounds	5.01 x 10-10	1.0 x 10-10
Cobalt, chromium, antimony and nickel compounds	1.50 x 10-10	3.00 x 10-11
Lead	1.21 x 10-11	2.40 x 10-12

a. All impacts from proposed source only. No hazardous air pollutant emissions in available for existing sources.

The same types of radiological and nonradiological air emissions from operation proposed SNF facilities would occur under the Regionalization Alternative as under Centralization Alternative. However, the magnitudes could be lower. As with the C Alternative, the combined dose equivalents from the operation of the proposed SNF f would be less than 1 percent of the NESHAP and less than 1 percent of the natural b radiation. The concentrations of non-radiological air emissions from the operation proposed SNF facilities under this alternative would remain within all applicable r guidelines (EPA 1992; PNL 1988).

5.8 Water Resources

Construction and operation of the SNF modules could affect surface and groundwa resources. Potential environmental impacts to surface water and groundwater resour construction include depletion of groundwater supplies, floodplain encroachment, an water sedimentation from erosion runoff occurring after land clearing. Potential n operational impacts could include depletion of groundwater supplies and diminished water and/or groundwater quality resulting from wastewater discharges from normal o

5.8.1 Centralization Alternative

Separate discussions are provided for surface water quantity, surface water qua groundwater quantity and groundwater quality.

5.8.1.1 Surface Water Quantity. Existing activities on the NTS derive their water supply

from groundwater sources, and the same would be true for construction and operation proposed SNF facilities. Therefore, construction and operation of the proposed SNF would have no impact on surface water availability in the region. In addition, und operating conditions, there would be no wastewater discharges to Area 5 watercourse could affect surface water flow characteristics.

Stormwater runoff associated with construction and operation of the proposed SN is expected to have a negligible impact on surface water quantity. During construc stormwater management techniques would be employed to attenuate runoff. The impact stormwater runoff on the ephemeral character of Area 5 watercourses during operatio

SNF facilities is also expected to be negligible. A site drainage and stormwater m system consisting of a perimeter drainage ditches and a retention pond would be inc of the SNF facilities (Johnson 1994). This system would provide for control of run erosion, which otherwise could affect Area 5 watercourses or the SNF facilities.

As discussed in Section 4.8.1, analyses of available data indicate that the are by the proposed SNF facility may lie in flood Zone X (100-year flood zone with dept 1 foot [0.30 meter]) and/or Zone AO (100-year flood zone with depths between 1 and [0.30 and 0.9 meter]) associated with the Halfpint Alluvial Fan. Accordingly, the would have to be located and constructed to minimize floodplain impacts and to avoi floodplains to the maximum extent possible, as required by Executive Order 11988 (F Management) and DOE Orders. Site-specific surveys would be performed to determine of flooding elevations more accurately.

5.8.1.2 Surface Water Quality. The proposed SNF facility in the northeast portion of

Area 5 is not served by the NTS sanitary sewer system. A number of NTS facilities contained sanitary sewer systems. The nearby Radioactive Waste Management Site doe own septic tank and leach field system to dispose of sanitary wastewater (DOE/NV 19 proposed SNF facilities would have a sanitary sewer system comprised of a sewage tr facility equipped with a sewage treatment and ejection pump system with a programma controller and software. A pressurized sanitary sewer line would be provided to ru lagoon at the facility (Johnson 1994). This system would be adequate to accommodat estimated 9,863 gallons (37,335 liters) per day of sanitary wastewater generated by facilities and personnel. This system would be operated in accordance with State o permitting requirements.

The proposed SNF facilities are designed to generate no liquid releases of wast hazardous chemicals or radiological characteristics related to SNF management opera These facilities would be constructed using state-of-the art technologies including containment, and leak detection and water balance monitoring equipment. The normal operation of the proposed SNF facilities is not expected to affect the quality of a on or near the NTS.

During construction, 90 acres (0.36 square kilometer) would be disturbed, all o previously undisturbed areas. This would create the potential for increased sedime dry washes and shallow drainages or to spread out overland as a result of sheetflow sediment runoff from construction activities would be controlled by implementing so control measures, which would result in negligible effects to surface water quality

In addition, as stated in Section 4.8.1, existing onsite contaminants may be tr dispersed beyond the facility boundary during flooding (USAF et al. 1991). Therefo potential exists for some incremental transportation and dispersion of any addition contaminants that might result from the construction or operation of the SNF facili this potential cannot be determined without additional studies, any additional cont would be unlikely, due to the design of the containment structures and leak detecti the SNF facilities.

5.8.1.3 Groundwater Quantity. Operation of the SNF facilities would require

approximately 9,863 gallons (37,335 liters) per day. This translates to an additio gallons (13,627 cubic meters) of water used at the NTS per year. It is assumed tha demand of the SNF facilities would be supplied via the existing NTS Area 5 supply w water distribution system. If this scenario should be demonstrated to be infeasibl a water supply and distribution system consisting of two 8-inch-diameter wells supp 250,000-gallon (946,333-liter) aboveground storage tanks would be constructed to se facility complex (Johnson 1994).

Water withdrawals to support the proposed SNF facilities would likely be from t Frenchman Flat hydrographic area of the Ash Meadows Subbasin. In 1993, 176 million (666,000 cubic meters) of groundwater was withdrawn by DOE from the Frenchman Flat hydrographic area. An additional 3.6 million gallons (14,000) cubic meters) per ye required for SNF operations. The recharge due to precipitation in the Frenchman Fl hydrographic area was estimated to be 32.6 million gallons (123,000 cubic meters) (This recharge estimate was exceeded for more than thirty years with no decline in s levels (DOE 1988b). Accurate measurement of static water levels are, however, prec numerous conditions on the NTS (Winograd 1970). More detailed analyses of perennia and total water withdrawal from the hydrographic area would be required if the NTS

chosen as a site for SNF management facilities, but because the estimated perennial been exceeded for more than thirty years with no measurable decline in static water likely that increased water use for the SNF Management Facility could be sustained.

Because of hydrogeologic complexities, a regional groundwater flow at the NTS i constrained by the hydrographic basins which are defined by local topography (USAF et al. 1991). Therefore any potential groundwater overdrafts in the Frenchma hydrographic area indicated by previous yield estimates are likely made up by untap groundwater from neighboring hydrographic areas. Localized impacts could occur if perennial yield of Frenchman Flat hydrographic area is exceeded. Potential impacts depletion of water stored locally in the regional aquifer, removal of that groundwa potential uses, and the potential modification of the rate and direction of contami resulting from underground nuclear testing. The complex issues of groundwater cont and use are being addressed in the Resource Management Plan being prepared in conju with the NTS site-wide EIS.

The vast majority of groundwater not withdrawn from the Frenchman Flat hydrogra area, and the Ash Meadows Subbasin as a whole, is discharged at Ash Meadows. Using water withdrawal data, NTS annual withdrawal from the Ash Meadows Subbasin would on increase by 1% or 3.6 million gallons (14,000 cubic meters) to approximately 370 mi (1.4 million cubic meters) if the proposed SNF facilities were sited on NTS. This withdrawal would have little impact on the subbasin as a whole as its perennial yie to be 12 to 18 billion gallons (46 to 68 million cubic meters) (DOE 1988b; USAF et Water from the groundwater systems which pass beneath the NTS annually discharge approximately 8.8 billion gallons (33 million cubic meters) to the deserts southwes (DOE/NV 1993b). Annual groundwater withdrawal for SNF operations would amount to 0 percent of this discharge. No impacts to down-gradient users and discharge areas w expected due to the small volume of water required and the vast amount of water in groundwater system.

Dewatering is not expected to be necessary to construct the SNF facility comple the relatively great depth to groundwater across the NTS. Although perched water t conditions at depths of 70 feet (21 meters) have been reported for Frenchman Flat, excavation activities are expected to occur in the vadose zone. Consequently, ther effect on groundwater quantity due to construction dewatering of wastewater with ha chemical or radiological characteristics related to SNF management activities.

5.8.1.4 Groundwater Quality. As previously mentioned, the proposed SNF facilities are

designed to have no liquid release to the environment. However, for the purpose of resource analysis, a conservative release scenario was evaluated to identify the po environmental consequences of a liquid release to the environment under normal oper conditions. The release scenario was evaluated for information purposes only, as n operating releases are planned for the proposed facility. The scenario consisted o potential liquid release to the environment under normal operating conditions such undetected secondary containment failure or piping leak. The scenario was evaluate conservative estimates of the sensitivity of actual leak detection systems and oper term data from similarly functioning facilities at the Idaho National Engineering L (INEL). The conservative estimates for the hypothetical release included a point r 5 gallons (19 liters) per day to the environment over the course of 1 month. The r and durations were considerably greater than existing leak detection system sensiti surveillance activities, and radiological surveys. Source terms were derived at th confidence level from 8 years of operational data at the INEL Fluorinel and Storage the Idaho Chemical Processing Plant.

The point source release as described above has been conservatively assumed to depth of 40 feet (12 meters) below land surface (the bottom of the Wet Storage Basi Receiving/Canning Facility). As detailed in Section 4.8.2, this is well within the underlying Area 5 at Frenchman Flat. Vertical flow in the uppermost portions of th zone at Area 5 is generally upward toward the surface, due to an extremely high evapotranspiration rate relative to precipitation. Site characterization data for that the vertical flow direction in the vadose zone is upward from 0 to 75 meters (below land surface. In the next interval (75 to 180 meters [250 to 600 feet]), a d rate of 3 meters/1,000 years (10 feet/1,000 years) has been calculated. At a depth meters (600 to 800 feet), a zone of equilibrium is present above the water table (a vertical movement). These data, combined with the relatively extensive depth to th (244 meters [800 feet]) and extreme travel times to the water table, indicate that described above would be highly unlikely to reach the saturated zone. The release

remain indefinitely in the vadose zone beneath the proposed SNF facilities, where i present a persistent source of contamination but would not affect groundwater quali

5.8.2 Regionalization Alternative

Potential impacts to surface water and groundwater from construction and operat proposed SNF facilities under the Regionalization Alternative would generally be as the Centralization Alternative. However, the quantity of groundwater withdrawn to operation of the proposed facilities could be less.

5.9 Ecological Resources

The Centralization and Regionalization Alternatives could potentially affect ec resources primarily through the alteration or loss of habitat. Potential impacts t aquatic resources and threatened and endangered species are described below for bot alternatives.

Radiation doses received by terrestrial biota from waste management activities expected to be similar to those received by humans. Although guidelines have not b established for acceptance limits for radiation exposure to species other than huma generally agreed that the limits established for humans are also conservative for o (NRC 1979). Evidence indicates that no other living organisms have been identified likely to be substantially more radiosensitive than humans (Casarett 1968; National Sciences 1972). Additionally, work areas where potential radiation exposure is hig monitored site workers utilize protective equipment, have controlled access measure entry by biota. Thus, so long as exposure limits protective of humans are not exce substantial radiological impact on populations of biota would be expected as a resu management activities at the proposed SNF facility.

5.9.1 Centralization Alternative

Under this alternative, 90 acres (0.36 square kilometer) of the creosote bush p community would be disturbed during construction. The area disturbed would include construction laydown areas, grading, and new buildings. In addition, disturbance w expected along access roads and other rights of way which have not been included in acres. This plant community is common to the southern portion of NTS. To obviate to this plant community, ground-disturbing activities would be kept to a minimum. also serve to reduce the number of non-native species, such as Russian thistle, to However, non-native species would probably become established in some areas, for ex along the access road.

Impacts to wildlife would occur as a direct result of habitat loss and/or an in increased human presence. There could be a decrease in the number of small mammals reptiles during the construction period due to ground-disturbing activities. More species would be able to move to other areas on the NTS during construction. Depen the carrying capacity of these areas, there could be increased competition for food resources. After construction activities are complete, it is expected that species developed areas would become established.

Impacts to birds protected under the Migratory Bird Treaty Act are expected to during construction, since there are no water sources at the proposed site. Howeve prior to construction may be required by the U.S. Fish and Wildlife Service. Durin there may be an increase in migratory birds utilizing the area due to the increase sources.

There would be no impact on wetlands or aquatic habitats due to the constructio facility because these habitats do not exist in the area. The operation of the pro facilities would increase water sources for wildlife species due to retention ponds lagoon area. This could bring an increase in species, especially migratory birds, habitats. The addition of new species to the area would impact upon the general ec increasing diversity of species. Since these areas would be within fenced enclosur expected that the larger mammals would be unable to directly utilize these water so

Noise and activity associated with construction would be expected to have short on most wildlife. Studies on the effects of noise on wildlife have shown varying r different species. Responses include becoming frightened and running away, alterin

or breeding patterns, changing home ranges (often decreasing them), or adapting to and activity (EPA 1980). These effects would continue indefinitely during the oper the proposed SNF facilities.

Potential impacts to threatened and endangered species would be the direct resu increased human presence and the loss or alteration of habitat. Any Federal Candid state-protected species on the site would result in further consultation with the U Wildlife Service and the Nevada State Forester. Mitigation plans would be develope cooperation with the appropriate agencies if any of these species were identified o site.

Although positive identification of most of the species listed on Table 4.9-1 h during prior studies, the addition of water sources to the area could increase the habitat for some endangered, threatened, or candidate bird species. These might in prey (bald eagle, peregrine falcon, ferruginous hawk, and golden eagle), and specie inhabit water areas such as shorebirds (mountain plover, western least bittern, wes plover, and white faced ibis). An increase in loggerhead shrikes may occur due to that would be erected around the facility and would serve as posts for this bird.

The project area is located within the range of the desert tortoise, a federall threatened species. Recent pre-activity surveys for other nearby projects have not desert tortoise in the general area of the project site. However, a pre-activity project would be needed to determine the presence or absence of the desert tortoise species of concern. If present, the desert tortoise could be impacted during const proposed SNF facilities due to increased vehicular traffic, construction of trenche and other temporary construction excavations. Prior to and during construction act of the areas and removal of tortoises within the fence would decrease the potential to the desert tortoise. All activities with this species must be completed by a qu

5.9.2 Regionalization Alternative

Impacts under this alternative are expected to be generally the same as under t Centralization Alternative. The major difference between the two is the total area disturbed. The Regionalization Alternative is expected to involve construction of and, therefore, to require disturbance of less land.

5.10 Noise

As discussed in Section 4.10, noises generated on the NTS do not propagate offs that impact the general population. Thus, the NTS noise impacts for both the Centr Regionalization Alternatives would be limited to those resulting from the transport personnel and materials to and from the site, which affect the nearby communities, resulting from onsite sources which may affect some wildlife near these sources. T noise on wildlife near SNF management facilities under the Centralization or Region Alternatives would be addressed in a project-specific environmental assessment.

The transportation noises are a function of the size of the work force (e.g., a work force would result in increased employee traffic and corresponding increases i truck and rail, and a decreased work force would result in decreased employee traff corresponding decreases in deliveries). The analysis of traffic noise took into ac the major roadway which provides access to the NTS. Vehicles used to transport emp personnel on roadways would be the principal sources of community noise impacts nea from the Centralization and Regionalization Alternatives.

This analysis used the day-night average sound level to assess community noise, by the U.S. Environmental Protection Agency (EPA 1982, 1974) and the Federal Intera Committee on Noise (FICON 1992). The change in the day-night average sound level f baseline noise level for each alternative was estimated based on the projected chan employment and traffic levels from the baseline levels. The baseline is comparable activity at the NTS for 1993. The combination of construction and operation employ considered. The traffic noise analysis considered U.S. Route 95, which employees u the NTS from Las Vegas. Changes in noise level below 3 decibels would not be expec result in a change in community reaction (FICON 1992).

5.10.1 Centralization Alternative

Under the Centralization Alternative, the projected NTS work force would increa about 48 percent of existing onsite employment in the years 2000 to 2002, the peak period, and decrease thereafter (Section 5.3). There would be a corresponding incr private vehicle, and bus trips. The day-night average sound level at 50 feet (15 m U.S. Route 95 would be expected to increase by about 1 decibel. No change is expec community reaction to noise along this route. No mitigation efforts are necessary.

5.10.2 Regionalization Alternative

Under the Regionalization Alternative, traffic noise impacts would be the same Centralization Alternative.

5.11 Traffic and Transportation

The proposed SNF management activities would involve a small increase in the nu employees commuting to the NTS and the transportation of SNF and hazardous chemical NTS. This section summarizes potential transportation impacts due to the proposed facilities on the NTS.

5.11.1 Centralization Alternative

5.11.1.1 Levels of Service. Levels of service were calculated for construction and

operation of the SNF facility at the NTS. The maximum reasonably foreseeable scena construction and operations occurs when the combined number of employees and popula at their highest. This would occur in 2001, when there would be 3,426 employees an projected baseline population in the Region of Influence of 1,209,316. The Region includes Nye and Clark counties. Direct employees associated with the proposed SNF generate direct trips in the Region of Influence. These trips are distributed to t Influence road network according to percentages based on a traffic flow between the where employees historically have lived. Increases in baseline population and indi employees generate indirect trips in the Region of Influence. These trips are dist on the current average daily traffic per present population in the region of influe segment. Direct and indirect average daily traffic are added and a new level of se determined. Construction and operation employees contribute little to the future t they represent such a small percentage of the Region of Influence population growth

None of the future baseline levels of service would change due to SNF-related i

5.11.1.2 Rail Transportation. The generic facility design would require rail access for

Naval fuel delivery. The rail spur would most likely be built from the Union Pacif approximately 50 miles (80 kilometers) east of the NTS. Impacts from construction operation of the rail spur would be evaluated in detail if the site were selected f facility.

5.11.1.3 Transportation Impacts of Hazardous Chemicals. It is assumed that the

hazardous chemicals required and hazardous waste generated by the proposed SNF faci operation would be transported by truck. The onsite transportation impacts for the chemicals and wastes shipments are calculated based on the assumptions that they do any incident free impacts, the material would not leak during transport, only risk fatalities, and the material spill of entire contents is bound by the risk evaluate Expended Core Facility, considered under facility accidents.

The total distance for onsite shipment of these hazardous chemicals is assumed maximum site boundary distance from the proposed SNF facility to the nearest highwa on the unit risk factor (Cashwell et. al. 1986), occupational and non-occupational considering a rural setting the onsite transportation risks are calculated, assumin shipments.

The maximum one-way distance from the site to the NTS gate by which trucks woul deliver hazardous wastes is 20 miles (32 kilometers). Based on 1.5 x 10-8 accident fatalities per kilometer per shipment, 4.0 x 10-4 accident occupational fatalities a 40-year period. Based on 5.3 x 10-8 accident non-occupational fatalities per kil shipment 1.4 x 10-3 accident non-occupational fatalities are estimated over a 40-ye

5.11.1.4 Transportation Impacts of Radioactive SNF. The definition of offsite

transportation include transportation of radioactive material from the shipping fac storage facility at the receiving site; therefore, local transportation does not se the onsite transportation impacts due to radioactive material shipment.

5.11.2 Regionalization Alternative

The impacts due to the Regionalization Alternative would be less than those des the Centralization Alternative due to the smaller size of the facility and the smal waste expected.

5.12 Occupational and Public Health and Safety

The Waste Minimization and Pollution Prevention Awareness Plan at the NTS would implemented within the SNF Management Program. While more chemicals per year would used, health impacts to the public would continue to be minimal as a result of admi design controls to minimize releases of radioactive and chemical pollutants to the and to achieve compliance with permit requirements and applicable standards. Worke continue to be protected from hazards specific to the workplace through appropriate protective equipment, monitoring, management controls, and occupational standards t limit atmospheric and drinking water concentrations of potentially hazardous chemic limit radiation exposures. This would include protection from wastes generated fro increased use of the chemicals needed to accommodate spent fuel storage and from ra associated with this storage. The NTS Emergency Preparedness Plan would continue t as designed to minimize or mitigate the impact of any emergency upon the health and employees and the public.

Health effects from radiation are presented here as the risk of fatal cancer. the ratio of their health risk estimator (risk of fatal cancer per rem of exposure) this estimator for exposures to the public is 5.0 x 10-4 for fatal cancers. The co estimator for exposures to workers is 4.0 x 10-4.

5.12.1 Centralization Alternative

This section evaluates the impacts to human health resulting from both contamin emissions and direct exposures associated with the proposed SNF facility under the Centralization Alternative. Pathways assessed include inhalation of air, ingestion submersion in plumes, and direct exposure.

5.12.1.1 Radiological Doses. Releases of additional radionuclides to the environment

from operations at the proposed SNF facilities are summarized in Table 5.7-1. The committed doses to the public resulting from the proposed SNF facilities plus basel in 1995 are provided in Table 5.7-3. The doses would be approximately 1 percent of restrictive health standard, and less than 0.1 percent of the natural background ra dose to the maximally exposed member of the public is assumed to remain constant ov 40-year operational lifetime of the SNF; the population dose would increase slightl 3 percent) due to population growth during this 40-year period.

Doses to SNF facility workers are assumed to be similar to those presently rece major DOE facility Waste Processing/Management personnel. Based on data for the ye through 1991 for the Hanford Site, INEL and the Savannah River Site (SRS) (DOE 1992 estimated that the average dose to a worker from annual SNF operations at the NTS w approximately 40 millirem and the maximum dose would be about 3,000 millirem. Assu 800 persons were involved at the peak of these operations, the total worker dose fr

SNF operations would be approximately 32 person-rem. Adding the baseline contribut total dose to all workers at the NTS would be about 36 person-rem.

5.12.1.2 Nonradiological Doses. Releases of additional nonradiological airborne

pollutants from operations at the proposed SNF facilities are summarized in Table 5 concentrations from these releases have been calculated and are presented in Tables 5.7-5.

5.12.1.3 Radiological Health Effects. The fatal cancer risk to the most exposed member

of the public due to operation of the proposed SNF facilities would be 5.9 x 10-8. cancer risk to the most exposed member of the public due to operation of the propos facilities plus baseline operations (1995 levels) would be 6.5 x 10, over 40 years storage duration), the risk to this individual would be approximately 2.6 x 10-6. number of fatal cancers to the population within 80 kilometers (50 miles) of the pr would be 4.4 x 10-5 for the operation of SNF facilities plus baseline operations an the operation of the SNF facilities without baseline operations. The number of inc cancers from total NTS operations to the public during the estimate storage duratio would be approximately 1.8 x 10-3. The number of fatal cancers from all causes th normally be expected to occur during this same time period to the 80-kilometer popu 1,500.

The calculation of the number of health effects to SNF workers from annual oper based on somewhat lower risk estimators than for the general public. The estimator as the result of different age distributions among workers and members of the publi of fatal cancer to the average worker is estimated to be 1.6 x 10-5. The correspon maximally exposed worker is estimated to be 1.2 x 10-3. An excess of 0.013 fatal c all SNF facility workers is projected from peak annual operations. It is projected to radiation over the lifetime of SNF operations could result in an excess of 0.40 among these workers and an increased risk of 6.4 x 10-4 to an individual worker who over this time period. The risks and numbers of excess fatal cancers, both from an lifetime operations, would be increased by about 15 percent if the impacts to worke with baseline activities (Section 4.12.2.1) were included. The health effects due doses to a noninvolved worker, i.e., an NTS worker involved in activities other tha be on the order of 1 percent of the occupational exposure to an SNF worker, based o for the SRS and INEL sites.

5.12.1.4 Nonradiological Health Effects. As indicated in Table 5.7-4, the concentrations

of all measured nonradiological pollutants at the NTS together with the inclusion o Action would remain well within the health-based regulatory guidelines. The increa pollutant concentrations from the Proposed Action would be negligible, compared to baseline concentration; no adverse health effects from these pollutants would be an

The calculated maximum atmospheric concentrations of hazardous chemicals at the boundary and onsite for the proposed action are presented in Table 5.7-5. The maxi concentrations at the site boundary are used to evaluate an exposure to a maximally individual, whereas the maximum onsite concentrations could result in an exposure t Of the potential hazardous chemicals identified for the proposed action, cadmium, n chromium VI (chrome) are carcinogens for which a total cancer risk was calculated. remaining seven chemicals are noncarcinogens for which a hazard index was calculate hazard index value greater than 1 indicates a potential for adverse health effects.

Based on the maximum hazardous chemical concentrations at the site boundary, th fatal cancer risk and the hazard index to the maximally exposed member of the publi only 5.4 x 10-13 and 2.5 x 10-3, respectively. Based on the maximum concentrations lifetime fatal cancer risk and hazard index to a worker would be only 2.7 x 10-12 a respectively. This indicates that there would be virtually no health impacts from releases.

5.12.1.5 Industrial Safety. The measures of impacts for workplace hazards used in this

analysis are (1) total reportable injuries and illnesses and (2) non-exposure-relat

the work place.

Based on hazard rates for personnel of DOE and its contractors, it is estimated injuries and illnesses would be reported and 0.48 fatality would occur from all SNF activities. It is further estimated that 807 injuries and illnesses would be repor fatality would occur among SNF workers during lifetime operations.

5.12.2 Regionalization Alternative

Under the Regionalization Alternative, the radiological and nonradiological dos operation of the proposed SNF facilities at the NTS could generally be lower than t described under the centralization alternative. Any corresponding health effects m decrease.

5.13 Utilities and Energy

Direct changes in utility demand as a result of the Centralization and Regional Alternatives were compared, depending on available data, against either projected 1 or the peak usage for the years 1988 through 1992 for each utility resource. Since NTS is projected to decrease, this comparison is conservative. Impacts to provisio are considered to occur if the demand for a utility is equal to or exceeds the avai within the designated Region of Influence. For the purpose of analysis, the Region for each resource is defined as the area served by the utility provider responsible service demands of the NTS.

5.13.1 Centralization Alternative

5.13.1.1 Water Consumption. For the Centralization Alternative, approximately

0.43 liter per second (6.85 gallons per minute) of water would be required to opera modules within the facility (Harr 1994). The 14 active wells had a capacity of 387 second (6,139 gallons per minute) in 1993 (DOE/NV 1993a). The SNF facilities would 0.1 percent of this amount. NTS wells would operate at 35 percent of total capacit 1989 peak water usage of 134 liters per second (2,125 gallons per minute) was combi SNF facility requirements.

The active wells at Area 5 have a capacity of 38 liters per second (595 gallons (DOE/NV 1994c). The SNF facilities under the Centralization Alternative would requ 1 percent of this amount. Water usage in Area 5 would increase to approximately 33 the pump yield if the 1993 water usage of 12 liters per second (191 gallons per min Area 5 is combined with the SNF facility requirements under the Centralization Alte

5.13.1.2 Electrical Consumption. Under the Centralization Alternative, the SNF

facilities would require approximately 23,000 megawatt hours of electricity per yea approximately 2.63 megavolt-amperes average demand (Harr 1994). The annual consump electricity of the SNF facilities would be approximately 12 percent of the 1995 ann consumption of electricity at NTS. The average electric demand of the SNF faciliti represent 6 to 7 percent of the projected 1995 peak electrical capacity of NTS. Th electric demand of the SNF facilities, combined with the peak electric demand of 39.5 megavolt-amperes, would utilize 94 to 105 percent of the transmission lines' c The 2.63 megavolt-amperes required for the SNF facility represents approximately 61 the operating capacity of the substation at Area 5. The energy requirements of the under the Centralization Alternative combined with the 1993 electric demand on the Flat substation would utilize 63 percent of the substation capacity. It might be n construct additional transmission lines or another substation to support the SNF fa

5.13.1.3 Fuel Consumption. Energy requirements for the SNF facilities under the

Centralization Alternative were calculated assuming electrical power purchased from the primary source of energy; however, fossil fuels may be used to power backup gen

during construction activities. The amount of fuel that would be required for thes would have little effect on fossil fuel usage at the NTS site.

5.13.1.4 Wastewater Disposal. Under the Centralization Alternative, approximately

0.43 liter per second (6.85 gallons per minute) of wastewater would be generated (H Currently, Area 5 has no wastewater facilities. A sewage treatment facility would constructed for the SNF facilities under the Centralization Alternative.

5.13.2 Regionalization Alternative

The proposed SNF facilities under the Regionalization Alternative could consume water, electricity, and fuel than under the Centralization Alternative. Less waste be generated; however, a sewage treatment facility would still need to be construct

5.14 Materials and Waste Management

Operation of the proposed SNF facilities would contribute transuranic, solid lo sanitary waste as a consequence of transport, receipt, unloading, handling, and sto NTS. Under the SNF program, sources of potential contaminants would continue to be to construction support and site operation activities.

SNF storage activities would require the use of chemicals, and the majority of be expected to eventually become waste. Provisions would have to be made for the s the chemical raw materials used within the SNF complex as well as the waste materia from use. It was conservatively assumed that all chemical raw materials used by SN become hazardous wastes. Table 5.14-1 presents the estimated waste generation by w classification for each of the two alternatives (Centralization and Regionalization the two options (wet storage and dry storage).

5.14.1 Centralization Alternative

The Centralization Alternative would generate the greatest amount of waste from complex, since it is the alternative that contributes the larger amount of spent nu stored. On an annual basis, the amount of waste generated by the SNF complex for t alternative would generally be greater than under the Regionalization Alternative. capacity of the SNF complex is the factor that determines the amount of waste gener

Table 5.14-1. Ten-year cumulative estimated waste generation for SNF alternatives NTS (m3).

Time Period	1995-2004	2005-2014	2015-2024	2025-2034
		Centralization Alternative		
		Wet Storage Option		
Transuranic waste	160	160	160	160
Low-level waste	1,950	1,950	1,950	1,950
Hazardous waste	7.4 x 101	7.4 x101	7.4 x 101	7.4 x 101
Sanitary waste	1.2 x 105	1.2 x 105	1.2 x 105	1.2 x 105
		Dry Storage Option		
Low-level waste	76	76	76	76
Sanitary waste	1.9 x 104	1.9 x 104	1.9 x 104	1.9 x 104
		Regionalization Alternative		
		Wet Storage Option		
Transuranic waste	<160	<160	<160	<160
Low-level waste	<1,950	<1,950	<1,950	<1,950
Hazardous	<7.4 x 101	<7.4 x 101	<7.4 x 101	<7.4 x 101
Sanitary waste	<1.2 x 105	<1.2 x 105	<1.2 x 105	<1.2 x 105
		Dry Storage Option		
Low-level waste	<76	<76	<76	<76
Sanitary waste	<1.9 x 104	<1.9 x 104	<1.9 x 104	<1.9 x 104

Source: Harr (1994).

5.14.1.1 Wet Storage Option.

5.14.1.1.1 Transuranic Waste-A small quantity (16 cubic meters, or 20.

9 cubic
yards) of transuranic waste would be generated per year due to the recovery and pur transuranic products from the wet storage option (Harr 1994). Placement of this wa transuranic waste storage cell would have minimal impact on the current transuranic management at the NTS.

5.14.1.1.2 Low-Level Waste-The wet storage option would contribute liquid low-

level waste as a result of its interim storage in water.
This underwater storage would require
filtered and deionized water to prevent possible corrosion problems with fuel eleme storage hardware; further waste would be generated from deionizer resin regeneratio backflushing, and chemical cleaning of the filter. An estimated 195 cubic meters (yards) per year of low-level waste would be generated due to operation of the wet s facility. Placement of this waste into the Radioactive Waste Management Site would option (see subsection 4.15.3). This quantity of low-level waste represents a mini the management of low-level waste at the NTS.

5.14.1.1.3 Hazardous Waste-Installation of the SNF complex would require

additional management of hazardous wastes, including the placement of satellite sto within the SNF complex and more frequent offsite shipments of hazardous waste.
An evaluation
of the impact that the additional hazardous wastes generated by the wet storage opt conducted as part of the required National Environmental Policy Act evaluation.

Additional hazardous waste accumulated would be transferred to the Hazardous Wa Accumulation Site, collected, and removed to an offsite EPA-permitted treatment, st disposal facility. The potential for hazardous waste to adversely affect the envir result of an accidental spill would be limited due to the great depth to groundwate climate, thereby minimizing the likelihood of migration of surface and shallow subs contamination. Similarly, any leaks from new underground or aboveground storage ta have limited potential to affect the environment (DOE/NV 1992c).

It is estimated that the wet storage option would generate approximately 7.4 cu (9.7 cubic yards) of hazardous waste annually. This quantity of hazardous waste re minimal impact to the management of hazardous wastes at the NTS.

5.14.1.1.4 Sanitary Waste-The SNF wet storage option would generate

approximately 1.
2 x 104 cubic meters (15,696 cubic yards) of sanitary waste annually. This quantity of sanitary waste would double the current sanitary waste disposal quantit This would require construction of additional septic/leach field capacity and/or ad lagoon capacity, creating the need for additional land area for sanitary waste disp

5.14.1.2 Dry Storage Option. Unless a hazardous material were added to the fuel at the

point of origination, hazardous material or mixed hazardous wastes would not be exp produced at a dry storage facility. With administrative controls applied at the st prevent hazardous material from coming in, the generation of mixed hazardous waste reduced or precluded. Any hazardous liquid and solid waste produced at the dry sto would be collected in a satellite accumulation area located inside the facility. M be stored onsite unless offsite storage and disposal facilities were licensed to ac waste.

Nonradioactive hazardous waste, such as oils, solvents, gloves, rags, and other associated with plant operation and maintenance, would be stored onsite until there

containers for shipment to an approved offsite treatment, storage, and disposal fac (Hale 1994).

5.14.1.2.1 Low-Level Waste-The low-level radioactive contaminated waste stream

would result mainly from wastes generated during the decontamination operations of crane, and contaminated areas, from disposed personal protective equipment and clot would be used and disposed of during decontamination operations, and from the filte exchange resins used to decontaminate the decontamination liquids.
This waste would be sent to
the waste packaging unit, where it would be compacted into drums for disposal. Old lids removed in the canning process would be collected and placed into solid waste (Hale 1994). Approximately 7.6 cubic meters (9.9 cubic yards) of low-level waste generated annually from the dry storage facility. This quantity of low-level waste minimal impact to the management of low-level waste at the NTS.

5.14.1.2.2 Sanitary Waste-Sanitary sewage is the only liquid effluent to be

released from the facility.
The SNF dry storage option would generate approximately 1.9 x 103
cubic meters (2.5 x 103 cubic yards) of sanitary waste annually. This quantity of would double the current sanitary waste disposal quantity at the NTS. This would r construction of additional septic/leach field capacity and/or additional sewage lag creating the need for additional land area for sanitary waste disposal.

5.14.2 Regionalization Alternative

The Regionalization Alternative would generate less waste from the SNF facility the Centralization Alternative, since it would contribute the smaller amount of SNF The handling capacity of the SNF complex determines the amount of waste generation. either the wet storage option or dry storage option, the wastes generated would be those presented for the Centralization Alternative. Therefore, Table 5.14-1 presen estimated waste generation for SNF for this alternative as less than that generated Centralization Alternative. The impacts presented for each of the waste categories Centralization Alternative apply to the Regionalization Alternative as well.

5.15 Facility Accidents

A potential exists for accidents at facilities associated with the handling, in storage of spent nuclear fuel at the NTS. Accidents can be categorized into events abnormal (for example, minor spills), events a facility was designed to withstand, facility is not designed to withstand. These categories are termed abnormal, desig beyond design basis accidents, respectively. Summarized here are consequences of p accidents for a member of the public at the nearest site boundary and at the neares the collective population within 80 kilometers (50 miles), for workers, and for the See Section 5.11 for a summary of the assessment of transportation accidents.

A review of the historical record of accidents at the NTS is summarized in the section. Methods used to assess potential future events are summarized in Section Evaluations of accident impacts by alternative are summarized in Section 5.15.3 thr A summary comparison of accident impacts by alternative is given in Section 3.2. A supporting documentation for the accident impacts is given in a separate report (HN

This section examines the various activities that have been performed to assess for accidents and their consequences for workers and the public for each alternativ potential reasonably forseeable accidents over the 40-year period are described whi accidents. Secondary impacts of accidents pertaining to cultural resources, econom endangered species, water resources, and ecology are also addressed. This section emergency preparedness plans that have been established to mitigate the primary and effects of accidents.

5.15.1 Historical SNF Accidents at NTS

There have been no SNF operations in the past several years at the NTS upon whi base an accident history.

5.15.2 Methodology

There are no facilities currently at the NTS for receiving, handling and storag can be used as a basis for accident analysis. In the absence of suitable design de proposed SNF facilities during this stage of the SNF Management Program upon which an accident analysis, the approach makes use of accident scenarios and associated d been analyzed and documented for similar facilities. They include spent nuclear fu INEL, the Hanford Site, SRS, and Naval sites.

5.15.2.1 Assumptions and Approach. A number of postulated accidents for similar

facilities have been selected to serve as a common basis for estimating accident co workers and the public at the NTS. Although the accident scenarios, source terms, assumptions are similar to those for other sites, the estimated consequences are un NTS because of site differences in modeling parameters pertaining to distances to s and population centers, population distributions, and meteorology. The GENII code was used to estimate accident consequences for the general public and for individua the site boundary, based on both 50 percent and 95 percent meteorology. Accident consequences and risk are described in terms of dose, latent cancer fatalities, and detriments for workers, for an individual at the site boundary, for a transient ind nearest public access, and for the public residing out to 80 kilometers (50 miles) proposed SNF facility. The estimated frequency of each selected accident is based reference source documentation.

The probability of an airplane crash into the facility is considered very small are no nearby airports with large aircraft activity. For calculational purposes, t such an accident is conservatively estimated at 10-6 per year. Potential accidents airplane crash into the SNF facilities and the estimated consequences have been ana

The secondary impacts of accidental releases of radioactive and hazardous mater also addressed in a qualitative manner. Secondary impacts pertain to effects of ac use, endangered species, water resources, cultural resources, and ecology.

5.15.2.2 Accident Screening. The potential accidents associated with existing SNF

facilities and operations were screened to determine which ones to include in the a analysis for the NTS. The source documentation for this effort was primarily Appen C, and D of Volume 1 that were selected by a screening process for existing SNF fac Initiating events were reviewed, including natural phenomena (e.g., earthquakes and and human-initiated events (e.g., human error, equipment failures, fires, explosive and terrorism). Accidents associated with Expended Core Facility (ECF) operations were analyzed separately, and the results are documented in Appendix D. For the NT maximum reasonably foreseeable criticality and nonradiological accidents are associ ECF. The potential for a criticality exists while the fuel is in dry storage, duri the wet storage pool. Although the probability of any criticality is very low, a h criticality of 1 x 1019 fissions was postulated in the ECF wet pool as a basis for maximum reasonably foreseeable consequences of a criticality.

The selected accidents include beyond-design-basis events in order to reflect t of accident consequences that envelop all other accidents having a reasonable proba occurrence. They also include other accidents with lower consequences and typicall probabilities of occurrence, to show a range of accident types and consequences. included in this set are reasonably foreseeable, meaning that there are one or more events that will lead to their occurrence, and the sequence with the highest probab occurrence is greater than 1 x 10-7 per year. Accidents falling outside of this en meteorite impact, have been judged unreasonable because the probability of occurren than 1 x 10-7 per year.

5.15.2.3 Accident Prevention and Mitigation. Under the Centralization and

Regionalization Alternatives, the proposed SNF facilities at the NTS will be of new construction and incorporate the latest technology for safety. The accidents postu SNF facilities are based on operations and safety analyses that have been performed facilities. One of the major design goals for the proposed SNF facilities is to ac risk to facility personnel and to public health and safety relative to that associa functions at existing SNF facilities. Significant improvements would exist between criteria and safety standards of the new SNF facilities and those for the current f reducing total risk. These would include changes in design to current DOE structur criteria and to planned throughput and storage capacity.

The SNF facilities would be designed to comply with current Federal, state, and DOE Orders, and industrial codes and standards. This would provide facilities that resistant to the effects of severe natural phenomena, including earthquakes, floods high winds, as well as credible events as appropriate to the site, such as fires an man-made threats to its continuing structural integrity for containing materials.

An emergency preparedness plan will also be prepared to lower the potential con of an accident to workers and the public. All workers receive evacuation training timely and orderly personnel movement away from high-risk areas. Plans and arrange local authorities will also be inplace to evacuate the general public that may be a exposure to hazardous materials that are accidently released.

5.15.3 No Action Alternative

There are currently no SNF operations at NTS. The No Action Alternative is not applicable for NTS.

5.15.4 Centralization Alternative

There is a potential for the accidental release of radioactive substances durin stages of SNF handling operations and storage. The operations begin with the recei shipment by truck or rail carrier followed by the unloading of the shipping cask fr transport vehicle. If the SNF requires cooling, the cask is placed into an unloadi the SNF is withdrawn from the cask, moved to a temporary wet storage basin, and pla fuel rack. Some SNF that does not require cooling will be handled in a special cel undergo canning and/or characterization. SNF that does not have to be cooled and d require canning and/or characterization will be loaded into a dry storage canister transfer cask and transported to modular above-grade dry storage. Accidents that m during these handling operations and storage may involve the release of radioactive air or water pathways. The cause of accidents may be due to internal initiators, s error, terrorism, and equipment failure or external initiators, such as an aircraft facility.

5.15.4.1 Radiological Impacts. The set of accidents described below have been chosen

to envelop the consequences of potential accidents for the proposed SNF facilities Although other accidents may occur, their estimated consequences are bounded by the in the envelop or their probability of occurrence would be less than 1 x 10-6 per y accidents were to occur, the dose and risk would be as shown in Tables 5.15-1 and 5 percent and 50 percent meteorology, respectively. Similarly, cancer fatalities ar Tables 5.15-3 and 5.15-4, and the health effects are shown in Tables 5.15-5 and 5.1

5.15.4.1.1 Fuel Assembly Breach-Physical damage and breach of a fuel assembly

could accidentally occur from its being dropped, from objects falling on it, or fro being cut.

The fuel-cutting accident that has been postulated to occur at SRS SNF facilities i

Table 5.15-1. Summary of the Centralization Alternative accident analysis dose and 95 percent meteorology.

		95 Percent m
Accident	Frequency	Dose

scenario	(per year)	MEIa (rem)	NPAIb (rem)	Workerc (rem)	Population (person-rem)
Fuel assembly breach	1.6 x 10-1 d	2.0 x 10-3	1.9 x 10-5	1.5 x 10-3	1.3 x 100
Dropped fuel cask	1.0 x 10-4 e	1.3 x 100	2.7 x 10-2	4.7 x 100	2.8 x 102
Severe impact and fire	1.0 x 10-6 f	9.3 x 100	9.9 x 10-2	3.5 x 100	5.8 x 103
Wind-driven missile impact into dry storage	1.0 x 10-5	3.5 x 10-3	3.2 x 10-4	1.2 x 10-2	5.7 x 10-1
Airplane crash into dry storage	1.0 x 10-6 f	1.5 x 100	7.7 x 10-2	1.2 x 101	5.6 x 102
Airplane crash into dry cell facility	1.0 x 10-6 f	1.2 x 101	2.4 x 10-1	2.3 x 101	7.0 x 103
Airplane crash into water pool	1.0 x 10-6 f	2.2 x 10-2	1.4 x 10-4	2.4 x 10-2	5.8 x 101

a. Maximum exposed individual (MEI). Dose received from inhalation, external,

b. Nearest public access individual (NPAI). Dose received from inhalation and

c. Dose received from inhalation and external pathways.

d. The value is <1.6 x 10-1. For calculational purposes, the value is assumed

e. The value is <1.0 x 10-4. For calculational purposes, the value is assumed

f. The value is <1.0 x 10-6. For calculational purposes, the value is assumed

Table 5.15-2. Summary of the Centralization Alternative accident analysis dose and at 50 percent meteorology.

50 Percent meteorology

Accident scenario	Frequency (per year)	Dose MEIa (rem)	NPAIb (rem)	Workerc (rem)	Populationd (person-rem)
Fuel assembly breach	1.6 x 10-1 e	5.0 x 10-5	2.9 x 10-7	4.7 x 10-5	3.4 x 10-2
Dropped fuel cask	1.0 x 10-4 f	3.2 x 10-2	4.1 x 10-4	1.5 x 10-1	6.9 x 100
Severe impact and fire	1.0 x 10-6 g	2.3 x 10-1	1.5 x 10-3	1.1 x 10-1	1.4 x 102
Wind-driven missile into dry storage area	1.0 x 10-5	8.7 x 10-5	4.7 x 10-6	3.7 x 10-4	1.3 x 10-2
Airplane crash into dry storage	1.0 x 10-6 g	3.7 x 10-2	1.2 x 10-3	3.9 x 10-1	1.4 x 101
Airplane crash into dry cell facility	1.0 x 10-6 g	3.1 x 10-1	3.7 x 10-3	7.4 x 10-1	1.7 x 102

Airplane crash into water pool	1.0 x 10-6 g	5.6 x 10-4	2.0 x 10-6	7.4 x 10-4	1.4 x 100

a. Maximum exposed individual (MEI). Dose received from inhalation, external, a

b. Nearest public access individual (NPAI). Dose received from inhalation and e

c. Dose received from inhalation and external pathways.

d. Dose received from inhalation, external, and ingestion pathways.

e. The value is <1.6 x 10-1. For calculational purposes, the value is assumed t

f. The value is <1.0 x 10-4. For calculational purposes, the value is assumed t

g. The value is <1.0 x 10-6. For calculational purposes, the value is assumed t

Table 5.15-3. Summary of the Centralization Alternative accident analysis cancer f Test Site at 95 percent meteorology.

Accident scenario	Frequency (per year)	Cancer fatalities		95 Percent meteorology	
		MEIa	NPAIb	Workerc	Popula
Fuel assembly breach	1.6 x 10-1 e	9.8 x 10-7	9.3 x 10-9	6.0 x 10-7	6.6 x
Dropped fuel cask	1.0 x 10-4 f	6.4 x 10-4	1.4 x 10-5	1.9 x 10-3	2.8 x
Severe impact and fire	1.0 x 10-6 g	4.7 x 10-3	5.0 x 10-5	1.4 x 10-3	5.8 x
Wind-driven missile impact into dry storage	1.0 x 10-5	1.7 x 10-6	1.6 x 10-7	4.9 x 10-6	2.9 x
Airplane crash into dry storage	1.0 x 10-6 g	7.4 x 10-4	3.9 x 10-5	4.8 x 10-3	5.6 x
Airplane crash into dry cell facility	1.0 x 10-6 g	6.1 x 10-3	1.2 x 10-4	1.8 x 10-2	7.0 x
Airplane crash into water pool	1.0 x 10-6 g	1.1 x 10-5	7.1 x 10-8	9.6 x 10-6	5.8 x

a. Maximum exposed individual (MEI). Radiation exposure received from inhalati

b. Nearest public access individual (NPAI). Radiation exposure received from i

c. Radiation exposure received from inhalation and external pathways.

d. Radiation exposure received from inhalation, external, and ingestion pathway

e. The value is <1.6 x 10-1. For calculational purposes, the value is assumed

f. The value is <1.0 x 10-4. For calculational purposes, the value is assumed

g. The value is <1.0 x 10-6. For calculational purposes, the value is assumed

Table 5.15-4. Summary of the Centralization Alternative accident analysis cancer f Test Site at 50 percent meteorology.

50 Pecent me

Accident scenario	Frequency (per year)	Cancer fatalities			
		MEIa	NPAIb	Workerc	Popu
Fuel assembly breach	1.6 x 10-1 e	2.5 x 10-8	1.4 x 10-10	1.9 x 10-8	1.7
Dropped fuel cask	1.0 x 10-4 f	1.6 x 10-5	2.1 x 10-7	6.0 x 10-5	3.5
Severe impact and fire	1.0 x 10-6 g	1.2 x 10-4	7.5 x 10-7	4.5 x 10-5	1.4
Wind-driven missile impact into dry storage	1.0 x 10-5	4.4 x 10-8	2.4 x 10-9	1.5 x 10-7	6.7
Airplane crash into dry storage	1.0 x 10-6 g	1.8 x 10-5	6.0 x 10-7	1.6 x 10-4	6.8
Airplane crash into dry cell facility	1.0 x 10-6 g	1.5 x 10-4	1.9 x 10-6	3.0 x 10-4	1.7
Airplane crash into water pool	1.0 x 10-6 g	2.8 x 10-7	1.0 x 10-9	3.0 x 10-7	7.0

a. Maximum exposed individual (MEI). Radiation exposure received from inhalat

b. Nearest public access individual (NPAI). Radiation exposure received from

c. Radiation exposure received from inhalation and external pathways.

d. Radiation exposure received from inhalation, external, and ingestion pathwa

e. The value is <1.6 x 10-1. For calculational purposes, the value is assumed

f. The value is <1.0 x 10-4. For calculational purposes, the value is assumed

g. The value is <1.0 x 10-6. For calculational purposes, the value is assumed

Table 5.15-5. Summary of the Centralization Alternative accident analysis health Site at 95 percent meteorology.

95 Percent m

Accident scenario	Frequency (per year)	Total health detrimentsa			
		MEIb	NPAIc	Workerd	Pop
Fuel assembly breach	1.6 x 10-1 f	1.4 x 10-6	2.1 x 10-10	8.4 x 10-7	9.7
Dropped fuel cask	1.0 x 10-4 g	9.3 x 10-4	3.0 x 10-7	2.6 x 10-3	4.1
Severe impact and fire	1.0 x 10-6 h	6.8 x 10-3	1.1 x 10-6	2.0 x 10-3	8.5
Wind-driven missile impact into dry storage	1.0 x 10-5	2.5 x 10-6	3.4 x 10-9	6.9 x 10-6	4.2
Airplane crash into dry st	1.0 x 10-6 h	1.1 x 10-3	8.8 x 10-7	6.7 x 10-3	8.2
Airplane crash into dry ce facility	1.0 x 10-6 h	8.9 x 10-3	2.7 x 10-6	2.6 x 10-2	1.0
Airplane crash into water	1.0 x 10-6 h	1.6 x 10-5	1.5 x 10-9	1.3 x 10-5	8.5

a. Maximum exposed individual (MEI). The estimated number of cancer fataliti

b. Radiation exposure received from inhalation, external, and ingestion pathw

c. Nearest public access individual (NPAI). Radiation exposure received from

d. Radiation exposure received from inhalation and external pathways.

e. Radiation exposure received from inhalation, external, and ingestion pathw

f. The value is <1.6 x 10-1. For calculational purposes, the value is assume

g. The value is <1.0 x 10-4. For calculational purposes, the value is assume

h. The value is <1.0 x 10-6. For calculational purposes, the value is assume

Table 5.15-6. Summary of the Centralization Alternative accident analysis health e at 50 percent meteorology.

		50 Perc		
		Total health detrimentsa		
Accident scenario	Frequency (per year)	MEIb	NPAIc	Workerd
Fuel assembly breac	1.6 x 10-1 f	3.7 x 10-8	1.4 x 10-8	2.6 x 10-
Dropped fuel cask	1.0 x 10-4 g	2.3 x 10-5	2.0 x 10-5	8.4 x 10-
Severe impact and f	1.0 x 10-6 h	1.7 x 10-4	7.2 x 10-5	6.2 x 10-
Wind-driven missile impact into dry storage	1.0 x 10-5	6.4 x 10-8	2.3 x 10-7	2.1 x 10-
Airplane crash into dry storage	1.0 x 10-6 h	2.7 x 10-5	5.6 x 10-5	2.2 x 10-
Airplane crash into dry cell facility	1.0 x 10-6 h	2.2 x 10-4	1.8 x 10-4	4.2 x 10-
Airplane crash into water pool	1.0 x 10-6 h	4.1 x 10-7	1.0 x 10-7	4.1 x 10-

a. Maximum exposed individual (MEI). The estimated number of cancer fatalities, ca

b. Radiation exposure received from inhalation, external, and ingestion pathways.

c. Nearest public access individual (NPAI). Radiation exposure received from inhal

d. Radiation exposure received from inhalation and external pathways.

e. Radiation exposure received from inhalation, external, and ingestion pathways.

f. The value is <1.6 x 10-1. For calculational purposes, the value is assumed to b

g. The value is <1.0 x 10-4. For calculational purposes, the value is assumed to b

h. The value is <1.0 x 10-6. For calculational purposes, the value is assumed to b
chosen as representative of the fuel assembly breach accident (E. I. du Pont de Nem Co. 1983). During normal SRS operations, the inert, non-uranium-containing extremi SNF elements are cut off in the repackaging basin before the elements are bundled. accident occurs when the actual uranium fuel is inadvertently cut, causing a radioa The source term for this accident is shown in Table 5.15-7. The estimated frequenc occurrence for this accident is 1.6 x 10-1 per year, based on SRS operating experie Because of anticipated differences in operations and facilities at the NTS, however frequency is expected to be much less than 1.6 x 10-1 per year.

5.15.4.1.2 Dropped Fuel Cask-The dropped fuel cask accident that has been

postulated to occur at the Hanford Site (reference Volume 1, Appendix A) is chosen representative of the dropped fuel cask/fuel handling accident for the new Centrali Alternative facility at NTS.
This accident is initiated when a fuel cask is dropped and overturned in the fuel transfer area. Broken fuel elements spill out of the cask, within the away from the pool. It is assumed that the shipping cask ruptures, exposing all of fuel elements in three canisters: 42 fuel elements, each containing 22.5 kilograms fuel. The source term for this accident is shown in Table 5.15-8. The probability is estimated to be less than 1 x 10-4 per year.

5.15.4.1.3 Severe Impact and Fire-The severe impact and fire accident that has

been postulated to occur at the Hanford Site (reference Volume 1, Appendix A) is ch representative of the severe impact and fire/onsite transportation accident for the Centralization Alternative facility at NTS.
This accident assumes an unspecified initiating event that subjects the fuel assemblies to a severe impact, breach of the transport cask, During the accident, the fuel pins rupture on impact or upon heating in the fire, w an hour before being extinguished. Volatiles, particulates, and noble gases are re atmosphere. The source term for a release of 540 curies is shown in Table 5.15-9. estimated probability of occurrence for this accident, reflecting the fact that the site would be new, is less than 1 x 10-6 per year.

5.15.4.1.4 Wind-driven Missile Impact into Storage Casks-The wind-driven

missile impact into storage casks accident that has been postulated to occur at the Reactors Site (reference Volume 1, Appendix D) is chosen as representative of the w
Table 5.
15-7. Estimated radionuclide releases for a fuel assembly breach accident at the NTS.

Radionuclide	Release (Ci)
Iodine-131	7.1 x 10-2
Iodine-133	1.4 x 10-30
Krypton-85	1.8 x 102
Xenon-133m	1.1 x 10-8
Xenon-133	1.1 x 100

a. Source: E. I. du Pont de Nemours & Co. (1983).

Table 5.15-8. Estimated radionuclide releases for a dropped fuel cask accident at the NTS.

Radionuclide	Release (Ci)	
	Onsite (2 hours)	Offiste (8 hours)
Plutonium-236	1.3 x 10-8	5.4 x 10-8
Plutonium-238	2.9 x 10-3	1.2 x 10-2
Plutonium-239	6.7 x 10-3	2.7 x 10-2
Plutonium-240	3.5 x 10-3	1.4 x 10-2
Plutonium-241	2.7 x 10-1	1.1 x 100
Plutonium-242	1.3 x 10-6	5.1 x 10-6
Americium-241	5.7 x 10-3	2.3 x 10-2
Curium-244	2.8 x 10-4	1.1 x 10-3
Europium-154	5.4 x 10-3	2.1 x 10-2
Cesium-134	7.9 x 10-3	3.2 x 10-2
Cesium-137	4.5 x 10-1	1.8 x 100
Cerium-144	1.7 x 10-3	6.8 x 10-3
Praseodymium-144	1.7 x 10-3	6.8 x 10-3
Praseodymium-144m	2.0 x 10-5	8.1 x 10-5
Promethium-147	1.2 x 10-1	4.9 x 10-1

Antimony-125	7.3 x 10-3	2.9 x 10-2
Tellurium-125m	1.8 x 10-3	7.3 x 10-3
Ruthenium-106	3.2 x 10-3	1.3 x 10-2
Strontium-90	3.5 x 10-1	1.4 x 100
Yttrium-90	3.5 x 10-1	1.4 x 100

a. Source: Volume 1, Appendix A, Table A-1.

Table 5.15-9. Estimated radionuclide releases for a severe impact and fire acciden at the NTS.

Radionuclide	Release (Ci)
Tritium	4.6 x 101
Krypton-85	4.0 x 102
Strontium-90	2.7 x 10-2
Ruthenium-106	1.3 x 100
Cesium-134	1.7 x 101
Cesium-137	8.0 x 101
Plutonium-238	8.9 x 10-4
Plutonium-239	1.6 x 10-3
Plutonium-240	1.8 x 10-3
Plutonium-241	7.3 x 10-2
Americium-241	1.0 x 10-3

a. Source: Volume 1, Appendix A, Table A-14.

missile accident for the new Centralization Alternative facility at NTS. This acci by natural phenomena, a major wind storm or tornado in excess of facility design ba scenario, a large object is propelled by the wind into a storage container, causing seal to be breached. No fuel damage results from the impact because of the strengt containers used. The source term is based on the spent nuclear fuel corrosion film of the original corrosion film on the fuel is released from the cask to the atmosph source term is shown in Table 5.15-10. The probability of this event is estimated 1 x 10-5 per year, based on a design basis tornado probability of 1 x 10-3 per year impact with damage probability of less than 1 x 10-2.

5.15.4.1.5 Airplane Crash Into Dry Storage-The airplane crash into dry storage

accident that has been postulated to occur at the Naval Reactors Site (reference Vo Appendix D) is chosen as representative of the airplane crash into the dry storage for the new Centralization Alternative facility at NTS.
This accident initiated by an airplane
crash into the SNF dry storage facility. The accident is postulated to cause damag storage cask. Due to the severity of the impact, the cask seal is assumed to be br resulting in damage to the fuel and the release of corrosion products, located on t exterior, to the environment. The impact also causes a fire and a release of fissi is assumed that 1 percent of all of the fuel units stored inside the cask are damag impact or by the fire, and that those fission products are available for release. fission products, 100 percent of the noble gases, 3 percent of the halogens, 1.1 pe cesium, and 0.1 percent of the remaining solids are released to the environment. Al of the original corrosion products from the fuel units are released from the cask t atmosphere. The source term for this accident is shown in Table 5.15-11. The prob accident is small and is assumed to be less than 1 x 10-6 per year.

5.15.4.1.6 Airplane Crash into Dry Cell Facility-The airplane crash into the dry

cell facility accident that has been postulated to occur at the naval Reactors Site Volume 1, Appendix D) is chosen as representative of the airplane crash into the ca characterization cell accident for the new Centralization Alternative facility at N
This
accident is initiated by an airplane crash into the dry cell facility. The acciden cause significant damage to the building, resulting in the loss of containment and

Table 5.15-10. Estimated radionuclide releases for a wind-driven missile impact in storage cask at the NTS.

Radionuclide	Release (Ci)
Cobalt-60	9.58 x 10-2

Iron-55	1.76 x 10-1
Cobalt-58	3.54 x 10-2
Manganese-54	5.98 x 10-3
Iron-59	5.11 x 10-4

a. Source: Volume 1, Appendix D, Section F.1.4.2.2.1.

Table 5.15-11. Estimated radionuclide releases for an airplane crash into dry stor at the NTS.

Radionuclide	Release (Ci)
Cesium-134	2.6 x 101
Cesium-137	3.6 x 101
Plutonium-238	5.9 x 10-2
Barium-137m	3.1 x 100
Strontium-90	3.1 x 100
Cerium-144	7.2 x 100
Niobium-95	4.4 x 100
Yttrium-90	3.1 x 100
Ruthenium-106	6.1 x 10-1

a. Source: Volume 1, Appendix D, Section F.1.4.2.2.2.

systems. The fuel units inside the dry cell are damaged by the impacts and fire. results in the release of corrosion products to the environment. For this accident percent of the fuel units stored inside the dry cell are assumed to be damaged by e impact or the resultant fire and those fission products would be available for rele fission products available for release, 100 percent of the noble gases, 3 percent o 1.1 percent of the cesium, and 0.1 percent of the remaining solids are released to environment. Ten percent of the available corrosion products are released to the e The source term for this accident is shown in Table 5.15-12. The probability of th estimated to be less than 1 x 10-6 per year.

5.15.4.1.7 Airplane Crash into Water Pool-The airplane crash into the SNF water

pool accident that has been postulated to occur at the Naval Reactors Site (referen Appendix D) is chosen as representative of the airplane crash into the SNF water po for the new Centralization Alternative facility at NTS.

This externally initiated accident occurs when an airplane crashes into an SNF water pool and damages the fuel units stored t Fission products and corrosion products are released from the fuel units into the w the pool water is not released to the environment. The presence of the pool water a release of gaseous fission products to the atmosphere. In this accident scenario the fuel units stored inside the pool are postulated to be damaged and those fissio available for release. Of the available fission products, 100 percent of the noble 25 percent of the halogens are released to the pool water. Due to the presence of there is a reduction of the halogen release by a factor of 10 prior to release to t The source term for this accident is shown in Table 5.15-13. The probability of th estimated to be less than 1 x 10-6 per year.

5.15.4.2 Nonradiological Hazards. The two bounding accidents involving nonradiological

hazards are a chemical spill and fire and a diesel fuel fire. Both of these accide with the Expended Core Facility operations and the accident frequencies and impacts addressed in Volume 1, Appendix D. The analyses of these accidents considered the workers on the site as well as to the offsite population. The impacts were measure potential heath effects due to exposure to toxic chemicals released during these ac the ECF at this site will be a new design and construction, it will incorporate all

Table 5.15-12. Estimated radionuclide releases for an airplane crash into dry fac

public in the event of an accident.

5.15.4.3 Secondary Impacts. In the event of an accidental release of radioactive

substances, there is a potential for secondary impacts to cultural resources, endan water resources, and public and agricultural land use, the ecology in the vicinity national defense, and local economics. In order to assess the impacts, a severe ac resulting release of radioactive material were evaluated. The accident chosen for an airplane crash into the Centralization Alternative canning and characterization Utilizing the 50 percent meteorology and the typical flat topography of the propose the dispersion of radioactive material and the resulting dose were calculated. Fig shows the isodose lines ranging from 870 millirem per year down to 87 millirem per is approximately equivalent to cosmic and terrestrial background radiation. The fa between the accident site and the 87 millirem per year line is 8,000 feet (2,400 me Therefore, in order to minimize the potential impact of an accident on the non-NTS and the public, the SNF facility should be located at least 8,000 feet (2,400 meter boundary. Given the available space within Area 5 and the large buffer zone surrou proposed SNF site and the NTS, the final siting location could easily accommodate t constraint. This design constraint could be applied to other environmental resour final siting process. The secondary impacts in other environmental resources which accommodated as easily are summarized below. Table 5.15-14 presents a summary of t postulated severe accident secondary impacts on the environment, economy, and natio defense. The evaluation was performed using 50 percent meteorology.

5.15.5 Decentralization Alternative

The Decentralization Alternative is not applicable for the NTS.

5.15.6 1992/1993 Planning and Basis Alternative

There are currently no SNF operations at NTS. The 1992/1993 Planning Basis Alt is not applicable for NTS.

Figure 5.15-1. Typical Isodose lines for an airplane crash into a dry cell accide

Table 5.15-14. Secondary impacts of the Centralized Alternative accidents at NTS.

Environmental or social factor	Impact
Land Use	Possible minor impact. The dispersion of radioactive material would be limited within the NTS boundaries. The major NTS facilities in the vicinity of the proposed SNF site include the Radioactive Waste Management Site and the Liquified Gaseous Fuels Spill Test Facility.
Cultural Resource	Possible minor impact. Surveys conducted for other Area 5 activities have indicated only scattered artifacts in the vicini the proposed SNF site. No major prehistoric/historic sites are anticipated to be located in the vicinity of the proposed SNF site. Access to any random artifacts found during the accident investigation and cleanup would have to be restricted until radioactive decay had occurred.
Aesthetic and Scenic Resources	No impact. The area of contamination does not envelop aesthetic and scenic resources.
Water Resources	No impact. The nuclear testing program has dispersed radioactive material in the vicinity of the proposed SNF site during aboveground nuclear tests. Due to the great depths of the groundwater, the groundwater was not contaminated. It is anticipated that an accident would not alter the pathways to the groundwater.
Ecological Resources	Possible impact. Many threatened or endangered plants and animals, except fish species, are potentially on or near the NTS
Treaty Rights	No impact. There are no onsite areas subject to Native American Treaty rights.
National Defense	No impact. The area of contamination does not envelop U.S. military or defense industry facilities.
Economic Impacts	Possible minor impact. The dispersion of radioactive material would be limited within the NTS boundaries. The major NTS

facilities in the vicinity of the proposed SNF site include the Radioactive Waste Management Site and the Liquified Gaseous Fuels Spill Test Facility.

5.15.7 Regionalization Alternative

Under the Regionalization Alternative, new facilities would be constructed and SNF. Details for the new facilities have not been defined, but it is reasonable to would be similar to but with less throughput and storage requirements than those ne Centralization Alternative. Due to smaller throughput and storage requirements, th for accidents (i.e., probability of occurrence) will be similar to but less than th the Centralization Alternative. The accident consequences would be similar for bot Consequently, it is reasonable to assume the accident consequences and risks descri Centralization Alternative envelop the Regionalization Alternative.

5.15.8 Emergency Preparedness and Plans

DOE has issued a series of Orders specifying the requirements for emergency pre (DOE Orders 5500.1A, 5500.2A, 5500.3, draft 5500.3A, 5500.4, and 5500.9), and each has established an emergency management program. These programs are developed and maintained to ensure adequate response for most accident conditions and to provide framework to readily extend response efforts for accidents not specifically conside emergency management program incorporates activities associated with planning, prep and response.

Officials at each DOE site have specified the emergency preparedness requiremen DOE facilities under their jurisdiction in a manner consistent with the relevant DO existing facilities have emergency plans and procedures that either implement the D requirements or are integrated with the site planning.

The Nevada Operations Office Emergency Preparedness Plan is designed to minimiz mitigate the impact of any emergency upon the health and safety of employees and th The plan integrates all emergency planning into a single entity to minimize overlap duplication, and to ensure proper responses to emergencies not covered by a plan or The plan is based upon the concept that the Manager, Nevada Operations Office, has capability to manage, counter, and recover from an emergency occurring within the N Operations Office responsibility.

The Nevada Operations Office plan provides for (1) identification and notificat personnel for any emergency that may develop during operational or nonoperational h (2) the receipt of warnings, weather advisories, or any other information that may advance warning of a possible emergency; and (3) prearranged actions which may be t minimize the effect of the emergency. The plan is based upon current Nevada Operat vulnerability assessments, resources, and capabilities regarding emergency prepared

5.16 Cumulative Impacts and Impacts from Connected or

Similar Actions

The NTS already contains several major DOE and non-DOE facilities, unrelated to that would continue to operate throughout the operating life of the proposed SNF ma facilities. The activities associated with these existing facilities produce envir consequences that have been included in the baseline environmental conditions (Chap against which Sections 5.1 through 5.15 have assessed the environmental consequence Centralization and Regionalization Alternatives. This section uses the environment conditions presented in Chapter 4 to assess potential cumulative impacts from the p management facilities, if constructed at the NTS, plus other reasonably forseeable

In addition to the proposed SNF management facilities, reasonably foreseeable a considered in this cumulative impact assessment include the proposed Expended Core (described in Volume 1, Appendix D), activities included in the present Five-Year P Master Plan for the NTS (DOE/NV 1993b), and the potential geologic repository at th Mountain site. Major programmatic initiatives consist of constructing the followin site improvements for a new consolidated testing area sponsored by Los Alamos and L Livermore National Laboratories; a Transuranic Waste Certification Building; refurb expansion of several existing facilities; construction of several small office buil

assessment and remediation projects; several roadway upgrading or improvement proje several flood control projects; and several utility installation or upgrade project number of communications, security, an safety improvements identified in the Master under consideration throughout the NTS.

Specifically with respect to Area 5, a number of projects are proposed (DOE/NV Continued use of the Radioactive Waste Management Site and the Spill Test Facility Providing storage for transuranic waste and hazardous waste prior to offsite dispos proposed. Additional projects have also been proposed to provide utility and infra upgrades and improvements. These projects include replacing the Frenchman Flat pow substation and a number of construction projects for water Service Area C including the Yucca Flat and Frenchman Flat water systems, and adding additional tanks and wa the area. Nearby proposals identified for Area 6 include following a formal, expan land-use plan for the Control Point, Yucca Lake, and the Construction Facilities.

The potential geologic repository at the Yucca Mountain site, which could invol construction and operation of a geologic repository for spent nuclear fuel and high NTS land and other federal land on the western boundary of the NTS, is also conside cumulative impacts analysis. Considering the relatively isolated location of the N offsite activities (other than the potential geologic repository at Yucca Mountain) be of limited scope.

The following cumulative impacts analysis considers the potential incremental e the proposed SNF management facilities and the proposed Expended Core Facility in d The potential incremental impacts from activities proposed in the Five-Year Plan, a Plan the potential geologic repository at the Yucca Mountain site, and from future activities are assessed in a more qualitative manner.

5.16.1 Centralization Alternative

Separate analyses of potential cumulative impacts from the Centralization Alter against the environmental baseline conditions presented in Chapter 4 are provided b

5.16.1.1 Land Use. Construction of the proposed SNF management facilities would

require the dedication of approximately 90 acres (0.36 square kilometer) of undevel the NTS. Construction of the proposed Expended Core Facility would require the ded an additional 30 acres (0.12 square kilometer) of undeveloped land, increasing the requirement to 120 acres (0.48 square kilometer). This represents less than 1 perc roughly 450,000 acres (1,800 square kilometers) of undeveloped land remaining on th acre (3,500 square kilometers) NTS. Additional unknown areas of undeveloped land, parcels of under 100 acres (0.4 square kilometer), might have to be dedicated to so activities proposed in the Five-Year Plan and Master Plan. Many of these proposed not require the dedication of undeveloped land. Land on the southwestern part of t already been allocated for the potential Yucca Mountain repository and current site characterization for a potential geologic repository at the Yucca Mountain site.

Considering the large area of undeveloped land on the NTS, the cumulative dedic land to all reasonably foreseeable activities on NTS would not likely serve to furt availability of land on the NTS for future development. Large areas of undeveloped available for development off of the NTS, and any future offsite development couple proposed onsite development discussed above is not likely to create regional land s could severely limit future regional development.

5.16.1.2 Occupational and Public Health. The annual collective effective dose

equivalent from the existing NTS facilities to the population within 50 miles (80 k the NTS is 0.0052 person-rem. Added to this baseline, operation of the proposed SN management facilities might contribute an additional 0.082 person-rem, increasing t effective dose to 0.087 person-rem.

The annual collective effective dose equivalent from the existing NTS facilitie maximally exposed individual at the site boundary is 0.011 millirem per year. Oper proposed SNF management facilities might contribute an additional 0.12 millirem per resulting in a cumulative annual dose of 0.13 millirem per year to this maximally e individual.

The total annual baseline worker dose seen from normal NTS operations is about

rem. The total annual SNF management facility worker dose is expected to be roughl 32 person-rem. Hence, the cumulative annual dose might be 36 person-rem.

Over the planned 40-year operational lifetime of the SNF management facility, a population dose of 3.5 person-rem will be observed from continuous operation of the NTS facilities and the SNF management facility. This equates to a risk of fatal ca 4.4 x 10-5 over the 40-year span. For the maximally exposed individual, the total 40-year period equates to a risk of fatal cancer of 2.6 x 10-6. For the SNF manage the total dose over the 40-year span corresponds to a risk of fatal cancer of 6.4 x

Additional radiological impacts are not expected from operation of the proposed Core Facility. Analysis has shown that the dose to all individuals considered (wor individuals) from Expended Core Facility operations might be much less than one mil year.

5.16.1.3 Noise. Increases in noise levels from construction and operation of the SNF

management facilities and the Expended Core Facility would be limited to temporary, construction noise and small increases in traffic noise occurring along various acc NTS due to increases in employment. Because of the NTS's large size and sparsely i surroundings, any cumulative noise levels generated on the NTS by the proposed SNF management facilities, the proposed Expended Core Facility, the potential geologic the Yucca Mountain site, and activities proposed in the Five-Year Plan and Master P not propagate offsite at levels that would impact the general population. Although cumulative offsite noise level attributed to future offsite activities can not be e potential incremental addition attributable to the proposed SNF management faciliti minimal. Minor increases in traffic noise on U.S. Route 95 could be possible due t activity on and near the NTS.

5.16.1.4 Groundwater and Surface Water Resources. Operation of the proposed SNF

management facilities would require the withdrawal of an estimated 3.6 million gall (13.6 million liters per year) of groundwater from the Ash Meadows Subbasin. Opera proposed Expended Core Facility would require the withdrawal of an estimated additi 2.5 million gallons per year (9.5 million liters per year) from that subbasin, resu combined withdrawal of an estimated 6.1 million gallons per year (23.1 million lite The water demands for the potential geologic repository at the Yucca Mountain site met by the Alkali Flat Furnace Creek Ranch Subbasin and therefore would not contrib cumulative water withdrawals from the Ash Meadows Subbasin. Information concerning water demands of activities in the Five-Year Plan, Master Plan, or future offsite a available.

Although total withdrawals of groundwater from the Ash Meadows Subbasin have no exceeded the subbasin perennial yield, localized withdrawals of groundwater in the Flat hydrographic area of the Ash Meadows Subbasin have exceeded the estimate of precipitation recharge for the area. This recharge estimate was exceeded for more years with no decline in static water levels. Accurate measurement of static water however, precluded by numerous conditions on the NTS. Because of hydrogeologic com regional groundwater flow at the NTS is not constrained by the hydrographic basins defined by local topography. Therefore any potential groundwater overdraft in the Flat hydrographic area indicated by previous yield estimates are likely be made up groundwater from neighboring hydrographic basins. Localized impacts could occur if perennial yield of Frenchman Flat hydrographic area is exceeded. Potential impacts depletion of water stored locally in the regional aquifer, removal of that groundwa potential uses, and the potential modification of the rate and direction of contami resulting from underground nuclear testing. The complex issues of groundwater cont and use are being addressed in the Resource Management Plan being prepared in conju with the NTS site-wide EIS.

5.16.1.5 Biotic Resources. Construction of the proposed SNF management facilities

would require the disturbance of approximately 90 acres (0.36 square kilometer) of supporting flora and fauna characteristic of the ecotone between the Mohave Desert Great Basin. Construction of the proposed Expended Core Facility would require the disturbance of an additional 30 acres (0.12 square kilometer) of desert habitat, re

combined conversion of 120 acres (0.48 square kilometer) of terrestrial habitat to Additional areas of desert habitat would be lost during construction of activities Five-Year Plan and Master Plan, during construction of the potential geologic repos Yucca Mountain site, and during future offsite construction activities. Considerin extent of desert habitat on and surrounding the NTS, the cumulative loss of desert be minimal.

The NTS lies within the range of the desert tortoise, a federally listed threat the desert tortoise occurred in areas subject to development, tortoises could be in construction activities. The proposed SNF management facilities (and the proposed Core Facility) would be constructed at the edge of the tortoise's range, however, a been found in the affected area. Habitat losses due to construction of the propose management facilities and other proposed onsite and offsite construction activities a slight cumulative loss of habitat for the desert tortoise. The U.S. Fish and Wil would be consulted in accordance with Section 7 of the Endangered Species Act prior construction of the potential SNF management facilities to ensure that any potentia effect on desert tortoise populations would be minimal. The U.S. Fish and Wildlife would also have to be similarly notified and given an opportunity to comment prior construction of the potential geologic repository at the Yucca Mountain site and pr other major construction activities.

5.16.1.6 Air Quality. The potential cumulative air emissions from the proposed SNF

management facilities and the proposed Expended Core Facility would not result in a exceedance of the National Ambient Air Quality Standards or Nevada state criteria. would be no exceedance of Federal National Emissions Standards for Hazardous Air Po or DOE radiological standards. Air emissions from the other planned activities hav been defined.

5.16.1.7 Socioeconomics. Operation of the proposed SNF management facilities might

generate up to 800 new jobs during the year 2005 and beyond. Operation of the prop Expended Core Facility might generate up to 562 additional jobs during that year, r combined increase of up to 1,362 new jobs. The 7,091 jobs presently forecasted for the year 2005 might be increased by 19 percent, to as much as 8,453 jobs. The 752, presently forecasted for the surrounding area in the year 2005 might be increased b percent, to as much as 753,718 jobs. Additional employment increases could also re potential geologic repository at the Yucca Mountain site, activities proposed in th Plan and Master Plan, and new offsite activities, but specific estimates are not av

The cumulative effect of the employment increases discussed above would depend actions at the NTS and throughout the regional economy. These employment increases cause minor fluctuations in employment and housing demands. However, activities at generally have a relatively modest effect on long-term regional economic growth and in Clark County because of the implicit growth projections in the services and reta driving long-term growth in the Las Vegas Metropolitan Statistical Area. Additiona years the shutdown of nuclear testing activities at the NTS has caused employment l These losses have not been considered in long-term employment forecasts. If nuclea activities do not resume at the NTS, the projected employment increases noted above offset by employment losses.

5.16.1.8 Transportation. An estimated 4.0 x 10-4 and 1.4 x 10-3 accident occupational

fatalities and accident nonoccupational fatalities might occur over the 40-year lif proposed SNF management facilities due to the transportation of hazardous material facilities. This does not include fatalities due to leakage of hazardous waste. S not available for the other planned activities.

5.16.1.9 Waste Management. Operation of the proposed SNF management facilities

would generate an estimated 203 cubic meters (266 cubic yards) per year of low leve an estimated 16 cubic meters (21 cubic yards) per year of transuranic waste. Opera proposed Expended Core Facility would generate an additional 425 cubic meters (556

yards) of low level waste (for a combined total by both facilities of 628 cubic met yards)) but would not generate any additional transuranic waste. No other radioact including high level waste or mixed waste, would be generated by either facility. data for the potential geologic repository at the Yucca Mountain site or for offsit activities proposed in the Five-Year Plan and Master Plan is not available. All wa by the proposed SNF management facilities and other planned activities on the NTS w treated and disposed of in accordance with all applicable Federal and state regulat

5.16.1.10 Other Resources. The absence of impacts, or very minimal impacts, from the

proposed SNF management facilities to cultural resources, aesthetic and scenic reso utilities, and geologic resources ensures that their potential contribution to cumu affecting these resources would be negligible.

5.16.2 Regionalization Alternative

Because impacts from the proposed SNF management facilities under the Regionali Alternative would be equal to or less than those under the Centralization Alternati potential cumulative impacts would also be equal or less. Generally, the Regionali Alternative requires less construction and smaller scale operations, and the potent cumulative impacts is therefore less.

5.17 Adverse Environmental Effects That Cannot Be Avoided

5.17.1 Overview

This chapter discusses potentially unavoidable adverse impacts to the environme from construction and operation of the proposed SNF facilities at the NTS under the Centralization and Regionalization Alternatives. Unavoidable adverse impacts are i cannot be mitigated by changes in project design, operation, or construction, or by measures.

5.17.2 Centralization Alternative

Operation of the proposed SNF facilities at the NTS under the Centralization Al would increase the radiation dose rate to the maximally exposed individual by 0.12 resulting in only a minimal increase in cancer risk. The number of fatal cancers p operations on the NTS from existing sources and the SNF facilities would be 4.4 x 1

Construction of the proposed SNF facilities would require the disturbance of ap 90 acres (0.36 square kilometer) of undeveloped land. Although this represents les percent of the undeveloped land on NTS, it would eliminate potential terrestrial wi including habitat potentially suitable for the federally listed desert tortoise. I the dedication of a small land parcel potentially suitable for other construction p similar land parcels are abundant on the NTS.

Operation of the proposed SNF facilities would require the withdrawal of an est 3.6 million gallons (13.6 million liters) per year of groundwater from the Ash Mead Existing localized withdrawals of groundwater from Frenchman Flat hydrographic area subbasin already exceed the estimate of precipitation rechange for the area. Howev withdrawal from the Ash Meadows Subbasin does not exceed its total perennial yield. withdrawn would therefore not be discharged at Ash Meadows and the other discharge the deserts southwest of NTS.

The potential impacts from the Centralization Alternative to the other environm resources discussed in Chapter 5 are not unavoidable adverse impacts.

5.17.3 Regionalization Alternative

Potential unavoidable adverse impacts associated with the Regionalization Alter resemble those discussed above for the Centralization Alternative. The extent of t could be less due to the reduced land requirements, reduced extent of construction

and reduced scale of operations.

5.18 Relationship Between Short-Term Use of the Environment

and the Maintenance and Enhancement of Long-Term Productivity

Implementation of any of the SNF management alternatives would cause some adver impacts to the environment and permanently commit certain resources. These resourc use of the environment and those associated with construction and operation of the management facilities.

The proposed alternatives for SNF management would require the short-term use o resources including energy, construction materials, and labor in order to achieve t safety managing SNF to minimize the risk to workers, the public, and the environmen

Development of new SNF interim management facilities would commit lands to thos from the time of construction through the cessation of operations, at which time th could be converted to other uses or decontaminated, decommissioned, and the site re original land use.

5.19 Irreversible and Irretrievable Commitments of Resources

5.19.1 Overview

This chapter discusses the irreversible and irretrievable commitments of resour from the use of materials that can not be recovered or recycled, or that must be co reduced to irrecoverable forms.

5.19.2 Centralization Alternative

Construction and operation of SNF facilities under the Centralization Alternati require commitments of electrical energy, fuel, concrete, steel, sand, gravel and m chemicals. Groundwater to operate the SNF facilities would not be discharged in th the southwest of NTS. More detailed analyses would be required to determine irreve effects on localized groundwater availability. The land dedicated to the SNF facil become available for other rural uses following closure and decommissioning.

5.19.3 Regionalization Alternative

Irreversible and irretrievable commitments of resources associated with the Reg Alternative would resemble those discussed above for the Centralization Alternative the extent of these resource commitments could be less, due to the reduced land req and reduced scale of operations.

5.20 Potential Mitigation Measures

5.20.1 Pollution Prevention

The DOE Nevada Field Office (DOE/NV) published a Waste Minimization and Polluti Prevention Awareness Plan in June 1991 to reduce the quantity and toxicity of hazar and radioactive wastes generated at DOE/NV facilities. The plan is designed to red possible pollutant releases to the environment and thus increase the protection of the public. All DOE/NV contractors and NTS users that exceed the EPA criteria for quantity generators are establishing their own waste minimization and pollution pre awareness programs that are implemented by the DOE/NV plan. Contractor programs en that waste minimization activities are in accordance with Federal, state, and local laws and regulations, and DOE Orders (DOE/NV 1993c).

Additional goals include the promotion and use of nonhazardous materials, estab a baseline of waste generation data, calculations of annual reductions of wastes ge implementation of recycling programs. Goals also include incorporation of waste mi concepts and technologies in planning and design of new processes and facilities, a

of existing facilities. A waste minimization task force composed of representative contractor and NTS user has been established to coordinate DOE/NV waste minimizatio pollution awareness activities (DOE/NV 1993c).

5.20.2 Potential Mitigation Measures

Potential impact avoidance and mitigation measures are addressed in Chapter 5, through 15 as appropriate.

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7.0 ABBREVIATIONS AND ACRONYMS

oC	degrees Celsius
CFR	Code of Federal Regulations
Ci	curie(s)
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
EIS	environmental impact statement
ECF	Expended Core Facility
EPA	U.S. Environmental Protection Agency
yF	degrees Fahrenheit
FEMA	Federal Emergency Management Agency
g	gram
gal	gallon(s)
hr	hour
INEL	Idaho National Engineering Laboratory
kg	kilogram
km	kilometer
kv	kilovolt
y	liter
m	meter
m3	cubic meter

mi	mile
mi2	square mile
min	minute
mph	miles per hour
mR	milliroentgen
mrem	millirem
MTHM	metric tons of heavy metal
MW	Megawatt
nCi	nanocurie
NEPA	National Environmental Policy Act
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PCB	polychlorinated biphenyl
pCi	picocurie(s)
PEIS	Programmatic Environmental Impact Statement
PM10	particulate matter less than 10 microns in diameter
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
SNF	spent nuclear fuel
SRS	Savannah River Site
TVA	Tennessee Valley Authority
ug	micrograms
USGS	U.S. Geological Survey
yr	year

OAK RIDGE RESERVATION

FIGURES

TABLES

#1. INTRODUCTION

This part assesses the impacts of contruction and operation of proposed spent n (SNF) facilities at the Oak Ridge Resevation (ORR). The ORR is being evaluated for facilities because of the area available, the appparently suitable site environment previous U.S. Department of Energy activities involving radioactive materials at th planned long-term government control of the site.

This appendix is organized as follows. Chapter 1 is the introduction, Chapter 2 stage for the area under analysis by providing an overview of the ORR and a discuss Regulatory Framework and the SNF Management Program, and Chapter 3 explains the SNF alternatives being considered at the site.

Chapter 4 describes the human and natural environment that could be affected as

of the introduction of an SNF facility at the ORR. Environmental parameters such as resources, socioeconomics, biological resources, and air quality are examples of th characterized.

Chapter 5 enumerates the environmental consequences that might be anticipated, summarizes the cumulative impacts, describes unavoidable adverse impacts, and descr irreversible and irretrievable committment of resources that might be anticipated i were built at the ORR. Chapter 6 contains the references used to develop this part environmental impact statement. Chapter 7 contains a list of abbreviations and acro this part of the environmental impact statement.

2. OAK RIDGE RESERVATION SITE BACKGROUND

2.1 Overview

2.1.1 Site Description

The Oak Ridge Reservation (ORR) is located on approximately 34,667 acres (140 s kilometers) of federally owned land within the incorporated city limits of Oak Ridg (see Figure 2.1-1). The City of Oak Ridge and the ORR lie between the Cumberland a Southern Appalachian mountain ranges. Knoxville is located approximately 25 miles kilometers) southeast of the ORR and is the largest city in the area. The populatio the five counties surrounding the ORR. The area around Knoxville is a heavily popu highly developed urban area, whereas the area surrounding the ORR is sparsely popul the exception of the city of Oak Ridge, which is considered to have medium density The two main land uses in the five counties surrounding the ORR are forestry and ag

Within the ORR there are three primary complexes: the Y-12 Plant, the K-25 Sit (formerly the Oak Ridge Gaseous Diffusion Plant), and the Oak Ridge National Labora (ORNL) (see Figure 2.1-2). Currently these facilities are being used for research, and production.

The Y-12 Plant is located on the eastern portion of the ORR known as Bear Creek The Y-12 Plant serves as a key manufacturing technology center for the development demonstration of unique materials, components, and services of importance to DOE an nation. This mission is accomplished through the reclamation and storage of nuclea the manufacture of components to the nation's defense capabilities, support to nati programs, and services provided to other customers as approved by DOE (MMES 1994a).

The K-25 Site is located on the northwestern portion of the ORR. Its mission i a base of operation for the Energy Systems Environmental Restoration and Waste Mana programs, thus serving as the "platform" for the restoration of the environment and of DOE wastes through leadership and central management of the Environmental Restor

Figure 2.1-1. Oak Ridge Reservation regional map. Figure 2.1-2. Oak Ridge Reser

managed for DOE by Energy Systems, other elements of the Federal Government, and th public. The Toxic Substances Control Act incinerator is managed by and located on Site (MMES 1994a).

The ORNL is located in the southern portion of the ORR. The primary mission of is to perform leading edge research and development in support of nonweapons roles (MMES 1994a). The ORNL uses test and experimental reactors to perform research and small-scale radioisotope production activities. The amount of spent nuclear fuel (by these facilities, the amount expected to be generated through the year 2035, and accommodations being undertaken at the present time to store the fuel currently bei are discussed in the following sections.

The buildings located off the ORR but owned and/or operated by the U.S. Departm Energy (DOE) are 1) the Scarboro Facility, 2) the Central Training Facility, 3) the Transportation Safeguards Division Maintenance Facility, and 4) some ancillary and administrative facilities and structures. The majority of the facilities used by v protection and security groups are located within the plant's boundary. Other offs include the DOE Oak Ridge Operations Office, the DOE Office of Scientific and Techn Information, the Oak Ridge Associated Universities facilities, the American Museum and Energy, the prime contractor's "Townsite" facilities, the National Oceanic and Administration's Atmospheric Turbulence and Diffusion Laboratory, and others. With exception of the Federal Office Building and space leased from the private sector,

are located on DOE-owned land.

The proposed site of the SNF management facility is located on 100 acres (0.40 kilometer) of land designated as the West Bear Creek Valley site (see Figure 2.1-2) (La Grone 1994; MMES 1994b). The proposed SNF storage facility will require 90 of acres (0.36 of the 0.40 square kilometer) set aside for the facility (Johnson, V. 1

The proposed SNF management facility is on Bear Creek Road adjacent to the Clin River on the west end of the ORR. The westernmost boundary of the proposed SNF fac less than 1 mile (1.6 kilometers) from the ORR boundary. Across Bear Creek Road fr proposed SNF management facility there is a privately owned industrial park (MMES 1

2.1.2 Site History

The ORR was originally purchased in the early 1940s to house the large-scale pr fissionable material for the first nuclear weapon in the world. The original tract purchased was 56,833 acres (230 square kilometers). Portions of the original tract build the City of Oak Ridge for the people who constructed and operated the ORR. R and business areas of the city were sold, and the ORR has been reduced to its prese

ORNL began in 1943 as the Clinton Laboratories, a pilot plant for testing and d of the plutonium-239 production and chemical separations processes. Major faciliti ORNL included the X-10 Graphite Reactor, a chemical pilot plant, and numerous suppo laboratories and shops. The ORNL's initial mission was fulfilled by 1945, but beca unique capabilities, new research and development programs were initiated in energy and environmental technology (DOE 1988).

Since 1945 emphasis at ORNL has been on exploration of the use of nuclear scien technology, which continues as a major component of research and development of the laboratory. A number of additional nuclear reactors and supporting facilities have operated at ORNL since the original mission associated with the Manhattan Project. and development in nuclear science and technology is supported currently by one ope research reactor, the High Flux Isotope Reactor. ORNL has proposed the Advanced Ne Source, which would take over many of the tasks now carried out by the High Flux Is Reactor (Brown 1994a; Hoel 1994).

In 1943 the Y-12 Plant was constructed as part of the Manhattan Project. The Y separated fissionable isotopes of uranium-235 by the electromagnetic process, which the world's first atomic bomb, detonated on August 5, 1945 (MMES 1990; DOE 1987). that time Y-12 has developed into a highly sophisticated nuclear weapons component manufacturing and development engineering organization and currently is used for we disassembly.

The Oak Ridge Gaseous Diffusion Plant, now the K-25 Site, was used to produce e uranium for U.S. nuclear weapons. It also provided an industrial toll enrichment s which uranium was enriched for use in nuclear-powered reactors around the world. I Oak Ridge Gaseous Diffusion Plant was permanently shut down.

2.1.3 Mission

The missions of the primary plant complexes within ORR are:

- Energy Research and Development at ORNL.
- Reclamation and Storage of Nuclear Material, Manufacturing of Defense Hardw and National Security, Technology Transfer, and Work for Others Programs at
- Environmental Restoration and Waste Management at the K-25 Site (MMES 1994a

The mission of ORNL includes services that only research reactors provide, incl production of transuranium isotopes used in basic research, medical, defense, and i applications, 2) neutron scattering research to determine fundamental structure and materials, 3) production of unique isotopes for medical treatment and research, 4) special commercial isotopes, and 5) irradiation of structural and fuel materials fo reactors and advanced nuclear reactors (Brown 1994a; Hoel 1994).

2.1.4 Oak Ridge Reservation Operations Management

Martin Marietta Energy Systems, Inc., operates the major facilities at the ORR K-25 Site, and ORNL). They are under contract to and administered by the DOE Oak R Operations Office. Current missions and functions can be grouped into the followin

categories: defense production activities; environmental management activities; ot activities; and work for others.

2.2 Regulatory Framework

The National Environmental Policy Act (NEPA) of 1969 (42 USC 4321-4347, as amen provides Federal agency decision makers with a process to systematically consider t environmental consequences of agency decisions. The DOE has prepared this environm impact statement (EIS) in conformance with the requirements of NEPA to evaluate the impacts of programmatic decisions on the management of SNF. This EIS provides the background, data, and analyses to help decision makers understand the potential env consequences of each alternative.

On October 22, 1990, the DOE published a Notice of Intent in the Federal Regist (FR 1990) announcing its intent to prepare a programmatic EIS addressing environmen restoration and waste management (including SNF management) activities across the e complex. On October 5, 1992, the DOE published a Notice of Intent in the Federal R (FR 1992) announcing its intent to prepare an EIS addressing environmental restorat waste management and SNF activities at the Idaho National Engineering Laboratory. further programmatic discussion of this topic, see Volume 1.

Significant state environmental and nuclear materials management laws applicabl ORR include the following (listed alphabetically):

- Air Pollution Control Regulations (Chapter 1200-3)
- Air Quality Act (Title 68 Chapter 201-101)
- Emergency Rules--Hazardous Substance Remedial Action (Chapter 1200-1-13)
- Emission Standards and Monitoring Requirements for Additional Control Areas (Chapter 1200-3-19)
- Hazardous Substance Site Remedial Action (Chapter 1200-1-13)
- Hazardous Waste Management (Chapter 1200-1-11)
- Licensing Requirements for Land Disposal of Radioactive Waste (Chapter 1200
- New Source Performance Standards (Chapter 1200-3-16)
- Prevention of Hazards and Pollution (Chapter 1200-1-6)
- Rules and Regulations Applied to Tennessee Codes Annotated -69-1-1 (Chapter 1200-4-8)
- Solid Waste Processing and Disposal (Chapter 1200-1-7)
- Underground Storage Tank Program (Chapter 1200-1-15)
- Visible Emission Regulations (Chapter 1200-3-5)
- Volatile Organic Compound (Chapter 1200-3-18)

2.3 Spent Nuclear Fuel Management Program

In the past, reactor-irradiated nuclear materials, which include SNF and reacto target material, have been stored prior to reprocessing activities to recover pluto and other isotopes. In the past several years, however, the DOE has either phased stopped its reprocessing of these materials. With this change, reactor-irradiated materials were being stored for longer periods of time than originally planned. Th reactor-irradiated nuclear materials and the conditions of storage for the material question throughout DOE facilities.

In an effort to assess whether extended storage conditions for reactor-irradiat materials are safe (i.e., whether protection exists for workers, the public, and th the DOE commissioned a study. This assessment also grouped any vulnerabilities of conditions into three categories where management attention could be directed: les 1 to 5 years, and greater than 5 years. In November 1993, the DOE published the Sp Working Group Report on Inventory and Storage of the Department's Spent Nuclear Fue Reactor Irradiated Nuclear Materials and Their Environmental, Safety and Health Vul hereafter referred to as the Spent Fuel Working Group Report, as a result of the as efforts (DOE 1993b; 1994b).

As a result of the Spent Fuel Working Group Report, a Plan of Action to Resolve Nuclear Fuel Vulnerabilities was also commissioned to address what was discovered i Working Group Report. Phase I of the Plan of Action to Resolve Spent Nuclear Fuel Vulnerabilities was published in February 1994. Phase II and Phase III were issued and October 1994, respectively. To address the vulnerabilities identified in the S Working Group Report, individual action plans were developed to reflect the DOE's s

urgency, concern for worker protection, commitment to minimize environmental impact need for compatible long-term solutions.

The ORR was assessed as part of the Spent Fuel Working Group Report. SNF locat the ORR is currently stored in facilities at the ORNL. The SNF at ORR is primarily from research or experimental reactors that are operating or have operated at ORNL. of SNF left over from research on fuel elements removed from commercial or demonstr reactors utilized by DOE predecessor agencies for advancement of nuclear science ar present. In the past, most of the SNF from the Oak Ridge research and experimental was chemically processed to recover fissile materials at Savannah River Site (Brown Hoel 1994).

This section describes the status of the SNF at the ORR using the information p the Spent Fuel Working Group Report, the Plan of Action to Resolve Spent Nuclear Fu Vulnerabilities, the Spent Fuel Inventory Data developed for the SNF EIS, and throu with ORR. If fuel can be contact handled, it has not been listed in the Spent Fuel SNF. The SNF management program at ORR utilizes 10 facilities for storage. These and their SNF contents are summarized on Table 2.3-1.

2.3.1 Building 3525 - Irradiated Fuels Examination Laboratory

This two-story brick structure was built in 1963 and contains hot cells. The f continues to be disassembly and examination of irradiated fuel and components. Bui contains 1 unit of research reactor fuel in the form of fuel samples and targets (D Wichmann 1995a, b).

2.3.2 Building 4501 - High-Level Radiochemical Laboratory

Constructed in 1951, this facility contains centrally located hot cells support laboratories capable of handling radioactive materials. SNF is in dry storage at t Building 4501 contains 0.006 metric tons of heavy metal (MTHM) of DOE-owned commerc fuel (DOE 1993b; Wichmann 1995a, b).

2.3.3 Building 7920 - Radiochemical Engineering Development Center

The Radiochemical Engineering Development Center is a multipurpose hot cell fac equipment, shielding, and containment provisions to safely process and store signif of highly radioactive targets. This facility was specifically built to prepare and from the High Flux Isotope Reactor. Building 7920 contains 0.024 MTHM of research fuel in the form of fuel samples in dry storage (DOE 1993b; Wichmann 1995a, b).

2.3.4 Dry Storage Facilities 7823A, 7827, and 7829

Now closed to further storage, these shielded, retrievable storage facilities a dry wells placed in the ground in Solid Waste Storage Area 5 North. They vary from inches (20 to 76 centimeters) in diameter and from 10 to 15 feet (3 to 4.6 meters) wells are placed on a concrete pad and are held in place by concrete collars or sla surrounded by dirt. Spent fuel and other materials were placed in the wells beginn

Table 2.3-1. Oak Ridge Reservation SNF Storage Facilities.

Facility name	Material stored at facility	Heavy metal mass (MTHM)
High Flux Isotope Reactor (HFIR) Pool	HFIR fuel	0.45
Bulk Shielding Reactor (BSR) Pool	BSR & ORR fuel	0.01
Molten Salt Reactor Experiment (MSRE)	MSRE fuel	0.037
Bldg. 4501	Misc. LWR fuels	0.006
Tower Shielding Reactor (TSR)	TSR fuel	0.0092
Facility 7823A	Misc. fuel	0.0008
Facility 7827	Misc. fuel	0.0837

Facility 7829	Peach Bottom	0.0137
Bldg. 7920	Dresden-1 fuels	0.024
Bldg. 3525	Misc. fuels	
Solid Waste Storage Area 6	KEMA Suspension Test Reactor fuela	0.037

Source: Wichmann (1995a,b)

a. See Section 2.3.5.6.
Facility 7823A contain 0.0008 MTHM; facility 7827 contains 0.0837 MTHM; and facilit contains 0.0137 MTHM. Activities to address the vulnerabilities in these facilitie transferring the fuel, 2) adding a new inner liner and relocating fuel in modified overpacking any fuel in suspect condition. These activities are expected to be com year 1996 (DOE 1994b; 1993b; Wichmann 1995a, b).

2.3.5 Research Reactors

Six existing reactors and one planned reactor are expected to be generating and at the ORNL. They are the High Flux Isotope Reactor (currently operating), the Tow Shielding Reactor No. II (shut down in 1992), the Bulk Shielding Reactor (shut down the Oak Ridge Research Reactor (shut down in 1987), the Molten Salt Reactor Experim down in 1969), the KEMA Suspension Test Reactor, and the Advanced Neutron Source Re (planned to start up in 2002 or 2003) (ANS 1988).

2.3.5.1 High Flux Isotope Reactor. The High Flux Isotope Reactor is a beryllium-

reflected, light water cooled and moderated, flux-trap-type reactor. The reactor u clad fuel plates containing highly enriched uranium-235. The reactor became operat and its current power level is 85 megawatts. Reactor missions include production medical and industrial applications, neutron-scattering experiments, and various ma irradiation experiments (ANS 1988; DOE 1993b).

The High Flux Isotope Reactor is operating. At the present time there are 62 f assemblies amounting to 0.45 MTHM from the research reactor fuel in onsite wet stor High Flux Isotope Reactor currently does not use onsite dry storage. If the reacto operation through the year 2035, the predicted SNF production will be an additional assemblies totalling 1.58 MTHM. (Holt 1993; ORNL 1992a; Wichmann 1995a, b).

Onsite storage at the reactor facility would have to be expanded to accommodate projected SNF generation rate. At the present time, reracking the existing storage installing modular dry-storage units at the High Flux Isotope Reactor are being con the installation of the dry-storage units, the potential for future expansion of st expected to continue indefinitely (ORNL 1992a).

In the past, SNF assemblies were shipped in casks via truck to the Savannah Riv the baseline plan is to continue shipments there. However, the Savannah River Site space and plans to accept only 20 fuel assembly shipments from the High Flux Isotop If shipment of SNF to another DOE storage facility is precluded or the commencement reracking at the High Flux Isotope Reactor is not approved by the DOE, the reactor required to shut down because the present pool storage racks cannot accommodate add fuel after early 1995 (Clark 1994).

2.3.5.2 Tower Shielding Reactor No. II and Tower Shielding Facility Building 7708.

The 1 megawatt Tower Shielding Reactor No. II is a light water moderated, movable t research reactor which was shut down in 1992. There are no plans for resuming oper this time. Tower Shielding Reactor No. II has no containment and was used at groun suspended from towers. The research included testing shielding designs and obtaini data (ANS 1988; DOE 1993b).

The Tower Shielding Reactor No. II was placed in standby in September 1992 pend DOE direction to prepare the facility for shutdown. At that time, the only existin Shielding Reactor No. II fuel assembly was being stored in the reactor core. For h storage purposes, an element is an integral core assembly composed of 4 upper centr

4 lower central plates, 12 annular plates, a central plug, and 4 fuel plates. One MTHM, is being stored in the reactor core. The corrective actions associated with vulnerabilities identified in the Spent Fuel Working Group Report for the Tower Shi No. II and Tower Shielding Facility Building 7708 are: 1) implement access control Shielding Reactor No. II area; 2) implement emergency operating procedures for the Shielding Reactor, i.e., those applicable to a seismic event requiring the experime checked for hazards by knowledgeable staff before personnel enter the area; 3) imp radiation protection controls requiring that a survey be completed by Radiation Pro personnel to verify acceptable radiation levels prior to granting access to a radio 4) remove the fork-lift from Building 7708 to eliminate a potential fire hazard and fuel pins to the Y-12 area for long-term storage to eliminate the potential of an a the same building (completed January 1994). All of these corrective actions plans completed and are being implemented (Holt 1993; ORNL 1994; DOE 1994b; Wichmann 1995 b).

Present options being discussed for storage of this fuel include shipment to th River Site or onsite dry storage at ORNL. Because this reactor is shut down, no ad elements are expected to accumulate through the year 2035 (Holt 1993; ORNL 1994).

2.3.5.3 Bulk Shielding Reactor. The 2 megawatt Bulk Shielding Reactor is an open pool,

light water moderated and reflected, training and research reactor. This reactor w and shut down in 1991; there are no plans for resumption of operations at this time DOE/OSTI 1993; DOE 1993b).

The Bulk Shielding Reactor is shut down and currently has no elements in the re on-site dry storage. Seventy-three of 90 storage locations are occupied in the ons There are 41 elements from the Bulk Shielding Reactor and 32 elements from the Oak Research Reactor for a total of 0.010 MTHM in the storage area. As the reactor is no additional fuel is expected to be added to the inventory through the year 2035; expansion of storage facilities onsite is expected (DOE 1993b; Wichmann 1995a, b).

2.3.5.4 Oak Ridge Research Reactor. The Oak Ridge Research Reactor was shut down

permanently in 1987 and has been defueled. Most of the fuel was transported to the River Site, but some of the fuel was transferred to the Bulk Shielding Reactor pool discussion of the spent fuel inventory in subsection 2.3.5.3 (Holt 1993; ANS 1988;

2.3.5.5 Molten Salt Reactor Experiment. The Molten Salt Reactor Experiment

operated from June 1965 to December 1969 at a nominal power level of 8 megawatts. purpose of the reactor was to test the practicality of a molten-salt reactor concep power station applications. The circulating fuel solution was a mixture of fluorid uranium fluoride as the fuel. The initial charge was uranium-235, but this was lat a charge of uranium-233. Processing capabilities were included as part of the faci fuel additions, removal of impurities, and uranium recovery. Following reactor shu fuel and flush salts were drained to critically safe storage tanks and isolated (Ha

The inventory at the Molten Salt Reactor Experiment consists of approximately 4,650 kilograms (9,514 pounds) of fuels salt mixture. The uranium salt is predomin 233 (31 kilograms [68 pounds]) with lesser amounts of uranium-234, uranium-235, and 238. The balance of the fuel salt is composed of lithium fluoride (LiF, 64.5 perce fluoride (BeF_2, 30.3 percent), and zirconium fluoride (ZrF_4, 5.0 percent). The Mol Experiment contains 0.037 MTHM as the reactor is shutdown, no additional SNF is exp be generated through the year 2035 (DOE 1993b; Hargrove 1993; Wichmann 1995a, b).

Radioactive material migration has been detected from the storage tanks. This could result in unnecessary personnel exposure. If left unabated, radiation levels to a point where access would be difficult. ORNL is determining appropriate correc and expects to implement its corrective action plan during fiscal year 1995 (DOE 19

2.3.5.6 KEMA Suspension Test Reactor. The KEMA Suspension Test Reactor was an

experimental fluidized bed test reactor. The fuel, consisting of one core, was pla Waste Storage Area 6 and totals 0.037 MTHM. The area of Solid Waste Storage Area 6

the fuel was placed is being managed by DOE as part of waste area grouping 6, an environmental restoration program activity, under the Comprehensive Environmental R Compensation, and Liability Act. As the reactor is shutdown, no additional SNF is be generated through the year 2035 (Wichmann 1995a, b).

2.3.5.7 Advanced Neutron Source Reactor. The Advanced Neutron Source Reactor is

currently in the conceptual design stage and has been proposed to be operational in 2002 or 2003. Its principal purpose will be for neutron beam experiments, but it w used for some isotope production (Holt 1993; DOE/OSTI 1993).

Since the current schedule projects initial operation of the Advanced Neutron S Reactor in the year 2002 or 2003, spent fuel is not expected to be generated until Estimates are that 18 elements per year will be discharged. (For handling and stor an element is an integral core assembly composed of two concentric fuel plates.) A 576 SNF elements are predicted to be produced if the reactor is in operation from t 2002 through 2035 (Holt 1993). As this reactor is in the conceptual design stage, expected to be generated is not included in the SNF Inventory Data.

3. SPENT NUCLEAR FUEL ALTERNATIVES

This chapter describes the spent nuclear fuel (SNF) management alternatives eva the U.S. Department of Energy (DOE) for this Programmatic Environmental Impact Stat (EIS) that are applicable to the Oak Ridge Reservation (ORR). The ORR generates an SNF as a result of reactor research activities. Unlike the Hanford Site, the Idaho Engineering Laboratory (INEL), and the Savannah River Site (SRS), SNF management is minor part of the ORR mission. Therefore, the No Action, Decentralization, and 199 Planning Basis alternatives could have minimal to no impact on ORR operations. How Regionalization and Centralization Alternatives would produce major impacts on ORR operations.

3.1 Description of Management Alternatives

3.1.1 Alternative 1 - No Action

The No-Action Alternative is restricted to the minimum actions necessary for th safe and secure management of SNF. As defined, this alternative stipulates no SNF or from DOE facilities. While the ORR generates and stores SNF as a result of reac activities, it does not receive SNF from offsite generators except occasionally in for specific research assignments. No offsite SNF would be shipped to the ORR unde alternative, nor would SNF be shipped offsite, which could affect the planned shipm Flux Isotope Reactor assemblies to the SRS. SNF storage capacity at the ORR for th High Flux Isotope Reactor would be adequate only through the year 2002. This could the shutdown of this reactor after this date. The proposed Advanced Neutron Source would need to consider this situation in the design and operation activities.

The environmental effects of the No-Action Alternative are essentially the same current onsite SNF storage and are included in the affected environment discussions current site operations.

Implementation of the No-Action Alternative at ORR could lead to the shutdown o High Flux Isotope Reactor as a result of filling the SNF storage capacity. If the Isotope Reactor were shutdown, it would eliminate the national capacity to provide isotopes, eliminate the only western-world source of some medical isotopes, and eli nationally and internationally important capability for research and development in of materials and irradiation effects on materials (Brown 1994a; Hoel 1994).

This alternative for the ORR is not analyzed or discussed further in this or su chapters except in the Facility Accidents section, 5.15.

3.1.2 Alternative 2 - Decentralization

Decentralization involves storage of SNF at or close to generation sites. Unde alternative no offsite SNF would be shipped to the ORR nor would SNF be shipped off environmental effects of this alternative are the same as those of the No-Action Al environmental effects of current onsite SNF storage are included in the affected en discussions covering current site operations. Consequently, this alternative is no discussed further in this or subsequent chapters for the ORR. Construction of new facilities could be initiated under this option.

The Decentralization Alternative would allow DOE to upgrade and/or replace faci the management of the SNF currently located on site. This alternative would allow operation of the High Flux Isotope Reactor by allowing new dry-storage facilities f generated and existing SNF in the High Flux Isotope Reactor pool. To allow the Hig Isotope Reactor to continue operations until a dry storage facility is available, a may be acquired. DOE could propose an interim, retrievable, aboveground, dry-stora for consolidating the SNF at ORR. DOE could also prepare facilities as necessary f characterization and packaging of SNF for interim storage. The fuel in the Molten Experiment reactor would need conditioning and stabilization before being relocated facility, or the Molten Salt Reactor Experiment fuel would need special storage fac (Brown 1994a; Hoel 1994).

3.1.3 Alternative 3 - 1992/1993 Planning Basis

The 1992/1993 Planning Basis Alternative is DOE's documented 1992/1993 plan for management of DOE and Naval SNF. This plan would include the shipment of SNF from ORR to other DOE sites as necessary to permit continued operation of ORR research r The environmental effects of current onsite SNF storage are included in the affecte environment discussions covering current site operations. Under this alternative, SNF storage at ORR would not increase. Therefore, this alternative would not have measurable impact on the environment since there would be no changes to current ORR operations. Consequently, this alternative is not analyzed or discussed further in subsequent chapters for the ORR.

At ORR, this alternative would be very similar to the Decentralization alternative some SNF would be shipped to SRS. The SNF currently stored at the High Flux Isotop Reactor and Bulk Shielding Reactor pools, and at the Tower Shielding Reactor would to SRS. Only 20 elements from the High Flux Isotope Reactor can be shipped to SRS other arrangements can be made. If the quantity of High Flux Isotope Reactor fuel shipped to SRS is limited to 20 elements, then the High Flux Isotope Reactor will r storage facilities to continue operation. DOE could prepare an interim, retrievabl aboveground, dry-storage facility for consolidating the SNF remaining at ORR. This would be similar to the one built under Alternative 2 except it would probably be s (Brown 1994a; Hoel 1994).

3.1.4 Alternative 4 - Regionalization

3.1.4.1 Overview. The Regionalization Alternative consists of two subalternatives.

Subalternative A would distribute existing and new SNF between the Hanford Site, IN SRS by SNF type. Under Subalternative B, SNF would be distributed to either an eas western regional site based on geographical location. SNF east of the Mississippi shipped to the eastern regional site (i.e., SRS or ORR). SNF west of the Mississip be shipped to the western regional site (i.e., Hanford Site, INEL, or Nevada Test S Additionally all Naval SNF would be shipped to only one of the regional sites, but regional site will only receive all the Naval fuel if also selected as the Naval si would be the alternative to the SRS as the eastern regional site, and the NTS would alternative to both the Hanford Site and INEL as the western regional site.

3.1.4.2 Regionalization Subalternative B. The following fuels would be transported to

the ORR for storage under the Regionalization Subalternative B:

- Naval-type SNF (if selected)
  - All, including from the INEL, shipyards, and prototypes

- Hanford Production SNF
  - From eastern sites
- Graphite SNF
  - From eastern sites
- DOE-owned commercial SNF
  - From eastern sites, including the West Valley Demonstration Project and Lynchburg
- Experimental - Stainless Steel SNF
  - From eastern sites, including the Foreign Research Reactors, and non-DO domestic research reactors
- Experimental - Zirconium SNF
  - From eastern sites, including the SRS
- Experimental - Other
  - From eastern sites
- SRS Production and Aluminum SNF
  - From eastern sites, including SRS, Brookhaven National Laboratory, Fore Research Reactors, and non-DOE domestic research reactors.

All SNF presently in storage at DOE facilities would arrive at the ORR stabiliz canned to the extent necessary for safe transportation. However, this SNF may need uncanned, stabilized, prepared, and recanned at the ORR to ensure safe interim stor non-DOE domestic and Foreign Research Reactor SNF would arrive in a state necessary transportation but uncanned. This fuel would be stabilized, prepared, and canned a ensure safe interim storage. All fuel would be cooled for a minimum of 120 days pr shipping and 5 years before being placed in dry storage.

The ORR currently has only limited-capacity facilities suitable for receiving, storing, or supporting the research activities necessary for the safe management of result, a new SNF management complex would be built at the ORR under the Regionaliz Subalternative B. The SNF management complex would include the following:

- SNF receiving and canning facility
- Technology development facility
- Interim dry storage area
- Expended Core Facility similar to the one currently at the INEL (if selecte fuel receipt).

The SNF receiving and canning facility would receive SNF cask shipments from of prepare the SNF for dry storage. A pool storage area would be included in this fac cooling SNF before it is placed into dry storage, as necessary. The technology dev facility would investigate the applicability of dry storage technologies and pilot-development for disposal of the various types of SNF. The interim dry storage area consist of passive storage modules designed to safely store the SNF for 40 years. selected for Naval fuel receipt, Naval SNF would be examined at the Expended Core F prior to being turned over for interim storage management.

The SNF management complex which would be built at the ORR under the Regionaliz Alternative would have the same components as that built under the Centralization A The dry storage component would be smaller, however, due to the smaller SNF invento would be transported to the ORR under the Regionalization Alternative. The other c of the SNF management complex would be the same general size as those built under t Centralization Alternative. This is because the inventories of new uncanned fuel w sent to the ORR under the Regionalization and Centralization Alternatives would be Additionally, since the major portion of the potential radiological and chemical re waste generation rates are associated with these components, the Regionalization Al not analyzed separately but is compared to the Centralization Alternative in a semi manner.

If the ORR was not chosen as the eastern regional site, all SNF at the ORR woul shipped to the SRS. An exception would be those fuels for which there is no availa technology for stabilization to permit safe transport. There is a small quantity o Molten Salt Reactor Experiment that is stored in tanks at the ORR. Currently, tech stabilize this SNF for transport does not exist. Under this alternative, if ORR we to the SRS, this Molten Salt Reactor Experiment SNF would continue to be stored at until it could be stabilized for safe shipment.

Based on the projected schedule for operation of additional regional SNF storag the option for acquiring dry storage facilities at the ORR would be maintained to e continued High Flux Isotope Reactor operation (Brown 1994a; Hoel 1994).

3.1.5 Alternative 5 - Centralization

3.1.5.1 Overview. Under the Centralization Alternative, all existing and new SNF would

be shipped to one DOE site. There are five Centralization options considered in th Hanford Site, the INEL, the SRS, the NTS, and the ORR. If the ORR was chosen as th centralization site, all SNF stored at the Hanford Site, INEL, SRS, and other sites storing DOE fuel would be transferred to the ORR.

3.1.5.2 Centralization Alternative Option D. The following fuels would be transported

to the ORR for storage under Centralization Alternative Option D:

- Naval-type SNF
  - From the INEL, shipyards, and prototypes
- Hanford Production SNF
  - From the Hanford Site
- Graphite SNF
  - From the INEL and the Public Service of Colorado
- DOE-owned commercial SNF
  - From the Hanford Site, INEL, West Valley Demonstration Project, and B&W Lynchburg
- Experimental - Stainless Steel SNF
  - From the Hanford Site, INEL, SRS, Foreign Research Reactors, and non-DO domestic research reactors
- Experimental - Zirconium Clad SNF
  - From the INEL and SRS
- Experimental - Other
  - From the ORNL
- SRS Production and Aluminum Clad SNF
  - From the INEL, SRS, ORNL, Los Alamos National Laboratory, Brookhaven National Laboratory, Foreign Research Reactors, and non-DOE domestic research reactors.

All SNF presently in storage at DOE facilities would arrive at the ORR stabiliz canned to the extent necessary for safe transportation. However, this SNF may need uncanned, stabilized, prepared, and recanned at the ORR to ensure safe interim stor non-DOE domestic, Foreign Research Reactor, and Naval SNF would arrive in a state n for safe transportation but uncanned. This fuel would be stabilized, prepared, and ORR to ensure safe interim storage. All fuel would be cooled a minimum of 120 days shipping and 5 years before being placed into dry storage. Additionally, Naval SNF examined at the ORR before it was turned over for interim storage management.

Although the ORR has a number of experimental and pilot facilities, probably no is suitable for receiving, canning, storing, or supporting research activities nece management of SNF, unless they are extensively upgraded and expanded. As a result, SNF management complex would be built at the ORR under the Centralization Alternati Option D. The SNF management complex would include the following:

- SNF receiving and canning facility
- Technology development facility
- Interim dry storage area
- Expended Core Facility for Naval-type fuel similar to the one currently at

The SNF receiving and canning facility would receive SNF cask shipments from of prepare the SNF for dry storage. A pool storage area would be included in this fac cooling SNF before it is placed into dry storage, as necessary. The technology dev facility would investigate the applicability of dry storage technologies and pilot-development for disposal of the various types of SNF. The interim dry storage area consist of passive storage modules designed to safely store the SNF for 40 years. would be examined at a new Expended Core Facility constructed at the ORR prior to b turned over for interim storage management.

The SNF management complex which would be built at the ORR under the Centraliza Alternative would have the same components as that built under the Regionalization However, the dry storage component would be about 10 times larger, due to the large inventory that would be transported to the ORR under the Centralization Alternative components of the SNF management complex would be the same general size as those bu under the Regionalization Alternative. This is because the inventories of new unca which would be sent to the ORR under the Centralization and Regionalization Alterna

would be very similar. Additionally, the major portion of the potential radiologic releases and waste generation rates are associated with these components and would significantly different for the Regionalization Alternative. Therefore, this alter the basis for a semiquantitative comparison with the Regionalization Alternative.

If the ORR is not chosen as the centralization site, all SNF at the ORR would b to the selected centralization site. An exception would be those fuels for which t available technology for stabilization to permit safe transport. There is a small from the Molten Salt Reactor Experiment that is stored in tanks at the ORR. Curren technology to stabilize this SNF for transport does not exist. Under this alternat to ship SNF to the SRS, this Molten Salt Reactor Experiment SNF would continue to b at the ORR until it could be stabilized for safe shipment.

Based on the projected schedule for operation of additional centralized SNF sto facilities, the option for acquiring dry storage facilities at the ORR would be mai ensure storage facilities at the ORR would be maintained to ensure continued High F Reactor operation (Brown 1994a; Hoel 1994).

3.2 Comparison of Alternatives

Table 3.2-1 shows a comparison of the alternatives. The Regionalization Altern column does not include the requirements of the Naval Expended Core Facility, altho facility may be constructed at the site under this alternative. The Centralization column does include the requirements of the Naval Expended Core Facility, which are in Volume 1, Appendix D, since this facility will be built at the site under this a

Table 3.2-1. Comparison of alternatives at the Oak Ridge Reservation.

Parameter	Regional Subalter
Land for new facilities (acres)	90
Site area (acres)	34,667
Percent of site area	0.26
SNF-related employmentb	556
Baseline site employment	17,082
Percent of baseline site employment	3.3
Estimated maximum latent cancer fatalities in 80-km population per year, SNF management operationsc	2.5 x 10
Estimated cancer fatalities in 80-km population per year, other site operations	2.7 x 10
Estimated probability of cancer fatalities in MEI per year, SNF management operationsc	3.1 x 10
Estimated probability of cancer fatalities in MEI per year, other site operations	9.2 x 10
Estimated probability of cancer fatality in average worker per year, SNF management operationsc	1.6 x 10
Estimated probability of cancer fatality in average worker per year, other site operations	1.1x 10-
Water use (million gallons) per year, SNF management	3.6
Baseline water use (million gallons) per year, site operations	6,680
Percent of baseline site water use	0.05
Electricity use (megawatt-hours) per year, SNF management	23,000

Table 3.2-1. (continued).

Parameter	Regionalization Subalternative B at ORR
Baseline electricity use (megawatt-hours) per year, site operations	1,000,000
Percent of baseline site electricity use	2.30
Sewage discharge (million gallons) per year, SNF management	3.6
Baseline sewage discharge (million gallons) per year, site operations	200
Percent of baseline site sewage discharge	1.8
High-level waste (cubic meters) per year, SNF management	0
Transuranic waste (cubic meters), SNF management	16
Mixed waste (cubic meters), SNF management	0
Low-level waste (cubic meters), SNF management	203
Estimated maximum cancer fatalities in 80-km population	2.1 x 10-2

from maximum risk accidentd	
Frequency of occurrence (number per year)d	1.6 x 10-1
Estimated maximum risk of cancer fatalities in 80-km population maximum risk accident (cancer fatalities per year)d	3.4 x 10-3
Estimated maximum worker cancer fatalities from maximum risk accidentd	1.9 x 10-3
Frequency of occurrence (number per year)d	1.0 x 10-4
Estimated maximum risk of worker cancer fatalities from maximum accident (latent cancer fatalities per year)d	1.9 x 10-7

a. Centralization Option includes the Naval Expended Core Facility (ECF) results f without ECF would be the same as for Regionalization.
b. Annual average SNF direct construction and operation jobs over the 10-year peri
c. Excludes baseline site operations.
d. Centralization Option is the same as the Regionalization Option for the SNF Man Naval Expended Core Facility accident analyses results from Volume 1, Appendix D.

4.0 AFFECTED ENVIRONMENT

4.1 Overview

This chapter describes the existing environmental conditions in areas potential programmatic decision to site spent nuclear fuel (SNF) facilities at the Oak Ridge under the Centralization and Regionalization alternatives. Topics were selected fo their potential to be affected by these alternatives. Each topic is addressed in t serve as a baseline for assessment of potential environmental consequences in Chapt

4.2 Land Use

The ORR occupies an area of approximately 34,667 acres (140 square kilometers) Tennessee, in a predominantly rural area about 25 miles (40 kilometers) west of Kno which is bordered on the southeast and southwest by the Clinch River, is within the boundaries of the City of Oak Ridge, and also lies within Roane and Anderson Counti

The ORR consists of three plants located on three separate sites: the Y-12 Plan or 3.4 square kilometers); the Oak Ridge National Laboratory (ORNL) (1.8 square mil kilometers); and the K-25 Site (1.1 square miles or 2.8 square kilometers) (MMES 19

Land use activities at the ORR have historically occurred within the boundaries plant sites. However, more recently, other ORR lands have also begun to be used. utilized for waste storage in the mid-1940s and for environmental research in the 1 management program was initiated in 1964, and the first comprehensive forest manage was released in 1965. The ORR has been used by research institutions, universities agencies as a site for the study of terrestrial ecology, aquatic ecology, forestry, Department of Energy (DOE) designated approximately 21 square miles (54 square kilo undeveloped ORR land as a National Environmental Research Park, which today provide areas for research and education in the environmental sciences (MMES 1989).

Land use outside the three main plant sites falls into seven general categories research and development; support services; waste management; environmental restora areas; public recreational park; and national environmental research park (Figure 4 58 percent of the land on the ORR (20,051 acres or 31 square miles) can be classifi due to its current land use designation (MMES 1994a).

Land uses bordering the ORR are primarily forest and agricultural. Residential the only other significant uses of land in the vicinity, and occur along the northe boundary of the ORR in the City of Oak Ridge. The land areas bordering the ORR com (mostly hardwood forests), small farms, and rural residences. Commercial forestry account for approximately 76 percent of the total land use in this region (MMES 199

The entire ORR has been placed under the forestry, agriculture, industry, and r classification by the City of Oak Ridge, although this designation does not bind DO on the site. DOE land use plans applicable to the ORR include the Oak Ridge Reserv Development and Facilities Utilization Plan, issued in 1989 and updated in 1990; th Comprehensive Plan and Zoning Ordinance, issued in 1985 and updated in 1988; and th

Management Plan for the U.S. DOE Oak Ridge Reservation, first issued in 1984.

The region surrounding the ORR has numerous local, state, and national public r (Figure 4.2-2). Federal outdoor recreation facilities include the Great Smoky Moun the Cherokee National Forest; the Cumberland Gap National Historic Park; the Big So River and Recreation Area; and the Obed Wild and Scenic River (MMES 1994a). State ORR site include the Frozen Head State Natural Area; the Big Ridge State Park; the Park; the Fall Creek Falls State Park; the Pickett State Rustic Park; the Panther C Hiwassee State Scenic River (MMES 1994a).

Figure 4.2-1. Generalized land use at the Oak Ridge Reservation. Figure 4.2-2.

such as fishing and boating. Wildlife management areas that allow in-season huntin South Fork National River and Recreation Area, Catoosa Wildlife Management Area, Ch Wildlife Management Area, and the ORR (MMES 1994a).

Numerous locally funded recreational areas exist near the ORR, the closest bein Ridge. The City of Oak Ridge has 2 golf courses, 11 athletic fields, 36 tennis cou areas, and a public outdoor swimming pool (MMES 1994a).

Clark Center Recreational Park, located on the ORR, is a 90-acre (0.36-square-k recreational area that is open to the public. The park consists of three shelters, fields, a swimming area, and a paved access road. It is located approximately 2 mi south of the Y-12 Plant (MMES 1994a).

The ORR is a controlled area with public access limited to through traffic on T Routes 95, 58, 62, 162, and 170 (MMES 1991b).

The site proposed for SNF activities is located within the West Bear Creek Vall the western portion of the ORR site near the site boundary. This area of the ORR i Natural Areas land use category and is designated for future Waste Management land 1994a). The area is designated as a Potential Site for a Future Programmatic Initi ORR Master Plan (MMES 1994a). With the exception of an industrial park, land uses ORR in the area of West Bear Creek Valley are primarily agricultural farmland and c with sparsely located residences (MMES 1994a).

The industrial park located just to the south of the proposed SNF management fa Creek Road houses two organizations. The Scientific Ecology Group, Inc., employs a people and is a low-level radioactive waste incinerator who's commercial operation International Technology, Inc., operates a hazardous and radioactive waste geotechn pilot lab, also on Bear Creek Road. This International Technology, Inc., operates a hazardous and radioactive waste geotechnical laborator also on Bear Creek Road. This International Technology, Inc., facility is an exten office and employs about 10 people at the facility (IT undated a, undated b; SEG un

There are no onsite areas that are subject to Native American Treaty rights o unique farmland.

4.3 Socioeconomics

4.3.1 Region of Influence

The socioeconomic information presented in this Programmatic Environmental Im covers the baseline conditions in the Region of Influence. The Region of Influence region in which the principal direct and indirect socioeconomic effects of actions occur and are expected to be of consequence for local jurisdictions. The Region of the current residential distribution of the DOE and contractor personnel employed b probable location of offsite contractor operations, and the probable location of la supporting indirect economic activity linked to the ORR. The Region of Influence i where 92 percent of DOE and contractor personnel employed by ORR reside. The Regio includes the counties of Anderson, where 34 percent of ORR personnel reside, Knox ((16 percent), and Loudon (6 percent) (Truex 1991 [Table J]).

4.3.2 Regional Economic Activity and Population

Regional economic linkage supporting production activity at the ORR occurs pr Anderson, Knox, and Roane counties, where most of the supporting contractors offsit capital supporting indirect economic activity linked to the ORR are located.

4.3.2.1 Anderson County. Most of the industrial and commercial development, dominated by

energy-related companies specializing in manufacturing and research and development ORR, has occurred in the City of Oak Ridge in Anderson County and Roane County.

The major employment sectors in Anderson County in 1990 were services, manufa government, and retail trade. As a percentage of Anderson County wage and salary e service and manufacturing sector each accounted for 30 percent, the government sect retail trade 11 percent. The number of employed persons in Anderson County in 1990 in Anderson County have increased 3 percent annually between 1980 and 1990, and are continue to increase at an average rate of less than 1 percent annually for the nex Department of Commerce 1993). Since 1988, the unemployment level for Anderson Coun remained below the national unemployment rate. The unemployment rate reached a low in 1990 and has slowly increased to 5.6 percent in 1992 (Anderson County 1993; Depa Economic and Community Development Industrial Development Division 1993).

Approximately 40 percent of the Anderson County population resides in the Cit with an additional 42 percent in rural areas, and the remaining 18 percent in other Anderson County (Anderson County 1993). Between 1980 and 1990, the population in County increased by over 1 percent from 67,500 to 68,250 persons (0.10 percent annu population in Anderson County is projected to continue to grow at an average rate o annually over the next several years, reaching 76,100 persons by 2004 (U.S. Departm 1993).

4.3.2.2 Knox County. In Knox County, the major employment sectors in 1990 were service,

manufacturing, retail trade, and government. As a percentage of Knox County wage a employment, the service sector accounted for approximately 27 percent, retail trade manufacturing 12 percent, and government 17 percent. The total number of persons e County in 1990 was 215,948. Jobs have increased 2 percent annually between 1980 an projected to continue to grow at an average rate of less than 1 percent annually fo (U.S. Department of Commerce 1993). The unemployment rate for Knox County was 4.6 1992 (Department of Economic and Community Development Industrial Development Divis

Between 1980 and 1990, the population in Knox County increased 5 percent from 335,750. The population in Knox County is projected to continue to increase at an than 1 percent annually for the next several years, reaching 377,130 persons by 200 of Commerce 1993).

4.3.2.3 Roane County. Development that has occurred in Roane County has been

predominantly residential. In Roane County, the major employment sectors in 1990 w manufacturing, services, and government. As a percentage of wage and salary employ County, retail trade accounted for approximately 26 percent, manufacturing 24 perce percent, and government 15 percent. The total number of persons employed in Roane was 24,640. Jobs have increased less than 1 percent annually between 1980 and 1990 to continue to increase at an average rate of less than 1 percent annually for the Department of Commerce 1993). The unemployment rate for Roane County was 6.8 perce (East Tennessee Development District 1993).

Between 1980 and 1990, the population in Roane County decreased 2.5 percent, 47,230. The population in Roane County is projected to increase at an average rate annually for the next several years, reaching 52,670 persons by 2004.

4.3.2.4 Loudon County. Total employment in Loudon County in 1990 was 12,560 persons. In

1990, the farming sector accounted for a considerably larger percentage, while the government sector accounted for a smaller percentage of total jobs than in Anderson counties (U.S. Department of Commerce 1993). The unemployment rate for Loudon Cou percent in 1992, dropping from 7.2 percent in 1991 due to increase in construction Tennessee Development District 1993).

The population of Loudon County increased by 1 percent annually, from 28,700 in 1990. The population of Loudon County is projected to increase at an average ra percent annually for the next several years, reaching 32,900 persons by 2004 (U.S. Commerce 1993).

4.3.2.5 Oak Ridge Reservation. The employment level at the ORR in 1994 was 18,200

persons (Truex 1995). In 1993, there were approximately three full-time-equivalent positions involved in SNF operations on the ORR (Brown 1994b). Employment levels a decrease to 16,980 by the year 1999 and are projected to remain constant through th 1994).

4.3.2.6 Aggregate Regional Economic and Demographic Baseline. For the purposes of

establishing a regional baseline to compare potential impacts for the programmatic 5.3, regional economic and demographic data for the four-county Region of Influence form one region (Table 4.3-1).

The total population of the Region of Influence, shown in Table 4.3-1, is pr persons in 1995, and is projected to grow at an annual average rate of less than 1 538,820 persons in 2004. The labor force of the Region of Influence is also projec annual average rate of less than 1 percent, growing to 360,000 persons in 2004. Th the Region of Influence is projected to grow at an annual average rate of approxima growing from 292,700 jobs in 1995 to 338,070 jobs in 2004.

4.3.3 Public Service, Education and Training, and Housing Infrastructure

4.3.3.1 Police and Fire. ORR fire protection services are provided by the fire departments on

the reservation. The ORR fire departments have mutual aid agreements among themsel City of Oak Ridge (MMES 1989).

Twelve city, county, and state law enforcement agencies provide police protec Influence. In 1990, the largest law enforcement agency in the four-county Region o Knoxville, with 296 sworn officers (FBI 1991). Law enforcement on the ORR is provi Oak Ridge Police Department. Security enforcement, established to meet the Atomic mission requirements, is provided by the prime management and operations contractor

Table 4.3-1. Aggregate regional economic and demographic indicators for ORR. a

Years	Regional employment	Regional labor force	Regional population
1995	311,700	332,000	506,600
1996	315,100	335,700	510,300
1997	318,600	339,400	51,400
1998	322,100	343,100	517,900
1999	325,700	346,900	521,700
2000	329,300	350,700	525,500
2001	331,500	353,000	528,800
2002	333,700	355,400	532,100
2003	335,900	357,700	535,500
2004	338,000	360,000	538,800
2005	340,300	362,400	542,200
Average Annual Growth Rate	0.9%	0.9%	0.7%

a. Sources: U.S. Department of Commerce 1993; East Tennessee Development District

Note: Aggregate region includes the Roane, Anderson, Loudon and Knox Counties. La force projection developed for this study.

4.3.3.2 Education and Training. Four school districts, Anderson, Knox, Loudon, and Roane,

provide public education services in the Region of Influence. In 1990, the four s average daily membership of 66,510 students. Knox County had the highest average d of 50,324 students (Tennessee Department of Education 1992).

4.3.3.3 Housing. Between 1980 and 1990, the number of housing units in the Region of

Influence increased 14 percent from 181,299 to 206,234. In 1980 and 1990, the home rates in the Region of Influence averaged 1.4 and 1.5 percent, respectively (Census Housing additions in the Region of Influence peaked at 3,882 units in 1990, b in 1991. In 1992, however, housing additions increased to a total of 3,880 units (Development District 1993).

4.4 Cultural and Paleontological Resources

4.4.1 Archeological Sites and Historic Structures

For approximately 10,000 years, people have inhabited the ORR site. A cultur conducted in 1975 did not identify any cultural resources on the proposed site for facilities. Therefore, no prehistoric or historic resources are expected to be loc for the SNF management facilities (Fielder 1975).

4.4.2 Native American Resources

In the early 1700s, the Overhill Cherokee lived in the area that is now the O remained in the area until 1838, when it was moved forcibly to Oklahoma under Feder al. 1984a). While the Cherokee may retain cultural affiliation with their ancestra known Native American resources on the proposed site for the SNF facilities.

4.4.3 Paleontological Resources

The ORR is underlain by nine geologic formations or groups ranging in age fro to Early Mississippian. On the ORR, the only formations known to contain fossils a (which does not usually contain fossils but does contain small coiled gastropods in Chickamauga Limestone (which contain many fossils including brachiopods, bryozoans, cephalopods, crinoid stems, corals, and trilobites); the Sequatchie Formation (whic abundant supply of fossils in the formation, but does contain large brachiopods, co bryozoans within several thin beds of gray limestone); the Rockwood Formation (whic stem fossils in the upper half of the formation); and the Fort Payne Chert, which c crinoid stems (McMaster 1988). No unusual paleontological remains from the ORR wer

4.5 Aesthetics and Scenic Resources

Visual or scenic resources comprise the natural and man-made features that give environment its aesthetic qualities. These features form the overall impression th an area or its landscape character. Visual sensitivity is assessed by considering and expectations of the public within a given area. High visual sensitivity exists unique, or in other ways special to viewers. Medium visual sensitivity exists when others in the area or is of secondary importance relative to other significant aspe visual sensitivity exists when a view has little value to viewers and an intrusion would have no impact on viewers.

Scenic resources at the ORR and the surrounding area are set in a landscape of predominantly parallel ridges with steep slopes interspersed with relatively flat v physiographically as the Ridge and Valley Province. Due to the rolling topography approximately 62 percent of the reservation is located on slopes of less than 14 pe The reservation is framed by the Clinch River at the west, south, and eastern bound Creek to the north. The vegetation present at the reservation is primarily a mixtu coniferous forest covering approximately 80 percent of the site (MMES 1989). Roads access to the interior of the site include State Routes 95 and 58, along with Bethe 4.2-1).

The location of the proposed SNF management facilities, under the Centralizatio set along the north side of Bear Creek Road west of State Route 95, between the ext and State Route 95, at the western end of the reservation. The public has access t

of State Route 95. As a result, the entrance to the site will be visible to traffi (MMES 1994a). The proposed facilities would consist of 90 acres (0.36 square kilom would be located within security fencing. The facility would have the appearance o ranging in height from one to three stories. The site would receive and unload up per day, or a total of 5,500 truck shipments over the 40-year operation period. Th the south side of Pine Ridge midway between the top of the ridge, with elevations r and 1,100 feet (274 and 335 meters), and Bear Creek Valley, with an elevation of ap (213 meters) (TVA 1987). Chestnut Ridge, located south of Pine Ridge on the reserv

Under the Regionalization Alternative, the location of the proposed SNF facilit same but would be reduced in area and extent. Operation of the facilities would al resulting in the receipt of fewer truck shipments over the 40-year operation period

The viewshed surrounding the ORR consists mainly of sparsely populated rural la Oak Ridge, along the northeast portion of the site, is the only adjacent urban area facilities from areas surrounding the reservation include those from public roadway 40 and 75, U.S. Route 70, and State Routes 62, 162, and 95. The reservation can al south bluffs along the Clinch River. The Great Smoky Mountains National Park and t Mountains are approximately 70 miles southeast of the ORR and are generally not vis reservation (MMES 1989). In general, views are limited by the rolling terrain, hea vegetation, and hazy atmospheric conditions.

The developed areas of the ORR could generally be classified as having low visu remainder of the site ranges from low to moderate visual sensitivity. Of the juris affected by the construction and operation of the proposed SNF facilities, only the its Comprehensive Plan has provided policies that promote elements of scenic resour preservation through streetscape design, landscaping, lighting, and signage improve the urban area and the city center. One entrance to the urban area that promotes s enhancement and preservation is Illinois Avenue, crossing the northeast portion of Oak Ridge 1989).

4.6 Geologic Resources

This section provides a general description of the geology, soils, geologic res volcanic, and other geologic hazards at the ORR and surrounding area. This section existing impacts to the geology and geologic resources resulting from past and pres at the ORR.

4.6.1 General Geology

As shown in Figure 4.6-1, the ORR lies entirely within the western portion of t near the boundary with the Cumberland Plateau. The Valley and Ridge Province, a zo rocks in the Appalachian mountain belt, is characterized by numerous linear ridges approximately southwest-northeast as shown on Figure 4.6-2. The rocks of the Valle Tennessee are Early Cambrian to Early Mississippian in age. A stratigraphic column East Fork Ridge (south of Interstate 95) is shown on Figure 4.6-3. A generalized g shown on Figure 4.6-2. Most of the ORR is underlain by the Rome Formation and Cona Groups, sedimentary rocks of Cambrian and Ordovician age (Hatcher et al. 1992). A ORR is shown on Figure 4.6-4.

The Rome Formation consists of interbedded sandstone, siltstone, and shale. Th is not exposed in the Oak Ridge area, but consideration of regional structural tren Rome Formation is in fault contact with younger rocks. On the Copper Creek and Whi thrust sheets the Rome is 120-180 meters (390-590 feet) thick, and on

Figure 4.6-1. Generalized map of the southern Appalachian geologic provinces show

Figure 4.6-2. Geologic map of the Oak Ridge Reservation. Figure 4.6-3. Stratigr

carry the name of the fault at their front, or northwest edge. Faults are shown on transition between the sandstones of the Rome Formation and the overlying Pumpkin V Conasauga Group occurs rather abruptly, as the more resistant sandstones grade into shales.

The formations of the Middle to Upper Cambrian Conasauga Group are primarily li interlayered with shales, limestones, and siltstones. At the ORR, the Conasauga Gr six units (see Figure 4.6-3). Approximately 450 meters (1,500 feet) of the Conasau at the ORR. The transition from the Conasauga Group to the overlying Knox Group is the dominant rock type shifting from shale and dolomitic limestones in the Conasaug dolomites with occasional limestones in the Knox Group.

At the ORR, as in the rest of eastern Tennessee, the Upper Cambrian to Lower Or Group is divided into five formations, which are shown on Figure 4.6-3. The Knox G approximately 914 meters (3,000 feet) thick on the ORR and consists primarily of th dolomite (Hatcher et al. 1992). Above the Knox Group is the Middle to Upper Ordovi Group. See Figure 4.6-3 for the units that comprise the Chickamauga on the Whiteoa sheet.

Surface relief at the ORR typically ranges from a ridge crest to valley floor r (100 to 225 feet) (Lee and Ketelle 1987). Surface elevations on the ORR range from meters (1,356 feet) National Geodetic Vertical Datum at the crest of Melton Hill (s minimum of 226 meters (740 feet) National Geodetic Vertical Datum near Mile 10 on t (Boyle et al. 1982). A series of crests and ridges that trend northeast and southw (Figure 4.6-2). In general, the crests or ridges are composed of resistant sandsto Limestone and shale generally form the ridge flanks and valley bottoms.

Sinkholes, large springs, caves, and other karst features are common in the Kno parts of the ORR underlain by limestones and dolomites (certain units in the Conasa Chickamauga Groups) are for the most part classified as karst terranes. In a karst little surface drainage because of the diversion of surface waters to subterranean routes. These subterranean routes are caves and other enlarged openings that have dissolution of the carbonate rock. Four major karst zones exist at the ORR that ap distinct stratigraphic horizons (Ketelle 1982). These four karst zones all occur i specifically in the Copper Ridge Dolomite, near the base of the Chepultepec Dolomit the Chepultepec Dolomite, and in the Kingsport Formation (Ketelle 1982). Karst dev present to varying degrees in the carbonate rocks of the Conasauga Group, most nota Maynardville Limestone. In Bear Creek Valley, karst development in the Maynardvill causes variations in discharge along Bear Creek as the surface water and groundwate in dominance (Lee et al. 1988). Bear Creek Valley is underlain by calcareous shale Conasauga Group (Bailey and Lee 1991). Although no site-specific geologic characte conducted at the West Bear Creek Valley site, it appears the proposed SNF managemen located over the lower Conasauga Group strata not normally characterized by karst d

The soils occurring in the ORR are predominantly clay, although chert and quart Soils developed in the Conasauga are clay. Hatcher et al. (1992) provides detailed Many of the soils belong to the broad group of Ultisols, which are reddish or yello acidic soils. Entisols, which are thin surface soils over bedrock that show little horizons, are found locally in steeply sloping areas. In addition, small areas of alluvial areas adjacent to streams (Boyle et al. 1982). These are young soils, als development. Soils on the ORR tend to retain moisture and are typically 90 percent depth of 3 meters (10 feet) (Ketelle and Huff 1984). Depths of soil profiles on th centimeters (6 inches) on slopes to 18 meters (60 feet) over dolomites in the Knox 1982).

4.6.2 Geologic Resources

The known resources of the geologic units exposed on the ORR are limited to ind including quarry rock and clay. These industrial minerals are of low unit value an elsewhere. Quarry rock has been mined at several major locations throughout ORR, b currently in operation (Oakes et al. 1984b).

There has been extensive seismic testing by private companies along roads trave explore for deep accumulations of oil and gas. Land has been leased by major oil c northwest of K-25 off the ORR; no exploratory wells have been drilled and the statu resources underlying the ORR is unknown at this time (Oakes et al. 1984b).

4.6.3 Seismic and Volcanic Hazards

There is no evidence that there has been volcanic activity in the vicinity of t 1 million years.

4.6.3.1 Historical Seismic Activities. From 1811 to 1975, only five major earthquakes or

earthquake series have affected the ORR area. These are the New Madrid, Missouri, and the Charleston, South Carolina; Knoxville, Tennessee; Strawberry Plains, Tennes Tennessee earthquakes. The New Madrid earthquake series of December 1811 to Februa produced maximum Modified Mercalli Intensity disturbances of V to VI in the ORR are

Mercalli Intensity V earthquake is felt by everyone. Typical damage includes some etc. being broken, a few instances of cracked plaster, and unstable objects being o Mercalli Intensity VI earthquake is also felt by all, and many become frightened an Typical damage includes some heavy furniture moved and a few instances of fallen pl chimneys. A Modified Mercalli Intensity of VI is approximately equal to a Richter (Griggs and Gilchrist 1977).

The 1844 Knoxville earthquake, which occurred approximately 40 kilometers (25 m ORR, had an epicenter shaking of Modified Mercalli Intensity VI. The Charleston ea had a Modified Mercalli Intensity of V to VI at the ORR, as did the 1913 Strawberry The 1930 Kingston earthquake, 8 kilometers (5 miles) northwest of the ORR, had an e Modified Mercalli Intensity V (Boyle et al. 1982). When intensities are reported a would have been less at the ORR, as intensities diminish with distance.

A Modified Mercalli Intensity VII earthquake does not typically cause severe da causes breaking of weak chimneys at the roof line, cracks in masonry, and the falli bricks, and stones. No Modified Mercalli Intensity VII earthquakes have been recor during the 165-year period from 1811 to 1975. Earthquakes with a Modified Mercalli generally occur one order of magnitude less frequently than earthquakes with a Modi Intensity of V to VI. Seismic records indicate that the ORR is located in a region activity having an average of one to two earthquakes per year, with seismic activit followed by long periods of no activity. No deformation of recent surface deposits and seismic shocks from the surrounding, more seismically active areas are dissipat the epicenters (Boyle et al. 1982).

The underlying structure of the ORR is complex due to the extensive faulting an characteristic of the region. There are three regional thrust faults in the ORR ar Whiteoak Mountain, and Copper Creek Faults (see Figure 4.6-4). All three strike to dip to the southeast. Latest movement on the faults was Late Pennsylvanian/Early P million years ago); consequently, they are not considered to be capable faults at p 1984b). According to 10 CFR Part 100, Appendix A, capable faults include those fau exhibited movement at or near the ground surface at least once during the past 35,0 of a recurring nature within the past 500,000 years.

4.6.3.2 Seismicity Studies. Four seismic studies have been specifically conducted for the

ORR for which the results have been published. Three of these studies have been su Beavers et al. (1982), and were performed by Blume in 1973, Dames and Moore in 1973 1981. The first two studies were directed toward the seismic hazards at the K-25 S Ridge Gaseous Diffusion Plant), and the latter focused on ORNL (Beavers et al. 1982

These three early studies presented preliminary analysis and conclusions. The (McGuire et. al. 1992), is a more recent seismic analysis for the entire ORR. DOE 1994a) and 1024 (DOE 1992b) summarize the results of recent seismic analyses at DOE that the peak ground accelerations for the ORR for 500-year, 1,000-year, 2,000-year seismic events are 0.08g, 0.13g, 0.19g and 0.29g, respectively.

Figure 4.6-5 presents the site specific uniform hazard response spectra for hori which were approved by DOE Headquarter's Office of Nuclear Energy on August 25, 199 1993). The response spectra noted on Figure 4.6-5 are for top of rock sites.

4.6.3.3 DOE Seismic Design Criteria. DOE Order 5480.28 requires that the Design and

Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phen UCRL-15910 (Kennedy et al. 1990), be used for natural phenomena hazards design and criteria until a DOE standard is issued. In April 1994, DOE-STD-1020 was issued to 15910.

At the SNF management facility site the categorization of each structure, syste would be determined in accordance with DOE Standard DOE-STD-1021, Performance Categ Criteria for Structures, Systems and Components at DOE facilities Subjected to Natu Hazards.

A maximum horizontal ground surface acceleration of 0.19g at ORR is estimated t earthquake that could occur once every 2,000 years (DOE, 1994a). The seismic hazar presented in this EIS is for general seismic hazard comparisons across DOE sites. and site specific procedures require that potential seismic hazards for existing an evaluated on a facility specific basis.

Figure 4.6-5. Oak Ridge- Site Specific Uniform Hazard Response Spectra for Horizontal Rock Motion 4.7 Air Resources

4.7.1 Climatology

Except where indicated, the information presented in this section is derived fr and NOAA 1991.

The ORR site is located within the Great Valley of Tennessee in which the Cumbe borders to the northwest and the Great Smoky Mountains lie to the southeast. Clima influenced by these terrain features.

The climate and meteorology in the lowlands are generally unlike those that occ mountainous regions of the southeastern United States. Daytime winds are usually s night-time winds are northeasterly, at least during periods of light wind. The ele the Cumberland Plateau and Great Smoky Mountains encompassing the valley impede win moderate degree. The Cumberland Plateau retards the drainage of cold air from the the valley during winter, thus reducing the probability of extremely cold temperatu The average daily temperature at the Oak Ridge National Weather Service Station, co representative of the ORR, was 14.2oC (57.5oF) for the period of record 1961-1990. temperatures varied from a low of 2.6oC (36.7oF) in January to a high of 24.8oC (76

Humidity data are maintained at the Knoxville National Weather Service with a p from 1961-1990. Records are reported for humidity readings during the hours 0100, 1900 (local time). The 0700 and 1900 values will be reported here. The mean 0700 was 86 percent with the mean monthly maximum of 92 percent occurring in July and Au mean monthly minimum of 80 percent occurring during February and March. The mean 1 humidity is 63 percent with the mean monthly maximum of 68 percent occurring in Sep December, and the mean monthly minimum of 52 percent occurring in April.

The mean wind speed measured at the Oak Ridge National Weather Service over the 1984 was 2.0 meters per second (4.4 miles per hour) at an average height above grou meters (41 feet). At a meteorological tower at the ORR the mean wind speed was 2.1 (4.7 miles per hour) at about 10 meters (33 feet) above ground level. Wind speeds influenced by local topographic conditions and are generally higher on top of the r valleys.

The wind direction above the ridgetops and within the valleys tends to follow t valleys. The prevailing wind direction is from the southwest, with a secondary max northeast during the winter, spring, and summer months. The situation is reversed

Figure 4.7-1 shows 1992 wind roses for the 10- and 60-meter levels of the Y-12 meteorological tower. The annual 10-meter level on the Y-12 west meteorological to peak wind direction frequencies from the west-southwest, with the secondary peak fr northeast. The annual 60-meter level shows wind direction frequencies from the nor secondary peak from the southwest. Since the valley floor is inclined, cold air wi during stable periods. Both wind rose levels show the influence of the topography

Damaging winds are uncommon in the region. Peak gusts recorded in the Great Va generally in the 27- to 31-meter-per-second (60- to 70-mile-per-hour) range for the through July; in the 22- to 27-meter-per-second (50- to 60-mile-per-hour) range for and December; and in the 16- to 20-meter-per-second (35- to 45-mile-per-hour) range November. The maximum gust reported in the region was about 37 meters per second (hour); it occurred during the month of March at Chattanooga. Knoxville has reporte about 33 meters per second (73 miles per hour) and Oak Ridge a gust of about 26 met miles per hour).

Winter is the wettest of the seasons in the ORR area; March and December are th and October the driest. The annual average precipitation measured at the ORR in Be 1944 through 1964 was 130.9 centimeters (51.5 inches), while the annual average pre

Figure 4.7-1. Wind Roses for Y-12 west tower (@ 10 and 60m) for 1992 at ORR. Nati

The maximum monthly precipitation was 48.9 centimeters (19.3 inches) in July 1967, maximum rainfall in a 24-hour period observed at the Oak Ridge National Weather Ser in August 1960 at 19.0 centimeters (7.5 inches).

On average there are about 51 thunderstorm days per year at the Oak Ridge Natio Service station. The summer thunderstorms, which may be accompanied by strong wind precipitation, or, less frequently, hail, occur primarily during the late afternoon Summer thunderstorms are attributable primarily to convective activity resulting fr the ground and generally moist atmospheric conditions. Thunderstorm activity in th

attributable mainly to frontal activity.

The Great Valley of Tennessee is infrequently subject to tornadoes. The wester has experienced three times as many tornadoes as the eastern half, where the ORR is did experience a tornado from a severe thunderstorm on February 21, 1993 (MMES 1993b). The tornado path passed the Y-12 Plant in an east-northeast directio 21 kilometers (13 miles), ending just north of Knoxville. The wind speeds associat ranged from 18 meters per second (40 miles per hour) to nearly 58 meters per second hour), depending on the location along the path (MMES 1993b).

Hurricanes are rarely sustained once they reach as far inland as the Great Vall loss of energy when they are cut off from their source of moisture. The remnants o were classified as devastating after crossing the coastline of the United States ha of Tennessee in the last 70 years.

Atmospheric dispersion improves as wind speed increases, conditions become more the depth of the mixing height increases. The transport and dispersion of airborne functions of air movement. Transport directions and speeds are governed by the gen flow (and by the nature of the terrain), whereas the diffusion of airborne material scale, random eddying of the atmosphere (i.e., turbulence). Turbulence is indicat stability classification. Data collected at Y-12 for calendar year 1992 were class temperature difference (i.e., between 60- and 10-meter levels) in accordance with N Commission Regulatory Guide 1.23 (NRC 1986). The atmospheric conditions are unstab Stability Classes A through C) approximately 5 percent of the time, neutral (Class percent of the time, and stable (Classes E through G) approximately 52 percent of t meter level.

4.7.2 Air Monitoring Networks

This section discusses the air monitoring networks of the ORR. Atmospheric emi ORR facilities are monitored by stack monitors and by a network of ambient air moni the perimeter of each major ORR operations area (ORNL, the Y-12 Plant, and K-25 Sit the ORR perimeter and throughout the surrounding communities.

4.7.2.1 Radiological Monitoring Network. Twelve of the ambient air monitoring stations on

the perimeter of the Y-12 Plant routinely monitor total suspended uranium particula perimeter monitoring network consists of four stations that monitor radiation param alpha, gross beta, iodine, and gamma-emitting radionuclides). Samples of atmospher collected monthly at selected perimeter stations.

4.7.2.2 Nonradiological Monitoring Network. The perimeter ambient air monitoring

network for K-25, which was upgraded in 1986, consists of five stations that monito contaminants such as nickel, lead, and chromium. In 1988, two additional ambient a stations were installed at the K-25 Site. These stations measure polychlorinated b dioxins, and hexachlorobenzene that may accidentally be released due to the Toxic S Act incinerator (located in the K-25 area).

4.7.3 Air Releases

4.7.3.1 Radiological Emissions. Table 4.7-1 presents the radioactive emissions to the atmosphere

from each of the three ORR areas (ORNL, K-25, and Y-12) during 1992.

Table 4.7-1. Radioactive atmospheric emissions (curies/yr) from the ORR during 1992.

Isotope	ORNL	K-25	Y-12
Hydrogen-3 (Tritium	2.14 x 103	0.0 x 100	0.0 x 100
Beryllium-7	8.91 x 10-6	0.0 x 100	0.0 x 100
Potassium-40	0.0 x 100	1.01 x 10-3	0.0 x 100
Cobalt-57	0.0 x 100	0.0 x 100	0.0 x 100
Cobalt-60	2.97 x 10-5	0.0 x 100	0.0 x 100
Bromine-82	1.02 x 10-5	0.0 x 100	0.0 x 100

Krypton-83m	7.32 x 101	0.0 x 100	0.0 x 100
Krypton-85	0.0 x 100	0.0 x 100	0.0 x 100
Krypton-85m	1.73 x 102	0.0 x 100	0.0 x 100
Krypton-87	3.50 x 102	0.0 x 100	0.0 x 100
Krypton-88	4.94 x 102	0.0 x 100	0.0 x 100
Krypton-89	6.27 x 102	0.0 x 100	0.0 x 100
Strontium-90	1.19 x 10-4	0.0 x 100	0.0 x 100
Niobium-95	0.0 x 100	0.0 x 100	0.0 x 100
Technetium-97	0.0 x 100	6.10 x 10-2	0.0 x 100
Ruthenium-106	0.0 x 100	4.36 x 10-4	0.0 x 100
Iodine-129	2.70 x 10-4	0.0 x 100	0.0 x 100
Iodine-131	1.25 x 10-1	0.0 x 100	0.0 x 100
Iodine-132	1.36 x 100	0.0 x 100	0.0 x 100
Iodine-133	6.48 x 10-1	0.0 x 100	0.0 x 100
Iodine-134	2.05 x 10-2	0.0 x 100	0.0 x 100
Iodine-135	1.22 x 100	0.0 x 100	0.0 x 100
Xenon-133	8.81 x 102	0.0 x 100	0.0 x 100
Xenon-133m	2.74 x 10	0.0 x 100	0.0 x 100
Xenon-135	2.82 x 10	0.0 x 100	0.0 x 100
Xenon-135m	1.55 x 102	0.0 x 100	0.0 x 100
Xenon-138	8.50 x 102	0.0 x 100	0.0 x 100
Cesium-134	6.03 x 10-7	0.0 x 100	0.0 x 100
Cesium-137	6.13 x 10-4	8.16 x 10-5	0.0 x 100
Cesium-138	0.0 x 100	0.0 x 100	0.0 x 100
Barium-137	3.84 x 10-4	0.0 x 100	0.0 x 100
Barium-137m	6.13 x 10-4	8.16 x 10-5	0.0 x 100
Barium-140	1.00 x 10-4	0.0 x 100	0.0 x 100
Lanthanum-140	1.39 x 10-6	0.0 x 100	0.0 x 100
Isotope	ORNL	K-25	Y-12
Cerium-144	0.0 x 100	1.23 x 10-6	0.0 x 100
Europium-152	1.86 x 10-12	0.0 x 100	0.0 x 100
Europium-154	5.87 x 10-6	0.0 x 100	0.0 x 100
Europium-155	3.02 x 10-6	0.0 x 100	0.0 x 100
Osmium-191	2.27 x 10-2	0.0 x 100	0.0 x 100
Gold-194	0.0 x 100	0.0 x 100	0.0 x 100
Lead-212	1.56 x 100	0.0 x 100	0.0 x 100
Thorium-228	9.52 x 10-6	1.54 x 10-3	0.0 x 100
Thorium-230	6.49 x 10-7	7.41 x 10-4	0.0 x 100
Thorium-232	1.86 x 10-7	2.96 x 10-5	0.0 x 100
Thorium-234	0.0 x 100	0.0 x 100	0.0 x 100
Protactinium-234m	0.0 x 100	4.07 x 10-1	0.0 x 100
Uranium-234	2.24 x 10-5	2.55 x 10-2	4.70 x 10-2
Uranium-235	4.79 x 10-7	1.12 x 10-3	1.49 x 10-3
Uranium-236	0.0 x 100	0.0 x 100	1.86 x 10-4
Uranium-238	7.57 x 10-7	3.74 x 10-2	4.11 x 10-3
Neptunium-237	0.0 x 100	1.10 x 10-4	0.0 x 100
Plutonium-238	7.40 x 10-6	6.02 x 10-4	0.0 x 100
Plutonium-239	2.06 x 10-5	1.12 x 10-4	0.0 x 100
Americium-241	1.37 x 10-5	0.0 x 100	0.0 x 100
Curium-244	2.05 x 10-4	0.0 x 100	0.0 x 100

4.7.3.2 Nonradiological Emissions. Table 4.7-2 presents the nonradiological emissions to the

atmosphere from each of the three ORR areas during 1992.

4.7.4 Air Quality

4.7.4.1 Radiological. A summary of ORR airborne radionuclide emissions for 1992 is

presented in Table 4.7-1. The GENII environmental transport and dose assessment mo
calculate the effective dose equivalent resulting from these radionuclide emissions
summarized in Table 4.7-3. The maximum effective dose equivalent at the ORR bounda

This is 33 percent of the corresponding National Emissions Standard for Hazardous A collective effective dose equivalents to the estimated population of 910,000 person (50 miles) of the proposed SNF facility is 52 person-rem. This dose is 0.019 perce background radiation affecting this population. Background radiation doses are pre

4.7.4.2 Nonradiological. The ORR is located in Anderson and Roane Counties, in the Eastern

Tennessee-Southwestern Virginia Interstate Air Quality Control Region 207. As of 1 within this Air Quality Control Region were designated as attainment with respect t Ambient Air Quality Standards (CFR 1993a).

One Prevention of Significant Deterioration ambient air quality Class I area ca vicinity of ORR. That is the Great Smoky Mountains National Park, located approxim kilometers (30 miles) southeast of ORR. Since the promulgation of the Prevention o Deterioration regulations, no such permits have been required for any emissions sou

Ambient air quality within and near the ORR is monitored for total suspended pa particulate matter less than 10 microns in diameter (PM10), fluorides, lead, and su monitored until August 1990 (MMES 1993a). Ambient air quality monitoring data coll are summarized in Table 4.7-4.

Table 4.7-2. Nonradiological emissions at ORR (kg/yr).

Pollutant	Y-12	ORNL	K-25
Carbon monoxide	36,807	45,872	12,119
Nitrogen dioxide	648,746	201,090	20,065
Particulates	1,576	5,599	1,137
Sulfur dioxide	268,894	703,419	302
Volatile organic compound	1,582	1,068	1,011
Chlorine	91	b	1,567
Hydrochloric acid	6,959	b	42
Methanol	26,407	b	b
Nitric acid	9,491	30	b
Perchloroethylene	12,245	b	b
Sulfuric acid	2,424	0	130
Hydrogen fluoride	73	b	b
Mercury	0.01	b	b
Trichloroethane	745	b	b

a. Source: MMES (1993a).

b. No source indicated.

Table 4.7-3. Summary of effective dose equivalents to the public from ORR operatio during 1992.

	Maximum exposed individual doseb	Collective dose to the population within 80 km of ORR sourcesc
Dose	3.3 mrem	52 person-rem
National Emission Standards for Hazardous Air Pollutants standard	10 mrem per year	--
Percentage of National Emission Standards for Hazardous Air Pollutants	33	--
Natural background dose	295 mrem per year	279,000 person-rem per year
Percentage of natural background dose	1.1	0.019

a. Sources: MMES (1993a); PNL (1988).

b. The maximum boundary dose is to the hypothetical individual who remains in the continuously during the year at the ORR boundary.

c. Based on estimated population of 910,000 persons within 80 kilometers of the pr

SNF facility site location in 1995.

Figure 4.7-2. Sources of radiation exposure, unrelated to Oak Ridge Reservation o

Table 4.7-4. Comparison of baseline concentrations with most stringent applicable

Criteria pollutant	Averaging time	Most stringent regulation or guideline (-g/m3)	Maximum(a) background concentration (-g/m3)	Maxi site (-g/
Carbon monoxide	8-hour	10,000	b	6.9
	1-hour	40,000	b	24.1
Nitrogen dioxide	Annual	100	b	2.1
Lead	Calendar quarter	1.5	b	c
Particulate matter less	Annual	50	8	4.0d
than 10 microns in diameter	24-hour	150	54	43.9
Sulfur dioxide	Annual	80	27	2.3
	24-hour	365	146	31.8
	3-hour	1,300	321	80.5
Total suspended	Annual	50	32	4.0
particulatesf	24-hour	150	73	43.9
Hydrogen	30-day	1.2	0.06	c
Fluoride	7-day	1.6	0.03	c
Hydrogen fluorides (as	24-hour	2.9	b	c
fluorides)	8-hour	3.7	b	c
Hazardouse air pollutants				
Chlorine	8-hour	150	b	0
Selenium	8-hour	20	b	c
Mercury	8-hour	0.5	b	c
Chromium	8-hour	5	b	c
Chrome	8-hour	5	b	c

a. Ambient air quality data (MMES 1992a, 1991a).

b. Not monitored.

c. Not estimated because the potential release is negligible.

d. It is conservatively assumed that data for particulate matter less than 10 micr particulates data.

e. State standard.

f. State guideline.

Table 4.7-4 presents the effects of site emissions on local ambient air qualit pollutants obtained from ambient air quality monitoring data are added to pollutant determined from air dispersion modeling using site-specific emission rates. The re compare total concentrations to applicable Federal and state criteria pollutant and pollutant guidelines and regulations. All pollutant concentrations of existing emi below applicable regulations.

4.8 Water Resources

4.8.1 Surface Water

The hydrologic system on the ORR is controlled by the Clinch River (MMES 1994a) River flows about 350 miles (560 kilometers) from its headwaters in southwest Virgi to its confluence with the Tennessee River at Kingston, Tennessee. Its drainage ar square miles (11,340 square kilometers) (Boyle et al. 1982). All water that drains

the Clinch River and subsequently the Tennessee River.

Flow in the Clinch-Tennessee River system is regulated by multipurpose dams o Valley Authority (TVA). Three dams operated by the TVA control the flow of the Cli Dam, approximately 31 miles (50 kilometers) upstream of the ORR, was constructed to control and low-flow regulation. Melton Hill Dam, south of the ORNL site, controls Clinch River near the ORR. Its primary function is power generation. Flood contro function. Watts Bar Dam, also used for power generation, is located on the Tenness influences the lower reaches of the Clinch River by creating backwaters that can ex as Melton Hill Dam (Oakes et al. 1987).

Heavy precipitation in the area causes localized flooding, primarily in the Cit (MMES 1994a) and along the Clinch River. A flood analysis was prepared by the TVA (TVA 1991). This analysis provides flood elevations for flooding events in the Cli tributaries on the ORR. Flooding events analyzed ranged from the 25-year flood (a chance of being equaled or exceeded in any given year) to probable maximum flooding Approximate 500-year floodplains (1 in 500 chance in any given year) are shown on F specific surveys should be performed to more accurately determine locations of floo

The average discharge from Melton Hill Dam between 1963 and 1979 was 5,300 cubi cubic meters) per second (Boyle et al. 1982). The average summer (June-September) same period was 4,730 cubic feet (134 cubic meters) per second. However, power is Hill Dam to help meet peak loads and, as a result, flow in the Clinch River is puls at the dam can be followed by periods of flow of up to 20,000 cubic feet (560 cubic Variations in the flow of the Clinch River affect the flow of the tributaries on th during peak periods of power generation at Melton Hill Dam, flow from White Oak Cre blocked or even reversed. The 1992 minimum monthly release at the Melton Hill Dam and was 3.5 billion cubic feet (100 million cubic meters) (MMES 1994a).

The ORR is drained by a network of tributaries of the Clinch River (Figure 4.8- stream classification system based on water quality, water use, and resident aquati streams on the ORR for fish and aquatic life, irrigation, and livestock watering (M designated classification, specific water quality criteria are applied, forming the National Pollutant Discharge Elimination System permits. No rivers designated as w on the ORR.

Stream flow on the ORR varies primarily with seasonal precipitation (MMES 1994a varies throughout the year, with the winter months and July experiencing the highes cycles of wet and dry seasons are also evident. Precipitation is lost through evap uptake, runoff to streams, and to groundwater recharge through the soil.

The drainage pattern on the ORR is a weakly developed "trellis" pattern (Lee an The majority of the small streams are located in the northeast-southwest-trending v flow across the ridges through water gaps that may have formed due to the presence (Golder Associates 1988). Karst topography also affects the appearance of surface

Figure 4.8-1. Locations of the Clinch River and tributaries on the Oak Ridge Rese

A number of wetlands occur on the ORR (MMES 1994a). Wetlands are surface featu periodically saturated with or covered by water, and have hydric soils and hydrophy regards to water resources issues, wetlands absorb flood waters and improve groundw Characteristic wetlands of the ORR region include forested wetlands along creeks, w marshes associated with streams and seeps, and emergent communities in shallow emba ponds.

The abundance of limestone and dolomite is reflected by the presence of calcium surface waters at the ORR. Water hardness is typically moderate, and the concentra dissolved solids normally range between 100 and 250 milligrams per liter (Rogers et

Measurements of surface water quality and flow are made at a number of sampling around the ORR. Reference surface waters, ORR surface waters receiving effluents, surface waters, and effluents are all sampled and analyzed as part of the surface w program. Water samples are collected and analyzed for radiological and nonradiolog results are reported yearly in publicly available environmental reports (e.g., MMES 1991a).

Although bedrock characteristics differ somewhat among the watersheds of these the observed differences in water quality are attributed to different contaminant l 1988). Both wastewater discharges and the groundwater transport of contaminants fr sites affect water quality in ORR streams. Consequently, a number of surface strea contaminated by activities at the ORR (DOE 1992c). In the past, contaminants have released to surface waters on the ORR. Indirect releases via shallow groundwater d water streams have occurred in the past and continue to date. For example, activit contaminated reaches of the White Oak Creek system and Melton Branch with radionucl other hazardous chemicals. The stream channel of Upper East Fork Poplar Creek in t

has been contaminated from past activities at the Y-12 Plant. Activities at the Y-contaminated surface water and groundwater in the Bear Creek Valley with nitrates, radionuclides, and metals beyond the ORR boundary. Operations at the Y-12 Plant ha contaminated Lower East Fork Poplar Creek beyond the ORR boundary with mercury, oth organics, and radionuclides. Ultimately, contaminants from all these streams have the Clinch River, where sediment contamination is a primary concern.

All effluent discharges to streams are required to meet specified National Poll Elimination System permit limits (MMES 1994a). For example, the quality of water i Creek partially reflects the influence of the Y-12 Plant and the City of Oak Ridge treatment facility. Each of the ORR installations has a National Pollution Dischar permit. In 1992, more than 400 National Pollution Discharge Elimination System sta requiring more than 65,000 water analyses. Significant reductions in the number of the ORR between 1991 to 1992 were engineered especially with respect to the Y-12 Pl Site was in 99.9 percent compliance with discharge limits. The Y-12 Plant was in 9 compliance with discharge limits. The ORNL was in 99 percent compliance with disch Table 4.8-1 lists the National Pollution Discharge Elimination System noncompliance **and discharge point.** At the Y-12 Plant, ORNL, and the K-25 Site, radiological effl well within limits at all effluent monitoring locations (MMES 1993a).

Water quality in the Clinch River is affected by ORR activities, by contaminant upstream from the ORR, and by flow regulation at the Tennessee Valley Authority dam impoundment has resulted in a rise in water temperatures, sediment retention, and c adsorption. Several institutions routinely monitor water quality in the Clinch Riv Valley Authority and the U.S. Geological Survey monitor just below Melton Hill Dam. Department of Environment and Conservation maintains a monitoring station on the Cl 2 miles (3.2 kilometers) below the mouth of Poplar Creek and the K-25 Site (Rogers

The Clinch River supplies most of the water to the ORR, the City of Oak Ridge, along the river (MMES 1994a). Major surface water uses in the Oak Ridge area inclu

Table 4.8-1. 1992 National Pollutant Discharge Elimination System noncompliance at

Installation	Discharge point	Parameter	Percent compliance	Numb sa
Y-12	302 (Rogers Quarry)	pH	99	
	501 (Central Pollution Control Facility [CPCF-1])	Total toxic organics	91	
	502 (West End Treatment Facility)	Total suspended solids	98	
	503 (Steam Plant Wastewater Treatment Facility)	Iron, total	99	
		Oil and grease	99	
	Category IV outfalls (untreated process wastewaters)	pH	95	
	506 (9204-3 sump pump oil)	Oil and grease	98	
		pH	98	
	512 (Groundwater Treatment Facility)	Polychlorinated biphenyls	97	
	Creek Outfalls	Visual	not applicable	
ORNL	X01 (Sewage Treatment Plant)	Oil and grease	99	
		Total suspended solids	96	
	X02 (Coal Yard Runoff Treatment Facility)	Oil and grease	94	
	Category I outfalls	Oil and grease	33	
	Category II outfalls	Oil and grease	87	
		Total suspended solids	91	
	Cooling systems	Chlorine, total residual	98	
		Copper, total	98	
		Zinc, total	98	
K-25	001 (K-1700 discharge)	Aluminum	96	
		Oil and grease	99	
	005 (K-1203 sanitary treatment facility)	Chlorine, residual	99	
		Fecal coliform, No./100 milliliter	99	
		Settleable solids, milliliter/liter	99	
	006 (K-1007-B holding pond)	Chemical Oxygen Demand	99	

007 (K-901-A holding pond)	Chromium, total	98
	Suspended solids	98
	Dissolved oxygen	98
Storm drain	Unpermitted discharge	not applicable

a. Source: MMES (1993a).

b. Number of noncompliances.

industrial and public water supplies, commercial and recreational navigation, and o activities such as fishing, boating, and swimming. Five public water supplies are the ORR (MMES 1994a). The two nearest are the K-25 Site water treatment plant and water treatment plant. These are located 2.5 miles (4 kilometers) above and 21 mil below the mouth of Poplar Creek, respectively.

4.8.2 Groundwater

Groundwater beneath the ORR is heavily influenced by the site geologic structur 1992). Geologic units of the ORR are assigned to two broad hydrologic groups: (1) formed by the Knox Group and the Maynardville Limestone (carbonate rocks), in which dominated by solution conduits and which stores and transmits relatively large volu the ORR aquitards, made up of all other geologic units of the ORR (sandstones, silt which flow is controlled by fractures. These aquitards may store fairly large volu transmit only limited amounts.

The hydrologic groups are divided into the near-surface stormflow zone, the vad groundwater zone, and the aquiclude (Solomon et al. 1992). Flow in the 3- to 7-foo deep stormflow zone accounts for approximately 90 percent of the water moving later subsurface. The stormflow zone can transmit some water laterally to surface stream 39 feet (12 meters) per hour through large pores; however, less than 1 percent of t the zone is large pores. Most water mass resides and migrates through smaller pore zone at rates 10 to 100 times slower. Advective-diffusive exchange between pores s contaminant migration rates. A vadose zone between the stormflow and groundwater z ORR except where the water table is at the land surface, such as along perennial st vadose zone is thickest beneath ridges and thinnest or non-existent in valleys. Mo movement through the vadose zone occurs vertically during precipitation events and discrete features such as fractures in the bedrock. Measurements of permeability, conductivity vary considerably by locality in the vadose zone. Generally, conducti inch (on the order of millimeters to centimeters) per day. The groundwater zone is saturated area in which the remaining 10 percent of lateral sub-surface water movem little water movement occurs in the deep aquiclude layer.

The Knox aquifer is the only true aquifer of the ORR and is the primary source flow in perennial streams such as Upper White Oak Creek, East Fork Poplar Creek, an (Solomon et al. 1992). In some places the Knox aquifer can supply large quantities Flow volumes are significantly larger than in the aquitards, and flow paths are dee groundwater flow path length in the Knox aquifer is also substantially greater than the order of a few miles or kilometers. The one strongly suspected instance of gro the ORR boundary occurs along the northeastern portion of Chestnut Ridge, where wat aquifer travels along a geological strike northeastward from the Y-12 Plant accross In March 1994, DOE announced that elevated levels of four industrial solvents (carb chloroform, tetrachloroethylene, and trichloroethylene) had been found in groundwat aquifer, 2,500 feet east of the Y-12 Plant in the Union Vally Industrial Park (Bowd solvents are found in groundwater monitoring wells at the Y-12 Plant. DOE is curre size and direction of the solvent plume. No proposed SNF management facilities wou overlying the Knox aquifer.

Virtually all mobile water in the aquitards is discharged to local streams with the ORR aquitards is shallow; about 98 percent occurs at depths of less than 100 fe (Solomon et al. 1992). Water in the aquitards travels through the uppermost part o zone along flow paths of up to 1,000 feet (300 meters) in length before being disch waters. Groundwater flow volume decreases and solute residence times increase shar Mean solute transport rate in the stormflow zone is on the order of meters per hour intermediate and deep intervals of the groundwater zone, representative transport r

few centimeters per year. Additionally, the mobility of most contaminants on the O reduced by sorption onto subsurface solids. Residence times of solutes near the wa aquitards range from a few days to a few years. In the intermediate and deep inter residence times range from hundreds to tens of thousands of years. Most groundwate aquitards occurs through a few widely spaced (23-164 feet [7-50 meters]) permeable

Water in the aquitards is at best a marginal resource (Solomon et al. 1992). A under 0.25 gallon per minute (0.02 liter per second). In many places, wells are in enough water to support a typical household.

Background groundwater quality at the ORR is generally good in the surficial aq poor (because of high total dissolved solids) in the bedrock aquifer at depths grea meters) (DOE 1993a). Water in the surficial aquifer is typically a nearly neutral calcium bicarbonate type. Transport processes in the subsurface (including diffusi the rock matrix, sorption, and exchange) have resulted in an accumulation of contam of the sources (Solomon et al. 1992).

Contaminated sites in need of environmental restoration include past-practice w waste storage tanks, spill sites, and contaminated inactive facilities (DOE 1993a). contaminants that exceed applicable standards at the Y-12 Plant include volatile or metals, and radioactivity (MMES 1993a). Exact rates and extent of the contaminatio quantified. However, data indicate that most contamination remains relatively clos example of the maximum extent of groundwater contamination, nitrate has been detect feet (920 meters) southwest of the source. Nitrate is relatively mobile in groundw define the maximum horizontal migration of contamination. At the ORNL, 20 waste ar have been identified and are being monitored for groundwater contamination. Monito each waste area group will direct further groundwater studies. At the K-25 Site, o commonly detected groundwater contaminants. Elevated levels of gross alpha and gro been detected in a number of wells. Uranium and technetium-99, respectively, appea responsible for the elevated gross alpha and gross beta levels. The metals chromiu barium have been detected in a number of wells at concentrations exceeding drinking Elevated levels of fluoride and polychlorinated biphenyls have also been detected i

In 1989, the Oak Ridge National Laboratory implemented an off-site residential quality monitoring program (MMES 1993a). The program objective is to document grou near the ORR and to monitor the potential impact of ORR operations on groundwater q Parameters monitored under the program include volatile organics, metals, anions, a radioactive parameters. Radionuclides and organics have been detected in some of t monitoring wells, however, concentrations have been below drinking water standards. detected at concentrations exceeding drinking water standards in one of the off-sit fluoride concentrations and accompanying high pH are most likely attributed to natu reactions in the substrate. No sources or flow paths have been identified for the detected.

Although surface water sources provide the main portion of potable water suppli groundwater does provide for some domestic, municipal, farm, irrigation, and indust 1993a). Single-family wells are common in areas not served by public water supplie However, because of the abundance of surface water and its proximity to the points groundwater is used at the ORR (DOE 1993a). Only one supply well exists on the res provides a supplemental supply to an aquatics laboratory.

All aquifers at the ORR are classified as Class II (DOE 1993a). Class II groun and potential sources of drinking water and those waters having other beneficial us source aquifers beneath the ORR (DOE 1993a). Water rights are not an issue in the

4.9 Ecological Resources

Land for the ORR was primarily in agricultural use at the time of acquisition b predecessor agencies. Clearings for orchards and pastures were on some of the uppe areas, and ridgetops; tillage crops were raised on the lower slopes and bottomland. also occurred in some areas. Except on very steep slopes, most of the forests had though not necessarily cleared for agricultural uses. Natural plant communities ha themselves on most of the ORR, although many areas are maintained as pine plantatio areas (ORNL 1988). Plant communities at the ORR are characteristic of the intermou central and southern Appalachia. Approximately 10 percent of the ORR has been deve withdrawn from public access; the remainder of the site has reverted to or been pla vegetation (MMES 1989).

Biotic media, such as fish and deer, that may be affected by the releases or th pathways of exposure to people are included in the environmental surveillance progr

Bluegill (Lepomis macrochirus) and whitetail deer (Odocoileus virginianus) are rout radionuclide contamination. In 1992, the maximum doses to man projected from actua were within the applicable regulatory requirements (see Section 4.12.4 and 4.12.5)

The following describes biotic resources at the ORR, including terrestrial reso aquatic resources, and threatened and endangered species. Within each biotic resou discussion focuses first on the ORR as a whole and then on the proposed site.

4.9.1 Terrestrial Resources

The vegetation of the ORR has been categorized into seven plant communities (Fi (Parr and Pounds 1987). The pine and pine-hardwood forest is one of the most exten plant communities on the ORR. Important species of this community type include lob shortleaf pine (Pinus echinata), and Virginia pine (Pinus virginiana) (Parr and Pou abundant plant community is the oak-hickory forest, which is commonly found on ridg ORR. Northern hardwood forest and hemlock-white pine-hardwood forest are the rares community types on the ORR. Currently, timber on the ORR is managed by thinning yo harvesting mature stands. Timber is also sold when an area is to be cleared for de 1994). A total of 899 species, subspecies, and varieties of plants have been ident et al. 1985; Cunningham and Pounds 1991).

Thirty areas on the ORR that are representative of the vegetational communities Appalachian region or that possess unique biotic features have been designated by D Environmental Research Park Reference Areas (Pounds et al. 1993). Several of these

Figure 4.9-1. Oak Ridge Reservation plant communties. The ORR provides habitat fo amphibians, 33 species of reptiles, 169 species of birds, and 39 species of mammals (Parr and Evans 1992). Habitats dominated by hardwood trees support the greatest n species, followed in order by wetlands, old fields, and pine plantations (ORNL 1988

Game animals present on the ORR include the whitetail deer, which has been hunt reservation since 1985 (MMES 1992b). Animals commonly found on the ORR include the toad (Bufo americanus), eastern garter snake (Thamnophis sirtalis), Carolina chicka carolinensis), northern cardinal (Cardinalis cardinalis), white-footed mouse (Perom raccoon (Procyon lotor). Raptors, such as the red-shouldered hawk (Buteo lineatus) owl (Bubo virginianus), and carnivores, such as the gray fox (Urocyon cinereoargent (Mustela vison), are ecologically important groups on the ORR (Loar et al. 1981).

The surrounding countryside has much greater proportions of cultivated fields, residential areas than the ORR, and much more fragmented forest cover. Because of continuity of forests and a lack of human disturbance over much of the ORR, wildlif affected by forest fragmentation offsite may find an abundance of suitable habitat ORR may serve as a refuge for wildlife and as a source of wildlife migration (ORNL

Vegetative communities of the West Bear Creek site are typical of the ORR as a of second-growth oak-hickory forest and mixed pine-hardwood forest. There are some plantations adjacent to the northern edge of the powerline right-of-way and between Bear Creek Road (Rosensteel 1994). There are no National Environmental Research Pa Areas on the SNF site. Fauna of the site would also be similar to those expected t

4.9.2 Wetlands

Wetlands on ORR have recently been evaluated based on National Wetland Inventor field surveys of vegetation (Cunningham and Pounds 1991). Soils and hydrology were considered in this survey. Wetlands on the ORR include emergent, scrub/shrub, and located in embayments of the Melton Hill and Watts Bar Reservoirs that border ORR; streams, including East Fork Poplar Creek, Poplar Creek, Bear Creek, and their trib ponds; and around groundwater seeps.

Several well-developed emergent communities greater than 1 acre (0.004 square-k in shallow embayments of the reservoirs. The emergent communities typically grade adjoining forested wetlands. Most forested wetland sites are typically less than 1 wetlands greater than 1 acre are found along the East Fork Poplar Creek and the Cli Gallahar Bridge. Ponds on the ORR vary in size and support diverse flora and fauna areas exist along utility rights-of-way, especially in Bear Creek and Melton Valley Pounds 1991).

Originating on the lower slopes of Pine Ridge are several headwater tributary s Creek that flow from north to south across the West Bear Creek site. The stream va wetlands. A powerline right-of-way crosses the stream bottoms, where the vegetatio

wetland scrubs and herbaceous species, of which a portion adjacent to the west boun designated a National Environmental Research Park Natural Area for the protection o plant species.

4.9.3 Aquatic Ecology

Aquatic habitats on or adjacent to the ORR range from small, free-flowing strea watersheds to larger streams with altered flow patterns because of dam construction habitats include tailwaters, impoundments, reservoir embayments, and large and smal

Sixty-four fish species have been collected on or adjacent to the ORR. The min largest number of species and is numerically dominant in most streams (ORNL 1988). fish species of the Clinch River in the vicinity of the ORR are shad (Dorosoma sp.) common carp (Cyprinus carpio), catfish (Ictalurus sp.), bluegill, crappie (Pomoxis (Aplodinotus sp.) (Loar et al. 1981). Important fish species taken commercially in common carp and catfish. Recreational species include crappie, bass (Micropterus s (Stizostedion canadense), sunfish (Lepomis sp.), and catfish (Rector 1994).

Results from the ORNL monitoring program indicate varying degrees of impact on communities of the small perennial streams resulting from past waste disposal pract these streams are dominated by pollutant-tolerant insect species (Loar 1992).

Portions of certain streams on the ORR have been designated by DOE as National Research Park Aquatic Natural or Reference Areas. These areas generally represent streams or reaches of streams and are used primarily for reference areas as part of monitoring and abatement programs or environmental remediation efforts at ORR facil presently eight Aquatic Natural Areas and nine Aquatic Reference Areas (Pounds et a the Aquatic Natural Area streams contain the Tennessee dace, a species listed as in by the State of Tennessee.

The aquatic resources occurring in the area of the West Bear Creek site are lim headwater tributary systems of Grassy Creek originating on the lower slopes of Pine from north to south across or adjacent to the site. Fifteen fish species have been Creek.

A National Environmental Research Park Aquatic Reference Area is located along and its tributaries, one of which runs through the eastern portion of the proposed diverse assemblage of invertebrates and fish species for a stream its size. The OR a reference area for studies of other streams affected by site development (Pounds

4.9.4 Threatened and Endangered Species

Federally and state-listed threatened, endangered, or other special-status spec Endangered Species Act and/or the state's Nongame and Endangered Species and the Ra Protection and Conservation Laws that have a reasonable potential for occurrence on in Table 4.9-1. The table indicates that 25 of these species have recent records o The potential occurrence of the other 22 species listed is due to historical record ranges, and migratory nature of species. No critical habitat for threatened and en defined in the Endangered Species Act (U.S. DOI 1992), exists on the ORR.

Although not all of the ORR has been surveyed for rare species, 33 different ar plant species (federally or state-listed) have been designated as National Environm Natural Areas by DOE (Pounds et al. 1993). The plant species listed in Table 4.9-1 these Natural Areas but are not excluded from other areas on ORR. These Natural Ar to provide protection for rare plant and animal species. The designated areas incl bluffs, calcareous barrens, mesic forests, flood plains, and wetland cover classes.

No animal species listed by the Federal Government as threatened or endangered reside on the ORR (Kroodsma 1987). The bald eagle (Federal, endangered) is a winte Bar Lake and Melton Hill Lake. None of the species listed in Table 4.9-1 have been proposed West Bear Creek Valley site. The purple fringeless orchid occurs in a Nat the western border of the site (Pounds et al. 1993). Pink lady's-slippers are expe the Pine Ridge area (MMES 1992a). Preferred habitat within the site indicates a gr occurrence of the barn owl, black vulture, Cooper's hawk, red-shouldered hawk, and Surveys of the proposed site will be required to verify the presence of these and o species.

Table 4.9-1. Federally and state-listed threatened, endangered, and other special- potentially occur on or in the vicinity of the Oak Ridge Reservation.

Statusb

Common name	Scientific name	Federal	State
Plants			
Appalachian bugbanec	Cimicifuga rubifolia	C2	T
Butternut	Juglans cinerea	C2	T
Canada (wild yellow) lilyc	Lilium canadense	NL	T
Carey's saxifragec	Saxifraga careyana	NL	S
Fen orchidc	Liparis loeselii	NL	E
Ginsengc	Panax quinquefolius	NL	T
Golden sealc	Hydrastis canadensis	NL	T
Gravid sedgec	Carex gravida	NL	S
Lesser lady's tressesc	Spiranthes ovalis	NL	S
Michigan lily	Lilium michiganense	NL	T
Mountain witch alderc	Fothergilla major	NL	T
Northern bush honeysucklec	Diervilla lonicera	NL	T
Nuttall waterweedc	Elodea nuttallii	NL	S
Pink lady's-slipperc	Cypripedium acaule	NL	E
Purple fringeless orchidc	Platanthera peramoena	NL	T
Spreading false foxglovec	Aureolaria patula	C1	T
Tall larkspurc	Delphinium exaltatum	C2	E
Tubercled rein-orchidc	Platanthera flava var. herbiola	NL	T
Virginia spiraea	Spiraea virginiana	T	E
Fish			
Flame chub	Hemitremia flammea	NL	D
Tennessee dacec	Phoxinus tennesseensis	NL	D
Amphibians			
Green salamander	Aneides aeneus	NL	D
Hellbenderc	Cryptobranchus alleganiensis	C2	D
Tennessee cave salamanderd	Gyrinophilus palleucus	C2	T
Reptiles			
Cumberland turtle	Chrysemys scripta troosti	NL	D
Eastern slender glass lizard	Ophisaurus attenuatus longicaudus	NL	D
Northern pine snake	Pituophis melanoleucus	C2	T
Six-lined racerunnerd	Cnemidophorus sexlineatus	NL	D
Birds			
Bachman's sparrow	Aimophila aestivalis	C2	E
Bald eaglee	Haliaeetus leucocephalus	E	E

Table 4.9-1. (continued).

Common name	Scientific name	Statusb Federal	Stat
Birds (continued)			
Barn owlc	Tyto alba	NL	D
Bewick's wren	Thyromanes bewickii altus	C2	T
Black-crowned night heronc	Nycticorax nycticorax	NL	D
Black vulturec	Coragyps atratus	NL	D
Cooper's hawkc	Accipiter cooperii	NL	T
Grasshopper sparrow	Ammodramus savannarum	NL	T
Northern harrier	Circus cyaneus	NL	T
Ospreyc	Pandion haliaetus	NL	E
Peregrine falcon	Falco peregrinus	E	E
Red-shouldered hawkc	Buteo lineatus	NL	D
Redheaded woodpecker	Malanerpes erythrocephalus	NL	D
Sharp-shinned hawkc	Accipiter striatus	NL	T
Mammals			
Eastern woodrat	Neotoma floridana magister	C2	D
Gray bat	Myotis grisescens	E	E
Indiana bat	Myotis sodalis	E	E

Smoky shrew	Sorex fumeus	NL	D
Southeastern shrew	Sorex longirostris	NL	D

a. Sources: Barclay (1990, 1992); Bay (1991); Cunningham et al. (1993); Hardy (199 Kitchings and Story (1984); Kroodsma (1987); ORNL (1981); ORNL (1988); 1992c, 1992d); TWRC (1991a, 1991b); U.S. DOI (1990, 1991, 1992).

b. Status codes:
C1 = Federal Candidate - Category 1 (probably appropriate to list)
C2 = Federal Candidate - Category 2 (possibly appropriate to list, more study requ
D = species deemed in need of management
E = endangered
NL = not listed
S = species of special concern
T = threatened, more study required

c. Recent record of species occurrence on the ORR.

d. Species collected on the ORR in 1964 (ORNL 1988).

e. Observed near ORR on Melton Hill and Watts Bar Lakes.

4.10 Noise

The major noise sources within the ORR occur primarily in developed operational include various facilities, equipment, and machines (e.g., cooling towers, transfor boilers, steam vents, paging systems, construction and materials-handling equipment Major noise sources outside the operational areas consist primarily of vehicles and At the site boundary, away from most of these activities, noise from these sources distinguishable from background noise levels. Some disturbance of wildlife activit ORR as a result of operational activities and construction activities.

Sound-level measurements have been made around the ORR in the process of testin preparing support documentation for the Atomic Vapor Laser Isotope Separation site The acoustic environment along the ORR site boundary in rural areas and at nearby r from traffic noise is typical of a rural location, with the average day-night sound to 50 decibels, A-weighted. Areas near the site within Oak Ridge are typical of a average day-night sound level in the range of 53 to 62 decibels, A-weighted (EPA 19 source of ORR noise at the site boundary and at residences near the site boundary i trucks, private vehicles, and freight trains. During peak hours, plant vehicular t contributor to traffic noise levels in the area. In addition, some noise due to ai via commercial air transport through the airport at Knoxville can be attributed to Section 4.11 (Traffic and Transportation) discusses vehicular, air, and rail transp

The State of Tennessee has not established specific numerical environmental noi applicable to the ORR. The City of Oak Ridge has specified allowable noise levels shown in Table 4.10-1.

During a normal week, about 17,000 employees travel to the ORR each day in pri from surrounding communities. In addition, both government-owned and private truck deliver materials at the site. Based on the number of employees, it was estimated vehicle trips are generated to and from the site each day; mostly on Tennessee Stat

Table 4.10-1. City of Oak Ridge maximum allowable noise limits applicable to the O

Adjacent uses	Where measured	Maximum sound level (dBA)b
All residential districts	Common lot line	50
Neighborhood business district	Common lot line	55
General business district	Common lot line	60
Industrial district	Common lot line	65
Major streets	Street lot line	75
Secondary residential streets	Street lot line	60

a. Source: City of Oak Ridge (1984).

b. Decibels, A-weighted.
and 162, which pass through the ORR and are open to the general public. Both gover private trucks pick up and deliver materials at the site. The contribution of ORR volumes along these routes, especially during peak traffic periods, affects noise l vicinity of the ORR and through the City of Oak Ridge.

Use of the railroad branches from the CSX and the Norfolk Southern Corporation and pick up shipments at the ORR may cause some noise impacts along these routes. service is scheduled to Y-12 from the CSX line. However, only 60 cars were deliver to K-25 is provided as needed. Only three or four trains serviced K-25 in 1993. H trains per week may be required beginning in 1994 (Pearman 1994). Noise sources fr include diesel engines, wheel-track contact, and whistle warnings at rail crossings

4.11 Traffic and Transportation

Traffic congestion is measured by level of service. Level of service A represe traffic. Level of service B is in the range of stable flow, but the presence of ot stream begins to be noticeable. Level of service C is in the range of stable flow, of the range of flow in which the operation of individual users becomes significant interactions with others in the traffic stream. Level of service D represents high Level of service E represents operating conditions at or near the capacity level. used to define forced or breakdown flow. The calculated level of service are for d a segment. Level of service will most likely be worse in urban areas and better in segment.

The Region of Influence for the ORR includes site roads and regional roads in A Knox, Loudon, and Roane counties. Regional and local transportation routes are pre 4.11-1 and Figure 2.1-2.

Primary roads on the ORR include Tennessee State Routes 95, 62, 162, and 170 (B Road), and Bear Creek Road. Except for Bear Creek Road, all are public roads. The the ORR are private. Interstate 75 and Tennessee State Routes 162, 62, and 61 form
Figure 4.11-1. Oak Ridge Reservation regional transportation map. Bear Creek Road and peak hour volume. Other areas on the site that have traffic problems include S entrances, and intersections.

Current baseline traffic (i.e., 1995) along segments providing access to the OR contribute to differing service level conditions (TDOT 1993). Tennessee State Rout at level of service D between Interstate 75 at Norris and U.S. Route 25W at Clinton service C between U.S. Route 25W at Clinton to Tennessee State Route 62 east of Oli Tennessee State Routes 58 and 170 (providing access from the east), as well as Bear would operate between level of service D and B. Tennessee State Routes 62 and 95 widely varying levels of service in the vicinity of ORR. Tennessee State Route 62 level of service E between Tennessee State Route 95 at Oak Ridge and Tennessee Stat Tennessee State Route 95 would operate at a level of service E between Tennessee St Tennessee State Route 62 at Oak Ridge.

Road reconstruction, widening, modification of interchanges, and new interchang projects are planned for segments of Bear Creek Valley Road, Scarboro Road, and Ten Routes 58, 62, and 95 (Johnson, C. 1994; MMES 1991b).

Current baseline traffic along segments providing regional access to the ORR is contribute to differing service level conditions. Interstate 40 passes within 5 mi south of the ORR. It has a level of service of A to B between U.S. Route 27 at Har which passes northeast about 11 miles (18 kilometers) and south about 3 miles (5 ki ORR. U.S. Route 25W passes the ORR about 10 miles (16 kilometers) to the east and level of service of D to E between Interstate 75 at Lake City to Tennessee State Ro

In 2001, when site-related impacts are at their highest along segments providin background traffic is projected to contribute to differing service level conditions Tennessee State Route 61 would operate at level of service D between Interstate 75 Route 25W at Clinton and level of service C between U.S. Route 25W at Clinton to Te Route 62 east of Oliver Springs. Tennessee State Routes 58 and 170 as well as Bear would operate between level of service D and B. Tennessee State Routes 62 and 95 w widely varying levels of service in the vicinity of the ORR, with a level of servic State Route 95 at Oak Ridge and Tennessee State Route 162. U.S. Routes 11/70 would of service F between Tennessee State Route 131 and U.S. Routes 11E/11W Split. All operate at level of service E or better (University of Tennessee 1993). Interstate B to D between U.S. Route 27 at Harriman to Tennessee State Route 162.

The level of service was calculated using average daily traffic counts (TDOT 19 parameters (ITE 1991; TRB 1985; Rand McNally 1993).

No public transportation service exists in the City of Oak Ridge. Other modes within the Region of Influence include railways and waterways. Railroad service in Influence is provided by CSX Transportation and the Norfolk Southern Corporation. serve the ORR. A CSX Transportation spur line serves the ORR site as well as the C Waterborne transport in the Region of Influence is via the Clinch River, which prov mode of transportation to the Oak Ridge area. The Clinch River waterway has rarely business, and no designated port facilities exist for such purposes (Corps 1991).

McGhee Tyson Airport in Knoxville, 40 miles (64 kilometers) from the ORR, recei passenger and cargo services from both national and international carriers. The cl facility to ORR is Atomic Airport in Oliver Springs. Numerous other private airpor throughout the Region of Influence (DOT 1991).

4.12 Occupational and Public Health and Safety

The Department of Energy's Oak Ridge Reservation released chemicals and small q radionuclides to the environment from operations at all facilities during 1992. Th quantified and characterized in detail in the Oak Ridge Environmental Report for 19 information, along with estimates of the potential consequences resulting from thes summarized in greater detail within sections 4.7, 5.7, 4.8, and 5.8 for the purpose existing radiation and chemical environment. The ORR baseline data presented withi expected to remain essentially constant between 1992 and 1995 (the year in which SN expected to commence).

Health effects from radiation are presented here as the risk of fatal cancer. of the health risk estimator (risk of fatal cancer per rem of exposure). The value exposures to the public is 5 x 10-4 for fatal cancers. The corresponding estimator workers is 4 x 10-4.

4.12.1 Atmospheric Emissions and Doses

Table 4.7-1 in Section 4.7 illustrates the breakdown of radioactive emissions t from each of the three ORR operations areas (ORNL, K-25, and Y-12), during 1992. T dose of 3.3 millirem/year due to 1992 operations, to the maximally exposed individu boundary, is well within the 10 millirem/year limit given in 40 CFR Part 61 (the U. Protection Agency's National Emission Standards for Hazardous Air Pollutants) (MMES

The concentrations at the ORR boundary of all radionuclides released to the atm three operations areas in 1992 were less than 1 percent of the DOE Derived Concentr is based upon an exposure of 100 millirem; this equates to a dose of less than 1 mi

The associated isotopic gaseous release cancer risks are presented within Secti

Table 4.7-2 in Section 4.7 presents the chemical releases for 1992 in a fashion 4.7-1. All of these releases are within permitted levels. The associated chemical presented within Section 4.12.6.

4.12.2 Groundwater/Surface Water Contamination and Doses

Referring to the various water contamination data presented in Section 4.8, it plausible 0.62 mrem/year of site operation could be incurred by a potential maximal individual at the site boundary due to water ingestion, fish ingestion, and other a **Table 4.12-1) (MMES 1993a).**

Additionally, a dose of 17 mrem/year of site operation could be incurred by thi maximally exposed individual, due to external exposure from contaminated liquid eff

Table 4.12-1. Summary of estimated radiation dose to public from 1992 operations a ORR.

Pathway	Location of maximally exposed individual	Committed effective dose equivalent to maximally exposed individual (mrem)	Collective committed effective do equivalent (person-rem)
Gaseous effluents	Nearest resident to		

Inhalation plus direct radiation from air, ground, and food chains	Y-12 Plant	2.7	29
	ORNL	0.06	2
	K-25 Site	0.53	21
	ORR	3.3	52
Liquid effluents			
Drinking water	Gallaher	0.2	0.85
Eating fish	Poplar Creek	0.4	1.0b
Other activities	Poplar Creek	0.02	
Direct radiationb	Clinch River shoreline	2	
	Poplar Creek (K-25 Site)	15	

a. Within 80 kilometers (50 miles) of the ORR.

b. Includes doses from all liquid pathways (MMES 1993a).

4.12-1). Fifteen mrem/year of this dose would result from a hypothetical individua hours/year along Poplar Creek near the K-25 storage areas (MMES 1993a).

The associated cancer risks related to these doses are presented in Section 4.1

4.12.3 External Gamma Radiation

External gamma radiation measurements were made with thermoluminescent dosimete locations coinciding with the ambient air locations. The average external gamma ra ORR perimeter for 1992 was 7.6 microroentgens per hour. All of the measurements we range of typical values for cities in the United States (MMES 1993a).

4.12.4 Radiation Dose and Health Effects Summary (Public and ORR Workers)

A summary of the effective dose equivalents to the hypothetical maximally expos from the important pathways of exposure during 1992 is presented in Table 4.12-1. receives the highest effective dose equivalent (3.3 millirem) from gaseous effluent from the Gallaher area (0.2 millirem), and went fishing at Poplar Creek (for 250 ho 25 site (15 millirem), that individual would receive a total effective dose equival 18.5 millirem, which is roughly 6.3 percent of the annual dose (295 millirem) from radiation (see Figure 4.7-2). All of these doses are within the applicable regulat millirem/year from the drinking water pathway, 10 millirem/year from the airborne r and 100 millirem/year total for all pathways) (MMES 1993a).

The risk of fatal cancer to the maximally exposed individual at the site bounda atmospheric emissions only) is 1.7 x 10-6 per year of operation, and the correspond this maximally exposed individual from drinking water is 1.0 x 10-7 per year of ope fatal cancer from direct radiation due to an individual's spending 250 hours/year f (K-25 Site) is 7.5 x 10-6 per year of exposure. A more realistic maximally exposed from direct radiation, an individual spending 250 hours/year along the Clinch River on which cesium-137 experiments were performed, yields an associated risk of 1 x 10 risk to the maximally exposed individual is 9.2 x 10-6 per year of operation; over management facility lifetime this risk would be 3.7 x 10-4. Table 4.12-1 also incl doses to the general population within 50 miles (80 kilometers) of the ORR. It was approximately 54 person-rem (which translates to an expected 0.027 fatal cancer) we liquid and gaseous effluents) by this population from 1992 ORR operations. Thus, o there would be approximately 1.1 fatal cancers expected.

Doses to onsite workers at the ORR have been reported by DOE for 1991 operation approximately 17,000 workers monitored, the maximally exposed individual was report 2 rem (assumed as 2 rem), which is well below the DOE guidelines of 5 rem (DOE 1992 dose to workers at the site was 2.8 mrem/yr. The risk of fatal cancer to the avera per year of operation; the risk to a worker who spent 40 years at ORR is approximat Additionally, the total collective (population) dose received by these workers was corresponds to 0.019 fatal cancers per year of exposure. Over a 40-year period, th expected 0.76 fatal cancer to this worker population.

4.12.5 Health Effects Studies

Two epidemiologic studies were conducted to determine whether the ORNL facility any excess cancers in the communities surrounding the facility. One study found no mortality in the population living in counties surrounding ORNL when compared to th populations located in other nearby counties and elsewhere in the United States (Ja other found slight excess cancer incidences of several types in the counties near O excess risks were statistically significant (Sharpe 1992).

An Oak Ridge health assessment study is ongoing. This study will include a rec doses received by the public from historical releases of radioactivity from the res Phase I report has been issued (Tennessee Department of Health and the Oak Ridge He Steering Panel 1993).

Studies of workers at Oak Ridge National Laboratory (Jablon et al 1991; Wing et an excess of leukemia deaths among maintenance workers and engineers who had worked 10 years, suggesting a possible excess attributed to exposures other than radiation percent in deaths from all causes and 4.94 percent for all cancers with every rem o exposure with a 20-year exposure lag was also reported. Excess cancer deaths were working in radioisotope production and chemical operations but not with work in phy or unknown job categories. Cancer mortality was also associated with exposure to b mercury.

In March 1990, the Secretary of Energy announced that DOE would turn over respo analytical epidemiologic research on long-term health effects on workers at DOE fac surrounding communities to the Department of Health and Human Services, and directe health and exposure data be released. A Memorandum of Agreement with the Departmen Human Services was signed in January 1991. The Department of Health and Human Serv conducting the ongoing health effects research program. To develop a database on w initiated an Epidemiologic Surveillance Program and Health-Related Records Inventor

4.12.6 Chemical Dose and Health Effects Summary

Table 4.7-2 in Section 4.7 presents the ORR chemical releases for 1992. Exposu released from the ORR was compared with acceptable levels of exposure (no adverse e noncarcinogens) for the ingestion exposure pathway via drinking water and consumpti Aluminum, nitrate, and polychlorinated biphenyls were measured above acceptable lev Creek; the ratios of their doses to acceptable doses were 3.4, 2.2, and 11.1, respe chemical exposure attributable to ORR operations that was found to exceed acceptabl mercury. This noncarcinogen was found in fish caught from the Clinch River. The r dose to acceptable dose levels was found to be 1.1 (MMES 1993a).

Because of concerns for possible contamination of the population by mercury, th Department of Health and Environment conducted a pilot study in 1984. The study sh difference in urine or hair mercury levels between individuals with potentially hig (residence or activity in contaminated areas based on soil measurements or consumpt the contaminated areas) and those with little potential exposure. Mercury levels i as high as 2,000 parts per million. Analysis of a few soil samples showed that mos soil was inorganic, however, thereby lowering the probability of bioaccumulation an Planned occupational studies at the ORR include a 24-month clinical follow-up of 11 mercury workers (Wing et al. 1991).

4.13 Utilities and Energy

4.13.1 Water Consumption

Both the Clinch River and the Melton Hill Reservoir supply water to the ORR. B part of the TVA flood control system, they are capable of maintaining a constant vo excess of the demands of the ORR (MMES 1993a).

In 1995, water supply facilities at the ORR will have a capacity of approximate second (27,916 gallons per minute). In 1993, the average demand for water on the O facilities was approximately 801 liters per second (12,708 gallons per minute) (Fri

A pumping station near Y-12 on the Melton Hill Reservoir supplies untreated wat water treatment plant. After treatment, the water is stored in two reservoirs with 26 million liters (7 million gallons). From the reservoirs, water is supplied by g operations site, ORNL, the Scarboro Facility (which houses the Oak Ridge Institute Education's Energy/Environmental Systems Division), and the City of Oak Ridge (MMES

A pumping station on the Clinch River provides water to the K-25 water system. the water is stored in two water storage tanks on Pine Ridge. This system provides Site, the Transportation Safeguards Facility, and the city's Clinch River Industria

The SNF facilities will be supplied with water from the K-25 water system. In water system will have a capacity of approximately 184 liters per second (2,917 gal the years 1988 to 1994, K-25 water usage varied from a high of 97 liters per second minute) in 1990 to a low of 78 liters per second (1,235 gallons per minute) in 1988 demand was 84 liters per second (1,324 gallons per minute). Significant growth in demand is not expected (Fritts 1994).

4.13.2 Electrical Consumption

The ORR electrical system is supplied power from four major power sources in th Kingston Steam Plant, Bull Run Steam Plant, Wolf Creek Hydroelectric Plant, and For Hydroelectric Plant. The K-25 Power Operations Department manages and operates the transmission and substation system of the ORR (MMES 1994a).

Three substations located at the K-25, Y-12, and ORNL sites comprise the ORR po The substations are tied together onsite by five DOE 161-kilovolt transmission line to ORR substations by six TVA electrical lines at 161 kilovolts, which is reduced t distribution (MMES 1994a).

In 1995, the connected capacity of ORR facilities would be approximately 920 me From 1989 through 1993, the peak demand of electricity varied from a high of 116 me 1989 to a low of 98 megavolt-amperes in 1993 (Fritts 1994).

4.13.3 Fuel Consumption

The East Tennessee Natural Gas Company supplies natural gas to the ORR, transpo from the supply areas through upstream pipelines and then through its own pipeline delivery to the ORR (MMES 1994a). By contract, ORR natural gas capacity is 7,600 d amount can be increased if necessary. In 1994, the average daily usage of natural decatherms (Fritts 1994).

Coal is used to produce steam at ORNL and as a backup fuel at the Y-12 steam pl to use more coal in the future as a replacement for natural gas (Fritts 1994).

4.13.4 Wastewater Disposal

The ORR does not have a centralized sewage system for all facilities. The K-25 have their own sewage systems, while Y-12 shares sewage lines with the City of Oak 1994a).

The sanitary sewage effluent from the Y-12 operations area flows to the Oak Rid Treatment Plant. DOE maintains the sewage lines extending from Y-12 to the east en road (Bear Creek Road). The City of Oak Ridge maintains the sewage lines from the road to the treatment plant on West Oak Ridge Turnpike (MMES 1994a).

The sewage treatment plant for ORNL discharges treated effluent into White Oak compliance with all permit requirements (MMES 1994a). There are no anticipated cap with the K-25 sanitary sewage system, which is permitted by the National Pollution Elimination system (MMES 1994a).

The SNF management facility could use the K-25 sanitary sewer treatment system, north of the proposed SNF site. The K-25 system has a capacity of 26 liters per se minute). From 1988 to 1994, wastewater production peaked at 24 liters per second (minute) during wet conditions in 1994 (Fritts 1994). As an alternative, a new onsi system and wastewater treatment plant might be required for the proposed SNF manage

4.14 Materials and Waste Management

This section describes the hazardous materials management (chemical raw materia categories, and the ongoing waste management activities, including onsite treatment onsite waste disposal, and preparation for appropriate offsite disposal, for the th within the ORR: the Y-12 Plant, the K-25 Site, and the ORNL (see Figure 2.1-2). O related activities at the ORR have resulted in the generation of low-level, mixed l transuranic, spent nuclear fuel (see Chapter 2 for discussion), and industrial soli are discussed in this section. Section 4.8 discusses nonhazardous liquid waste tre of the Y-12 Plant, the K-25 Site, and ORNL waste categories and the waste managemen to each of these complexes follows.

Facilities at the Y-12 Plant are being used to manage low-level radioactive, ha Conservation and Recovery Act hazardous/mixed polychlorinated biphenyl and polychlo biphenyl/uranium), and nonhazardous solid wastes. Figure 4.14-1 shows the waste ma at the Y-12 Plant.

Figure 4.14-1. Flow diagram of Y-12 Plant storage and disposal units at ORR (Page

wastes. Nonhazardous solid wastes are disposed at the Y-12 Plant Sanitary Landfill shows the waste management process at the K-25 Site.

Facilities at the ORNL are being used to manage transuranic, low-level radioact mixed waste. Nonhazardous solid wastes are disposed at the Y-12 Plant Sanitary Lan shows the waste management process at the ORNL.

The overall ORR waste management activities, as well as details on the faciliti wastes, are presented by waste category (transuranic, mixed low-level, low-level, h industrial solid) in Sections 4.14.1 through 4.14.5 respectively. Note that the 19 presented in tables associated with these sections are a representation of the annu operations until the year 2035. Section 4.14.6 describes the management of the che used for ORR activities.

4.14.1 Transuranic Waste

The ORNL is the only complex at the ORR that generates and manages transuranic 4.14-1 presents a summary of transuranic waste management activities projected for on the facilities used to manage transuranic wastes are presented in Table 4.14-2.

4.14.2 Mixed Low-Level Waste

All three complexes at the ORR generate and manage mixed low-level wastes. The 25 Site, and the ORNL manage non-Resource Conservation and Recovery Act wastes (pol biphenyls, beryllium, and asbestos) contaminated by low-level radioactive materials substances and include them with the Resource Conservation and Recovery Act-regulat contaminated materials as mixed wastes. Table 4.14-3 presents a summary of mixed l management activities projected for 1995, and details on the facilities used to man low-level waste are presented in Table 4.14-4.

Figure 4.14-2. Flow diagram of K-25 waste storage units at ORR (Page 1 of 2). F

Figure 4.14-3. Flow diagrams of ORNL waste treatment units and storage and dispos

Table 4.14-1. Projected 1995 transuranic waste management activities at the ORR (O

Waste category	Generation rateb	Treatment method	Treatment capacity	Storage method	St
Transuranic (Solid)					
Contact handled	10.7 m3	None	Not available	Staged	61
Remote handled	5.4 m3	None	Not available	Shielded storage	22

a. Sources: Snider (1993); Turner (1994).
b. 1991 data.
c. WIPP = Waste Isolation Pilot Plant

Table 4.14-2. Baseline transuranic waste management activities as of 1995 at the O

Waste description	Facility number	Facility description	Facility storage capacity
Transuranic	7802N	TRUc trenches	199 concrete casks

7855	RH-TRUd waste storage facility	108 concrete casks
7878	Interim storage facility	Not applicable (inspection facility
7824	Waste examination and assay facility (dual use facility)	Not available
7879	CH-TRUe/LLWf solids storage (dual storage facility)	372 m2

a. Sources: PAI Corporation (1993a); Turner (1994).
b. 1993 data.
c. TRU = Transuranic waste.
d. RH-TRU = Remote-handled transuranic waste.
e. CH-TRU = Contact-handled transuranic waste.
f. LLW = Low-level (radioactive) waste.

Table 4.14-3. Projected 1995 mixed low-level waste management activities at the OR

Complex	Waste category	Generation rate	Treatment method	Treatment capacity
Y-12 Plant	Mixed solidb	242,869 kgc (573 m3/yr)	None	N/A
	Mixed liquidb	1,537,234 kge (426,120 gal/yr)	Settlement and filtration	8,716 m3 yr (2.3 million gal/yr)
K-25 Site	Mixed liquidg	47,022.9 m3 h	Settlement and filtration/ incineration	58,400,000 gal
	Mixed solidg	535.2 m3j	Planned	Planned
ORNL	Mixed liquidg	Not reported	Ion exchange	259,199.4 m3
	Mixed solidg	48.9 m3 k	Planned	Planned

a. Sources: Snider (1993); Brown (1994c).

b. 1992 data.

c. Includes 37,434 kg of contaminated (radionuclides) asbestos beryllium oxide was

d. RCRA/PCB Warehouse (Building 9720-9), RCRA and PCB Container Storage Area (Buil 9720-12) and PCB Drum Storage Facility (Building 9407-7).

e. Includes 13,152 kg of polychorinated biphenyl/uranium waste.

f. OD-9 and OD-10.

g. 1991 data.

h. TSCA (Toxic Substances Control Act) incinerator waste water.

i. Includes permitted container (solid/sludges/liquid wastes) and tank (liquids) s
j. May include some polychlorinated biphenyl-tainted waste.

k. Includes polychlorinated biphenyl and asbestos waste.

l. Mixed Waste Drum Storage Pads - Bldg 7507 W, Part A permit, 22,000 gal.

Table 4.14-4. Baseline mixed low-level waste management activities as of 1995 at t

Complex	Waste identification	Facility number	Facility description
Y-12 Plant	Mixedb	9201-4	Mixed waste storage area
		9404-7	PCB storage facility (dual storage/use)

		9720-9	Mixed and PCBc storage area (dual storage/use)
		9720-31	RCRAd staging and storage facility (dual storage/use)
		9720-58	RCRAd and PCBc container storage area (dual storage/use)
		9811-1	Waste oil tank storage area, OD-7 (dual storage/use)
		9811-8	Waste oil solvent drum storage facility OD-8 (dual storage/use)
		9811-8	Organic liquid storage area, OD-9 (dual storage/use)
		None	Containerized waste storage area (dual storage/use)
K-25 Sitef	Mixede	K-1065A, B, C, D, E	Container storage
		K-1419	Liquid waste storage facility
		K-31	Waste piles (dual storage/use facility)
		K-33	Waste piles (dual storage/use facility)
		K-27	Withdrawal alleys and vaults
		K-27	Vault 31X
ORNL	Mixed	7075	Used oil storage tank
		7507W	Mixed waste storage facility
Complex	Waste identification	Facility number	Facility description
		7654	Long term hazardous waste storage facility
		7823	Mixed waste storage facility
		7830A	Waste storage tank

a. Sources: PAI Corporation (1993b); PAI Corporation (1994); Turner (1994).

b. 1993 data.

c. PCB = Polychlorinated biphenyl.

d. RCRA = Resource Conservation and Recovery Act.

e. 1994 data.

f. For additional mixed waste facilities see hazardous waste facilities at the K-2

4.14.3 Low-Level Waste

The Y-12 Plant, K-25 Site, and the ORNL generate and manage low-level wastes. presents a summary of low-level waste management activities projected for 1995, and details on the facilities used to manage low-level waste are presented in Table

4.14.4 Hazardous Waste

All three complexes at the ORR generate and manage hazardous wastes. The Y-12 Site, and the ORNL manage non-Resource Conservation and Recovery Act wastes (asbest polychlorinated biphenyls) as dangerous substances and include them with the Resour and Recovery Act-regulated wastes as hazardous wastes. Table 4.14-7 presents a sum hazardous waste management activities projected for 1995, and details on the facili to manage hazardous waste are presented in Table 4.14-8.

4.14.5 Industrial Solid Waste

The K-25 Site and the ORNL industrial solid wastes are disposed of at the Y-12 Landfill (PAI Corporation 1994; PAI Corporation 1993a). Table 4.14-9 presents a su industrial solid waste management activities projected for 1995 at the Y-12 Plant, and details on the facilities used to manage industrial solid waste are presented i

4.14.6 Hazardous Materials

The ORR uses a variety of chemical raw materials for activities associated with finishing/plating, uranium recovery, laboratory services, cooling tower operation, cleaning/maintenance operations. Examples of chemicals used at the ORR include aci nitric), organics (methanol, perchloroethylene), and inorganics (hydrogen fluoride, 309 specific chemicals and 20 chemical categories are being reviewed for possible r Superfund Amendments and Reauthorization Act Section 313 requirements. For 1992, t 7 extremely hazardous substances and 39 hazardous chemicals for the Y-12 Plant; 5 e substances and 16 hazardous chemicals for the K-25 Site; and 20 extremely hazardous hazardous chemicals for ORNL (MMES 1993a).

In addition, diesel fuel and gasoline, used to fuel site service and constructi in bulk containers (55-gallon drums, aboveground storage tanks, and underground sto

The Y-12 Plant underground storage tank program includes seven in-service petro addition, there are seven active petroleum underground storage tanks at the K-25 Si there is one active underground storage tank containing heating oil and 22 active u tanks that will be taken out of service or upgraded by 1998. The contents of these (MMES 1993a).

Table 4.14-5. Projected 1995 low-level waste management activities at the ORR.

Complex	Waste category	Generation rateb	Treatment method	Treatment capacity	Sto
Y-12 Plant	Low-level solidb	1,438,680 kgc (5,793 m3/yr)	Compaction/ incineration	Offsite	Sto Y-1
	Low-level liquidb	565,929 kg (148,186 gal/yr)	Settlement and filtration	20,644m3/yre (5,400,000 gal/yr)	Sto
K-25 Site	Low-level liquidf	Included in mixed	Settlement and filtration	See mixed liquid	Non
	Low-level solidf	978.7 m3 g	Compaction/ smelting	Offsite	Ons
ORNL	Low-level liquidf	2,064.4 m3	Neutralization & precipitation	1.5292M m3 i	Sto und tan
	Low-level solidf	130 m3 j	Compaction	Offsite	Ons

a. Sources: Snider (1993); Brown (1994c).

b. 1992 data.

c. Includes 649,429 kg of contaminated scrap metal.

d. N/A = not applicable.

e. West End Treatment Facility and Central Pollution Control Facility.

f. 1991 data.

g. Includes contaminated scrap metal.

h. Does not include 6.9 acre scrap metal storage site.

Table 4.14-5. (continued)

i. NPDES discharge limit for the ORNL Non-rad Wastewater Treatment Facility.

j. Includes scrap metal only. Does not include low-level radioactive waste solid Wastewater Treatment Plant.

k. Solid Waste Storage Area.

Table 4.14-6. Baseline low-level waste management activities as of 1995 at the ORR

Complex	Waste identification	Facility number	Facility description	Facili capaci
Y-12 Plant	Low-levelb	9720-12	Low-level waste storage	
			Indoor area	465 m2
			Outside area	557 m2
		9720-44	Low-level waste storage pad	Not re
		9825-1, 2	Uranium oxide storage vaults I and II	906 m3 (each
		None	Contaminated scrap metal storage area	Not re
		None	Outside low-level waste storage	359 m3
		None	Above grade low-level waste storage facility	3,948
		9720-25	Classified waste storage facility	340 m3
		None	Containerized waste storage area (dual use/storage)	2,323
K-25 Site	Low-levelc	K-770	Contaminated scrap metal storage yard	31,857
		K-1035-A	Temporary drum storage	2.5 m3
		K-1066-H	LLWd storage	3,830
		K-1417	Sludge-drum storage yard	8,846
		RUBB-2	LLWd storage	138 m3
		K-25	Process vaults (dual storage/use facility)	2,469
		K-33	Waste piles (dual storage/use facility)	961 m3
		K-1232	Container storage area (dual storage/use facility)	42.5 m

Complex	Waste identification	Facility number	Facility description	Faci capa
ORNL	Low-levelb	7831	Waste compaction facility	Not (tre
		7841	Contaminated equipment storage yard	Not
		7856	Cask storage site	Not
		7823A, B, C, D, E	RUBB buildings	Not
		7824	Waste examinations and assay facility, dual use facility	Not
		7879	CH-TRUf/LLWd solids storage facility (dual storage facility)	372
		7842	SWSA-6g staging and equipment building	297
		None	Tumulus I and II	Not

a. Sources: PAI Corporation (1993b); PAI Corporation (1994); PAI Corporation (199

b. 1993 data.

c. 1994 data.

d. LLW = Low-level (radioactive) waste.

e. RCRA = Resource Conservation and Recovery Act.

f. CH-TRU = Contact-handled transuranic waste.

g. SWSA-6 = Solid Waste Storage Area - 6.

Table 4.14-7. Projected 1995 hazardous waste management activities at the ORR.

Complex	Waste category	Generation rate	Treatment method	Treatment capacity
Y-12 Plant	Hazardous solidb	511,421 kgc (846 m3/yr)	None	Not applicable
	Hazardous liquidb	767,874 kge (215,492 gal/yr)	Settlement and filtration	See low-level liqui
K-25 Site	Hazardous liquidg	8,410.6 m3 h	Neutralization/ precipitation	See mixed
	Hazardous solidg	680.5 m3	Compaction for non-RCRA/TSCAi incineration	Offsite
ORNL	Hazardous liquidg	0.8 m3	Neutralization/ detonation	Not applicable
	Hazardous solidg	84.1 m3 j	None	Not applicable

a. Sources: Snider (1993); Brown (1994c).

b. 1992 data.

c. Includes 420,192 kg of uncontaminated (radionuclides) asbestos/beryllium oxide waste.

d. Remaining West End Tank Farm sludge storage capacity.

e. Includes 55,624 kg of uncontaminated (radionuclides) polychlorinated biphenyl w

f. Liquid Organic Waste Storage Facility OD3, Building 9418-9, and OD9.

Table 4.14-7. (continued)

g. 1991 data.

h. Hydrogen softener blowdown from the steam plant.

i. RCRA = Resource Conservation and Recovery Act; TSCA = Toxic Substances Control

j. Includes polychlorinated biphenyls and asbestos.

k. Hazardous Waste Storage Facility.

Table 4.14-8. Baseline hazardous waste management activities as of 1995 at the ORR

Complex	Waste identification	Facility number	Facility description
Y-12 Plant	Hazardousb	None	Interim reactive waste treatment area (open burning)
		9720-45	Organic liquid storage facility
		9720-9	Mixed and PCBc storage area (dual storage/use)
		9720-31	RCRAd staging and storage facility (dual storage/use)
		9720-58	RCRAd and PCBc container storage area (dual storage/use)
		9811-1	Waste oil tank storage Area

			OD-7 (dual storage/use)
		9811-8	Waste oil solvent drum storage facility, OD-8 (dual storage/use)
		9811-8	Organic liquid storage area, OD-9 (dual storage/use)
		9404-7	PCBc storage facility
		None	East Chestnut Ridge Waste Pile (dual use/storage facility)
K-25 Site	Hazardous/ mixed	K-25	Process vaults (dual storage/use facility)
		K-711	Container storage building (dual storage/use facility)
		K-1025C	Container storage (dual storage/use facility)
		K-1036A	Container storage facility (dual storage/use facility)
Complex	Waste identification	Facility number	Facility description
		K-1202	Storage tanks (dual storage/use facility)
		K-1302	Compressed gas cylinder storage (dual storage/use facility)
		K-1420A	Hazardous waste storage tank (dual storage/use facility)
		K-1425	Container storage/tank management units (dual storage/use facility)
		K-726	Container storage building (dual storage/use facility)
		K-33	TSCAf (dual storage/use facility)
	Hazardousb	7659-A	Gas cylinder venting facility
ORNL		7667	Chemical waste detonation facility
		7507	PCBsg, liquids and solids storage facility
		7651	Used oil storage facility
		7652	Hazardous waste storage facility
		7653	Chemical waste storage facility

a. Sources: PAI Corporation (1993b); PAI Corporation (1994); PAI Corporation (199

b. 1993 data.

c. PCB = Polychlorinated biphenyl.
d. RCRA = Resource Conservation and Recovery Act.

e. 1994 data.

f. TSCA = Toxic Substances Control Act.

g. PCB = Polychlorinated biphenyl.

Table 4.14-9. Projected 1995 industrial solid waste management activities at the O

Complex	Waste category	Generation rateb	Treatment method	Treatment capacity	Stora
Y-12 Plant	Industrial solidb	5,554,873 kg	None	N/A	None

		(48,518 m3/yr)			
K-25 Site	Industrial solide	3,899.5 m3	None	Not applicable	None
	Other solide	5,046.4 m3g	Compaction	Not applicable	None
ORNL	Industrial solide	13 m3	None	Not applicable	None
	Other solide	30.6 m3h	None	Not applicable	None

a. Sources: Snider (1993); Brown (1994c); PAI Corporation (1994); PAI Corporation

b. 1992 data.

c. M = million

d. New sanitary landfill to open in 1994.

e. 1991 data.

f. Wastes are disposed of at the Y-12 Plant Sanitary Landfill.

g. Includes construction/demolition spoil and scrap metal.

h. Includes construction/demolition spoil; scrap metal estimates not available.

Table 4.14-10. Baseline industrial solid waste management activities as of 1995 at

Complex	Waste identification	Facility number	Facility description	Facilit capacit
Y-12 Plant	Industrial solid	None	New salvage yard	4,046.9
		None	Industrial landfill IV (classified waste landfill)	Not rep
		9983-44	Industrial landfill II	Storage
		None	Spoil Area 3 (construction debris)	Facilit
		9720-25	Classified waste storage (dual use facility)	Not app (nonhaz staging
K-25 Site	Industrial solidc			
ORNL	Industrial solidc			

a. Source: PAI Corporation (1993b).

b. 1993 data.

c. Wastes are disposed of at the Y-12 Plant Sanitary Landfill.

In addition, diesel fuel and gasoline, used to fuel site service and constructi stored in bulk containers (55-gallon drums, aboveground storage tanks, and undergro tanks).

The Y-12 underground storage tanks program includes seven in-service petroleum tanks. In addition, there are seven active ptroleum underground storage tanks at th K-25 Site. At the ORNL there is one active underground storage tank containing heat 22 active underground storage tanks that will be taken out of service or upgraded b The contents of these tanks was not reported (MMES 1993a).

5. ENVIRONMENTAL CONSEQUENCES

5.1 Overview

This chapter describes the potential environmental consequences from the constr operation of spent nuclear fuel (SNF) facilities at the Oak Ridge Reservation (ORR) Centralization and Regionalization Alternatives. Potential environmental consequen assessed to the extent necessary to support a programmatic decision concerning the proposed SNF facilities. More detailed considerations of potential environmental c would be performed as necessary prior to initiating construction or operation of th

Impacts on the operation of the current facilities at ORR that create or store discussed in Chapter 3.

5.2 Land Use

The proposed site for SNF activities is in the eastern portion of the West Bear area, located in the western portion of the ORR. The SNF program's land requiremen assumed to be 90 acres (0.36 square kilometer), including all facilities and buffer majority of the land in the West Bear Creek Valley Area can be characterized as vac and developable.

5.2.1 Centralization Alternative

Use of the West Bear Creek Valley area of the ORR for program activities would consistent with the current land use and land use policies and plans for that area. land use designation for this area is Natural Areas, a generic category that includ within the ORR not under any other specific land use designation (DOE 1993a). Use area for program activities would also be consistent with proposed future land uses the ORR Site Development Plan (MMES 1989).

Future land uses proposed for the area of Roane County adjacent to the ORR near proposed SNF site are low-density residential and public/semi-public uses (Roane Co Regional Planning Commission 1992). These low intensity uses would be compatible w development in the western portion of the ORR.

Use of the West Bear Creek Valley site for the placement of SNF facilities may irreversible and irretrievable impacts to land use in that area by precluding all b management-type uses in the future. However, the placement of SNF facilities at th would be consistent with U.S. Department of Energy's (DOE's) 1994 future land use p designates the West Bear Creek Valley site for these uses (MMES 1989). Therefore, mitigation measures are proposed.

5.2.2 Regionalization Alternative

As under the Centralization Alternative, land use impacts resulting from the Re Alternative would not be expected to be significant. Impacts would be similar in c those described for the Centralization Alternative.

5.3 Socioeconomics

Socioeconomics as addressed in this programmatic environmental impact statement encompasses the interaction of economic, demographic, and social conditions. Econo consequences (e.g., technology requirements for operation of an SNF management faci business activities, market structures, procurement methods, and dissemination of c within and between regions. Demographic consequences (e.g., in-migration of specia resources to support the SNF management program) affect size, distribution, and com the population, labor force, and the housing market in the regions. Social consequ capacity modifications of public infrastructure to support SNF activity) affect the of life enjoyed by the residents of a community (Murdock and Leistritz 1979). Thes are potentially affected either directly or indirectly by actions proposed under th Management Program.

The significance of actions and their intensity are relative to the affected re can be described as a dynamic socioeconomic system, where physical and human resour technology, social and economic institutions, and natural resources interrelate to products, processes, and services to meet consumer demands. The measure of a regio

to support these demands depends on its ability to respond to changing economic, de and social conditions.

Potential socioeconomic effects are addressed only to the extent that they are with the natural or physical environment (CFR 1993c). Direct effects include those caused by the action and occurring at the same time and place. Indirect effects in impacts caused by the action that are later in time or farther removed in distance, reasonably foreseeable (i.e., offsite) (CFR 1993b).

Socioeconomic effects are quantified for regional economic activity and populat Potential impacts to individual communities such as public infrastructure and housi discussed qualitatively to address programmatic issues.

Economic projections include direct and indirect jobs. Direct jobs are those j construct or support operation of the SNF management complex at ORR. Indirect jobs created throughout the regional economy within the Region of Influence as a result procurement for materials, services, and other commodities; and induced effects fro spending. These direct and indirect impacts reflect both construction and operatio demands that may occur concurrently or independently throughout the project plannin Indirect jobs were projected using parameters from the U.S. Bureau of Economic Anal Regional Input-Output Modeling System.

Two scenarios were analyzed to account for two potential distributions of the S construction efforts. The construction effort consists of fabricating various stru its own construction labor need and a duration of either three or five years. The accelerates the construction labor requirements into the first two years of constru Average Scenario averages the labor requirements of a structure for the duration of The total construction effort for all structures, in labor years is the same for ea Therefore, for structures with a three year construction duration, the Peak Scenari labor needs for the first two years and then a substantial reduction for the third Average Scenario has a constant labor requirement for the three years. Likewise, f with a five year construction duration, the Peak Scenario has a high labor need for years, then a lower need for the remaining three years, while the Average Scenario constant requirement for all five years. Because the total construction labor year structure is the same for both scenarios, the Average Scenario will have a lower re than the Peak Scenario in the first two years, then will have a higher requirement Scenario in the remaining construction years.

Regional population projections reflect the potential change in population resu increase in regional economic activity. Detailed assumptions regarding in-migratio with SNF Management Program were not developed given the programmatic scope of the analysis. Potential in-migration effects resulting from direct job creation are p qualitatively where appropriate.

5.3.1 Centralization Alternative

The upper and lower bounds of construction and operations related jobs generate implementation of the Centralization Alternative from 1995 to 2005 are illustrated and tabulated in Table 5.3-1. In the initial phases, the Centralization Alternativ 90 jobs (25 direct, 65 indirect) beginning in 1995 and continuing through the year project planning, engineering design, and environmental permitting and compliance. Construction is expected to begin in the year 2000, requiring a total of 4,352 dire indirect jobs). In that year and 2001, the Peak Scenario requires 1,587 constructi while the Average Scenario needs 1,346. There is no operational labor required for period. In 2002 after two years of construction, the Peak Scenario decreases its c labor requirements to 928 workers, while the Average Scenario maintains its 1,346 l Additionally, 300 operational personnel are needed, raising the total of SNF worker the Peak Scenario and 1,646 for the Average Scenario. By 2003, the buildings with construction durations have been completed; therefore, both the Peak and Average Sc construction labor requirements decline to 125 and 157, respectively. Operation la

Figure 5.3-1. Total employment effects- ORR Centralization Alternative. Table 5.3

		Time period				
Years	1995-1999	2000, 2001	2002	2003	2004	2005 +
		Operations				
Direct jobs	25	0	300	300	487	800
Indirect jobs	65	0	780	780	1,265	2,079
Total jobs	90	0	1,080	1,080	1,752	2,879
		Construction				

Direct jobs						
Peak	0	1,587	928	125	125	0
Average	0	1,346	1,346	157	157	0
Indirect jobs						
Peak	0	2,597	1,519	205	205	0
Average	0	2,203	2,203	257	257	0
Total jobs						
Peak	0	4,184	2,447	330	330	0
Average	0	3,549	3,549	414	414	0
			Total			
Direct jobs						
Peak	25	1,587	1,228	425	612	800
Average	25	1,346	1,646	457	644	800
Indirect jobs						
Peak	65	2,597	2,299	984	1,470	2,079
Average	65	2,203	2,983	1,036	1,522	2,079
Total jobs						
Peak	90	4,184	3,527	1,408	2,082	2,879
Average	90	3,548	4,629	1,493	2,166	2,879
			Population Change			
Peak	82	4,366	(1,001)	(3,214)	1,022	2,011
Average	82	3,688	1,640	(4,759)	1,022	1,797

requirements remain at 300 workers. Total SNF labor requirements are 425 workers f Peak Scenario and 457 for the Average Scenario. In 2004, construction labor needs scenarios remains at their previous level, but operational personnel increase. Tot requirements are 612 workers in the Peak Scenario and 644 workers in the Average Sc By 2005, all construction has been completed and operational personnel have increas full staff labor requirement of 800 workers.

The peak scenario reaches it maximum construction labor with 1,587 direct jobs jobs created) over a 2-year period from years 2000 through 2001. The average scena have its maximum construction labor with 1,346 direct jobs (3,549 total jobs create through 2002.

Ancillary operation (Table 5.3-1) activity associated with the Centralization A begin in the year 2002; the initial operations might create approximately 1,080 pha (300 direct, 780 indirect). Additional operation activity would also begin, creati 187 phase-related jobs (485 indirect jobs). The remaining operation activities are start in 2005, after construction is finished, creating a total of 2,879 phase-rela direct, 2,079 indirect), and the jobs will continue through 2035.

Regional businesses and the workforce will benefit from increased competition f procurements and jobs associated with SNF Centralization Alternative. Most of this anticipated to be captured by Anderson, Knox, and Roane counties, with a small shar in Loudon County. The impact to the regional economy, however, only represents a p the total economic activity generated by the Centralization Alternative. For insta materials purchases and technology acquisition may occur outside Tennessee. The ec activity occurring outside the region might result in economic benefits for that re indirect effect is not captured by this analysis since it occurs outside of the Reg defined in Section 4.3.

Most of the population change in the Region of Influence above the baseline for be driven by the in-migration of labor and households to support SNF management act ORR. It is likely that most of the operation jobs will be filled by SNF personnel other DOE sites where SNF inventories were stored prior to shipments to ORR. These personnel would be familiar with the processes, technologies, and research involved operations elsewhere. Other operational jobs not associated with SNF management wi be filled by the regional labor force. The regional labor force would be likely to for construction jobs, except for specialized tasks.

To assess potential population and housing impacts, an in-migration rate per jo estimated using a ratio between forecasted employment and population figures (Table This ratio was applied to the number of total (direct and indirect) jobs created by management activities at ORR, giving the total estimated number of persons migratin Region of Influence per job created (Table 5.3-1).

With initial operation in 1995 under both scenarios, a total of 82 persons will the Region of Influence. The number of persons migrating into the Region of Influe be at its largest when construction starts, for the years 2000 through 2001; (a tot in-migrants for the peak scenario and 3,688 for the average scenario). For the yea

2003, after most of the construction has finished, people might migrate out of the Influence. The number of in-migrants might increase as more of the SNF management operations start in the years 2004 and 2005. After the year 2005, in-migration due management activities would cease due to the fact that SNF management activities wo create any more jobs.

Assuming one housing unit per household, and an average family size of 2.6 pers family (U.S. Department of Commerce 1991), the number of houses demanded in 1995, w preliminary operations start, might be 32. Between the year 2000 and 2002, a total housing units might be demanded. Even though this demand is only a temporary deman Region of Influence may have difficulty providing new housing during this time peri year 2003 and 2004, however, there might be a surplus of 1,236 housing units due to out of construction. In 2005, once SNF operational activities are under way, there demand for 1,167 housing units associated with SNF management activities.

The greatest impact to the Region of Influence housing market may occur between years 2000 and 2002, when construction starts. The demand for housing during the S construction period would be for transitional housing. While the population in the Influence under baseline conditions has historically been growing and is projected than 1 percent annually, recent vacancy rates for housing in the Region of Influenc low (Census 1982, 1991). Therefore the in-migration associated with SNF constructi cause shortages in the housing market, and might cause shortages in construction su However, due to decreasing employment levels on ORR between 1990 and 1999 (Section 4.3.1.5), additional housing units above the baseline may be available, thus reduci strain on the housing market. Since construction will only be temporary, there may capacity in the regional infrastructure when all SNF management operations begin in

5.3.1.1 Potential Public Service and Education Impacts. Given the population growth

associated with the SNF Management Program, increases in capital expenditure may be to meet the increased demand of housing utilities, including electricity generation treatment, and water (see Section 5.13), transportation infrastructure (see Section education or service levels, assuming current conditions are constant through the a

Assuming that the Centralization Alternative would be an addition to the ORR's operations, security and fire protection on the site would need to be investigated to determine whether or not current capacity could accommodate the requirements of Management Program.

5.3.2 Regionalization Alternative

Socioeconomic impacts resulting from the Regionalization Alternative are expect similar to the Centralization Alternative. The construction and operation cycles f alternative would be the same; therefore, the same issues identified for the Centra Alternative would apply. Labor requirements may be slightly reduced for the Region Alternative. Although the volume of SNF stored would be less for the Regionalizati Alternative, an economy of scale occurs for both alternatives, so that differences capital between the two alternatives would be minimized.

5.3.3 Mitigation Measures

5.3.3.1 Coordination with Local Jurisdictions. To reduce construction- and operation-

related impacts, possible coordination with local communities could address potenti from increased labor and capital requirements. The knowledge of the extent and eff growth due to SNF management activities could greatly enhance the ability of affect jurisdictions to plan effectively. Effective planning would address changes in lev housing, infrastructure, utilities, transportation, and public services and finance

5.3.3.2 Enhance Labor Force Availability. To alleviate potential impacts associated with

the in-migration of labor, local labor force availability could be increased throug employment training and referral systems. The goal of these systems would be to re

potential for in-migration of labor to support SNF management activities.

5.4 Cultural and Paleontological Resources

5.4.1 Centralization Alternative

Under the Centralization Alternative, the proposed construction area for the SN is not expected to exceed 100 acres. There are no known historical, archeological, paleontological or Native American traditional sites in the proposed area (Fielder impacts to cultural or paleontological resources are expected due to ground disturb air emissions during construction or operation of the SNF facilities. Consultation Tennessee State Historic Preservation Officer prior to project implementation is re section 106 of the National Historic Preservation Act.

5.4.2 Regionalization Alternative

Under the Regionalization Alternative, the location of the SNF facilities would same, but would be reduced in area. As with the Centralization Alternative, impact anticipated.

5.5 Aesthetics and Scenic Resources

5.5.1 Centralization Alternative

When fully constructed and under operation, the proposed SNF facilities associa Centralization Alternative would consist of a series of buildings set within a 90-a maximum height of the buildings contained at the site would not exceed 42 feet abov level, or two to three stories. The entrance to the site and security fencing will traffic on Bear Creek Road.

Since the buildings would be set into the south face of Pine Ridge, between Pin Chestnut Ridge, the site would not be visible from areas outside the reservation, w exception of a limited section of Gallaher Road on the west side of the Clinch Riv east along Bear Creek Valley (TVA 1987). However, since the approximate distance f boundary of the reservation to the proposed location is in excess of 2 miles, and i terrain and heavy vegetation, public views looking on to the site from off-site are be affected. Impacts to aesthetics and scenic resources on and off ORR are not ant

5.5.2 Regionalization Alternative

Under the Regionalization Alternative, proposed SNF facilities are reduced in a intensity of operations, and environmental effects to aesthetics and scenic resourc than those under the Centralization Alternative. Therefore, adverse environmental the Regionalization Alternative are also not anticipated.

5.6 Geologic Resources

This section describes any incremental or additional impacts on geology and geo resources that might result from the construction and operation of the new faciliti with the storage of SNF at the ORR.

For the most part, geologic impacts from construction activities would be limit disturbance, although in some areas, ripping or blasting of limestone, dolomite, or might be required. Since no extensive or unique geologic or mineral resources are occur on the West Bear Creek Valley site, impacts to geologic resources would not b

Because previously undisturbed areas would be used for new construction, some s from siting SNF facilities at the West Bear Creek Valley site would occur as a resu Potential impacts from sediment runoff generated during construction activities wou minimized by implementation of soil erosion and sediment control measures. During impacts to soil resources would be controlled by the planting or landscaping of lan

covered by pavement and buildings.

Major seismic activity and associated mass movement and subsidence are unlikely during the construction or operation phases, because although ground-shaking has oc the ORR due to earthquakes in other parts of the country, faults in the area have n active since the late Paleozoic.

5.7 Air Resources

The proposed SNF management facility would be composed of a wet and dry storage facility and a technology development facility, with construction to take place in years 2000-2004. Air quality is assessed for construction and operation with regar radiological and nonradiological air emissions. This section characterizes the imp expected air quality effects resulting from an SNF facility. This section also dis quantitative impacts under the Regionalization Alternative. The Centralization Alt qualitative impacts are compared with the regionalization impacts in order to deter exceedances, if any, of existing local and Federal standards for both alternatives.

5.7.1 Releases

Emissions of radiological and nonradiological air pollutants might result from construction and operation of a SNF management facility. These emissions might inc airborne radionuclides, criteria pollutants, and hazardous air pollutants.

The impact of air emissions from construction activities might include criteria of particulate matter (fugitive dust) primarily from the moving of soil, and exhaus particulate matter with an aerodynamic diameter equal to or less than 10 microns (P monoxide; sulfur dioxide; volatile organic compounds; and nitrogen dioxide from ear and equipment-handling machinery and equipment. During construction, a small incre traffic volume above existing levels might result in a small increase in air pollut (Section 5.11 discusses the level of traffic activity projected for the constructio phases of the SNF facility.)

During operations, the transport of SNF within the ORR from points of generatio storage sites to the disposal site would result in emissions of criteria air pollut vehicles as well. Some emissions of air pollutants from worker vehicles would also within and beyond the ORR.

5.7.1.1 Radiological Emissions. There are no expected contributions to radiological air

emissions during the construction phases of the proposed SNF management facility. operations, the facility would be expected to generate negligible radiological emis potential radiological emissions associated with the proposed SNF management facili associated with the baseline are presented in Table 5.7-1 by isotope.

5.7.1.2 Nonradiological Emissions. The construction phase of the SNF facility for the

Receipt/Storage Facility and Canning Factory is estimated to be complete in about 8 Short-term emissions, such as fugitive dust and heavy equipment exhaust emissions, generated temporarily, and would only affect receptors close to construction areas. emissions would be minimized by watering. Under the operational phase of the SNF management facility, criteria and hazardous air pollutants might be emitted. Table total expected annual emissions associated with the SNF storage facility. These no emissions are primarily from the technology development facility and were estimated previous design for a similar facility proposed at INEL.

Table 5.7-1. Isotopic release additions due to SNF management facility presence (Ci/yr) at ORR.

	(Baseline) ORR	(SNF) ISF	ORR+ ISF
Hydrogen-3	2.1 x 103	7.9 x 10-1	2.1 x 103
Beryllium-7	8.9 x 10-6	0.0 x 100	8.9 x 10-6
Carbon-14	0.0 x 100	1.2 x 100	1.2 x 100
Potassium-40	1.0 x 10-3	0.0 x 100	1.0 x 10-3
Manganese-54	0.0 x 100	2.2 x 10-8	2.2 x 10-8

Cobalt-60	3.0 x 10-5	4.2 x 10-8	3.0 x 10-5
Bromine-82	1.0 x 10-5	0.0 x 100	1.0 x 10-5
Krypton-83M	7.3 x 101	0.0 x 100	7.3 x 101
Krypton-85	0.0 x 100	1.0 x 104	1.0 x 104
Krypton-85M	1.7 x 102	0.0 x 100	1.7 x 102
Krypton-87	3.5 x 102	0.0 x 100	3.5 x 102
Krypton-88	4.9 x 102	0.0 x 100	4.9 x 102
Krypton-89	6.3 x 102	0.0 x 100	6.3 x 102
Strontium-90	1.2 x 10-4	3.3 x 10-6	1.2 x 10-4
Yttrium-90	1.2 x 10-4	3.3 x 10-6	1.2 x 10-4
Technetium-99	6.1 x 10-2	0.0 x 100	6.1 x 10-2
Ruthenium-106	4.4 x 10-4	1.1 x 10-5	4.5 x 10-4
Antimony-125	0.0 x 100	3.4 x 10-4	3.4 x 10-4
Iodine-129	3.1 x 10-4	1.0 x 10-1	1.0 x 10-1
Iodine-131	1.2 x 10-1	0.0 x 100	1.2 x 10-1
Iodine-132	1.4 x 100	0.0 x 100	1.4 x 100
Iodine-133	6.5 x 10-1	0.0 x 100	6.5 x 10-1
Iodine-134	2.1 x 10-2	0.0 x 100	2.1 x 10-2
Iodine-135	1.2 x 100	0.0 x 100	1.2 x 100
Xenon-133	8.8 x 102	0.0 x 100	8.8 x 102
Xenon-133M	2.7 x 101	0.0 x 100	2.7 x 101
Xenon-135	2.8 x 101	0.0 x 100	2.8 x 101
Xenon-135M	1.6 x 102	0.0 x 100	1.6 x 102
Xenon-138	8.5 x 102	0.0 x 100	8.5 x 102
Cesium-134	6.3 x 10-7	6.2 x 10-8	6.9 x 10-7
Cesium-137	7.0 x 10-4	4.8 x 10-5	7.5 x 10-4
Cesium-144	1.2 x 10-6	0.0 x 100	1.2 x 10-6
	(Baseline) ORR	(SNF) ISF	ORR+ ISF
Barium-140	1.0 x 10-4	0.0 x 100	1.0 x 10-4
Lanthanum-140	1.4 x 10-6	0.0 x 100	1.4 x 10-6
Europium-152	4.4 x 10-11	0.0 x 100	4.4 x 10-11
Europium-154	5.9 x 10-6	0.0 x 100	5.9 x 10-6
Europium-155	3.0 x 10-6	0.0 x 100	3.0 x 10-6
Osmium-191	2.3 x 10-2	0.0 x 100	2.3 x 10-2
Lead-212	1.6 x 100	0.0 x 100	1.6 x 100
Thorium-228	1.5 x 10-3	0.0 x 100	1.5 x 10-3
Thorium-230	7.4 x 10-4	0.0 x 100	7.4 x 10-4
Thorium-232	3.0 x 10-5	0.0 x 100	3.0 x 10-5
Protactinium-234	1.2 x 10-3	0.0 x 100	1.2 x 10-3
Uranium-234	7.2 x 10-2	0.0 x 100	7.2 x 10-2
Uranium-235	2.6 x 10-3	0.0 x 100	2.6 x 10-3
Uranium-236	1.9 x 10-4	0.0 x 100	1.9 x 10-4
Uranium-238	4.1 x 10-2	0.0 x 100	4.1 x 10-2
Neptunium-237	1.1 x 10-4	0.0 x 100	1.1 x 10-4
Plutonium-238	6.1 x 10-4	0.0 x 100	6.1 x 10-4
Plutonium-239	1.3 x 10-4	0.0 x 100	1.3 x 10-4
Plutonium-240	0.0 x 100	0.0 x 100	0.0 x 100
Americium-241	1.4 x 10-5	0.0 x 100	1.4 x 10-5
Curium-244	2.0 x 10-4	0.0 x 100	2.0 x 10-4

a. Source: Johnson, V. (1994).

Cm241 with 35 day half-life included with AM241 with 458 yr half-life.
Os194 with 8.0 yr half-life decays to Ir194 with 17.4 hr half-life, then to P1194 w
ISF: Interim Storage Facility.

Table 5.7-2. Total annual nonradioactive emissions for the SNF management facility

Criteria pollutants	Release rate (kg/yr)
Carbon monoxide	1.7 x 103
Particulate matter, PM10b	1.0 x 10-3
Nitrogen oxides	5.5 x 103
Sulfur dioxide	1.3 x 102
Lead	5.0 x 10-9

Hazardous air pollutants	
Selenium compounds	1.6 x 10-4
Mercury compounds	5.1 x 10-1
Chlorine	3.5 x 103
Hydrogen fluoride	1.6 x 101
Cadmium compounds	2.9 x 10-7
Cobalt, chromium, antimony, and nickel compounds	2.0 x 10-10

a. Source: Johnson, V. (1994).

b. It is assumed that PM10 (particulate matter less than 10 microns in diameter) d suspended particulate data.

5.7.2 Air Quality

5.7.2.1 Radiological. The GENII Environmental Transport and Dose Assessment Model,

along with 1992 Y-12 west meteorological data and 1992 source terms (Table 5.7-1), calculate the effective dose equivalent for the year 2005. A population of 988,754 80 kilometers (50 miles) is estimated. A radiation background level of 306 millire used.

Based on model results, 1 year of operation at the SNF management facility migh a calculated dose of 9.5 millirem per year to the maximally exposed member of the p dose is below the National Emission Standards for Hazardous Air Pollutants limit of per year and is 3.1 percent of the natural background radiation received by the ave near the ORR.

The annual population dose from operation in the year 2005 was calculated to be person-rem. The population dose from operation of this option in 2005 is approxima 2.1 x 10-2 percent of the dose received by the surrounding population from natural radiation.

Table 5.7-3 summarizes the effective dose equivalents for the maximum boundary to the population with 80 kilometers (50 miles) of the proposed SNF facility. Comp background radiation, these increased doses are very small. The total doses are we regulatory limits.

5.7.2.2 Nonradiological. The Industrial Source Complex Short-Term Air Dispersion

model was used with 1992 meteorological data from the Y-12 west meteorological moni station at ORR to determine pollutant concentrations resulting from the centralizat nonradiological emissions listed in Table 5.7-2. An emissions baseline was establi

Table 5.7-3. Summary of effective dose equivalents to the public from ORR operatio the proposed SNF management facility.

	Maximally exposed individual dosea	Collective dose to population within 80 km of ORR sources
Dose	9.5 mrem per yearb	5.7 x 101 c
Location	Site boundary 1.2 km SW of ORR storage facility	9.1 x 105 people within 80 km of SNF storage facility
NESHAPb standard	10 mrem per year	-
Percentage of NESHAP	95	-
Natural background dose	306 mrem	2.79 x 105 person-rem
Percentage of	3.1	2.1 x 10-2

natural
background dose

a. The maximum boundary dose is the hypothetical individual exposed continuously d year at ORR boundary located 1.2 km SW from the SNF site.

b. The SNF management facility contributes 6.2 mrem to this dose.

c. The SNF management facility contributes 5.2 person-rem to this dose.

NESHAP: National Emission Standards for Hazardous Air Pollutants.

km: kilometer

mrem: millirem

Note: Effective dose equivalents computed using GENII (PNL 1988).
characterize conditions at ORR using actual emission rates (MMES 1993a). It is als that 1995 operations at the ORR will result in the same baseline nonradiological em 1992 operations at the ORR. The results of modeling are presented in Table 5.7-4, existing ORR site contribution concentration is compared to the existing DOE site c concentration plus the proposed SNF contribution. Table 5.7-5 presents the annual concentration for hazardous air pollutants for offsite receptors. These concentrat Section 5.12 for calculation of health effects. The increases in pollutant concent proposed action are negligible in magnitude. The concentrations of nonradiological from operation of the SNF facilities, under that alternative, and from existing sou remain within all applicable regulatory guidelines.

If a Regionalization Alternative SNF facility is operated at the ORR, the incre contribution to maximum concentrations of pollutants would be less than for the Cen Alternative. The concentrations of nonradiological air pollutants from operation o facilities, under this alternative, and from existing sources would remain within a guidelines.

5.8 Water Resources

Construction and operation of SNF management facilities could potentially affec resources. Potential environmental impacts to surface water and groundwater resour construction include depletion of water supplies, floodplain encroachment, and surf sedimentation from erosion runoff occurring after land clearing. Potential normal impacts would include depletion of water supplies, and diminished water quality res wastewater discharges from normal operations.

Impacts are analyzed for the Centralization Alternative, which would cause the impacts to water resources at the ORR, if chosen. However, for the Centralization no significant impacts are identified with respect to water resources issues. Ther significant impacts are expected from the Regionalization Alternative as the Centra Alternative is the bounding case.

Table 5.7-4. Comparison of baseline concentrations with most stringent applicable and guidelines at ORR and proposed SNF management facility plus current operations.

Criteria pollutant	Averaging time	Most stringent regulation or guidelinea (-g per m3)	Total existing maximum concentrationb (-g per m3)	Total projected maximum concentration including SNF (-g per m3)
Carbon monoxidec	8-hour	10,000	6.9	6.9
	1-hour	40,000	24.1	33.5
Nitrogen dioxide	Annual	100	2.1	2.7
Lead	Calendar quarter	1.5	d	3.7 x 10-12
PM10e	Annual	50	12.0	12.0
	24-hour	150	97.9	97.9
Sulfur dioxide	Annual	80	29.29	29.34
	24-hour	365	177.8	178.0

	3-hour	1,300	401.5	401.5
Total suspended particulates	Annual	50a	36.0	36.0
	24-hour	150a	116.9	116.9
Hydrogen fluoride (as fluorides)	30-day	1.2a	0.06	0.06
	7-day	1.6a	0.03	0.03
	24-hour	2.9a	d	f
	8-hour	3.7a	d	f
Hazardous air pollutants				
Selenium	8-hour	20	d	2.18 x 10-7
Mercury compounds	8-hour	0.5	d	2.18 x 10-3
Chlorine compounds	8-hour	150	d	1.52
Cadmium compounds	8-hour	5	d	1.81 x 10-9
Cobalt, chromium, antimony, and nickel compounds	8-hour	5	d	5.5 x 10-10

a. State standard.

b. Includes background concentration plus existing DOE facilities impact concentra concentration.

c. Existing maximum and projected maximum did not occur in the same location.

d. Zero release (no sources indicated).

e. It is assumed that PM10 (particulate matter less than 10 microns in diameter) d particulate data.

f. Not estimated because the potential release is negligible.

Table 5.7-5. Calculated annual maximum concentrations for hazardous air pollutants at ORR for offsite receptors.

Hazardous air pollutant	Maximum average concentration(-g/m3)
Selenium compounds	8.85 x 10-8
Mercury compounds	8.85 x 10-4
Chlorine compounds	0.62
Hydrogen fluoride	1.53 x 10-3
Cadmium compounds	7.35 x 10-10
Cobalt, chromium, antimony and nickel compounds	2.21 x 10-10

a. Offsite includes public access roads within the ORR. All impacts from proposed source only. No hazardous air pollutant emissions information available for existing sources.

5.8.1 Surface Water Quantity

The ORR currently receives its water supply from the Clinch River basin. Const operation of SNF management facilities would have very minimal impact on the quanti in the river and in local surface streams.

Construction of SNF management facilities would require some water consumption. However, the amount of water required would not significantly affect the Clinch Riv level.

Stormwater runoff associated with both the construction and operation of SNF fa expected to have a negligible impact on surface water quantity. During constructio stormwater management techniques would be employed to attenuate runoff. A site dra stormwater management system consisting of perimeter drainage ditches and a retenti

would be included as part of SNF operations (Johnson, V. 1994). This system would runoff and erosion control, which could otherwise affect receiving water courses or operations.

As discussed in Section 4.8.1, analysis of available data indicates that the pr management facilities would be sited outside the 500-year floodplain. The SNF mana facilities would be located and constructed to minimize any floodplain impact, as r Executive Order 11988 (Floodplain Management) and DOE Orders. Site-specific survey be performed to more accurately determine precise locations of flooding elevations.

Operation of SNF management facilities would require approximately 9,863 gallon liters) of water per day. This would mean that an additional 3.6 million gallons (liters) of water would be used at the ORR per year. This figure is significantly l minimum monthly release for 1992 which was 3.5 billion cubic feet (100 million cubi May of that year (MMES 1993a). Therefore no impacts to water supply from SNF opera are expected.

Operation of SNF management facilities would involve the discharge of almost al withdrawn, as very little would be consumed. A new onsite sanitary wastewater trea would be required at the SNF facility. If all water withdrawn were to be treated a a constant rate over the course of a year, the increased flow from SNF operations w approximately 0.13 gallon (0.5 liter) per second. Flow in Grassy Creek at its conf Clinch River has been estimated at 20 gallons (80 liters) per second. Water discha other appropriate mitigation measures would be selected in accordance with state an requirements so as not to impact surface water quantity and flow in streams receivi

5.8.2 Surface Water Quality

During construction of SNF management facilities, 90 acres (36 hectares) would disturbed, all in previously undisturbed areas. This would create the potential fo sediment runoff into wetlands, adjacent to the site and along the downstream reache Creek as well as into Grassy Creek and its tributaries, which drain to the Clinch R sediment runoff from construction activities would be controlled and minimized by i soil erosion control measures.

Under the Centralization Alternative, SNF management facilities would require a sewer system comprising a sewage treatment facility equipped with a sewage treatmen ejection pump system with a programmable controller and software. A pressurized sa sewer line would be provided that would run to a permitted stream discharge point (Johnson, V. 1994). This would accommodate the estimated 9,863 gallons (37,335 lit of sanitary wastewater generated by SNF facilities and personnel, and would result appreciable impact to surface water quality. This system would be operated in acco State of Tennessee permitting requirements.

The proposed SNF management facilities are designed to have no liquid release o wastewater with hazardous chemical or radiological characteristics related to SNF m operations. These facilities would be constructed using state-of-the-art technolog secondary containment, and leak detection and water balance monitoring equipment. no environmental consequences related to surface water resources are anticipated fr normal operation of SNF management facilities.

A very low probability release scenario was evaluated to identify the potential environmental consequences of a liquid release to the environment under normal oper conditions. The release scenario was evaluated for information purposes only, as n operating releases are planned for the proposed facilities. The scenario evaluated maximum potential liquid release to the environment under normal operating conditio an undetected secondary containment failure or piping leak. The scenario was devel conservative estimates of the sensitivity of actual leak detection systems and oper term data from similarly functioning facilities at the Idaho National Engineering L (INEL). The estimates for the hypothetical release included a point release of 5 g liters) per day to the environment over the course of 1 month. The release volume durations are considerably greater than existing leak detection system sensitivitie activities, and radiological surveys. Source terms were derived at the 95 percent from 8 years of operational data at the INEL Fluorinel and Storage Facility at the Chemical Processing Plant.

This release was assumed to occur at 40 feet (12 meters) below the land surface would be at either the depth of the vadose zone or the groundwater zone in most cas SNF management facilities would be sited on the ORR. Any release to the vadose zon migrate downward to the groundwater zone as described in Section 4.8.2. The upper

the groundwater zone in the ORR aquitards (where SNF management facilities would be flow laterally to discharge points in nearby streams.

Most radiological constituents would be below drinking water standards at the p release. Those radiological constituents above drinking water standards would be d movements through the vadose zone, groundwater zone, and immediately upon entry int receiving surface water body. Migration of contaminants through the vadose and gro zones would also be greatly reduced by sorption.

The short-term scenario evaluated would result in a long-term release of dilute contaminants to local streams and the Clinch River. Any release from the SNF manag facilities would discharge to Grassy Creek through the subsurface. Although there continuous records of stream discharge for Grassy Creek, the average discharge of G to the Clinch River has been estimated at 20 gallons (80 liters) per second (Bailey Lee 1991). The worst-case undetected release from the SNF facilities (5 gallons [1 day) would constitute less than 0.0003 percent of the estimated daily creek dischar Clinch River. Therefore, any hazardous constituents would be well below establishe at the confluence of Grassy Creek and the river. Even if a release were to occur d of low flow in Grassy Creek, the percentage would still be very small. Additionall minimum monthly release (in May) of 3.5 billion cubic feet (100 million cubic meter Melton Hill Dam on the Clinch River averages to approximately 10,000 gallons (40,00 second (MMES 1994a). Therefore, no significant contaminant concentrations would be at the confluence of Grassy Creek and the Clinch River, or in the river itself.

5.8.3 Groundwater Quantity

No groundwater would be used for SNF management activities given the plentiful water supplies at the ORR. Therefore no impacts to groundwater quantity are expect

5.8.4 Groundwater Quality

As previously mentioned in Section 5.8.2, the proposed SNF management facilitie designed to have no liquid release to the environment of wastewater with hazardous radiological characteristics. However, for the purpose of this analysis, a conserv scenario was analyzed.

As discussed in Section 4.8, virtually all mobile groundwater in the ORR aquita discharged to local streams through the upper layers of the groundwater zone. The intervals of groundwater have extremely high residence times. Therefore, even the scenario of a release to groundwater would have negligible impacts to these resourc significant impacts to offsite groundwater.

5.9 Ecological Resources

The Centralization and Regionalization Alternatives could affect ecological res primarily through the alteration or loss of habitat. Potential impacts to terrestr resources and threatened and endangered species are described below for both altern

Radiation doses received by terrestrial biota from SNF activities would be expe similar to those received by man. Although guidelines have not been established fo limits for radiation exposure to species other than man, it is generally agreed tha established for humans are also conservative for other species (NRC 1979). Evidenc that no other living organisms have been identified that are likely to be significa radiosensitive than man (Casarett 1968; National Academy of Sciences 1972). Thus, exposure limits protective of man are not exceeded, no significant radiological imp populations of biota would be expected as a result of SNF activities at the West Be

5.9.1 Centralization Alternative

Under this alternative, construction of the proposed SNF management facility wo in the disturbance of approximately 90 acres (0.36 square kilometers), or less than the ORR. It is assumed that the area to be disturbed includes construction laydown grading, and new buildings, and that the access road or other rights-of-ways have n included in total area to be disturbed. Vegetation within the area proposed for th

management facility would be destroyed during land clearing activities but may be m revegetating with native species where possible. Vegetation cover in this area is oak-hickory forest or pine and pine-hardwood forest. Both forest types are common and within the region.

Construction of the proposed SNF management facility would have some adverse ef animal populations. Less mobile animals, such as amphibians, reptiles, and small m within the project area would be destroyed during land-clearing activities. Larger birds in construction and adjacent areas would be disturbed by construction activit move to nearby suitable habitat. The long-term survival of these animals would dep whether the area to which they moved was at or below its carrying capacity. Areas revegetated upon completion of construction would be of minimal value to most wildl be repopulated by more tolerant species.

The Migratory Bird Treaty Act is primarily concerned with the destruction of mi birds, as well as their eggs and nests. It may be necessary to survey construction nests of migratory birds prior to construction and/or avoid clearing operations dur breeding season.

Activities associated with operation, such as noise, increased human presence a and night lighting could affect wildlife living immediately adjacent to the site. disturbances may cause some sensitive species to move from the area, most animals s able to adjust.

Construction of the proposed SNF management facility would likely displace the wetlands adjacent to tributaries of Grassy Creek flowing through the proposed site. unavoidable displacement of wetlands would be accomplished in accordance with the U Corps of Engineers and Tennessee Water Quality Control Administration requirements. potential also exists to disturb wetlands further down stream through erosion and s Such impacts would be controlled through implementation of a soil erosion and sedim plan. Construction-related discharges to Grassy Creek would be relatively low and negligible impacts to wetlands associated with the creek. No impacts to wetlands a during facility operations.

Construction of the proposed SNF management facility would require the rechanne tributaries to Grassy Creek that cross the proposed site and, thus, the loss of thi In addition, soil erosion due to construction could cause water quality changes (pr sediment loading) to Grassy Creek and its tributaries. These impacts could be mini implementation of soil erosion and sediment control measures. No operational impac aquatic resources are anticipated. It is assumed that the proposed project will ha retention pond and a sewage lagoon area within the security fence that may provide habitat for amphibians in the area.

No federally listed species are expected to be affected by construction and ope SNF management facility. Site surveys will be required to verify the presence of s other special status species. Land clearing activities may destroy protected plant purple fringeless orchid and pink lady's-slippers, that may occur within the site. species including the Cooper's, sharp-shinned, and red-shouldered hawks, the barn o black vulture, which potentially occur in the area, could be impacted by project ac Approximately 90 acres (36 hectares) of potential nesting and foraging habitat wou result of construction activities. Because this type of habitat is abundant in the not expected to affect the viability of populations of these species. However, app would be taken to prevent nest disturbance. The DOE would consult with the Tenness Department of Environment and Conservation as appropriate to avoid or mitigate immi impacts to state-listed species.

5.9.2 Regionalization Alternative

Impacts under this alternative are expected to be generally the same as under t Centralization Alternative. The major difference between the two is the total area disturbed. The Regionalization Alternative is expected to have fewer buildings req therefore, fewer acres to be disturbed.

5.10 Noise

As discussed in Section 4.10, noises generated on the ORR do not propagate offs levels that impact the general population. Thus, ORR noise impacts for both the Ce and Regionalization Alternatives are those resulting from the transportation of per

materials to and from the site that affect the nearby communities, and those result sources that may affect some wildlife near these sources. The effect of noise on w SNF management facilities under the Centralization or Regionalization Alternatives addressed in a project-specific environmental assessments.

The transportation noises are a function of the size of the work force (e.g., a the size of the work force would result in increased employee traffic and correspon in deliveries by truck and rail, and a decreased work force would result in decreas traffic and corresponding decreases in deliveries). This analysis of traffic noise noise from the major roadways that provide access to the ORR. Vehicles used to tra employees and personnel on roadways would be the principal sources of community noi impacts near the ORR from the Centralization and Regionalization Alternatives.

This analysis used the day-night average sound level to assess community noise by the U.S. Environmental Protection Agency (EPA 1974, 1982) and the Federal Intera Committee on Noise (FICON 1992). The change in day-night average sound level from baseline noise level for each alternative was estimated based on the projected chan employment and traffic levels from the baseline levels. The baseline levels are th The combination of construction and operation employment was considered. A change level below 3 decibels would not be expected to result in a change in community rea (FICON 1992).

Under the Centralization Alternative the projected ORR work force might increas about 9 percent in the years 2000 to 2002, during the peak construction period, and decrease thereafter (Section 5.3). There would be a corresponding increase in priv and truck trips to the site. The day-night average sound level at 15 meters (50 fe roads that provide access to the ORR would be expected to increase by less than 1 d change is expected in the community reaction to noise along these routes. No mitig are necessary.

Under the Regionalization Alternative the traffic noise impacts would be the sa the Centralization Alternative.

5.11 Traffic and Transportation

5.11.1 Centralization Alternative

The proposed SNF management activities would involve a small increase in the nu employees commuting to the ORR and the transportation of SNF and hazardous chemical onsite. This section summarizes the potential transportation impacts due to the pr facilities on the ORR.

5.11.1.1 Level of Service. Levels of service were calculated for construction and

operation of the SNF facility at the ORR. The maximum reasonably foreseeable scena operations occurs when the projected combined employees and population are at the h level. This occurs in 2001, when there are 4,184 employees and a projected populat Region of Influence of 528,800. The Region of Influence includes Anderson, Blount, Loudon, and Roane counties. This is the region from which employees can be expecte commute. The employees and population associated with the proposed action generate trips in the Region of Influence. These trips to the site are distributed to the R Influence road network according to percentages based on a traffic flow to the site employees historically have lived. Increase in baseline population and indirect si employees will generate indirect traffic trips in the Region of Influence. These t distributed based on the current average daily traffic per present population in th influence for a given segment. Direct and indirect average daily traffic is added of service is determined. Construction and operation employees contribute little t traffic because they represent such a small percentage of the Region of Influence p growth.

The following segment has a poorer level of service due to site-related impacts future baseline. Tennessee State Route 61 between Interstate 75 at Norris and 25W will worsen to a level of service of E while Tennessee State Route 62 between Inter Knoxville and US 441/TN 33 at Knoxville will worsen to a level of service of F. Th other site-related impacts on any other segment.

Road reconstruction, widening, modification of interchanges, and new interchang construction projects are planned for segments of Bear Creek Valley Road, Scarboro

Tennessee State Routes 58, 62, and 95 (Johnson, C. 1994; MMES 1991b).
Possible mitigation of impacts on local and regional roads having level of serv include adding lanes or employing traffic demand management.
The generic facility design would require rail access for Naval fuel delivery. create impacts that would be evaluated in detail if the site were selected for the

5.11.1.2 Transportation of Hazardous Chemicals. The hazardous chemicals required

and hazardous waste generated by the proposed SNF facility operation are assumed to transported by truck. The onsite transportation impacts for these hazardous chemic wastes shipments are calculated based on the assumptions that (a) they do not have free impacts, (b) the material would not leak during transport, (c) only risk is du fatalities, and (d) the material spill of entire contents is bound by the risk eval Expended Core Facility considered under facility accidents.
The total distance for onsite shipment of these hazardous chemicals is assumed maximum site boundary distance from the proposed SNF facility to the nearest highwa on the unit risk factor (Cashwell et al. 1986) and occupational and nonoccupational considering a rural setting, the onsite transportation risks are calculated, assumi shipments.
The maximum one-way distance from the site to the ORR gate by which trucks woul deliver hazardous waste is 16 kilometers (10 miles). Based on 1.5 x 10-8 accident fatalities per kilometer per shipment, 1.92 x 10-4 accident occupational fatalities over a 40-year period. Based on 5.3 x 10-8 accident non-occupational fatalities pe shipment, 6.8 x 10-4 accident non-occupational fatalities are estimated for a 40-ye

5.11.1.3 Transportation of Radioactive SNF. The definition of offsite transportation

includes transportation of radioactive material from the shipping facility to the s the receiving site; therefore this local transportation does not separately address transportation impacts due to radioactive materials shipment except for handling at facility. Based on current inventories and expected future generation, DOE estimat approximately 480 spent nuclear shipments over 40 years (1995-2035) from the High F Reactor. The distance between the High Flux Isotope Reactor and the proposed SNF management facility at ORR is about 6 miles (9.75 km). Incident-free onsite radiol transportation impacts from the estimated 480 shipments were calculated for transpo members (occupational) and general population. Occupational dose of 0.34 person-re 40 years was calculated based on a unit risk factor of 7.16 x 10-5 person-rem per k (Appendix I). This dose results in 1.36 x 10-4 fatal cancers. The general populat x 10-3 person-rem over 40 years was calculated based on a unit risk factor of 1.83 rem per kilometer (Appendix I). This dose results in 4.28 x 10-6 fatal cancers.

5.11.2 Regionalization Alternative

The impacts due to the Regionalization Alternative would be less than those des the Centralization Alternative.

5.12 Occupational and Public Health and Safety

5.12.1 Centralization Alternative

This section evaluates the impacts to human health resulting from both contamin emissions and direct exposures associated with the proposed SNF management facility Centralization Alternative. Based on current inventories and expected future gener estimates approximately 480 spent nuclear shipments over 40 years (1995 - 2035) fro Flux Isotope Reactor. The distance between the High Flux Isotope Reactor and the p SNF management facility at ORR is about 6 miles (9.75 km). Incident-free onsite ra transportation impacts from the estimated 480 shipments were calculated for transpo members (occupational) and general population. Occupational dose of 0.34 person-re years was calculated based on a unit risk factor of 7.16 x 10-5 person-rem per kilo (Appendix I). This dose results in 1.36 x 10-4 fatal cancers. The general populat

x 10-3 person-rem over 40 years was calculated based on a unit risk factor of 1.83 rem per kilometer (Appendix I). This dose results in 4.28 x 10-6 fatal cancers.

5.12.1.1 Radiological Dose and Cancer Impacts. Computation and modeling (see

Table 5.7-1) have shown that the dose rate (due to atmospheric effluents only) to t exposed individual, conservatively taken to be at the site boundary of the ORR (wit presence of the interim storage facility), is 3.3 millirem per year of site operati **associated risk of fatal cancer of 1.7 x 10-6 to this maximally exposed individual.** established (see Section 4.12.4) that liquid effluents may present an additional pl of 15.2 millirem per year of site operation (MMES 1993a) to a potential maximally e individual at the site boundary (due to both water consumption [0.2 millirem] and e liquid material [15 millirem]), yielding a corresponding risk of 7.6 x 10-6 per yea Subsequently, an additional 6.2 millirem per year to the postulated maximally expos at the site boundary has been tabulated due to the presence of interim storage faci effluents (no radioactive liquid effluents are expected from the interim storage fa the spent fuel were brought to the ORR, it could result in a total cumulative dose interim storage facility) to the maximally exposed individual at the site boundary per year of site operation (see Table 5.12-1), with an associated total risk from O of 1.2 x 10-5 for fatal cancer; the resulting increase in risk to this individual f with SNF management included is 34 percent. The total dose (24.7 millirem) to the exposed individual is well within all applicable DOE limits (i.e., 4 millirem per y drinking water pathway, 10 millirem per year from the airborne release pathways, an millirem per year total for all pathways). Table 5.12-1 shows the relationship amo sources of radiation doses to the maximally exposed individual. The risks are pres both 1 and 40 years of exposure. The latter values are approximate and correspond operating lifetime of the SNF facility.

The annual population dose (80-kilometer [50-mile] radius) from total site oper (without the interim storage facility) is 54 person-rem, resulting in an increase o 0.027. The increase in annual population dose from SNF operations is 5 person-rem, an increase of 2.5 x 10-3 for fatal cancer.

Over 40 years the increase in fatal cancers from SNF operations is 0.10. The i 9 percent in fatal cancers to the population from site operations with SNF results from 0.019 to 0.021 percent in the comparison of the dose received from ORR to that from background. Table 5.12-1 also includes a summary of these population health i

Table 5.12-1. Critical Interim Storage Facility impacts on radiation dose and cance

	Dose rate to the maximally exposed individual (mrem per yr)	Associated fatal cancer risk (yr of operation)a	Associated facility lifetime fatal cancer risk (40 years)a
Natural background	295	1.5 x 10-4	5.9 x 10-3
Public			
Baseline site operations	18.5	9.2 x 10-6	3.7 x 10-4
SNF operations	6.2	3.1 x 10-6	1.2 x 10-4
Baseline & SNF	24.7	1.2 x 10-5	4.9 x 10-4
Percent increase SNF over baseline	34	34	34
Workers			
Baseline site operations	2.8b	1.1 x 10-6	4.5 x 10-5
SNF operations	40b	1.6 x 10-5	6.4 x 10-4

a. Facility lifetime fatal cancer risk accounts for time-varying number of workers.
b. Dose rate to an average worker.

It has been assumed that the additional doses to SNF workers (due to interim st facility operations) will be similar in nature to those for major DOE facility Wast Processing/Management personnel. Hence, by examining the dose data from 1989, 1990 1991 for Richland, INEL, and Savannah River Site and assuming that the nuclear acti SNF would remain fairly constant until it is dealt with at the interim storage faci

asserted that a maximally exposed interim storage facility worker could plausibly r additional (above background) annual dose of 3 rem from normal operations; this is a risk of 1.2 x 10-3 for fatal cancer per year of operation. However, the average (incurred in 1989, 1990, and 1991) to SNF workers was approximately 40 millirem per is equivalent to a risk of 1.6 x 10-5 for fatal cancer per year of operation, and t risk of 6.4 x 10-4 to a worker who is present during the entire 40-year facility li

An excess of 0.013 fatal cancer among all SNF facility workers is projected fro annual operations; exposures to radiation over the lifetime of SNF operations could excess of 0.40 fatal cancer. The maximum health effects due to radiological doses noninvolved worker, i.e., an ORR worker at a faciity other than SNF, would be on th 1 percent of the occupational exposure to an SNF worker based on analyses for the S INEL sites. Table 5.12-1 includes a summary of the doses and fatal cancer risks to

5.12.1.2 Chemical Exposure Health Impacts. The calculated atmospheric maximum

concentrations of hazardous chemicals (at the site boundary) for the proposed actio presented in Table 5.7-5 in Section 5.7. The maximum concentrations at the site bo reflect an exposure to a maximally exposed individual, whereas the maximum onsite concentrations reflect an exposure to a worker. Of the potential hazardous chemica for the proposed action, cadmium, nickel and chromium VI (chrome) are carcinogens f total cancer risk is calculated. The remaining seven chemicals are noncarcinogens hazard index is calculated. A hazard index value of greater than 1 serves as an in potential adverse health effects.

The offsite concentrations in Table 5.7-5 represent values at public access roa reservation. However, a maximally exposed individual is assumed to be unable to ta residence on these roads, but instead takes up residence along the reservation fenc concentrations at the fence line are 62 percent of those listed as offsite. On the concentrations at the roads, being the highest listed within the fence line, are us represent maximum concentrations for ORR workers.

Based on the maximum hazardous chemical concentrations at the site boundary, th fatal cancer risk and hazard index to the maximally exposed member of the public ar and 1.2 x 10-2, respectively. Based on the maximum concentrations onsite, the life cancer risk and hazard index to a worker are 4.0 x 10-12 and 1.9 x 10-2, respective that there will be virtually no health impacts from nonradiological releases.

5.12.1.3 Labor and Construction Health Risks. There are expected to be 25,212 total

occupational/total labor worker-years for the 40-year duration of the interim stora Hence, over the 40-year interim storage facility life span, it is estimated that 80 injuries/illnesses and 0.81 fatality to DOE and contractor personnel would result. 4,352 total construction worker-years for the 40-year duration of the interim stora results in 270 total injuries/illnesses and 0.48 fatality to DOE and contractor per

5.12.2 Regionalization Alternative

Although the Regionalization Alternative is not explicitly analyzed, its impact than those from the Centralization Alternative.

5.13 Utilities and Energy

Direct changes in utility demand as a result of the Centralization and Regional Alternatives were compared against the current capacity and peak demand for each ut resource. Impacts to provision of a utility are considered to occur if the current annual demand, or peak demand for a utility is equal to or exceeds the current avai within the designated Region of Influence. For the purpose of analysis, the Region for each resource area is defined as the area served by the utility provider respon meeting the service demands of the ORR.

5.13.1 Centralization Alternative

5.13.1.1 Water Consumption. For the Centralization Alternative, approximately 0.43

liter per second (6.85 gallons per minute) of water is required to operate all the the facility (Harr 1994). The K-25 plant, which would provide water to the site, h 184 liters per second (2,917 gallons per minute) (Fritts 1994).

The proposed SNF management facilities would require approximately 0.2 percent K-25 plant's water capacity. The K-25 plant would operate at 53 percent of its cap SNF facilities' water requirements are combined with the 1990 peak water usage of 9 second (1,533 gallons per minute).

5.13.1.2 Electrical Consumption. The proposed SNF management facilities under the

Centralization Alternative would require approximately 23,000 megawatt hours of ele year or approximately 2.63 megavolt-amperes average demand (Harr 1994). This repre 0.3 percent of ORR's 920 megavolt-ampere connected capacity. Thirty-one percent of connected capacity of ORR would be utilized when the peak electric requirement of 2 megavolt-amperes was combined with the electrical requirements of the Centralizatio Alternative.

5.13.1.3 Fuel Consumption. Energy requirements for the proposed SNF management

facilities under the Centralization Alternative were calculated assuming that elect purchased from a utility provider was the primary source of energy; however, fossil used to power backup generators and during construction. The amount of fuel requir operations would be small and should not substantially increase ORR fuel requiremen

5.13.1.4 Wastewater Disposal. Under the Centralization Alternative, approximately

0.43 liter per second (6.85 gallons per minute) of wastewater would be generated (H new onsite sanitary sewage system and wastewater treatment plant might be required facility. If a new system is not built, and sanitary sewage and wastewater are tre addition would represent approximately 2 percent of the K-25 sanitary sewer treatme capacity of 26 liters per second (417 gallons per minute). Ninety-four percent of capacity of the K-25 sanitary sewer treatment system would be utilized when the pea production of 24 liters per second (378 gallons per minute) was combined with the w production of the SNF management facilities.

5.13.2 Regionalization Alternative

5.13.2.1 Water Consumption. The proposed SNF management facilities under the

Regionalization Alternative would require less water than the facilities under the Alternative; therefore, the impacts would be less.

5.13.2.2 Electrical Consumption. The proposed SNF management facilities under the

Regionalization Alternative would require less electricity than the facilities unde Centralization Alternative; therefore, the impacts would be less.

5.13.2.3 Fuel Consumption. Energy requirements for the proposed SNF management

facilities under the Regionalization Alternative were calculated assuming that elec purchased from a utility provider was the primary source of energy; however, fossil used to power backup generators and during construction activities. The amount of for these operations would be small and should not substantially increase ORR fuel requirements.

5.13.2.4 Wastewater Disposal. The proposed SNF management facilities under the

Regionalization Alternative would produce less wastewater than the Centralization A therefore, the impacts would be less.

5.14 Materials and Waste Management

This section discusses the potential environmental consequences of the Centrali Regionalization Alternatives for the management of chemical raw materials and trans level radioactive, and hazardous waste at the ORR. Nonhazardous (sanitary) wastes discussed in Section 5.8. Section 4.14 describes the waste categories and outlines waste management activities for the ORR. These waste management activities include and offsite waste treatment, onsite and offsite waste disposal, and onsite waste st Section 4.14 also describes the chemical raw material management activities for the

5.14.1 Methodology

This analysis considers the impact of the Centralization and Regionalization Al current waste management activities at the ORR (baseline conditions). In addition land area for SNF management, both alternatives would generate transuranic, low-lev radioactive, hazardous, and nonhazardous wastes. Neither alternative is projected mixed wastes or high-level wastes. This analysis is based on a comparison of the p amounts of waste generated by the Centralization and Regionalization Alternatives v current waste generation rates and storage capacity at the ORR.

5.14.2 Materials and Waste Management

SNF management activities would require the use of chemicals, and it is conserv assumed that all chemical raw materials used within the proposed SNF management fac would become hazardous wastes. The proposed SNF management facility would contribu transuranic, solid low-level, and sanitary (sewage) wastes. Table 5.14-1 presents waste generations by waste classification for each of the two alternatives (Central Regionalization) and by each of two storage options (wet storage, dry storage).

5.14.2.1 Centralization Alternative. Under the Centralization Alternative, all DOE SNF

(including Naval and domestic and foreign research reactors) will be transferred to at the ORR.

5.14.2.2 Wet Storage Option. The wet storage option would generate transuranic, low-

level, hazardous, and sanitary wastes. The effect that the projected amounts of ea wastes would have on the ORR waste management is discussed below.

5.14.2.2.1 Transuranic Waste-Over a period of 40 years of operation the

projected amount of transuranic waste generated due to the recovery and purificatio transuranic products would be 644 cubic meters (22,750 cubic feet).
The current storage capacity
at the ORR (ORNL) is 833.4 cubic meters (295,000 cubic feet). ORNL will continue t transuranic waste, and disposal is eventually planned for the Waste Isolation Pilot the Waste Isolation Pilot Plant unit does not come on line, the ORR transuranic was

Table 5.14-1. Ten-year cumulative estimated waste generation for SNF alternatives at the ORR (m3).

Alternative/ storage option	Time period

	1995-2004	2005-2014	2015-2024	2025-2034
Centralization Alternative				
Wet storage option				
Transuranic waste	161	161	161	161
Low-level waste	1,950	1,950	1,950	1,950
Hazardous waste	74	74	74	74
Sanitary waste (sewage)	1.2 x 105	1.2 x 105	1.2 x 105	1.2 x 105
Dry storage option				
Low-level waste	76	76	76	76
Sanitary waste (sewage)	1.9 x 104	1.9 x 104	1.9 x 104	1.9 x 104
Regionalization Alternative				
Wet storage option				
Transuranic waste	<161	<161	<161	<161
Low-level waste	<1,950	<1,950	<1,950	<1,950
Hazardous waste	<74	<74	<74	<74
Sanitary waste (sewage)	<1.2 x 105	<1.2 x 105	<1.2 x 105	<1.2 x 105
Dry storage option				
Low-level waste	<76	<76	<76	<76
Sanitary waste (sewage)	<1.9 x 104	<1.9 x 104	<1.9 x 104	<1.9 x 104

a. Source: Harr (1994).
capacity may have to be expanded to accommodate transuranic waste generated at the facility.

5.14.2.2.2 Low-Level Waste-The wet storage option would generate liquid low-

level waste as a result of its interim storage in water.
Over a period of 40 years of operation, an
estimated 7,800 cubic meters (over 2 million gallons) of low-level liquid waste mig generated. The total ORR (Y-12, K-25, ORNL) storage capacity for liquid low-level about 98,300 cubic meters (about 26 million gallons) (see Tables 4.14-1, 4.14-3, an Impacts would be small.

5.14.2.2.3 Hazardous Wastes-Installation of the proposed SNF management

facility would require additional management of hazardous wastes, including the pla satellite storage areas within the SNF complex and more frequent offsite shipments wastes.
It is estimated that the wet storage option will generate approximately 7.4 cubic m (261 cubic feet) of waste annually. Currently ORR manages about 10,000 cubic meter 353,000 cubic feet) of hazardous waste annually (see Tables 4.14-1, 4.14-3, and 4.1 the impact of SNF generated hazardous waste on the management of hazardous waste at ORR would be minimal.

5.14.2.2.4 Sanitary Waste-Sanitary wastes are covered in Section 5.

8.

5.14.2.3 Dry Storage Option. The dry storage option would generate low-level waste

and sanitary waste. The effects that the projected amounts of each of these wastes on the ORR waste management is discussed below.

5.14.2.3.1 Low-Level Waste-The low-level radioactive contaminated waste stream

would result from wastes generated during decontamination operations.
Over a period of
40 years of operation, an estimated 304 cubic meters (10,700 cubic feet) of low-lev be generated. As reported in Section 5.14.2.2.2 the total ORR storage capacity for level waste is about 98,300 cubic meters (about 26 million gallons). Impacts from operations on low-level waste management would be minimal.

5.14.2.3.2 Sanitary Waste-Sanitary wastes are covered in Section 5.

8.

5.14.2.2 Regionalization Alternative. Under the Regionalization Alternative, the ORR

would be the alternate site for the SRS. This alternative would generate less wast SNF complex than the Centralization Alternative since it is the alternative that st For either the wet storage or dry storage option, the waste generated would be less presented for the Centralization Alternative. Therefore, Table 5.14-1 presents the waste generation for the SNF for the Regionalization Alternative as less than those the Centralization Alternative. The impacts presented for each of the waste catego two options (wet storage, dry storage) for the Centralization Alternative apply to Regionalization Alternative as well.

5.15 Facility Accidents

A potential exists for accidents at facilities associated with the handling, in storage of spent nuclear fuel at the ORR. Accidents can be categorized into events abnormal (for example, minor spills), events a facility was designed to withstand, facility is not designed to withstand. These categories are termed abnormal, desig beyond design basis accidents, respectively. Summarized here are consequences of p accidents for a member of the public at the nearest site boundary and at the neares the collective population within 80 kilometers (50 miles), for workers, and for the See Section 5.11 for a summary of the assessment of transportation accidents.

A review of the historical record of accidents at the ORR is summarized in the section. Methods used to assess potential future events are summarized in Section Evaluations of accident impacts by alternative are summarized in Sections 5.15.3 th A summary comparison of accident impacts by alternative is given in Section 3.2. A supporting documentation for the accident impacts is given in a separate report (HN

This section examines the various activities that have been performed to assess for accidents and their consequences for workers and the public for each alternativ potential reasonably foreseeable accidents over the 40-year period are described wh all accidents. Secondary impacts of accidents pertaining to cultural resources, ec use, endangered species, water resources, and ecology are also addressed. This sec addresses emergency preparedness plans that have been established to mitigate the p secondary effects of accidents.

5.15.1 Historical SNF Accidents at ORR

The records of unusual events, including accidents, at the ORR have been review determine whether there have been any accidents with offsite impacts. The results there have been no accidents at the ORR associated with SNF that have had significa consequences for the general public.

5.15.2 Methodology

5.15.2.1 Existing Facilities.

5.15.2.1.1 Assumptions and Approach-The potential accidents associated with

the existing SNF management facilities and operations were screened to determine wh include in the accident analysis for the No Action Alternative.
Source terms were developed for
each accident analysis. The GENII code (PNL 1988) was used to estimate accident consequences for the general public and for individuals onsite or at the site bound both 50 percent and 95 percent meteorology. Accident consequences and risk are des terms of dose, cancer fatalities, and total health detriments for workers, an indiv boundary, and the public residing as far as 80 kilometers (50 miles) from the propo management facility.

5.15.2.1.2 Accident Screening-The potential accidents associated with the existing

SNF management facilities and operations were screened to determine which ones to i the accident analysis for the No Action Alternative.
Initiating events were reviewed including
natural phenomena (earthquakes, tornadoes, etc.), human initiated events (human err equipment failures, fires, explosions, airplane crashes, and terrorism. One refere fuel handling accident was selected for detailed analysis.

The dam in the High Flux Isotope Reactor fuel pool is removed and stored within during refueling operations. The reference design basis fuel handling accident pos during refueling operations, the dam falls and damages all the 62 spent fuel cores, most recently discharged core, located in the pool. The fission products from all cores are released to the water in the pool (ORNL 1992b).

A beyond design basis tornado accident was considered that resulted in collapse Flux Isotope Reactor bay roof and the roof's major structural member falls into the damages all the 62 spent fuel cores located in the pool. The fission products from fuel cores are released to the water in the pool (Flanagan 1994).

Additional beyond design basis accidents initiated by an airplane crash were po the High Flux Isotope Reactor and Bulk Shielding Reactor but were screened out beca probability of an airplane crash into the fuel pool was estimated to be less than 1 year.

The consequences of postulated operational and reference design basis accidents existing facilities are enveloped by the accident consequences presented in Subsect the Centralization Alternative.

5.15.2.2 New Facilities. In the absence of suitable design details for new SNF

management facilities during this stage of the SNF Management Program upon which to accident analysis, the approach makes use of accident scenarios and associated data been analyzed and documented for similar facilities. They include spent nuclear fu INEL, Hanford, Savannah River Site, and Naval sites.

5.15.2.2.1 Assumptions and Approach-A number of postulated accidents for the

similar facilities have been selected to serve as a common basis for estimating acc consequences for workers and the public at the ORR site.
Although the accident scenarios,
source terms, and related assumptions are common for both sites, the estimated cons are unique to the ORR site because of site differences in modeling parameters perta distances to site boundaries and population centers, population distributions, and The GENII code was used to estimate accident consequences for the general public an individuals onsite or at the site boundary based on both 50 percent and 95 percent Accident consequences and risk are described in terms of dose, cancer fatalities, a detriments for workers, an individual at the site boundary, a transient individual public access, and the public residing as far as 80 kilometers (50 miles) from the facility. The estimated frequency of each selected accident is based on the refere documentation.

The probability of an airplane crash into the new SNF management facility is co small because there are no nearby airports with large aircraft activity. The proba expected to be in the 1 x 10-6 to 1 x 10-8 per year range. For calculational purpo probability of this accident is conservatively estimated at 1 x 10-6 per year. Pot

initiated by an airplane crash into the SNF management facilities and the estimated consequences have been analyzed.

The secondary impacts of accidental releases of radioactive and hazardous mater also addressed in a qualitative manner. Secondary impacts pertain to effects of ac use, endangered species, water resources, cultural resources, and ecology.

5.15.2.2.2 Accident Screening-The potential accidents associated with existing

SNF management facilities and operations were screened to determine which ones to i the accident analysis for the ORR.
The source documentation for this purpose was primarily
Appendices A, B, C, and D of Volume 1 of this EIS. The source documentation descri potential accidents for existing and planned SNF management facilities that were se screening process. Initiating events were reviewed including natural phenomena (ea tornadoes, etc.), human initiated events (human error), equipment failures, fires, airplane crashes, and terrorism. Accidents associated with the Expended Core Facil at the ORR, were analyzed separately and the results are documented in Appendix D o EIS. For the ORR the maximum reasonably foreseeable criticality and nonradiologica are associated with the Expended Core Facility. The potential for a criticality ex fuel is in dry storage, during handling, and in the wet storage pool. Although the any criticality is very low, a hypothetical criticality of 1 x 1019 fissions was po Expended Core Facility wet pool as a basis for estimating the maximum reasonably fo consequences of a criticality.

The selected accidents include beyond reference design basis events to reflect magnitude of accident consequences that envelop all other accidents that have a rea probability of occurrence. They also include other accidents with lower consequen typically higher probabilities of occurrence to show a range of accident types and The accidents included in this set are reasonably foreseeable, meaning that there a more sequences of events that will lead to their occurrence and the sequence with t probability of occurrence is greater than 1 x 10-7 per year. Accidents falling out envelope, such as a meteorite impact, have been judged unreasonable because the pro occurrence in less than 1 x 10-7 per year.

5.15.2.2.3 Accident Prevention and Mitigation - Under the Centralization and

Regionalization alternatives, the SNF management facilities at the ORR will be of n and construction and incorporate the latest technology for safety.
The accidents postulated for
the SNF management facilities are based on operations and safety analyses that have performed at similar facilities. One of the major design goals for the SNF managem is to achieve a reduced risk to facility personnel and to public health and safety associated with similar functions at the existing SNF management facilities. Signi exist between design criteria and safety standards for the new SNF management facil those for the current facilities, thus reducing total risk. These changes include DOE structural and safety criteria and to planned throughput and storage capacity.

The new SNF management facilities would be designed to comply with current Fede state, and local laws, DOE Orders, and industrial codes and standards. This would facilities that are highly resistant to the effects of severe natural phenomena, in earthquake, flood, tornado, high wind, as well as credible events as appropriate to as fire and explosions, and man-made threats to its continuing structural integrity materials.

Emergency preparedness plans have also been prepared for existing facilities an revised for new facilities to lower the potential consequences of an accident to wo public. All workers receive evacuation training to ensure timely and orderly perso away from high-risk areas. Plans and arrangements with local authorities are also evacuate the general public that may be at risk of exposure to hazardous materials accidentally released.

5.15.3 No Action Alternative

There is a potential for the accidental release of radioactive substances durin stages of SNF handling operations and storage. The operations begin with discharge

from the reactor during refueling operations. The discharged SNF is placed in the cooling and short term storage. After an adequate cooldown period, SNF is removed pool and transported offsite for long term storage. Accidents that may occur durin handling operations and storage may involve the release of radioactive material to pathways. The cause of accidents may be due to internal initiators, such as operat equipment failure, and terrorism, or external initiators, such as an earthquake.

In the event that SNF can not be transported offsite for long term storage, rea operations will cease when the fuel pool is full. Presently the SNF stored in the is sound and has not deteriorated. If the existing SNF were to remain in the ORR f an extended period of time and deterioration of the aluminum fuel cladding occurred no existing facilities at the ORR to characterize the SNF.

5.15.3.1 Radiological Impacts. The potential accidents associated with the existing SNF

management facilities and operations were screened to determine which ones to inclu accident analysis for the No Action Alternative. One reference design basis accide beyond design basis accident were selected for detailed analysis. Although other a occur, their estimated consequences are bounded by this beyond design basis acciden probability of occurrence is less than 1.0 x 10-7per year. If these accidents were dose and risk to the onsite worker and the general population are shown in Tables 5 5.15-2 for 95 percent and 50 percent meteorology respectively. Similarly, cancer f shown in Tables 5.15-3 and 5.15-4, and the health effects are shown in Tables 5.15-

5.15.3.1.1 Reference Design Basis Accident-The dam that separates the High

Flux Isotope Reactor pool from the clean center pool during normal reactor operatio to a position between the east and center clean pools prior to defueling the reacto The dam is
lifted approximately 3 feet above the water over its slot between the reactor and c then moved with the crane across the center clean pool, and then lowered into its s the east and center pools. During this movement, and when the dam is being moved b fuel in the center pool is subjected to the possibility of dropping the dam and mec

Table 5.15-1. Summary of No Action Alternative accident analysis dose and risk est meteorology.

Accident scenario	Frequency (per year)	95 percent meteorology Dose MEIa (rem)	NPAIb	Workerd (rem)	Population (person-rem)
Dropped dam	1.0 x 10-4 e	3.7 x 10-1	6.2 x 10-1	2.3 x 10-2	3.5 x 103 c
Beyond design basis tornado	1.9 x 10-7	4.9 x 100 d	7.5 x 101	2.6 x 101	4.5 x 104 d

a. Maximum exposed individual (MEI).

b. Nearest public access individual (NPAI) - Radiation exposure received from inhal

c. Radiation exposure received from inhalation, external, and ingestion pathways.

d. Radiation exposure received from inhalation and external pathways.

e. The value is expected to be in the 1.0 x 10-4 to 1.0 x 10-6 range. For calculat

Table 5.15-2. Summary of No Action Alternative accident analysis dose and risk est meteorology.

50 percent meteorology

Accident scenario	Frequency (per year)	Dose MEIa (rem)	NPAIb	Workerd (rem)	Population (person-rem)	R
Dropped dam	1.0 x 10-4 e	8.6 x 10-2	1.9 x 10-1	5.7 x 10-3	1.2 x 103 c	

Beyond design basis tornado	1.9 x 10-7	9.5 x 10-1	1.9 x 101	4.0 x 100	7.2 x 103 d

a. Maximum exposed individual (MEI).

b. Nearest public access individual (NPAI). Radiation exposure received from i

c. Radiation exposure received from inhalation, external, and ingestion pathway

d. Radiation exposure received from inhalation and external pathways.

e. The value is expected to be in the 1.0 x 10-4 to 1.0 x 10-6 range. For calc

Table 5.15-3. Summary of No Action Alternative accident analysis cancer fatality a percent meteorology.

95 percent meteorology

Accident scenario	Frequency (per year)	Cancer fatalities MEIa	NPAIb	Workerd	Population	C (c
Dropped dam	1.0 x 10-4 e	1.8 x 10-4	3.1 x 10-4	9.2 x 10-6	1.7 x 100 c	
Beyond design basis tornado	1.9 x 10-7	2.5 x 10-3	7.5 x 10-2	2.0 x 10-2	2.3 x 101 d	

a. Maximum exposed individual (MEI).

b. Nearest public access individual (NPAI). Radiation exposure received from i

c. Radiation exposure received from inhalation, external, and ingestion pathway

d. Radiation exposure received from inhalation and external pathways.

e. The value is expected to be in the 1.0 x 10-4 to 1.0 x 10-6 range. For calc

Table 5.15-4. Summary of No Action Alternative accident cancer fatality and risk e meteorology.

50 percent meteorology

Accident scenario	Frequency (per year)	Cancer fatalities MEIa	NPAIb	Workerd	Population
Dropped dam	1.0 x 10-4 e	4.3 x 10-5	9.5 x 10-5	2.3 x 10-6	6.2 x 10-1 c
Beyond design basis tornado	1.9 x 10-7	4.8 x 10-4	9.5 x 10-3	1.6 x 10-3	3.6 x 100 d

a. Maximum exposed individual (MEI).

b. Nearest public access individual (NPAI). Radiation exposure received from i

c. Radiation exposure received from inhalation, external, and ingestion pathway

d. Radiation exposure received from inhalation and external pathways.

e. The value is expected to be in the 1.0 x 10-4 to 1.0 x 10-6 range. For calc

Table 5.15-5. Summary of No Action Alternative accident analysis health effects an percent meteorology.

95 percent meteorology

Accident	Frequency	Total health detrimentsa

scenario	(per year)	MEIb	NPAIc	Workere	Population
Dropped dam	1.0 x 10-4 f	2.7 x 10-4	4.6 x 10-4	1.3 x 10-5	2.5 x 100 d
Beyond design basis tornado	1.9 x 10-7	3.6 x 10-3	1.1 x 10-1	2.9 x 10-2	3.3 x 101 e

a. The estimated number of cancer fatalities, cancer nonfatalities, and genetic

b. Maximum exposed individual (MEI).

c. Nearest public access individual (NPAI). Radiation exposure received from i

d. Radiation exposure received from inhalation, external, and ingestion pathway

e. Radiation exposure received from inhalation and external pathways.

f. The value is expected to be in the 1.0 x 10-4 to 1.0 x 10-6 range. For calc

Table 5.15-6. Summary of No Action Alternative accident analysis health effects an percent meteorology.

50 percent meteorology

Accident scenario	Frequency (per year)	Total health detrimentsa			
		MEIb	NPAIc	Workere	Population
Dropped dam	1.0 x 10-4 f	6.3 x 10-5d	1.4 x 10-4	3.2 x 10-6	9.0 x 10-1 d
Beyond design basis tornado	1.9 x 10-7	6.9 x 10-4	1.4 x 10-2	2.2 x 10-3	5.3 x 100 e

a. The estimated number of cancer fatalities, cancer nonfatalities, and genetic

b. Maximum exposed individual (MEI).

c. Nearest public access individual (NPAI). Radiation exposure received from i

d. Radiation exposure received from inhalation, external, and ingestion pathway

e. Radiation exposure received from inhalation and external pathways.

f. The value is expected to be in the 1.0 x 10-4 to 1.0 x 10-6 range. For calc damaging the fuel. There is also a possibility that the dam could somehow be dropp being lowered into (or raised from) its place between the clean pools and then fall would damage the fuel in either pool. The reference design basis fuel handling acc postulated that during refueling operations, the dam falls and damages all the 62 s including the most recently discharged core, located in the pool. The fission prod spent fuel cores are assumed to be instantaneously released into the water in the p analysis assumed that the pool area exhaust system was operational, it carried off fission products, it filtered the stream, and it released the remaining fission pro The source term released up the stack is shown in Table 5.15-7. The frequency of o this accident is in the range of 1.0 x 10-4 to 1.0 x 10-6 per year (ORNL 1992b).

5.15.3.1.2 Beyond Design Basis Accident-The beyond design basis accident

postulated that a beyond design basis tornado with wind speeds of approximately 300 the High Flux Isotope Reactor reactor bay.
The reactor bay roof collapses and the major
structural member in the roof falls into the fuel pool and damages all the 62 spent including the most recently discharged core, located in the pool. The fission prod 62 spent fuel cores are assumed to be instantaneously released into the water in th analysis assumed that all evaporated fission products are released directly to the

ground level. The source term is similar to the reference design basis accident so present in Table 5.15-7 except that no credit was taken for filtration of the iodin from the pool. The iodine released in the beyond design basis source term is 100 t than the iodine released in the reference design basis accident source term (Flanag

The annual return frequency of a tornado with wind speeds of approximately 300 ORR is 1.4 x 10-5. The conditional probability for collapse of the reactor bay roo 300 mph tornado is 0.46. The ratio of the spent fuel area to the reactor bay floor probability that the falling structural member will fall into the spent fuel area o 0.03. The frequency of occurrence for this beyond design basis accident is 1.9 x 1 (Flanagan 1994).

Due to the dose consequences associated with the postulated accident, protectiv were assumed for the offsite population. The analysis took no credit for evacuatio from the affected area. However, credit was taken for removing contaminated food f general public.

Table 5.15-7. Estimated radionuclide releases for the High Flux Isotope Reactor fuel pool dam drop accident at ORR.

Isotope	Release Duration	
	0-2 hr Curies	0-30 day Curies
Hydrogen-3 (Tritium)	3.5 x 102	3.5 x 102
Krypton-83m	1.9 x 102	1.9 x 102
Krypton-85	1.0 x 104	1.0 x 104
Krypton-85m	3.6 x 103	3.6 x 103
Krypton-87	4.2 x 10-1	4.2 x 10-1
Krypton-88	1.1 x 103	1.1 x 103
Iodine-151	3.8 x 100	1.5 x 101
Iodine-132	5.0 x 100	5.1 x 100
Iodine-133	4.7 x 100	6.2 x 100
Iodine-134	2.2 x 10-7	2.2 x 10-7
Iodine-135	7.4 x 10-1	8.1 x 10-1
Xenon-131m	2.3 x 103	2.3 x 103
Xenon-133	8.7 x 105	8.7 x 105
Xenon-133m	2.5 x 104	2.5 x 104
Xenon-135	1.7 x 105	1.7 x 105
Xenon-135m	1.2 x 103	1.2 x 103

Source: ORNL 1992b

5.15.3.2 Nonradiological Hazards. The two bounding accidents involving nonradiological

hazards postulated for the Centralization Alternative in subsection 5.15.4.2 are as bounding for the No Action Alternative. SNF operations under the No Action Alterna should not introduce any nonradiological hazards unique to the ORR SNF facilities.

5.15.4 Centralization Alternative

There is a potential for the accidental release of radioactive substances durin stages of SNF handling operations and storage. The operations at the new SNF manag facilities begin with the receipt of an SNF shipment by truck or rail carrier, foll unloading of the shipping cask from the transport vehicle. If the SNF requires coo is placed into an unloading pool where the SNF is withdrawn from the cask, moved to temporary wet storage basin, and placed into a fuel rack. Some SNF that does not r cooling will be handled in a special cell where it will undergo canning and/or char SNF that does not have to be cooled and does not require canning and/or characteriz be loaded into a dry storage canister within a transfer cask and transported to mod grade dry storage. Accidents that may occur during these handling operations and s existing or new SNF management facilities may involve the release of radioactive ma or water pathways. The cause of accidents may be due to internal initiators, such error, terrorism, and equipment failure, or external initiators, such as an airplan facility.

5.15.4.1 Radiological Impacts. The accidents described below have been chosen to

envelop the consequences of potential accidents for the proposed new SNF management at the ORR. Although other accidents may occur, their estimated consequences are b the accidents in the envelope or their probability of occurrence is less than 1 x 1 these accidents were to occur, the dose and risk would be as shown in Tables 5.15-8 for 95 percent and 50 percent meteorology respectively. These doses are in additio average natural background radiation exposure of 360 millirem per year. Similarly, fatalities are shown in Tables 5.15-10 and 5.15-11, and the health effects are show 5.15-12 and 5.15-13.

5.15.4.1.1 Fuel Assembly Breach-Physical damage and breach of a fuel assembly

could accidentally occur from dropping, objects falling on the assembly, or cutting Table 5.

15-8. Summary of the Centralization Alternative accident analysis dose and risk es Site at 95 percent meteorology.

95 percent meteor

Accident scenario	Frequency (per year)	Dose MEIa (rem)	NPAIb (rem)	Workerc (rem)	Populationd (person-rem)
Fuel assembly breach	1.6 x 10-1 e	1.2 x 10-2	3.8 x 10-3	1.5 x 10-3	2.1 x 101
Dropped fuel cask	1.0 x 10-4 f	7.8 x 100	1.2 x 101	4.7 x 100	1.9 x 104
Severe impact and fire	1.0 x 10-6 g	5.6 x 101	8.8 x 100	3.4 x 100	1.0 x 105
Wind-driven missile impact into dry storage	1.0 x 10-5	2.2 x 10-2	2.9 x 10-2	1.2 x 10-2	5.2 x 101
Airplane crash into dry storage	1.0 x 10-6 g	9.0 x 100	3.4 x 101	1.2 x 101	1.7 x 104
Airplane crash into dry cell facility	1.0 x 10-6 g	7.6 x 101	5.8 x 101	2.3 x 101	1.2 x 105
Airplane crash into water pool	1.0 x 10-6 g	1.4 x 10-1	5.9 x 10-2	2.3 x 10-2	5.6 x 103

a. Maximum exposed individual (MEI). Dose received from inhalation, external, and

b. Nearest public access individual (NPAI). Dose received from inhalation and exte

c. Dose received from inhalation and external pathways.

d. Dose received from inhalation, external, and ingestion pathways.

e. The value is <1.6 x 10-1. For calculational purposes, the value is assumed to b

f. The value is <1.0 x 10-4. For calculational purposes, the value is assumed to b

g. The value is <1.0 x 10-6. For calculational purposes, the value is assumed to b

Table 5.15-9. Summary of the Centralization Alternative accident analysis dose and

50 percent meteorology.

50 percent m

Accident scenario	Frequency (per year)	Dose MEIa (rem)	NPAIb (rem)	Workerc (rem)	Populationd (person-rem)
Fuel assembly breach	1.6 x 10-1 e	1.2 x 10-3	6.7 x 10-4	3.2 x 10-4	2.5 x 100
Dropped fuel cask	1.0 x 10-4 f	7.5 x 10-1	2.2 x 100	1.0 x 100	2.7 x 103
Severe impact and fire	1.0 x 10-6 g	5.5 x 100	1.6 x 100	7.5 x 10-1	1.2 x 104
Wind-driven missile impact into dry storage	1.0 x 10-5	2.1 x 10-3	5.5 x 10-3	2.5 x 10-3	7.7 x 100
Airplane crash into dry storage	1.0 x 10-6 g	8.9 x 10-1	6.2 x 100	2.7 x 100	2.5 x 103
Airplane crash into dry cell facility	1.0 x 10-6 g	7.2 x 100	1.1 x 101	5.1 x 100	1.5 x 104
Airplane crash into water pool	1.0 x 10-6 g	1.3 x 10-2	1.1 x 10-2	5.0 x 10-3	5.2 x 102

a. Maximum exposed individual (MEI). Dose received from inhalation, external, and

b. Nearest public access individual (NPAI). Dose received from inhalation and exte

c. Dose received from inhalation and external pathways.

d. Dose received from inhalation, external, and ingestion pathways.

e. The value is <1.6 x 10-1. For calculational purposes, the value is assumed to b

f. The value is <1.0 x 10-4. For calculational purposes, the value is assumed to b

g. The value is <1.0 x 10-6. For calculational purposes, the value is assumed to b

Table 5.15-10. Summary of the Centralization Alternative accident analysis cancer Ridge Site at 95 percent meteorology.

95 percent m

Accident scenario	Frequency (per year)	Cancer fatalities MEIa	NPAIb	Workerc	Popula
Fuel assembly breach	1.6 x 10-1 e	6.0 x 10-6	1.9 x 10-6	6.0 x 10-7	2.1 x
Dropped fuel cask	1.0 x 10-4 f	3.9 x 10-3	6.0 x 10-3	1.9 x 10-3	1.9 x
Severe impact and fire	1.0 x 10-6 g	5.6 x 10-2	4.4 x 10-3	1.4 x 10-3	1.0 x
Wind-driven missile impact into dry storage	1.0 x 10-5	1.1 x 10-5	1.5 x 10-5	4.9 x 10-6	5.2 x
Airplane crash	1.0 x 10-6 g	4.5 x 10-3	3.4 x 10-2	4.8 x 10-3	1.7 x

into dry storage					
Airplane crash into dry cell facility	1.0 x 10-6 g	7.6 x 10-2	5.8 x 10-2	1.8 x 10-2	1.2 x
Airplane crash into water pool	1.0 x 10-6 g	6.9 x 10-5	3.0 x 10-5	9.2 x 10-6	5.6 x

a. Maximum exposed individual (MEI). Radiation exposure received from inhalatio

b. Nearest public access individual (NPAI). Radiation exposure received from in

c. Radiation exposure received from inhalation and external pathways.

d. Radiation exposure received from inhalation, external, and ingestion pathways

e. The value is <1.6 x 10-1. For calculational purposes, the value is assumed t

f. The value is <1.0 x 10-4. For calculational purposes, the value is assumed t

g. The value is <1.0 x 10-6. For calculational purposes, the value is assumed t

Table 5.15-11. Summary of the Centralization Alternative accident analysis cancer Ridge Site at 50 percent meteorology.

				50 percent meteor	
Accident scenario	Frequency (per year)	Cancer fatalities			
		MEIa	NPAIb	Workerc	Popula
Fuel assembly breach	1.6 x 10-1 e	6.0 x 10-7	3.4 x 10-7	1.3 x 10-7	1.3 x
Dropped fuel cask	1.0 x 10-4 f	3.7 x 10-4	1.1 x 10-3	4.0 x 10-4	2.7 x
Severe impact and fire	1.0 x 10-6 g	2.8 x 10-3	8.1 x 10-4	3.0 x 10-4	1.2 x
Wind-driven missile impact into dry storage	1.0 x 10-5	1.0 x 10-6	2.7 x 10-6	1.0 x 10-6	3.8 x
Airplane crash into dry storage	1.0 x 10-6 g	4.4 x 10-4	3.1 x 10-3	1.1 x 10-3	2.5 x
Airplane crash into dry cell facility	1.0 x 10-6 g	3.6 x 10-3	5.5 x 10-3	2.0 x 10-3	1.5 x
Airplane crash into water pool	1.0 x 10-6 g	6.4 x 10-6	5.5 x 10-6	2.0 x 10-6	5.5 x

a. Maximum exposed individual (MEI). Radiation exposure received from inhalation

b. Nearest public access individual (NPAI). Radiation exposure received from inh

c. Radiation exposure received from inhalation and external pathways.

d. Radiation exposure received from inhalation, external, and ingestion pathways.

e. The value is <1.6 x 10-1. For calculational purposes, the value is assumed to

f. The value is <1.0 x 10-4. For calculational purposes, the value is assumed to

g. The value is <1.0 x 10-6. For calculational purposes, the value is assumed to

Table 5.15-12. Summary of the Centralization Alternative accident analysis health
Site at 95 percent meteorology.

95 percent m

Accident Scenario	Frequency (per year)	Total health detrimentsa MEIb	NPAIc	Workerd
Fuel assembly breach	1.6 x 10-1 f	8.8 x 10-6	2.8 x 10-6	8.4 x 10-7
Dropped fuel cask	1.0 x 10-4 g	5.7 x 10-3	8.8 x 10-3	2.6 x 10-3
Severe impact and fire	1.0 x 10-6 h	8.2 x 10-2	6.4 x 10-3	1.9 x 10-3
Wind-driven missile impact into dry storage	1.0 x 10-5	1.6 x 10-5	2.1 x 10-5	6.8 x 10-6
Airplane crash into dry storage	1.0 x 10-6 h	6.6 x 10-3	5.0 x 10-2	6.7 x 10-3
Airplane crash into dry cell facility	1.0 x 10-6 h	1.1 x 10-1	8.5 x 10-2	2.6 x 10-2
Airplane crash into water pool	1.0 x 10-6 h	1.0 x 10-4	4.3 x 10-5	1.3 x 10-5

a. The estimated number of cancer fatalities, cancer nonfatalities, and genetic

b. Maximum exposed individual (MEI). Radiation exposure received from inhalati

c. Nearest public access individual (NPAI). Radiation exposure received from i

d. Radiation exposure received from inhalation and external pathways.

e. Radiation exposure received from inhalation, external, and ingestion pathway

f. The value is <1.6 x 10-1. For calculational purposes, the value is assumed

g. The value is <1.0 x 10-4. For calculational purposes, the value is assumed

h. The value is <1.0 x 10-6. For calculational purposes, the value is assumed

Table 5.15-13. Summary of the Centralization Alternative accident analysis health
50 percent meteorology.

50 perc

Accident scenario	Frequency (per year)	Total health detrimentsa MEIb	NPAIc	Workerd
Fuel assembly breach	1.6 x 10-1 f	8.8 x 10-7	4.9 x 10-7	1.8 x 10-7
Dropped fuel cask	1.0 x 10-4 g	5.5 x 10-4	1.6 x 10-3	5.6 x 10-4
Severe impact and fire	1.0 x 10-6 h	4.0 x 10-3	1.2 x 10-3	4.2 x 10-4
Wind-driven missile impact into dry storage	1.0 x 10-5	1.5 x 10-6	4.0 x 10-6	1.4 x 10-6

Airplane crash into dry storage	1.0 x 10-6 h	6.5 x 10-4	4.5 x 10-3	1.5 x 10-3
Airplane crash into dry cell facility	1.0 x 10-6 h	5.2 x 10-3	8.0 x 10-3	2.9 x 10-3
Airplane crash into water pool	1.0 x 10-6 h	9.3 x 10-6	8.0 x 10-6	2.8 x 10-6

a. The estimated number of cancer fatalities, cancer nonfatalities, and genetic def

b. Maximum exposed individual (MEI). Radiation exposure received from inhalation,

c. Nearest public access individual (NPAI). Radiation exposure received from inhal

d. Radiation exposure received from inhalation and external pathways.

e. Radiation exposure recieved from inhalation, external, and ingestion pathways.

f. The value is <1.6 x 10-1. For calculational purposes, the value is assumed to b

g. The value is <1.0 x 10-4. For calculational purposes, the value is assumed to b

h. The value is <1.0 x 10-6. For calculational purposes, the value is assumed to b
part of an assembly. The fuel cutting accident that has been postulated to occur a River Site facilities is chosen as representative of the fuel assembly breach accid (E. I. du Pont de Nemours & Co. 1983). During normal operations at the Savannah Ri the inert, non-uranium-containing extremities of some spent nuclear fuel elements a the repackaging basin before the bundling of the elements. The accident occurs whe uranium fuel is inadvertently cut, causing a radioactive release. The source term is shown in Table 5.15-14. The estimated frequency of occurrence for this accident per year based on the Savannah River Site's operating experience with SNF. However of anticipated differences in operations and facilities at the ORR, the actual freq expected to be much less than 1.6 x 10-1 per year.

5.15.4.1.2 Dropped Fuel Cask-The dropped fuel cask accident that has been

postulated to occur at the Hanford Site (reference Volume 1, Appendix A) is chosen representative of the dropped fuel cask/fuel handling accident for the new Centrali Alternative facility at the ORR.
This accident is initiated when a fuel cask is dropped and overturned in the fuel transfer area and broken fuel elements spill out of the cask pool building but away from the pool. It is assumed that the shipping cask rupture of the broken fuel elements in three canisters--42 fuel elements, each containing 2 (50 pounds) of fuel. The source term for this accident is shown in Table 5.15-15. probability of this accident is estimated to be less than 1 x 10-4 per year.

5.15.4.1.3 Severe Impact and Fire-The severe impact and fire accident that has

been postulated to occur at the Hanford Site (reference Volume 1, Appendix A) is ch representative of the severe impact and fire/onsite transportation accident for the Centralization Alternative facility at the ORR.
This accident assumes an unspecified initiating event that subjects the fuel assemblies to a severe impact, breach of the transport fire. During the accident, the fuel pins rupture on impact or upon heating in the burns for an hour before being extinguished. Volatiles, particulates, and noble ga to the atmosphere. The source term for a release of 540 curies is shown in Table 5 estimated probability of occurrence for this accident, reflecting the fact that the site would be new, is less than 1 x 10-6 per year.

5.15.4.1.4 Wind-driven Missile Impact into Storage Casks-The wind-driven

missile impact into storage casks accident that has been postulated to occur at the
Table 5.

15-14. Estimated radionuclide releases for a fuel assembly breach accident at ORR.

Radionuclide	Release (Ci)
Iodine-131	7.1 x 10-2
Iodine-133	1.4 x 10-30
Krypton-85	1.8 x 102
Xenon-133m	1.1 x 10-8
Xenon-133	1.1 x 100

a. Source: E.I. du Pont de Nemours & Co. (1983).

Table 5.15-15. Estimated radionuclide releases for a dropped fuel cask accident at

Radionuclide	Release (Ci) Onsite (2 hours)	Offsite (8 hours)
Plutonium-236	1.3 x 10-8	5.4 x 10-8
Plutonium-238	2.9 x 10-3	1.2 x 10-2
Plutonium-239	6.7 x 10-3	2.7 x 10-2
Plutonium-240	3.5 x 10-3	1.4 x 10-2
Plutonium-241	2.7 x 10-1	1.1 x 100
Plutonium-242	1.3 x 10-6	5.1 x 10-6
Americium-241	5.7 x 10-3	2.3 x 10-2
Curium-244	2.8 x 10-4	1.1 x 10-3
Europium-154	5.4 x 10-3	2.1 x 10-2
Cesium-134	7.9 x 10-3	3.2 x 10-2
Cesium-137	4.5 x 10-1	1.8 x 100
Cerium-144	1.7 x 10-3	6.8 x 10-3
Praseodymium-144	1.7 x 10-3	6.8 x 10-3
Praseodymium-144M	2.0 x 10-5	8.1 x 10-5
Promethium-147	1.2 x 10-1	4.9 x 10-1
Antimony-125	7.3 x 10-3	2.9 x 10-2
Tellurium-125M	1.8 x 10-3	7.3 x 10-3
Ruthenium-106	3.2 x 10-3	1.3 x 10-2
Strontium-90	3.5 x 10-1	1.4 x 100
Yttrium-90	3.5 x 10-1	1.4 x 100

a. Source: Appendix A, Table A-1.

Table 5.15-16. Estimated radionuclide releases for a severe impact and fire accident at ORR.

Radionuclide	Release (Ci)
Hydrogen-3 (Tritium)	4.6 x 101
Krypton-85	4.0 x 102
Strontium-90	2.7 x 10-2
Ruthenium-106	1.3 x 100
Cesium-134	1.7 x 101
Cesium-137	8.0 x 101
Plutonium-238	8.9 x 10-4
Plutonium-239	1.6 x 10-3
Plutonium-240	1.8 x 10-3
Plutonium-241	7.3 x 10-2
Americium-241	1.0 x 10-3

a. Source: Appendix A, Table A-14.

(reference Volume 1, Appendix D) is chosen as representative of the wind-driven mis accident for the new Centralization Alternative facility at the ORR. This accident natural phenomena: a major wind storm or tornado in excess of the facility design scenario, a large object is propelled by the wind into a storage container, causing seal to be breached. No fuel damage would result from the impact because of the st the containers used. The source term is based on the spent nuclear fuel corrosion

percent of the original corrosion film on the fuel would be released from the cask atmosphere. The source term is shown in Table 5.15-17. The probability of this ev estimated to be less than 1 x 10-5 per year based on a design basis tornado probabi per year and a missile impact with damage probability of less than 1 x 10-2.

5.15.4.1.5 Airplane Crash Into Dry Storage-The airplane crash into dry storage

accident that has been postulated to occur at the Naval Site (reference Volume 1, A is chosen as representative of the airplane crash into the dry storage area acciden Centralization Alternative facility at the ORR.
This accident is externally initiated by an airplane
crash into the SNF dry storage facility. The accident is postulated to cause damag storage cask. Due to the severity of the impact, the cask seal is assumed to be br resulting in damage to the fuel and the release of corrosion products, located on t exteriors, to the environment. The impact also causes a fire and a release of fiss is assumed that 1 percent of all of the fuel units stored inside the cask are damag impact or by the fire and that those fission products are available for release. O fission products, 100 percent of the noble gases, 3 percent of the halogens, 1.1 pe cesium, and 0.1 percent of the remaining solids are released to the environment. A 10 percent of the original corrosion products from the fuel units are released from the atmosphere. The source term for this accident is shown in Table 5.15-18. The this accident, based on analyses of other facilities at the site (Flanagan 1994), i assumed to be less than 1 x 10-6 per year.

5.15.4.1.6 Airplane Crash into Dry Cell Facility-The airplane crash into the dry

cell facility accident that has been postulated to occur at the Naval Site (referen Appendix D) is chosen as representative of the airplane crash into the canning and characterization cell accident for the new Centralization Alternative facility at t This
accident is initiated by an airplane crash into the dry cell facility. The acciden cause significant damage to the building, resulting in the loss of containment and

Table 5.15-17. Estimated radionuclide releases for a wind-driven missile impact into a storage cask at ORR.

Radionuclide	Release (Ci)
Cobalt-60	9.6 x 10-2
Iron-55	1.8 x 10-1
Cobalt-58	3.5 x 10-2
Manganese-54	6.0 x 10-3
Iron-59	5.1 x 10-4

a. Source: See Section F.1.4.2.2.1, Appendix D to Volume 1.

Table 5.15-18. Estimated radionuclide releases for an airplane crash into dry storage facility at ORR.

Radionuclide	Release (Ci)
Cesium-134	2.6 x 101
Cesium-137	3.6 x 101
Plutonium-238	5.9 x 10-2
Barium-137m	3.1 x 100
Strontium-90	3.1 x 100
Cerium-144	7.2 x 100
Niobium-95	4.4 x 100
Yttrium-90	3.1 x 100
Ruthenium-106	6.1 x 10-1

a. Source: See Section F.1.4.2.2.2, Appendix D to Volume 1.

systems. The fuel units inside the dry cell could also be damaged due to mechanica potential fire. The mechanical impact also could result in the release of corrosio the environment. For this accident scenario, 1 percent of the fuel units stored in cell are assumed to be damaged by either the impact or resultant fire and those fis would be available for release. Of the fission products available for release, 100

noble gases, 3 percent of the halogens, 1.1 percent of the cesium, and 0.1 percent remaining solids could be released to the environment. Ten percent of the availabl products could be released to the environment. The source term for this accident i **Table 5.15-19.** The probability of this accident is estimated to be less than 1 x 1

5.15.4.1.7 Airplane Crash into Water Pool-The airplane crash into the SNF water

pool accident that has been postulated to occur at the Naval Site (reference Volume Appendix D) is chosen as representative of the airplane crash into the SNF water po for the new Centralization Alternative facility at the ORR.
This externally initiated accident
occurs when an airplane crashes into an SNF water pool and damages the fuel units s Fission products and corrosion products are released from the fuel units into the w the pool water is not released to the environment. The presence of the pool water release only of gaseous fission products into the atmosphere. In this accident sce of all the fuel units stored inside the pool were postulated to be damaged and thos products are available for release. Of the available fission products, 100 percent gases and 25 percent of the halogens are released to the pool water. Due to the pr pool water, there is a reduction of the halogen release by a factor of 10 prior to atmosphere. The source term for this accident is shown in Table 5.15-20. The prob accident is estimated to be less than 1 x 10-6 per year.

5.15.4.1.8 Integration of Existing Facilities- Existing SNF management facilities

will be integrated into the Centralization, Regionalization, and Planning Basis Alt storage functions until the existing ORR operating reactors are shutdown.
The accident
consequences postulated for the No Action Alternative in subsection 5.15.3 can occu the High Flux Isotope Reactor is operational. After the High Flux Isotope Reactor operational, the accident consequence will decrease as the spent reactor cores, sto age. The reference design basis accident frequency of occurrence and risk will be because refueling operations have ceased and requirements for movement of the dam a reduced. Since the beyond design accident is initiated by natural phenomenon (i.e.

Table 5.15-19. Estimated radionuclide releases for an airplane crash into dry cell ORR.

Radionuclide	Release (Ci)
Cesium-134	4.5 x 101
Cesium-137	6.2 x 101
Plutonium-238	1.0 x 10-1
Barium-137m	5.4 x 100
Strontium-90	5.5 x 100
Cerium-144	1.3 x 101
Niobium-95	7.7 x 100
Yttrium-90	5.5 x 100
Ruthenium-106	1.1 x 100

a. Source: See Section F.1.4.2.3.3, Appendix D to Volume 1.

Table 5.15-20. Estimated radionuclide releases for an airplane crash into an SNF w at ORR.

Radionuclide	Release (Ci)
Iodine-129	7.6 x 10-4
Iodine-131	1.6 x 10-2
Hydrogen-3 (Tritium)	4.3 x 102

a. Source: See Section F.1.4.2.1.4, Appendix D to Volume 1.
beyond design basis accident frequency of occurrence will remain the same as long a Flux Isotope Reactor cores remain in the spent fuel pool area.

5.15.4.2 Nonradiological Hazards. The two bounding accidents involving nonradiological

hazards are a chemical spill and fire and a diesel fuel fire. Both of these accide with the Expended Core Facility operations and the accident frequencies and impacts addressed in Volume 1, Appendix D. The analyses of these accidents considered the workers on the site as well as to the offsite population. The impacts were measure potential health effects due to exposure to toxic chemicals released during these a the Expended Core Facility at this site will be a new design and construction, it w all applicable standards and regulations and therefore limit the potential exposure workers and the public in the event of an accident.

5.15.4.3 Secondary Impacts. In the event of an accidental release of radioactive

substances, there is a potential for secondary impacts to cultural resources, endan water resources, public and agricultural land use, the ecology in the vicinity of t national defense, and local economics. Figure 5.15-1 illustrates the radiological environment in the event of a severe accident at a new SNF management facility and of radioactive material with 50 percent meteorology. The accident chosen for this airplane crash into the Centralization Alternative canning and characterization (dr Figure 5.15-1 shows several isodose lines ranging from 870 millirem per year down t per year. The solid line represents the site boundary, and it can be seen from the some doses exceeding background would exist outside the site boundary.

Table 5.15-21 presents a summary of the postulated severe accident secondary im the environment, economy, and national defense. The evaluation was performed using 50 percent meteorology.

5.15.5 Decentralization Alternative

The Decentralization Alternative is not applicable for the ORR.

Figure 5.15-1. Isodose lines for an airplane crash into dry cell accident with 50

Table 5.15-21. Secondary impacts of Centralization Alternative accidents at the ORR.

Environmental or social factor	Impact
Land use	Yes. Major portions of the ORR, including the ORNL and K-25 areas, will be contaminated. Offsite contamination will occur. Industrial, residential, forest, and agricultural areas wil be contaminated.
Cultural resources	Yes. Archaeological sites, cemeteries, and historic sites will be contaminated.
Aesthetic and scenic resources	Possible impact. Scenic public viewing areas are within 2 miles of the ORR border.
Water resources	Yes. The Clinch River will be contaminated. It is used for industrial and public water supplies, navigation, fishing, boating, and swimming.
Ecological resources	Possible impact. Many endangered or threatened plants and animals are potentially on or near the ORR.
Treaty rights	No impact. There are no ORR areas subject to Native American Treaty rights.
National defense	Possible impact. With the 50 percent meteorology, the area of contamination does not envelop U.S. military facilities or the Y-12 area. However, with the 95 percent meteorology, the Y-12 area will be contaminated.
Economic impacts	Yes. Offsite contamination will occur. Industrial, residential, forrest, and agricultural areas will be contaminated. Major portions of the ORR will be contaminated. The accident consequences may require the evacuation and cleanup of onsite facilities, including but not limited to the ORNL and K-25 areas, and adjacent residential, industrial, forest, and agricultural area The Clinch River will be contaminated. The associated industrial and residential water supplies will be contaminated. The commercial and recreational fishing industries may be

impacted.

5.15.6 1992/1993 Planning Basis Alternative

The facility accident consequences and risks for the ORR No Action Alternative the facility accident consequences and risks for the 1992/1993 Planning Basis Alter

5.15.7 Regionalization Alternative

Under the Regionalization Alternative, new facilities will be constructed and o SNF. Details for the new facilities needed have not been defined, but it is reason that they will be similar to but with less storage requirements than those needed f Centralization Alternative. Due to smaller throughput and storage requirements, th for accidents (i.e., probability of occurrence) will be similar to but less than th the Centralization Alternative. The accident consequences will be similar for both Consequently, it is reasonable to assume that the accident consequences and risks d the Centralization Alternative envelop the Regionalization Alternative.

5.15.8 Emergency Preparedness and Plans

The DOE has issued a series of Orders specifying the requirements for emergency preparedness (DOE 5500.1A, DOE 5500.2A, DOE 5500.3, draft DOE 5500.3A, DOE 5500.4, DOE 5500.9), and each DOE site has established an emergency management program. Th programs are developed and maintained to ensure adequate response for most accident conditions and to provide the framework to readily extend response efforts for acci specifically considered. The emergency management program incorporates activities with planning, preparedness, and response.

Officials at each DOE site have specified the emergency preparedness requiremen DOE facilities under their jurisdiction in a manner consistent with the relevant DO existing facilities have emergency plans and procedures that either implement the D requirements or are integrated with the site planning.

DOE-Oak Ridge Operations has overall responsibility at the plant and laboratory emergency response. However, primary authority for event response has been delegat Martin Marietta Energy Systems, Inc., DOE's operating contractor. Although their p responsibility is onsite, they have agreed to provide offsite assistance if request of existing mutual aid agreements or Martin Marietta policies. If a hazardous mate occurs at a DOE-Oak Ridge Operations facility, the Governor of Tennessee is respons State's response efforts. The Governor's Executive Order No. 4 establishes the Ten Emergency Management Agency as the agency given responsibility for coordinating sta emergency services. If a hazardous materials accident at DOE-Oak Ridge Operations beyond the capability of the local government, and assistance is requested, the Ten Emergency Management Agency Director may direct that assistance from state agencies provided to local governments. To accomplish this task and ensure prompt initiatio emergency response actions, the Director may cause the State Emergency Operations C Field Coordination Center as well as any local Emergency Operations Center to be ac

5.16 Cumulative Impacts and Impacts From Connected

or Similar Actions

The ORR already contains several major DOE and non-DOE facilities, unrelated to that would continue to operate throughout the operating life of the proposed SNF ma facilities. A number of offsite industrial and research facilities in surrounding continue to operate throughout this period. The activities associated with these e produce environmental consequences that have been included in the baseline environm conditions (Chapter 4) against which Sections 5.1 through 5.15 have assessed the en consequences of the Centralization and Regionalization alternatives. This section environmental baseline conditions presented in Chapter 4 to assess potential cumula from the proposed SNF management facilities, if constructed at the ORR, plus other foreseeable activities planned by government agencies or private concerns for areas the ORR.

In addition to the proposed SNF management facilities, reasonably foreseeable a considered in this cumulative impact assessment include the proposed Expended Core proposed hazardous waste remediation activities on the ORR, and activities proposed present Five-Year Plan for the ORR. Major programmatic initiatives planned for the the Five-Year Plan (MMES 1994a) consist of constructing the following: the propose Neutron Source Facility; the proposed Uranium-Atomic Vapor Laser Isotope Separation facilities proposed for construction as a part of Complex-21; proposed low-level wa facilities; the proposed Mixed Waste Treatment Facility; the proposed Environmental Social Sciences Complex; the proposed Materials, Science, and Engineering Complex; proposed Solid Waste Storage Area-7. Several minor construction projects such as t refurbishment or expansion of existing facilities, widening of roadways, and instal are also included in the Five-Year Plan.

The ORR is part of the City of Oak Ridge, which also includes an urban area to of the ORR and several industrial areas in various locations around the perimeter o Additional construction and expanded operational activities is anticipated in these areas. For example, the Scientific Ecology Group, a private business in the Bear C Park on Bear Creek Road west of the ORR, is considering expanding its operations an presently constructing a second radioactive waste incinerator. The City of Oak Rid Comprehensive Plan encourages further development of several presently undeveloped several industrial parks (City of Oak Ridge 1989). The Comprehensive Plan also ant additional residential and commercial development in the City. The City of Oak Rid presently proposing construction of a golf course and residential development on ap 700 acres (2.8 square kilometers) east of the ORR.

The following cumulative impacts analysis considers in detail the potential inc effects from the proposed SNF management facilities; the proposed Expended Core Fac the proposed Advanced Neutron Source facility. Adequate information is not availab consider in detail the other proposed Five-Year Plan activities or the proposed act in the City of Oak Ridge outside of the ORR. The potential incremental impacts fro activities are therefore assessed in a more qualitative manner.

5.16.1 Centralization Alternative

Separate analyses of potential cumulative impacts from the Centralization Alter each of the environmental resources addressed in Chapter 5 are provided below.

5.16.1.1 Land Use. Construction of the proposed SNF management facilities would

require the dedication of 90 acres (0.36 square kilometer) of undeveloped land on B Road in the western part of the ORR. Construction of the proposed Expended Core Fa would require the dedication of an additional 30 acres (0.12 square kilometer) of u land on the ORR. Construction of the proposed Advanced Neutron Source facilities w require the dedication of an additional 75 to 115 acres (0.30 to 0.46 square kilome the ORR (MMES 1992c). The cumulative land area dedicated to these three projects w total as much as 235 acres (0.95 square kilometer), which represents only about 1 p roughly 20,600 acres (83 square kilometers) of undeveloped land remaining on the 34 (140 square kilometer) ORR. Additional unspecified areas of undeveloped land, gene parcels of under 100 acres (0.40 square kilometer), would have to be dedicated to s activities proposed in the Five-Year Plan. Many of these proposed activities do no dedication of undeveloped land. Additional undeveloped land on the ORR might have dedicated to the other planned activities, but their land requirements have not yet quantified.

Although large areas of undeveloped land remain both on the ORR and in the City Ridge, much of this land is steep or otherwise has constraints that limit its futur potential. The City of Oak Ridge indicates in its Comprehensive Plan that it seeks additional ORR land declared excess by the DOE and made available for urban expansi City (City of Oak Ridge 1989). Demand for buildable land on the ORR by the City of Ridge represents another cumulative demand for ORR land. The site of the proposed residential development and golf course east of the ORR is land recently sold by th City of Oak Ridge since adoption of the Comprehensive Plan.

5.16.1.2 Occupational and Public Health. The annual collective effective dose

equivalent from the existing ORR facilities to the population within 50 miles (80 k the ORR is 52 person-rem (MMES 1994a). Added to this baseline, operation of the pr SNF management facilities might contribute an additional 5 person-rem, and operatio proposed Advanced Neutron Source facilities might contribute an additional 4.3 pers (MMES 1992c), resulting in a cumulative effective dose of 61 person-rem to the popu within 50 miles of the ORR.

The annual collective effective dose equivalent from the existing ORR facilitie potential maximally exposed individual at the site boundary is 3.3 millirem per yea of the proposed SNF management facilities might contribute an additional 6.2 millir resulting in a cumulative annual dose of 9.5 millirem per year to this maximally ex individual.

The total annual baseline worker dose seen from normal ORR operations is about person-rem. The total annual SNF management facility worker dose is expected to be person-rem. Hence, the cumulative annual dose might be 80 person-rem.

Over the planned 40-year operational lifetime of the SNF management facility, a population dose of roughly 2,500 person-rem will be observed from continuous operat existing ORR facilities and the SNF management facility. This equates to a total h detriment (the summated risk of fatal cancer, nonfatal cancer, and genetic effects) 40-year span. For the maximally exposed individual, a total dose of 380 millirem w over the 40-year period, which equates to a total detriment of 2.8 x 10-4. For the management worker, a total dose of 3,200 person-rem will be observed over the 40-ye this corresponds to a total health detriment of 1.8.

Additional radiological impacts are not expected from operation of the proposed Core Facility. Analysis has shown that the dose to all individuals considered (wor individuals) from Oak Ridge Expended Core Facility operations might be much less th 1 millirem per year.

5.16.1.3 Noise. Cumulative increases in noise levels from the proposed SNF

management facilities, the proposed Expended Core Facility, and the proposed Advanc Neutron Source facilities would be limited to temporary, minor construction noise a increases in traffic noise occurring along various access routes to the ORR due to employment. This increase is not expected to result in any increased annoyance to Noise levels from other planned activities have not yet been determined. Each woul minimum, involve temporary periods of construction noise, but information on operat is not available.

5.16.1.4 Groundwater and Surface Water Resources. Operation of the proposed SNF

management facilities would require the withdrawal of an estimated 4 million gallon (15 million liters per year) of groundwater. Operation of the proposed Expended Co would require the withdrawal of an estimated additional 2 million gallons per year liters per year). Although the specific water demands of the proposed Advanced Neu facility and other proposed activities are not known, the combined water demands wo represent a small percentage of the total average discharge of the Clinch River, as Melton Hill Dam, of 5,300 cubic feet per second (150 cubic meters per second).

Discharges of wastewater from the SNF management facilities would increase the Grassy Creek by an estimated average of less than 1 percent. Discharge points woul selected in accordance with permit requirements to minimize impacts to surface wate The sanitary wastewater and cooling water from the Advanced Neutron Source facility discharged to separate streams and therefore would not contribute to cumulative imp Grassy Creek. Discharges from other planned facilities have not yet been designed. no expected cumulative impacts to groundwater quality and quantity.

5.16.1.5 Biotic Resources. Construction of the proposed SNF management facilities

would require the disturbance of approximately 90 acres (0.36 square kilometer) of forested terrestrial habitat, construction of the proposed Expended Core Facility w the disturbance of an additional 30 acres (0.12 square kilometer), and construction proposed Advanced Neutron Source facilities would require the disturbance of an add

75 to 115 acres (0.30 to 0.46 square kilometer). This would result in a combined c much as 235 acres (0.94 square kilometer) of forested habitat to developed uses. A areas of forested habitat on the ORR would be lost during construction of activitie the Five-Year Plan. Additionally, losses of similar forested habitat off of the OR anticipated due to future construction in the City of Oak Ridge. For example, cons the proposed golf course and residential development east of the ORR by the City of would result in the conversion of several hundred acres of forested habitat to stru lawns.

The total losses would represent only a small percentage of the total forested ORR and in the surrounding vicinity. However, the several scattered areas of habit planned for the ORR, including that associated with the SNF management facilities, increase fragmentation of the relatively contiguous forest cover over much of the O fragmentation could affect the suitability of the forested habitat on the ORR for s

5.16.1.6 Air Resources. The potential cumulative air emissions from the proposed SNF

management facility, Expended Core Facility, and Advanced Neutron Source facilities result in an exceedance of the National Ambient Air Quality Standards or Tennessee criteria. Also, there would be no exceedance of Federal National Emissions Standar Hazardous Air Pollutants or DOE radiological standards. Air emission data for the planned activities (Five-Year Plan or offsite) are not available.

5.16.1.7 Socioeconomics. Operation of the proposed SNF management facilities might

generate up to 800 new jobs during the year 2005. Operation of the proposed Expend Facility might generate up to 562 additional jobs during that year, resulting in a increase of up to 1,362 new jobs. The 16,980 jobs presently forecasted for the ORR 2005 would be increased by 8 percent, to as much as 18,342 jobs. The 360,000 jobs forecasted for the surrounding area in the year 2005 might be increased by less tha as much as 361,352 jobs. Additional employment increases could also result from th Advanced Neutron Source facility project, activities proposed in the Five-Year Plan offsite activities, but specific estimates are not available.

The proposed SNF management facilities could cause cumulative growth-inducing e when coupled with the proposed Advanced Neutron Source facilities or with other pla activities on the ORR. Previous actions at the ORR have had a modest effect on lon growth and productivity in Knox County and Loudon County, but they did not have a g effect on long-term growth and productivity in Anderson County and Roane County.

5.16.1.8 Transportation. For transportation, minor levels of service changes might occur

due to employment increases associated with the proposed SNF management facilities, proposed Expended Core Facility, the proposed Advanced Neutron Source facility, som proposed onsite activities in the Five-Year Plan, and some of the proposed offsite Maps included in the Five-Year Plan show several road improvements on the ORR to accommodate presently projected regional traffic increases.

5.16.1.9 Waste Management. Operation of the proposed SNF management facilities

would generate an estimated 203 cubic meters per year of low-level waste and an est cubic meters per year of transuranic waste. Operation of the proposed Expended Cor would generate an additional 425 cubic meters of low-level waste (for a combined to facilities of 628 cubic meters) but would not generate any additional transuranic w radioactive waste, including high-level waste or mixed waste, would be generated by facility. Although it is known that the proposed Advanced Neutron Source facility generate low-level waste, comparable quantitative data are not available for it or activities, or for activities proposed in the Five-Year Plan. All wastes generated SNF management facilities and other planned activities on the ORR would be treated disposed of in accordance with all applicable Federal and state regulations.

5.16.1.10 Other Resources. The absence of impacts, or the potential for very minimal

impacts, from the proposed SNF management facilities to cultural resources, aesthet resources, utilities, and geologic resources ensures that their potential contribut impacts affecting these resources would be negligible. No further analysis is nece

5.16.2 Regionalization Alternative

The Regionalization Alternative would have similar or fewer cumulative impacts than Centralization Alternative. Generally, the alternative requires less construction operations, and the potential for cumulative impacts is therefore less.

5.17. Adverse Environmental Effects That Cannot Be Avoided

5.17.1 Overview

This section discusses potentially unavoidable adverse impacts to the environme from construction and operation of the proposed spent nuclear fuel (SNF) management at the Oak Ridge Reservation (ORR) under the Centralization and Regionalization Alt Unavoidable adverse impacts are impacts that cannot be mitigated by changes in proj operation, construction, or by other measures.

5.17.2 Centralization Alternative

Operation of the proposed SNF facilities at the ORR under the Centralization Al would increase the radiation dose rate to the maximally exposed individual by 6.2 m year, resulting in a 34 percent increase in cancer risk to this individual from ORR These cancer risks still would be minimal. The number of fatal cancers resulting f operations on the ORR from all sources (including baseline and the SNF facilities) 3.0 x 10-2, the number of nonfatal cancers per year would be 5.9 x 10-3, and the nu effects per year would be 7.7 x 10-3.

Construction of the proposed SNF management facilities would require the distur approximately 90 acres (0.36 square kilometer) of mostly forested undeveloped land long-term dedication of approximately 85 acres (0.34 square kilometer) of land. Al represents less than 1 percent of the undeveloped land on ORR, it would eliminate p foraging and nesting habitat and would destroy plant species in the area. It would the dedication of a reasonably level land parcel that could have otherwise accommod construction projects.

The potential impacts from the Centralization Alternative to the other environm resources discussed in Chapter 5 are not unavoidable adverse impacts.

5.17.3 Regionalization Alternative

Potential unavoidable adverse impacts associated with the Regionalization Alter resemble those discussed above for the Centralization Alternative. The extent of t could be less due to the reduced land requirements, reduced extent of construction and reduced scale of operations.

5.18 Relationship Between Short-Term Use of the Environment and

the Maintenance of Long-Term Productivity

Implementation of any of the SNF management alternatives would cause some adver impacts to the environment and permanently commit certain resources. These resourc use of the environment and those associated with construction and operation of the management facilities.

The proposed alternatives for SNF management would require the short-term use o resources including energy, construction materials, and labor in order to achieve t safety managing SNF to minimize the risk to workers, the public, and the environmen

The premature shutdown of research reactors due to a lack of sufficient SNF int

storage space under the No Action Alternative could have an impact upon the ORR reg communities. The ORR High Flux Isotope Reactor is an important source of radiopharmaceuticals. The reactors are unique research and training facilities for and students in many fields of research and development: materials science, enviro science, physics, biology, and electronics.

Development of new SNF interim management facilities would commit lands to thos from the time of construction through the cessation of operations, at which time th could be converted to other uses or decontaminated, decommissioned, and the site re original land use. Existing SNF management facilities could also be converted to o the lands could be restored following decommissioning.

5.19. Irreversible and Irretrievable Commitments of Resources

5.19.1 Overview

This section discusses the irreversible and irretrievable commitments of resour from the use of materials that cannot be recovered or recycled, or that must be con reduced to irrecoverable forms.

5.19.2 Centralization Alternative

Construction and operation of spent nuclear fuel (SNF) management facilities un Centralization Alternative would require commitments of electrical energy, fuel, co sand, gravel, and miscellaneous chemicals. Most of the water that would be withdra Clinch River to operate the SNF management facilities would be returned to surface Clinch River watershed, although some evaporative losses would be unavoidable. The dedicated to the SNF management facilities could become available for other urban u following closure and decommissioning. However, the soils on the site would have t amended to support land uses such as agriculture, forestry, or wildlife management.

5.19.3 Regionalization Alternative

Irreversible and irretrievable commitments of resources associated with the Reg Alternative would resemble those discussed above for the Centralization Alternative the extent of these resource commitments could be less due to the reduced land requ and reduced scale of operations.

5.20 Potential and Mitigation Measures

5.20.1 Pollution Prevention

The DOE Oak Ridge Field Office established a Waste Minimization and Pollution Prevention Awareness Plan to reduce the quantity and toxicity of hazardous, mixed, radioactive wastes generated at Oak Ridge. The plan is designed to reduce the poss releases to the environment and thus increase the protection of employees and the p contractors and users that exceed the EPA criteria for small-quantity generators ar their own waste minimization and pollution prevention awareness programs. Contract programs ensure that waste minimization activities are in accordance with Federal, local environmental laws and regulations, and DOE Orders.

Additional goals include the promotion and use of nonhazardous materials, estab a baseline of waste generation data, calculations of annual reductions of waste gen implementation of recycling programs. Goals also include incorporation of waste mi concepts and technologies in planning and design of new processes and facilities, a of existing facilities. A waste minimization task force composed of representative contractor has been established to coordinate waste minimization and pollution awar activities.

5.20.2 Potential Mitigation Measures

Potential impact avoidance and mitigation measures are addressed in Chapter 5, through 15 as appropriate.

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7.0 ABBREVIATIONS AND ACRONYMS

yC	degrees Celsius
CFR	Code of Federal Regulations
Ci	curie(s)
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
EIS	environmental impact statement
ECF	Expended Core Facility
EPA	U.S. Environmental Protection Agency
yF	degrees Fahrenheit

FEMA	Federal Emergency Management Agency
g	gram
gal	gallon(s)
hr	hour
INEL	Idaho National Engineering Laboratory
kg	kilogram
km	kilometer
kv	kilovolt
y	liter
m	meter
m3	cubic meter
mi	mile
mi2	square mile
min	minute
mph	miles per hour
mR	milliroentgen
mrem	millirem
MTHM	metric tons of heavy metal
MW	Megawatt
nCi	nanocurie
NEPA	National Environmental Policy Act
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PCB	polychlorinated biphenyl
pCi	picocurie(s)
PEIS	Programmatic Environmental Impact Statement
PM10	particulate matter less than 10 microns in diameter
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
SNF	spent nuclear fuel
SRS	Savannah River Site
TVA	Tennessee Valley Authority
ug	micrograms
USGS	U.S. Geological Survey
yr	year

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