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Appendix G

Acronyms/Abbreviations

CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EA	environmental assessment
ECF	Expended Core Facility
EIS	Environmental Impact Statement
HS	Hanford Site
INEL	Idaho National Engineering Laboratory
MEI	maximally exposed individiual
MTHM	metric tons of heavy metal
NNPP	Naval Nuclear Propulsion Program
NTS	Nevada Test Site
ORR	Oak Ridge Reservation
PEIS	Programmatic Environmental Impact Statement
PUREX	Plutonium Uranium Extraction
SNF	spent nuclear fuel
SRS	Savannah River Site
TRIGA	training, research, and isotope reactors built by General Atomics

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Appendix H

Glossary

Terms in this glossary are defined based on the context in which they are use

100-year flood : A flood event of such magnitude it occurs, on average, every 100 y
percent probability of occurring in any given year).

500-year flood : A flood event of such magnitude it occurs, on average, every 500 y
percent probability of occurring in any given year).

abnormal condition : Any deviation from normal conditions.

accident : An unplanned sequence of events that results in undesirable consequences

actinide : Any of a series of chemically similar, mostly synthetic, radioactive ele
ranging from actinium-89 through lawrencium-103.

alpha-emitter : A radioactive substance that decays by releasing an alpha particle.

alpha-low-level waste : Waste that was previously classified as transuranic waste b
concentration lower than the currently established limit for transuranic waste. Lo
additional controls and special handling. This waste stream cannot be accepted for
current waste acceptance criteria; therefore, it is special-case waste.

alpha particle : A positively charged particle ejected spontaneously from the nucle
elements. It is identical to a helium nucleus that has a mass number of 4 and an e

as low as reasonably achievable (ALARA) : A process by which a graded approach is a
maintaining dose levels to workers and the public, and releases of radioactive mate
low as reasonably achievable.

atomic number : The number of positively charged protons in the nucleus of an atom
electrons on an electrically neutral atom.

background radiation : Radiation from cosmic sources; naturally occurring radioacti
including radon (except as a decay product of source or special nuclear material),
exists in the environment from the testing of nuclear explosive devices.

baseline : For purposes of this EIS, the conditions projected to exist in June 1995
Record of Decision, against which the environmental consequences of the various alt

beta-emitter : A radioactive substance that decays by releasing a beta particle.

beta particle : A charged particle emitted from a nucleus during radioactive decay,
1/1837 that of a proton. A negatively charged beta particle is identical to an ele
beta particle is called a positron.

boiling water reactor : A type of nuclear reactor that uses fission heat to generat
drive turbines and generate electricity.

breeder reactor : A type of nuclear reactor that creates more fissionable fuel than

by-product material : (a) Any radioactive material (except special nuclear material
radioactive by, exposure to the radiation incident to the process of producing or u
material, and (b) the tailings or wastes produced by the extraction or concentratio
from any ore processed primarily for its source material content [Atomic Energy Act
material is exempt from regulation under the Resource Conservation and Recovery Act

calcination : The process of converting high-level waste to unconsolidated granules
calcining).

calcine : The material produced by a calcination.

canning : The process of placing spent nuclear fuel in canisters to retard corrosio
releases, or control geometry.

capable fault : In part, a capable fault is one that may have had movement at or ne
least once within the past 35,000 years, or has had recurring movement within the p
Further definition can be found in 10 CFR 100, Appendix A.

characterization : The determination of waste composition and properties, whether b
knowledge, nondestructive examination or assay, or sampling and analysis, generally
determining appropriate storage, treatment, handling, transport, and disposal requi

cladding : The outer jacket of fuel elements and targets usually made of aluminum,
zirconium alloy, used to prevent fuel corrosion and retain fission products during
prevent releases into the environment during storage.

co-located workers : Workers in a fixed population outside the day-to-day process
controls of a given facility area. In practice, this fixed population is normally
facility area located some distance from the reference facility area.

committed dose equivalent (H50) : The dose equivalent to organs or tissues of refer received from an intake of radioactive material by an individual during the 50-year intake. The International Commission on Radiological Protection defines this as th dose.
committed effective dose equivalent (HE,50) : The sum of the products of the weight applicable to each of the body organs or tissues that are irradiated and the commit organs or tissues. The International Commission on Radiological Protection defines effective dose.
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) : A Federal law (also known as "Superfund") that provides a comprehensive with past or abandoned hazardous materials. The Comprehensive Environmental Respon and Liability Act of 1980 (CERCLA) provides for liability, compensation, cleanup, a for hazardous substances released into the environment that could endanger public h environment, as well as the cleanup of inactive hazardous waste disposal sites. CE over any release or threatened release of any "hazardous substance" to the environm the definition of "hazardous" is much broader than under the Resource Conservation the hazardous substance need not be a waste. If a site meets the CERCLA requiremen ranked along with other "Superfund" sites and listed on the National Priorities Lis is the U.S. Environmental Protection Agency's way of determining which sites have t cleanup.
contact-handled waste : Packaged waste whose external surface dose rate does not ex 200 millirem per hour.
contamination : The deposition of unwanted radioactive material on the surfaces of objects, or personnel.
coolant : A gas or liquid circulated through a nuclear reactor to remove or transfe
core : The central portion of a nuclear reactor containing the fuel elements, moder support structures.
curie (Ci) : The basic unit used to describe the intensity of radioactivity in a sa equal to 37 billion disintegrations per second, which is approximately the rate of 1 gram of radium. A curie is also a quantity of any radionuclide that decays at a disintegrations per second.
decay, radioactive : The decrease in the amount of any radioactive material with th to the spontaneous emission from the atomic nuclei of either alpha or beta particle gamma radiation (see half-life, radioactive).
decommissioning : The process of removing a facility from operation, followed by de entombment, dismantlement, or conversion to another use.
decontamination : The actions taken to reduce or remove substances that pose a subs potential hazard to human health or the environment, such as radioactive contaminat or equipment by washing, chemical action, mechanical cleaning, or other techniques.
degraded (spent nuclear fuel) : Spent nuclear fuel whose external cladding has crac corroded, or potentially allows the leakage of radioactive materials.
DOE orders : Requirements internal to the U.S. Department of Energy (DOE) that esta lish DOE policy
and procedures, including those for compliance with applicable laws.
DOE site boundary : A geographic boundary within which public access is controlled governed by the U.S. Department of Energy (DOE) and its contractors, not by local a definition of exclusion zone, a public road traversing a DOE site is considered to boundary if DOE or the site contractor has the capability to control the road at an
dosage : The concentration-time profile for exposure to toxicological hazards.
dose (or radiation dose) : A generic term that means absorbed dose, dose equivalent equivalent, committed dose equivalent, committed effective dose equivalent, or tota equivalent, as defined elsewhere in this glossary.
driver fuel : These fuel tubes or assemblies usually contain enriched uranium, plut materials, which can be fissioned (or split) by neutrons. Because this fuel drives targets in a production or research reactor, these fuels are called drivers.
dry storage : Storage of spent nuclear fuel in environments where the fuel is not i purposes of cooling and/or shielding.
effective dose equivalent (EDE) : The sum of the products of the dose equivalent to and the weighting factors applicable to each of the body organs or tissues that are dose from radiation sources internal and/or external to the body and is expressed i International Commission on Radiation Protection defines this as the effective dose
enriched uranium : Uranium that has greater amounts of the fissionable isotope uran naturally. Naturally occurring uranium is 0.72 percent uranium-235.
environmental monitoring : The process of sampling and analysis of environmental me

a facility being monitored for the purpose of (a) confirming compliance with perfor
(b) early detection of any contamination entering the environment to facilitate tim
existing facilities : Facilities that are projected to exist as of the Record of De
for June 1995.
external accident : Accidents initiated by manmade energy sources not associated wi
given facility. Examples include airplane crashes, induced fires, transportation
facility, and so forth.
facility worker : Any worker whose day-to-day activities are controlled by process
programs and a common emergency response plan associated with a facility or facilit
includes any individual within a facility/facility area or its 0.4-mile exclusion z
include those transient individuals or small populations outside the exclusion zone
defined by the maximally exposed co-located worker if reasonable efforts to account
been made in the facility or facility area emergency plan. For facility accident a
defined as an individual located 100 meters (328 feet) downwind of the facility loc
release occurs.
fissile material : Although sometimes used as a synonym for fissionable material, t
more restricted meaning; namely, any material fissionable by thermal (slow) neutron
fissile materials are uranium-233, uranium-235, and plutonium-239.
fission : The splitting of a nucleus into at least two other nuclei and the release
of energy. Two or three neutrons are usually released during this type of transfor
fission products : The nuclei (fission fragments) formed by the fission of heavy el
nuclides formed by the fission fragments' radioactive decay.
fissionable material : Commonly used as a synonym for fissile material, the meaning
extended to include material that can be fissioned by fast neutrons, such as uraniu
gamma-emitter : A radioactive substance that decays by releasing gamma radiation.
gamma ray (gamma radiation) : High-energy, short wavelength electromagnetic radiati
energy) emitted from the nucleus. Gamma radiation frequently accompanies alpha and
always accompanies fission. Gamma rays are very penetrating and are best stopped o
dense materials, such as lead or uranium. Gamma rays are similar to x-rays, but ar
geologic repository : A system that is intended to be used for, or may be used for,
radioactive waste or spent nuclear fuel in excavated geologic media. A geologic re
geologic repository operations area, and (b) the portion of the geologic setting th
near-surface disposal area is not a geologic repository.
groundwater : Generally, all water contained in the ground. Water held below the w
freely enter wells.
grouting : Grouting is the process of immobilizing or fixing solid forms of waste s
stored or disposed.
half-life : The time in which half the atoms of a particular radioactive substance
nuclear form. Measured half-lives vary from millionths of a second to billions of
half-life.
hazardous chemical : A term defined under the Occupational Safety and Health Act an
Planning and Community Right-to-Know Act as any chemical that is a physical hazard
hazardous material : A substance or material, including a hazardous substance, whic
determined by the U.S. Secretary of Transportation to be capable of posing an unrea
safety, and property when transported in commerce.
hazardous substance : Any substance that when released to the environment in an unc
unpermitted fashion becomes subject to the reporting and possible response provisio
Act and the Comprehensive Environmental Response, Compensation, and Liability Act.
hazardous waste : Under the Resource Conservation and Recovery Act, a solid waste,
solid wastes, which because of its quantity, concentration, or physical, chemical,
may (a) cause, or significantly contribute to an increase in mortality or an increa
incapacitating reversibile, illness; or (b) pose a substantial present or potential
environment when improperly treated, stored, transported, or disposed of, or otherw
special nuclear material, and by-product material, as defined by the Atomic Energy
excluded from the definition of solid waste.
heterogeneous : Pertaining to a substance having different characteristics in diffe
synonym is nonuniform.
high-efficiency particulate air (HEPA) filter : A filter with an efficiency of at l
to separate particles from air exhaust streams prior to releasing that air into the
high-level waste : The highly radioactive waste material that results from the repr
fuel, including liquid waste produced directly from reprocessing and any solid wast
that contains a combination of transuranic and fission product nuclides in quantiti
isolation. High-level waste may include other highly radioactive material that the
Commission, consistent with existing law, determines by rule requires permanent iso

hot cell/hot cell facility : A heavily shielded enclosure for handling and processi mote means or automatically), or storing highly radioactive materials.
hydrogeology : The study of the geological factors relating to water.
hydrology : The study of water, including groundwater, surface water, and rainfall.
incineration : The efficient burning of combustible solid and liquid wastes to dest and reduce the volume of the waste. Incinerators are designed to burn with an extr greater the burning efficiency, the cleaner the air emission. Incineration of radi destroy the radionuclides but does significantly reduce the volume of these wastes. particulate air (HEPA) filters are used to prevent radionuclides and heavy metals f and into the atmosphere.
inconel : A metal alloy containing nickel, chromium, and iron, which exhibits good in aqueous environments.
interim action (NEPA) : An action that may be undertaken while work on a required p progress, and the action is not covered by an existing program statement. An inter undertaken unless such action: (a) is justified independently of the program; (b) i adequate EIS or has undergone other NEPA review; and (c) will not prejudice the ult program. Interim action prejudices the ultimate decision on the program when it te subsequent development or limit alternatives.
intermittent surface water : A stream, creek, or river that does not contain water year.
internal accidents : Accidents that are initiated by man-made energy sources associ of a given facility. Examples include process explosions, fires, spills, criticali
involved worker : Workers that would be involved in a proposed action as opposed to be on the site of a proposed action but not involved in the action.
isotope : One of two or more atoms with the same number of protons, but different n their nuclei. Thus, carbon-12, carbon-13, and carbon-14 are isotopes of the elemen denoting the approximate atomic weights. Isotopes have very nearly the same chemic different physical properties (for example, carbon-12 and -13 are stable, carbon-14
life cycle : The entire time period from generation to permanent disposal or elimin
liquid metal cooled breeder reactor : A reactor that creates more fissionable mater and uses liquid metal as a coolant. Liquid sodium is a common metal used to cool t tor.
liquid metal fast breeder reactor : A reactor that operates using a type of fission where the neutrons that are used to split the atoms are not slowed down or moderate with normal fission. It creates more fissionable material than it consumes and use Liquid sodium is a common metal used to cool this type of reactor.
long-term storage : The storage of hazardous waste (a) onsite (a generator site) f greater, other than in a satellite accumulation area, or (b) offsite in a properly disposal facility for any period of time.
low-level waste : Waste that contains radioactivity and is not classified as high-l waste, or spent nuclear fuel. Test specimens of fissionable material irradiated fo only, and not for the production of power or plutonium, may be classified as low-le concentration of transuranic elements is less than 100 nanocuries per gram of waste
major radionuclides : The radioisotopes that together comprise 95 percent of the to waste package by volume and have a half-life of at least 1 week. Radionuclides tha facility's radiological performance assessment and/or a safety analysis and are lis acceptance criteria are considered major radionuclides.
management (of spent nuclear fuel) : Emplacing, operating, and administering facili systems, and procedures to assure safe and environmentally responsible handling and fuel pending (and in anticipation of) a decision on ultimate disposition.
maximally exposed co-located worker (MCW) : A hypothetical individual defined to al dosage comparison with numerical criteria for co-located workers. This individual the greater of 0.4 miles from the facility area boundary (that is, the exclusion zo the distance to the nearest independent facility area (that is, the low population irrelevant if the DOE site boundary is closer than the MCW location.
maximally exposed individual (MEI) : A hypothetical individual defined to allow dos comparison with numerical criteria for the public. This individual is located at t boundary nearest to the facility in question. Sometimes called maximally exposed o
maximally exposed offsite individual (MOI) : A hypothetical individual defined to a dosage comparison with numerical criteria for the public. This individual is locat site boundary nearest to the facility in question. Sometimes called the maximally
maximum contaminant level (MCL) : Under the Safe Drinking Water Act, the maximum pe concentrations of specific constituents in drinking water that is delivered to any that serves 15 or more connections and 25 or more people. The standards set as max

levels take into account the feasibility and cost of attaining the standard.
metric tons of heavy metal (MTHM) : Quantities of unirradiated and spent nuclear fu traditionally expressed in terms of metric tons of heavy metal (typically uranium), other materials, such as cladding, alloy materials, and structural materials. A metric ton is 1,000 kilograms, which is equal to about 2,200 pounds.
millirem : One thousandth of a rem (see rem).
mixed waste : Waste that contains both hazardous waste under the Resource Conservat Act and source, special nuclear, or by-product material subject to the Atomic Energ
mitigation : Those actions that avoid impacts altogether, minimize impacts, rectify eliminate impacts, or compensate for the impact.
nanocurie : One billionth of a curie (see curie).
National Priorities List (NPL) : A formal listing of the nation's most hazardous wa under the Comprehensive Environmental Response, Compensation, and Liability Act (CE been identified for remediation.
natural phenomena accidents : Accidents that are initiated by phenomena such as ear tornadoes, floods, and so forth.
near-surface disposal : Disposal in the uppermost portion of the earth, approximate surface disposal includes disposal in engineered facilities that may be built total provided that such facilities have protective earthen covers. A near-surface dispo a geologic repository.
nitrogen oxides (NOx) : Gases formed in great part from atmospheric nitrogen and o combustion takes place under conditions of high temperature and high pressure; cons pollutant. Two major nitrogen oxides, nitric oxide (NO) and nitrogen dioxide (NO2) contaminants. In the presence of sunlight, nitric oxide combines with atmospheric nitrogen dioxide, which in high enough concentrations can cause lung damage.
normal conditions : All activities associated with a facility mission, whether oper storage, and so forth, which are carried out within a defined envelope. This envel conditions, performance in accordance with procedure, and so forth.
normal operation : All normal conditions and those abnormal conditions that frequen techniques indicate occur with a frequency greater than 0.1 events per year.
NOx : A generic term used to describe the oxides of nitrogen (see nitrogen oxides).
nuclear criticality : A self-sustaining chain reaction, which releases neutrons and radioactive by-product material.
nuclear fuel : Materials that are fissionable and can be used in nuclear reactors t
nuclide : A general term referring to all known isotopes, both stable (279) and uns chemical elements.
off-link doses : Doses to members of the public within 800 meters (2,625 feet) of a
offsite facility : A facility located at a different site or location than the ship
on-link doses : Doses to members of the public sharing a road or railway.
onsite : The same or geographically contiguous property that may be divided by publ way, provided the entrance and exit between the properties is at a cross-roads inte crossing as opposed to going along the right-of-way. Non-contiguous properties own but connected by a right-of-way that he/she controls and to which the public does n considered onsite property.
onsite facilities : Buildings and other structures, their functional systems and eq systems and equipment installed onsite.
operator : The organization that operates a facility.
passivation : The process of making metals inactive or less chemically reactive. F the surface of steel by chemical treatment.
perennial stream : A water course that flows year-round.
performance objectives : Parameters within which a facility must perform to be cons
permeability : The degree of ease with which water can pass through a rock or soil.
playa : The shallow central basin of a desert plain in which water gathers and then
picocurie : One trillionth of a curie (see curie).
pollutant migration : The movement of a contaminant away from its initial source.
pollution prevention : The use of any process, practice, or product that reduces or generation and release of pollutants, hazardous substances, contaminants, and waste protect natural resources through conservation or more efficient utilization.
polychlorinated biphenyls (PCBs) : A class of chemical substances formerly manufact insulating fluid in electrical equipment that is highly toxic to aquatic life. In t many of the characteristics of dichloro diphenyl trichloroethane (DDT); they persis long time and accumulate in animals.
population dose : The overall dose to the offsite population.
porosity (n) : Porosity is an index of relative pore volume. It is the total unit

divided into the void volume.
pressurized water reactor : A nuclear power reactor that uses water under pressure water boiled to generate steam is in a separate system.
probable maximum flood : The largest flood for which there is any reasonable expect area. The probable maximum flood is normally several times larger than the largest
process knowledge : The set of information that is used by trained and qualified in cognizant of the origin, use, and location of waste-generating materials and proces to certify the identity of the waste.
processing (of spent nuclear fuel) : Applying a chemical or physical process design characteristics of the spent nuclear fuel matrix.
production reactor : A nuclear reactor that is used to irradiate target material to material or by-product material.
public : Anyone outside the DOE site boundary at the time of an accident or during respect to accidents analyzed in this EIS, anyone outside the DOE site boundary at
rad : The special unit of absorbed dose. One rad is equal to an absorbed dose of 1
radiation (ionizing radiation) : Alpha particles, beta particles, gamma rays, x-ray electrons, high-speed protons, and other particles capable of producing ions. Radi does not include nonionizing radiation such as radio- or microwaves, or visible, in
radiation worker : A worker who is occupationally exposed to ionizing radiation and training and radiation monitoring devices to work in such circumstances.
radioactive waste : Waste that is managed for its radioactive content.
radioactivity : The property or characteristic of material to spontaneously "disint of energy in the form of radiation. The unit of radioactivity is the curie (or bec
radioisotope : An unstable isotope of an element that decays or disintegrates spont radiation. Approximately 5,000 natural and artificial radioisotopes have been iden
radiological survey : The evaluation of the radiation hazard accompanying the produ existence of radioactive materials under a specific set of conditions. Such evalua physical survey of the disposition of materials and equipment, measurements or esti radiation that may be involved, and a sufficient knowledge of processes affecting t hazards resulting from unexpected or possible changes in materials or equipment.
radionuclide : See radioisotope.
Record of Decision (ROD) : A public document that records the final decision(s) con action. The Record of Decision is based in whole or in part on information and tec either during the Comprehensive Environmental Response, Compensation, and Liability process or the National Environmental Policy Act (NEPA) process, both of which take public comments and community concerns.
recycling : Recycling techniques are characterized as use, reuse, and reclamation t recovery). Use or reuse involves the return of a potential waste material either t substitute for an input material or to another process as an input material. Recla useful or valuable material from a waste stream. Recycling allows potential waste beneficial use rather than going to treatment, storage, or disposal.
regulated substances : A general term used to refer to materials other than radionu regulated by Federal, state, (or possibly local) requirements.
rem : The dosage of an ionizing radiation that will cause the same biological effec gamma-ray exposure.
remote-handled waste : Packaged waste whose external surface dose rate exceeds 200
remote handling : The handling of wastes from a distance so as to protect human ope unnecessary exposure.
repository : A permanent deep geologic disposal facility for high-level or transura nuclear fuel.
reprocessing (of spent nuclear fuel) : Processing of reactor irradiated nuclear mat nuclear fuel) to recover fissile and fertile material, in order to recycle such mat programs. Historically, reprocessing has involved aqueous chemical separations of uranium or plutonium) from undesired elements in the fuel.
research reactor : A nuclear reactor used for research and development.
Resource Conservation and Recovery Act (RCRA) : A Federal law addressing the manage waste. Subtitle C of the law addresses hazardous waste under which a waste must ei the U.S. Environmental Protection Agency's (EPA's) hazardous waste lists or meet on hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity, as characterization leaching procedure (TCLP). Cradle-to-grave management of wastes cl hazardous wastes must meet stringent guidelines for environmental protection as req guidelines include regulation of transport, treatment, storage, and disposal of RCR waste. Subtitle D of the law addresses the management of nonhazardous, nonradioacti municipal wastes.

retrieval : The process of recovering wastes that have been stored or disposed of o appropriately characterized, treated, and disposed of.
risk : Quantitative expression of possible loss that considers both the probability and the consequences of that event.
safety analysis report : A report, prepared in accordance with DOE Orders 5481.1B a summarize the hazards associated with the operation of a particular facility and de requirements.
sanitary waste : Liquid or solid wastes that are generated as a result of routine o are not considered hazardous or radioactive.
saturated zone : That part of the earth's crust in which all naturally occurring vo
scaling factor : A multiplier that allows the inference of one radionuclide concent more easily measured.
scientific notation : A notation adopted by the scientific community to deal with v numbers by moving the decimal point to the right or left so that only one number ab the decimal point. Scientific notation uses a number times 10 and either a positiv show how many places to the left or right the decimal place has been moved. For ex notation, 120,000 would be written as 1.2 x 105, and 0.000012 would be written as 1 of scientific notation often used in computer printouts, the multiplication sign an the letter E. The above numbers would be written as 1.2E5 and 1.2E-5, respectively
segregation : The process of separating (or keeping separate) individual waste type to facilitate their cost-effective treatment and storage or disposal.
seismicity : The phenomenon of earth movements; seismic activity. Seismicity is re size, and rate of occurrence of earthquakes.
seiche : A wave that oscillates in partially or totally enclosed bodies of water fr hours, caused by seismic or atmospheric disturbances.
sole source aquifer : A designation granted by the U.S. Environmental Protection Ag groundwater from a specific aquifer supplies at least 50 percent of the drinking wa the aquifer. Sole-source aquifers have no alternative source or combination of sou legally, and economically supply all those who obtain their drinking water from the aquifers are protected from federally financially assisted activities determined to the aquifer.
solid waste : Any garbage, refuse, or sludge from a waste treatment plant, water su air pollution control facility and other discarded material, including solid, liqui gaseous material resulting from industrial, commercial, mining, and agricultural op community activities. It does not include solid or dissolved material in domestic materials in irrigation return flows or industrial discharges, which are point sour Section 402 of the Federal Water Pollution Control Act, as amended, or source, spec material as defined by the Atomic Energy Act of 1954, as amended [Public Law 94-580 Conservation and Recovery Act)].
solvents : Liquid chemicals, usually organic compounds, that are capable of dissolv Exposure to some organic solvents can produce toxic effects on body tissues and pro
source material : (a) Uranium, thorium, or any other material that is determined by Regulatory Commission pursuant to the provisions of the Atomic Energy Act of 1954, source material; or (b) ores containing one or more of the foregoing materials, in U.S. Nuclear Regulatory Commission may by regulation determine from time-to-time [A 11(z)]. Source material is exempt from regulation under to Resource Conservation a
SOx : A generic term used to describe the oxides of sulfur. The combination of sul vapor produces acid rain (see sulfur oxides).
special-case commercial reactor spent nuclear fuel : Complete or partial spent nucl assemblies from commercial nuclear power plants that were to be used to support DOE and development programs. This includes spent nuclear fuel from development reacto Peach Bottom Unit 1, and Fort St. Vrain); spent nuclear fuel used for destructive a examination and testing; spent nuclear fuel remaining at the West Valley Demonstrat nuclear fuel remnants (Three-Mile Island Unit 2).
special nuclear material : (a) Plutonium, or uranium enriched in the isotope 233 or and any other material that the U.S. Nuclear Regulatory Commission, pursuant to the Atomic Energy Act of 1954, Section 51, determines to be special nuclear material; o artificially enriched by any of the foregoing, but does not include source material exempt from regulation under the Resource Conservation and Recovery Act (RCRA).
specimen : A small sample of material (fuel or non-fuel) inserted into a reactor fo the material's performance. Test specimens may be constructed of plant materials, materials, or fuel materials.
spent nuclear fuel : Fuel that has been withdrawn from a nuclear reactor following constituent elements of which have not been separated. For the purposes of this EI

includes uranium/neptunium target materials, blanket subassemblies, pieces of fuel,
stabilization (of spent nuclear fuel) : Actions taken to further confine or reduce
with spent nuclear fuel, as necessary for safe management and environmentally respo
extended periods of time. Activities that may be necessary to stabilize spent nucl
processing, and passivation.
stakeholder : Any person or organization with an interest in or affected by DOE act
may include representatives from Federal agencies, State agencies, Congress, Native
unions, educational groups, industry, environmental groups, other groups, and membe
storage : The collection and containment of waste or spent nuclear fuel in such a m
disposal of the waste or spent nuclear fuel for the purposes of awaiting treatment
not short-term accumulation).
subsurface : The area below the land surface (including the vadose zone and aquifer
sulfur oxides : Pungent, colorless gases formed primarily by the combustion of foss
major air pollutants; sulfur oxides may damage the respiratory tract as well as veg
target : A tube, rod, or other form containing material that, on being irradiated i
produce a designed end product (that is, uranium-238 produces plutonium-239 and nep
plutonium-238).
total effective dose equivalent : The sum of the external dose equivalent (for exte
the committed effective dose equivalent (for internal exposures).
transient : A change in the reactor coolant system temperature and/or pressure. Tr
adding or removing neutron poisons, by increasing or decreasing the electrical load
or by accident conditions.
transuranic waste : Waste containing more than 100 nanocuries of alpha-emitting tra
with half-lives greater than 20 years, per gram of waste, except for (a) high-level
that the U.S. Department of Energy has determined, with the concurrence of the Admi
Environmental Protection Agency, does not need the degree of isolation required by
that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-
accordance with 10 CFR 61.
transuranium radionuclide : Any radionuclide having an atomic number greater than 9
tsunami : A huge ocean wave caused by an underwater earthquake or a volcanic erupti
ultimate disposition : The final step in which a material is either processed for s
vadose zone : The zone between the land surface and the water table. Saturated bod
groundwater, may exist in the vadose zone. Also called the zone of aeration and th
vitrification : The process of immobilizing waste material that results in a glass-
volatile organic compound (VOC) : Chemical containing mainly carbon, hydrogen, and
readily evaporates at ambient temperature. Exposure to some organic compounds can
on body tissue and processes.
Volcanic Rift Zones : Linear belts of basaltic vents marked by open fissures, monoc
faults. Volcanic rift zones were produced during the propagation of vertical molte
surface eruptions.
vulnerabilities : Conditions or weaknesses that may lead to radiation exposure to t
increased exposure to the workers, or release of radioactive materials to the envir
DOE facilities have had leakage from spent fuel storage pools, excessive corrosion
radiation levels in the pool, or degradation of handling systems. Vulnerabilities
institutional controls, such as cessation of facility funding or reductions in faci
waste acceptance criteria (WAC) : The requirements specifying the characteristics o
packaging acceptable to a waste receiving facility; and the documents and processes
certify that waste meets applicable requirements.
waste certification : A process by which a waste generator certifies that a given w
meets the waste acceptance criteria of the facility to which the generator intends
treatment, storage, or disposal. Certification is accomplished by a combination of
documentation, quality assurance, and periodic audits of the certification program.
waste characterization : See characterization.
Waste Isolation Pilot Plant (WIPP) : A facility near Carlsbad, New Mexico, authoriz
safe disposal of defense-generated transuranic waste in a deep geologic medium.
waste management : The planning, coordination, and direction of those functions rel
handling, treatment, storage, transport, and disposal of waste, as well as associat
maintenance activities.
waste management facility : All contiguous land, structures, other appurtenances, a
the land, used for treating, storing, or disposing of waste or spent nuclear fuel.
several treatment, storage, or disposal operational units (for example, one or more
impoundments, or combinations of them).
waste management program : A systematic approach to organize, direct, document, and
activities associated with waste generation, treatment, storage, or disposal. A wa

consists of all the functional elements, organizations, and activities that compris
properly manage waste. These functions and activities can be performed by various
waste management systems assessment : A systems assessment of the entire low-level
management (or all of waste management) structure/program at a given site that cons
disposal, as well as onsite and offsite points of generation with an emphasis on op
the operations, including, but not limited to, protection of human health and the e
compliance, and cost effectiveness.
waste minimization : An action that economically avoids or reduces the generation o
reduction, reducing the toxicity of hazardous waste, improving energy usage, or rec
be consistent with the general goal of minimizing present and future threats to hum
environment.
water pool : A type of facility usually used for the storage of irradiated nuclear
The water shields the material being stored while allowing it to be accessible for
referred to as a water pit.
wet storage : Storage of spent nuclear fuel in a pool of water, generally for the p
shielding.

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APPENDIX I Offsite Transportation of Spent Nuclear Fuel

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FIGURES

TABLES

Appendix I Offsite Transportation of Spent Nuclear Fuel

I-1 INTRODUCTION

This appendix summarizes the methods and results of analysis for determining impacts of spent nuclear fuel (SNF) transportation on public highways and rail syst boundaries of U.S. Department of Energy (DOE) sites (offsite). The impacts are pre include doses and health effects.

This appendix does not address the impacts of SNF transport within the bounda (onsite). Onsite transport impacts are addressed in site-specific Appendices A thr addresses offsite shipments of naval-type SNF stored at the Idaho Chemical Processi to storage locations at other sites as identified by certain alternatives. Transpo and prototypes to the equivalent expended core facility at the alternative sites ar Appendix D in Volume 1, along with transport of naval test specimens.

This appendix also includes the impacts of shipments of foreign research reac points of entry identified in the Implementation Plan for this EIS (Hampton Roads, South Carolina; Savannah, Georgia; Seattle-Tacoma, Washington; Portland, Oregon; an California) and the points of entry at the Military Ocean Terminal at Sunny Point, Galveston, Texas. The six points of entry identified in the Implementation Plan we following criteria: (a) adequacy of harbor and dock characteristics to satisfy the requirements, (b) availability of safe and secure lag storage, (c) adequacy of over from points of entry to the storage sites, (d) experience in safe and secure handli emergency preparedness status at the point of entry and nearby communities, and (f) proposed storage sites. The Military Ocean Terminal at Sunny Point, North Carolina was recently used for foreign research reactor SNF shipments. Galveston, Texas was entry because it was on the Gulf Coast and has container-handling experience. A fu points of entry, including these and other points of entry, is being evaluated in t Statement on a Proposed Nuclear Nonproliferation Policy Concerning Foreign Research

Nuclear Fuel,and no decision concerning the choice of points of entry will be made Programmatic Spent Nuclear Fuel Management and the Idaho National Engineering Labor Environmental Restoration and Waste Management Programs Environmental Impact Statem Environmental Impact Statement on a Proposed Nuclear Nonproliferation Policy Concer Research Reactor Spent Nuclear Fuel are completed. The ocean-going portion of fore SNF shipments and a detailed evaluation of point of entry activities are also not a but will be assessed in the Draft Environmental Impact Statement on a Proposed Nucl Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel.

The impacts of historical shipments of SNF to the Hanford Site, Idaho Nationa Laboratory, Savannah River Site, Oak Ridge Reservation, and the Nevada Test Site an transportation impacts are also discussed in this appendix. The historical impacts include shipments of naval SNF and test specimens.

I-2 TRANSPORTATION REGULATIONS

The regulatory standards for packaging and transport of SNF are designed to a objectives:

- Protect persons and property from radiation emitted from packages durin specific limitations on the allowable radiation levels
- Provide proper containment of the SNF in the package (achieved by packa requirements based on performance-oriented packaging integrity tests an criteria)
- Prevent nuclear criticality (an unplanned nuclear chain reaction that m concentrating too much fissile material in one place)
- Provide physical protection against theft and sabotage during transit.

The U.S. Department of Transportation regulates the transportation of hazardo (including SNF) in interstate and intrastate commerce by land, air, and on navigabl 1979 Memorandum of Understanding with the U.S. Nuclear Regulatory Commission, the U Transportation specifically regulates the carriers of SNF and the conditions of tra handling and storage, and vehicle and driver requirements. The U.S. Department of regulates the labeling, classification, and marking of all SNF packages.

The U.S. Nuclear Regulatory Commission regulates the packaging and transport licensees, which includes commercial shippers of SNF. In addition, under an agreem Department of Transportation, the U.S. Nuclear Regulatory Commission sets the stand containing fissile materials and SNF.

The DOE, through its management directives, orders, and contractual agreement protection of public health and safety by imposing on its transportation activities those of the U.S. Department of Transportation and the U.S. Nuclear Regulatory Comm authority, granted by a 1973 Memorandum of Understanding between the U.S. Departmen and the Atomic Energy Commission, to certify DOE SNF packages. The DOE may design, certify its own SNF packages to be used by the DOE and its contractors if the packa safety to that provided in 10 CFR Part 71.

The U.S. Department of Transportation also has requirements that help to redu impacts. For example, there are requirements for drivers, routing, packaging, labe placarding. There are also requirements that specify the maximum dose rate associa material shipments, which help to reduce incident-free transportation doses.

The Federal Emergency Management Agency is responsible for establishing polic coordinating civil emergency management, planning, and interaction with Federal exe have emergency response functions in the event of a SNF transportation incident. T Management Agency coordinates Federal and state participation in developing emergen is responsible for the development of the interim Federal Radiological Emergency Re

Federal Radiological Emergency Response Plan is designed to coordinate Federal supp governments, upon request, during the event of a SNF transportation incident.

The Interstate Commerce Commission is responsible for the regulation of the e SNF transportation for land shipments. The Comission issues operating authorities monitors and approves freight rates.

Spent nuclear fuel is transported in Type B packages, which are designed and their radioactive contents in both normal and severe accident conditions.

Under normal conditions a cask must withstand:

- Hot [100F (38C)] and Cold [-40F (-40C)] temperatures
- External pressure changes from 3.5 to 20 pounds per square inch (24.5 t
- Normal vibration experienced during transportation
- Simulated rainfall of 2 inches (5 centimeters) per hour for 1 hour
- Free drop from 1 to 4 feet (0.3 to 1.2 meters), depending on the packag
- Compression loading (the greater of 5 times the weight of package or 1. pounds per square inch (12.75 kilopascal) times the vertical projecte package) applied uniformly to the top and bottom of the package for a period
- Impact of a 13-pound (6-kilogram) steel cylinder with rounded ends drop (1 meter) onto the most vulnerable surface of the cask.

Under accident conditions a cask must withstand:

- Free drop for 30 feet (9 meters) onto an unyielding surface in a way mo damage to the cask
- Free drop from 40 inches (1 meter) onto the end of a 6-inch-diameter (1 diameter) vertical steel bar
- Exposure for not less than 30 minutes to temperatures of 1475F (802C)
- Immersion in at least 50 feet (15 meters) of water for 8 hours and, for considerations, immersion in at least 3 feet (0.9 meters) of water for for which maximum leakage is expected.

Compliance with these requirements is demonstrated by using a combination of methods, computer modeling techniques, or full-scale or scale-model testing of cask

I-3 SNF TRANSPORTATION MODES AND ROUTES

I-3.1 SNF Transportation Routing Models

To assess incident-free and transportation accident impacts, route characteri each of the origins and destinations associated with SNF shipments. Each origin re generates or stores SNF that must be transported, and each destination represents a For offsite transport, representative highway and rail routes were analyzed using t HIGHWAY (Johnson et al. 1993a) and INTERLINE (Johnson et al. 1993b). The routes we conforming to current routing practices and applicable routing regulations and guid

characteristics include total shipment distance between each origin and destination in rural, suburban, and urban population density zones (see Table I-1). The HIGHWA routing computer codes are described below.

The HIGHWAY computer code predicts highway routes for transporting radioactiv the United States. The HIGHWAY database is a computerized road atlas that currentl approximately 240,000 miles of roads. A complete description of the Interstate Hig States highways, most of the principal state highways, and a number of local and co identified in the database. The HIGHWAY computer code calculates routes that maxim interstate highways. This feature allows the user to predict routes for transport conform to U.S. Department of Transportation regulations, as specified in 49 CFR Pa The routes calculated conform to applicable guidelines and regulations; therefore, could be used. However, they may not be the actual routes used in the future. The periodically to reflect current road conditions, and it has been benchmarked agains observations of commercial truck firms.

The INTERLINE computer code is designed to simulate routing of the United Sta The INTERLINE database consists of 94 separate subnetworks and represents various c companies in the United States. The database used by INTERLINE was originally base Administration data and reflected the United States railroad system in 1974. The d expanded and modified over the past two decades. The routes used for this study us assumptions in the INTERLINE computer code that simulate the selection process rail transport of radioactive material. Currently, there are no specific routing regula radioactive material by rail. INTERLINE is updated periodically to reflect current been benchmarked against reported mileage and observations of commercial rail firms

Table I-1. Transportation distances between facilities for spent nuclear fuel ship

Route		Miles
	Truck routes	
Idaho National Engineering Laboratory	Hanford Site	599.0
Idaho National Engineering Laboratory	Nevada Test Site	712.0
Idaho National Engineering Laboratory	Savannah River Site	2311.0
Idaho National Engineering Laboratory	Oak Ridge Reservation	2048.0
Idaho National Engineering Laboratory	Brookhaven National Laboratory	2437.0
Idaho National Engineering Laboratory	Argonne National Laboratory-East	1582.0
Idaho National Engineering Laboratory	Los Alamos National Laboratory	1144.0
Idaho National Engineering Laboratory	Sandia National Laboratories - Albuquerque	1168.0
Hanford Site	Nevada Test Site	1128.0
Hanford Site	Savannah River Site	2727.0
Hanford Site	Oak Ridge Reservation	2464.0
Hanford Site	Brookhaven National Laboratory	2853.0
Hanford Site	Argonne National Laboratory-East	1998.0

Hanford Site	Los Alamos National Laboratory	1560.0
Hanford Site	Sandia National Laboratories - Albuquerque	1584.0
Nevada Test Site	Savannah River Site	2414.0
Nevada Test Site	Oak Ridge Reservation	2151.0
Nevada Test Site	Brookhaven National Laboratory	2670.0
Nevada Test Site	Argonne National Laboratory-East	1815.0
Nevada Test Site	Los Alamos National Laboratory	997.0
Nevada Test Site	Sandia National Laboratories - Albuquerque	909.0
Savannah River Site	Oak Ridge Reservation	379.0
Savannah River Site	Brookhaven National Laboratory	897.0
Savannah River Site	Argonne National Laboratory-East	892.0
Savannah River Site	Los Alamos National Laboratory	1742.0
Savannah River Site	Sandia National Laboratories - Albuquerque	1644.0
Savannah River Site	Lawrence Livermore National Laboratory	2750.0
Oak Ridge Reservation	Brookhaven National Laboratory	821.0
Oak Ridge Reservation	Argonne National Laboratory-East	584.0
Oak Ridge Reservation	Los Alamos National Laboratory	1480.0
Oak Ridge Reservation	Sandia National Laboratories - Albuquerque	1382.0
Idaho National Engineering Laboratory	Hanford Site	658.0
Idaho National Engineering Laboratory	Nevada Test Site	756.0
Idaho National Engineering Laboratory	Savannah River Site	2407.0
Idaho National Engineering Laboratory	Oak Ridge Reservation	2055.0
Idaho National Engineering Laboratory	Brookhaven National Laboratory	2607.0
Idaho National Engineering Laboratory	Argonne National Laboratory-East	1655.0
Idaho National Engineering Laboratory	Los Alamos National Laboratory	1179.0
Idaho National Engineering Laboratory	Sandia National Laboratories - Albuquerque	1247.0
Hanford Site	Nevada Test Site	1302.0
Hanford Site	Savannah River Site	2953.0

Hanford Site	Oak Ridge Reservation	2601.0
Hanford Site	Brookhaven National Laboratory	3153.0
Hanford Site	Argonne National Laboratory-East	2200.0
Hanford Site	Los Alamos National Laboratory	1725.0
Hanford Site	Sandia National Laboratories - Albuquerque	1793.0
Nevada Test Site	Savannah River Site	2839.0
Nevada Test Site	Oak Ridge Reservation	2487.0
Nevada Test Site	Brookhaven National Laboratory	3039.0
Nevada Test Site	Argonne National Laboratory-East	2348.0
Nevada Test Site	Los Alamos National Laboratory	1169.0
Nevada Test Site	Sandia National Laboratories - Albuquerque	1065.0
Savannah River Site	Oak Ridge Reservation	417.0
Savannah River Site	Brookhaven National Laboratory	1239.0
Savannah River Site	Argonne National Laboratory-East	976.0
Savannah River Site	Los Alamos National Laboratory	2252.0
Savannah River Site	Sandia National Laboratories - Albuquerque	2315.0
Oak Ridge Reservation	Brookhaven National Laboratory	1152.0
Oak Ridge Reservation	Argonne National Laboratory-East	648.0
Oak Ridge Reservation	Los Alamos National Laboratory	1686.0
Oak Ridge Reservation	Sandia National Laboratories - Albuquerque	1749.0
Fort St. Vrain Nuclear Generating Station	Savannah River Site	1636.0
Fort St. Vrain Nuclear Generating Station	Hanford Site	1108.0
Fort St. Vrain Nuclear Generating Station	Idaho National Engineering Laboratory	692.0
Fort St. Vrain Nuclear Generating Station	Oak Ridge Reservation	1372.0
Fort St. Vrain Nuclear Generating Station	Nevada Test Site	852.0
Fort St. Vrain Nuclear Generating Station	Savannah River Site	1853.0
Fort St. Vrain Nuclear Generating Station	Hanford Site	1218.0
Fort St. Vrain Nuclear Generating Station	Idaho National Engineering Laboratory	672.0

Fort St. Vrain Nuclear Generating Station	Oak Ridge Reservation	1526.0
Fort St. Vrain Nuclear Generating Station	Nevada Test Site	1104.0
Savannah River Site	Hampton Roads, VA	505.0
Savannah River Site	Seattle-Tacoma, WA	2900.0
Savannah River Site	Charleston, SC	209.0
Savannah River Site	Savannah, GA	265.0
Savannah River Site	Oakland, CA	2791.0
Savannah River Site	Portland, OR	2849.0
Savannah River Site	Military Ocean Terminal, Sunny Point, NC	250.0
Savannah River Site	Alexandria Bay, NY	1012.0
Savannah River Site	Galveston, TX	1000.0
Hanford Site	Hampton Roads, VA	2903.0
Hanford Site	Seattle-Tacoma, WA	226.0
Hanford Site	Charleston, SC	2862.0
Hanford Site	Savannah, GA	2804.0
Hanford Site	Oakland, CA	875.0
Hanford Site	Portland, OR	236.0
Hanford Site	Military Ocean Terminal, Sunny Point, NC	2868.0
Hanford Site	Alexandria Bay, NY	2768.0
Hanford Site	Galveston, TX	2327.0
Idaho National Engineering Laboratory	Hampton Roads, VA	2487.0
Idaho National Engineering Laboratory	Seattle-Tacoma, WA	793.0
Idaho National Engineering Laboratory	Charleston, SC	2446.0
Idaho National Engineering Laboratory	Savannah, GA	2388.0
Idaho National Engineering Laboratory	Oakland, CA	963.0
Idaho National Engineering Laboratory	Portland, OR	721.0
Idaho National Engineering Laboratory	Military Ocean Terminal, Sunny Point, NC	2407.0

Idaho National Engineering Laboratory	Alexandria Bay, NY	2352.0
Idaho National Engineering Laboratory	Galveston, TX	1911.0
Oak Ridge Reservation	Hampton Roads, VA	548.0
Oak Ridge Reservation	Seattle-Tacoma, WA	2636.0
Oak Ridge Reservation	Charleston, SC	408.0
Oak Ridge Reservation	Savannah, GA	456.0
Oak Ridge Reservation	Oakland, CA	2563.0
Oak Ridge Reservation	Portland, OR	2585.0
Oak Ridge Reservation	Military Ocean Terminal, Sunny Point, NC	496.0
Oak Ridge Reservation	Alexandria Bay, NY	927.0
Oak Ridge Reservation	Galveston, TX	963.0
Nevada Test Site	Hampton Roads, VA	2590.0
Nevada Test Site	Seattle-Tacoma, WA	1322.0
Nevada Test Site	Charleston, SC	2549.0
Nevada Test Site	Savannah, GA	2492.0
Nevada Test Site	Oakland, CA	719.0
Nevada Test Site	Portland, OR	1250.0
Nevada Test Site	Military Ocean Terminal, Sunny Point, NC	2457.0
Nevada Test Site	Alexandria Bay, NY	2619.0
Nevada Test Site	Galveston, TX	1862.0
Savannah River Site	Hampton Roads, VA	529.0
Savannah River Site	Seattle-Tacoma, WA	3123.0
Savannah River Site	Charleston, SC	140.0
Savannah River Site	Savannah, GA	114.0
Savannah River Site	Oakland, CA	3192.0
Savannah River Site	Portland, OR	3154.0
Savannah River Site	Military Ocean Terminal, Sunny Point, NC	382.0
Savannah River Site	Alexandria Bay, NY	1281.0
Savannah River Site	Galveston, TX	1174.0
Hanford Site	Hampton Roads, VA	3187.0
Hanford Site	Seattle-Tacoma, WA	416.0

Hanford Site	Charleston, SC	3059.0
Hanford Site	Savannah, GA	3091.0
Hanford Site	Oakland, CA	986.0
Hanford Site	Portland, OR	239.0
Hanford Site	Military Ocean Terminal, Sunny Point, NC	3203.0
Hanford Site	Alexandria Bay, NY	2878.0
Hanford Site	Galveston, TX	2392.0
Idaho National Engineering Laboratory	Hampton Roads, VA	2641.0
Idaho National Engineering Laboratory	Seattle-Tacoma, WA	976.0
Idaho National Engineering Laboratory	Charleston, SC	2513.0
Idaho National Engineering Laboratory	Savannah, GA	2545.0
Idaho National Engineering Laboratory	Oakland, CA	1102.0
Idaho National Engineering Laboratory	Portland, OR	785.0
Idaho National Engineering Laboratory	Military Ocean Terminal, Sunny Point, NC	2657.0
Idaho National Engineering Laboratory	Alexandria Bay, NY	2332.0
Idaho National Engineering Laboratory	Galveston, TX	1846.0
Oak Ridge Reservation	Hampton Roads, VA	689.0
Oak Ridge Reservation	Seattle-Tacoma, WA	2795.0
Oak Ridge Reservation	Charleston, SC	581.0
Oak Ridge Reservation	Savannah, GA	587.0
Oak Ridge Reservation	Oakland, CA	2686.0
Oak Ridge Reservation	Portland, OR	2827.0
Oak Ridge Reservation	Military Ocean Terminal, Sunny Point, NC	542.0
Oak Ridge Reservation	Alexandria Bay, NY	972.0
Oak Ridge Reservation	Galveston, TX	1053.0
Nevada Test Site	Hampton Roads, VA	3073.0
Nevada Test Site	Seattle-Tacoma, WA	1620.0
Nevada Test Site	Charleston, SC	2945.0

Nevada Test Site	Savannah, GA	2977.0
Nevada Test Site	Oakland, CA	860.0
Nevada Test Site	Portland, OR	1429.0
Nevada Test Site	Military Ocean Terminal, Sunny Point, NC	3089.0
Nevada Test Site	Alexandria Bay, NC	2763.0
Nevada Test Site	Galveston, TX	1955.0
Savannah River Site	Cornell University	896.0
Savannah River Site	Georgia Institute of Technology	197.0
Savannah River Site	Idaho State University	2248.0
Savannah River Site	Iowa State University	1175.0
Savannah River Site	Kansas State University	1121.0
Savannah River Site	Manhattan College	830.0
Savannah River Site	Massachusetts Institute of Technology	1040.0
Savannah River Site	North Carolina State University	318.0
Savannah River Site	Ohio State University	708.0
Savannah River Site	Oregon State University	2937.0
Savannah River Site	Pennsylvania State University	849.0
Savannah River Site	Purdue University	768.0
Savannah River Site	Reed College	2849.0
Savannah River Site	Rensselaer Polytechnic Institute	955.0
Savannah River Site	Rhode Island Nuclear Science Center	1009.0
Savannah River Site	State University of New York - Buffalo	1001.0
Savannah River Site	Texas A&M University	1099.0
Savannah River Site	University of Arizona	1926.0
Savannah River Site	University of California - Irvine	2406.0
Savannah River Site	University of Florida	496.0
Savannah River Site	University of Illinois	803.0
Savannah River Site	University of Lowell	1045.0
Savannah River Site	University of Maryland	589.0
Savannah River Site	University of Michigan	903.0
Savannah River Site	University of Missouri - Columbia	858.0
Savannah River Site	University of Missouri - Rolla	835.0

Savannah River Site	University of New Mexico	1653.0
Savannah River Site	University of Texas	1169.0
Savannah River Site	University of Utah	2127.0
Savannah River Site	University of Virginia	478.0
Savannah River Site	University of Wisconsin	1038.0
Savannah River Site	Washington State University	2699.0
Savannah River Site	Worcester Polytechnic Institute	1002.0
Savannah River Site	Cornell University	1098.0
Savannah River Site	Georgia Institute of Technology	221.0
Savannah River Site	Idaho State University	2323.0
Savannah River Site	Iowa State University	1281.0
Savannah River Site	Kansas State University	1274.0
Savannah River Site	Manhattan College	1156.0
Savannah River Site	Massachusetts Institute of Technology	1223.0
Savannah River Site	North Carolina State University	385.0
Savannah River Site	Ohio State University	726.0
Savannah River Site	Oregon State University	3381.0
Savannah River Site	Pennsylvania State University	963.0
Savannah River Site	Purdue University	903.0
Savannah River Site	Reed College	3154.0
Savannah River Site	Rensselaer Polytechnic Institute	1044.0
Savannah River Site	Rhode Island Nuclear Science Center	1252.0
Savannah River Site	State University of New York - Buffalo	1051.0
Savannah River Site	Texas A&M University	1194.0
Savannah River Site	University of Arizona	2245.0
Savannah River Site	University of California - Irvine	3180.0
Savannah River Site	University of Florida	328.0
Savannah River Site	University of Illinois	1028.0
Savannah River Site	University of Lowell	1239.0
Savannah River Site	University of Maryland	669.0
Savannah River Site	University of Michigan	913.0
Savannah River Site	University of Missouri - Columbia	1011.0

Savannah River Site	University of Missouri - Rolla	966.0
Savannah River Site	University of New Mexico	2315.0
Savannah River Site	University of Texas	1314.0
Savannah River Site	University of Utah	2378.0
Savannah River Site	University of Virginia	637.0
Savannah River Site	University of Wisconsin	1092.0
Savannah River Site	Washington State University	2864.0
Savannah River Site	Worcester Polytechnic Institute	1176.0
Hanford Site	Cornell University	2730.0
Hanford Site	Georgia Institute of Technology	2550.0
Hanford Site	Idaho State University	546.0
Hanford Site	Iowa State University	1703.0
Hanford Site	Kansas State University	1624.0
Hanford Site	Manhattan College	2786.0
Hanford Site	Massachusetts Institute of Technology	2986.0
Hanford Site	North Carolina State University	2862.0
Hanford Site	Ohio State University	2342.0
Hanford Site	Oregon State University	324.0
Hanford Site	Pennsylvania State University	2578.0
Hanford Site	Purdue University	2111.0
Hanford Site	Reed College	236.0
Hanford Site	Rensselaer Polytechnic Institute	2819.0
Hanford Site	Rhode Island Nuclear Science Center	2965.0
Hanford Site	State University of New York - Buffalo	2534.0
Hanford Site	Texas A&M University	2212.0
Hanford Site	University of Arizona	1699.0
Hanford Site	University of California - Irvine	1270.0
Hanford Site	University of Florida	2894.0
Hanford Site	University of Illinois	2033.0
Hanford Site	University of Lowell	2991.0
Hanford Site	University of Maryland	2753.0
Hanford Site	University of Michigan	2227.0

Hanford Site	University of Missouri - Columbia	1870.0
Hanford Site	University of Missouri - Rolla	2082.0
Hanford Site	University of New Mexico	1593.0
Hanford Site	University of Texas	2216.0
Hanford Site	University of Utah	643.0
Hanford Site	University of Virginia	2757.0
Hanford Site	University of Wisconsin	1943.0
Hanford Site	Washington State University	361.0
Hanford Site	Worcester Polytechnic Institute	2948.0
Hanford Site	Cornell University	2842.0
Hanford Site	Georgia Institute of Technology	2732.0
Hanford Site	Idaho State University	602.0
Hanford Site	Iowa State University	1788.0
Hanford Site	Kansas State University	1743.0
Hanford Site	Manhattan College	3070.0
Hanford Site	Massachusetts Institute of Technology	3105.0
Hanford Site	North Carolina State University	3172.0
Hanford Site	Ohio State University	2482.0
Hanford Site	Oregon State University	340.0
Hanford Site	Pennsylvania State University	2760.0
Hanford Site	Purdue University	2359.0
Hanford Site	Reed College	239.0
Hanford Site	Rensselaer Polytechnic Institute	2934.0
Hanford Site	Rhode Island Nuclear Science Center	3166.0
Hanford Site	State University of New York - Buffalo	2637.0
Hanford Site	Texas A&M University	2954.0
Hanford Site	University of Arizona	1804.0
Hanford Site	University of California - Irvine	1528.0
Hanford Site	University of Florida	3138.0
Hanford Site	University of Illinois	2158.0
Hanford Site	University of Lowell	3095.0
Hanford Site	University of Maryland	2900.0

Hanford Site	University of Michigan	2369.0
Hanford Site	University of Missouri - Columbia	1948.0
Hanford Site	University of Missouri - Rolla	2246.0
Hanford Site	University of New Mexico	1796.0
Hanford Site	University of Texas	2473.0
Hanford Site	University of Utah	774.0
Hanford Site	University of Virginia	2902.0
Hanford Site	University of Wisconsin	2210.0
Hanford Site	Washington State University	251.0
Hanford Site	Worcester Polytechnic Institute	3089.0
Idaho National Engineering Laboratory	Cornell University	2314.0
Idaho National Engineering Laboratory	Georgia Institute of Technology	2134.0
Idaho National Engineering Laboratory	Idaho State University	65.0
Idaho National Engineering Laboratory	Iowa State University	1287.0
Idaho National Engineering Laboratory	Kansas State University	1208.0
Idaho National Engineering Laboratory	Manhattan College	2370.0
Idaho National Engineering Laboratory	Massachusetts Institute of Technology	2570.0
Idaho National Engineering Laboratory	North Carolina State University	2446.0
Idaho National Engineering Laboratory	Ohio State University	1926.0
Idaho National Engineering Laboratory	Oregon State University	809.0
Idaho National Engineering Laboratory	Pennsylvania State University	2162.0
Idaho National Engineering Laboratory	Purdue University	1695.0
Idaho National Engineering Laboratory	Reed College	721.0
Idaho National Engineering Laboratory	Rensselaer Polytechnic Institute	2403.0
Idaho National Engineering	Rhode Island Nuclear Science Center	2549.0

Laboratory		
Idaho National Engineering Laboratory	State University of New York - Buffalo	2118.0
Idaho National Engineering Laboratory	Texas A&M University	1796.0
Idaho National Engineering Laboratory	University of Arizona	1301.0
Idaho National Engineering Laboratory	University of California - Irvine	942.0
Idaho National Engineering Laboratory	University of Florida	2478.0
Idaho National Engineering Laboratory	University of Illinois	1617.0
Idaho National Engineering Laboratory	University of Lowell	2575.0
Idaho National Engineering Laboratory	University of Maryland	2337.0
Idaho National Engineering Laboratory	University of Michigan	1811.0
Idaho National Engineering Laboratory	University of Missouri - Columbia	1454.0
Idaho National Engineering Laboratory	University of Missouri - Rolla	1666.0
Idaho National Engineering Laboratory	University of New Mexico	1177.0
Idaho National Engineering Laboratory	University of Texas	1800.0
Idaho National Engineering Laboratory	University of Utah	227.0
Idaho National Engineering Laboratory	University of Virginia	2341.0
Idaho National Engineering Laboratory	University of Wisconsin	1612.0
Idaho National Engineering Laboratory	Washington State University	652.0
Idaho National Engineering Laboratory	Worcester Polytechnic Institute	2532.0
Idaho National Engineering Laboratory	Cornell University	2296.0
Idaho National Engineering Laboratory	Georgia Institute of Technology	2186.0
Idaho National Engineering Laboratory	Idaho State University	56.0

Idaho National Engineering Laboratory	Iowa State University	1242.0
Idaho National Engineering Laboratory	Kansas State University	1197.0
Idaho National Engineering Laboratory	Manhattan College	2524.0
Idaho National Engineering Laboratory	Massachusetts Institute of Technology	2559.0
Idaho National Engineering Laboratory	North Carolina State University	2626.0
Idaho National Engineering Laboratory	Ohio State University	1936.0
Idaho National Engineering Laboratory	Oregon State University	878.0
Idaho National Engineering Laboratory	Pennsylvania State University	2214.0
Idaho National Engineering Laboratory	Purdue University	1813.0
Idaho National Engineering Laboratory	Reed College	785.0
Idaho National Engineering Laboratory	Rensselaer Polytechnic Institute	2388.0
Idaho National Engineering Laboratory	Rhode Island Nuclear Science Center	2620.0
Idaho National Engineering Laboratory	State University of New York - Buffalo	2091.0
Idaho National Engineering Laboratory	Texas A&M University	1920.0
Idaho National Engineering Laboratory	University of Arizona	1376.0
Idaho National Engineering Laboratory	University of California - Irvine	982.0
Idaho National Engineering Laboratory	University of Florida	2592.0
Idaho National Engineering Laboratory	University of Illinois	1612.0
Idaho National Engineering Laboratory	University of Lowell	2549.0
Idaho National Engineering Laboratory	University of Maryland	2354.0
Idaho National Engineering Laboratory	University of Michigan	1823.0

Idaho National Engineering Laboratory	University of Missouri - Columbia	1402.0
Idaho National Engineering Laboratory	University of Missouri - Rolla	1619.0
Idaho National Engineering Laboratory	University of New Mexico	1250.0
Idaho National Engineering Laboratory	University of Texas	1927.0
Idaho National Engineering Laboratory	University of Utah	228.0
Idaho National Engineering Laboratory	University of Virginia	2357.0
Idaho National Engineering Laboratory	University of Wisconsin	1664.0
Idaho National Engineering Laboratory	Washington State University	876.0
Idaho National Engineering Laboratory	Worcester Polytechnic Institute	2544.0
Oak Ridge Reservation	Cornell University	821.0
Oak Ridge Reservation	Georgia Institute of Technology	202.0
Oak Ridge Reservation	Idaho State University	1985.0
Oak Ridge Reservation	Iowa State University	900.0
Oak Ridge Reservation	Kansas State University	857.0
Oak Ridge Reservation	Manhattan College	754.0
Oak Ridge Reservation	Massachusetts Institute of Technology	965.0
Oak Ridge Reservation	North Carolina State University	408.0
Oak Ridge Reservation	Ohio State University	400.0
Oak Ridge Reservation	Oregon State University	2674.0
Oak Ridge Reservation	Pennsylvania State University	774.0
Oak Ridge Reservation	Purdue University	460.0
Oak Ridge Reservation	Reed College	2585.0
Oak Ridge Reservation	Rensselaer Polytechnic Institute	879.0
Oak Ridge Reservation	Rhode Island Nuclear Science Center	933.0
Oak Ridge Reservation	State University of New York - Buffalo	744.0
Oak Ridge Reservation	Texas A&M University	1004.0
Oak Ridge Reservation	University of Arizona	1782.0
Oak Ridge Reservation	University of California - Irvine	2209.0

Oak Ridge Reservation	University of Florida	546.0
Oak Ridge Reservation	University of Illinois	516.0
Oak Ridge Reservation	University of Lowell	970.0
Oak Ridge Reservation	University of Maryland	537.0
Oak Ridge Reservation	University of Michigan	595.0
Oak Ridge Reservation	University of Missouri - Columbia	594.0
Oak Ridge Reservation	University of Missouri - Rolla	571.0
Oak Ridge Reservation	University of New Mexico	1391.0
Oak Ridge Reservation	University of Texas	1026.0
Oak Ridge Reservation	University of Utah	1864.0
Oak Ridge Reservation	University of Virginia	402.0
Oak Ridge Reservation	University of Wisconsin	730.0
Oak Ridge Reservation	Washington State University	2435.0
Oak Ridge Reservation	Worcester Polytechnic Institute	927.0
Oak Ridge Reservation	Cornell University	935.0
Oak Ridge Reservation	Georgia Institute of Technology	228.0
Oak Ridge Reservation	Idaho State University	1996.0
Oak Ridge Reservation	Iowa State University	954.0
Oak Ridge Reservation	Kansas State University	948.0
Oak Ridge Reservation	Manhattan College	1164.0
Oak Ridge Reservation	Massachusetts Institute of Technology	1199.0
Oak Ridge Reservation	North Carolina State University	511.0
Oak Ridge Reservation	Ohio State University	406.0
Oak Ridge Reservation	Oregon State University	3055.0
Oak Ridge Reservation	Pennsylvania State University	822.0
Oak Ridge Reservation	Purdue University	495.0
Oak Ridge Reservation	Reed College	2827.0
Oak Ridge Reservation	Rensselaer Polytechnic Institute	1028.0
Oak Ridge Reservation	Rhode Island Nuclear Science Center	1259.0
Oak Ridge Reservation	State University of New York - Buffalo	731.0
Oak Ridge Reservation	Texas A&M University	1013.0
Oak Ridge Reservation	University of Arizona	2103.0

Oak Ridge Reservation	University of California - Irvine	2615.0
Oak Ridge Reservation	University of Florida	634.0
Oak Ridge Reservation	University of Illinois	592.0
Oak Ridge Reservation	University of Lowell	1189.0
Oak Ridge Reservation	University of Maryland	582.0
Oak Ridge Reservation	University of Michigan	591.0
Oak Ridge Reservation	University of Missouri - Columbia	695.0
Oak Ridge Reservation	University of Missouri - Rolla	640.0
Oak Ridge Reservation	University of New Mexico	1749.0
Oak Ridge Reservation	University of Texas	1045.0
Oak Ridge Reservation	University of Utah	2051.0
Oak Ridge Reservation	University of Virginia	451.0
Oak Ridge Reservation	University of Wisconsin	765.0
Oak Ridge Reservation	Washington State University	2536.0
Oak Ridge Reservation	Worcester Polytechnic Institute	1183.0
Nevada Test Site	Cornell University	2547.0
Nevada Test Site	Georgia Institute of Technology	2238.0
Nevada Test Site	Idaho State University	649.0
Nevada Test Site	Iowa State University	1520.0
Nevada Test Site	Kansas State University	1312.0
Nevada Test Site	Manhattan College	2603.0
Nevada Test Site	Massachusetts Institute of Technology	2802.0
Nevada Test Site	North Carolina State University	2549.0
Nevada Test Site	Ohio State University	2098.0
Nevada Test Site	Oregon State University	1245.0
Nevada Test Site	Pennsylvania State University	2395.0
Nevada Test Site	Purdue University	1928.0
Nevada Test Site	Reed College	1250.0
Nevada Test Site	Rensselaer Polytechnic Institute	2636.0
Nevada Test Site	Rhode Island Nuclear Science Center	2782.0
Nevada Test Site	State University of New York - Buffalo	2350.0
Nevada Test Site	Texas A&M University	1852.0

Nevada Test Site	University of Arizona	723.0
Nevada Test Site	University of California - Irvine	364.0
Nevada Test Site	University of Florida	2582.0
Nevada Test Site	University of Illinois	1850.0
Nevada Test Site	University of Lowell	2808.0
Nevada Test Site	University of Maryland	2509.0
Nevada Test Site	University of Michigan	2044.0
Nevada Test Site	University of Missouri - Columbia	1557.0
Nevada Test Site	University of Missouri - Rolla	1769.0
Nevada Test Site	University of New Mexico	918.0
Nevada Test Site	University of Texas	1662.0
Nevada Test Site	University of Utah	487.0
Nevada Test Site	University of Virginia	2444.0
Nevada Test Site	University of Wisconsin	1857.0
Nevada Test Site	Washington State University	1286.0
Nevada Test Site	Worcester Polytechnic Institute	2765.0
Nevada Test Site	Cornell University	2727.0
Nevada Test Site	Georgia Institute of Technology	2618.0
Nevada Test Site	Idaho State University	700.0
Nevada Test Site	Iowa State University	1674.0
Nevada Test Site	Kansas State University	1628.0
Nevada Test Site	Manhattan College	2956.0
Nevada Test Site	Massachusetts Institute of Technology	2990.0
Nevada Test Site	North Carolina State University	3058.0
Nevada Test Site	Ohio State University	2367.0
Nevada Test Site	Oregon State University	1400.0
Nevada Test Site	Pennsylvania State University	2646.0
Nevada Test Site	Purdue University	2245.0
Nevada Test Site	Reed College	1429.0
Nevada Test Site	Rensselaer Polytechnic Institute	2820.0
Nevada Test Site	Rhode Island Nuclear Science Center	3051.0
Nevada Test Site	State University of New York - Buffalo	2522.0

Nevada Test Site	Texas A&M University	1967.0
Nevada Test Site	University of Arizona	818.0
Nevada Test Site	University of California -Irvine	424.0
Nevada Test Site	University of Florida	3024.0
Nevada Test Site	University of Illinois	2044.0
Nevada Test Site	University of Lowell	2980.0
Nevada Test Site	University of Maryland	2786.0
Nevada Test Site	University of Michigan	2255.0
Nevada Test Site	University of Missouri - Columbia	1833.0
Nevada Test Site	University of Missouri - Rolla	2050.0
Nevada Test Site	University of New Mexico	1065.0
Nevada Test Site	University of Texas	2358.0
Nevada Test Site	University of Utah	528.0
Nevada Test Site	University of Virginia	2788.0
Nevada Test Site	University of Wisconsin	2096.0
Nevada Test Site	Washington State University	1520.0
Nevada Test Site	Worcester Polytechnic Institute	2975.0
West Valley Demonstration Plant	Savannah River Site	883.0
West Valley Demonstration Plant	Hanford Site	2556.0
West Valley Demonstration Plant	Idaho National Engineering Laboratory	2140.0
West Valley Demonstration Plant	Oak Ridge Reservation	766.0
West Valley Demonstration Plant	Nevada Test Site	2373.0
Babcock & Wilcox	Savannah River Site	455.0
Babcock & Wilcox	Hanford Site	2738.0
Babcock & Wilcox	Idaho National Engineering Laboratory	2322.0
Babcock & Wilcox	Oak Ridge Reservation	350.0
Babcock & Wilcox	Nevada Test Site	2491.0
West Valley Demonstration Plant	Savannah River Site	1217.0
West Valley Demonstration	Hanford Site	2654.0

Plant		
West Valley Demonstration Plant	Idaho National Engineering Laboratory	2108.0
West Valley Demonstration Plant	Oak Ridge Reservation	889.0
West Valley Demonstration Plant	Nevada Test Site	2554.0
Babcock & Wilcox	Savannah River Site	661.0
Babcock & Wilcox	Hanford Site	2879.0
Babcock & Wilcox	Idaho National Engineering Laboratory	2333.0
Babcock & Wilcox	Oak Ridge Reservation	386.0
Babcock & Wilcox	Nevada Test Site	2765.0
Three Mile Island	Idaho National Engineering Laboratory	2315.0
Pleasanton, CA	Idaho National Engineering Laboratory	969.0
Pleasanton, CA	Hanford Site	881.0
Pleasanton, CA	Savannah River Site	2768.0
Pleasanton, CA	Oak Ridge Reservation	2532.0
Pleasanton, CA	Nevada Test Site	687.0
Gaithersburg, MD	Idaho National Engineering Laboratory	2316.0
Gaithersburg, MD	Hanford Site	2732.0
Gaithersburg, MD	Savannah River Site	597.0
Gaithersburg, MD	Oak Ridge Reservation	536.0
Gaithersburg, MD	Nevada Test Site	2488.0
San Ramon, CA	Idaho National Engineering Laboratory	962.0
San Ramon, CA	Hanford Site	874.0
San Ramon, CA	Savannah River Site	2775.0
San Ramon, CA	Oak Ridge Reservation	2538.0
San Ramon, CA	Nevada Test Site	694.0
Midland, MI	Idaho National Engineering Laboratory	1902.0
Midland, MI	Hanford Site	2318.0
Midland, MI	Savannah River Site	1036.0
Midland, MI	Oak Ridge Reservation	719.0
Midland, MI	Nevada Test Site	2135.0
San Diego, CA	Idaho National Engineering Laboratory	976.0

San Diego, CA	Hanford Site	1352.0
San Diego, CA	Savannah River Site	2345.0
San Diego, CA	Oak Ridge Reservation	2193.0
San Diego, CA	Nevada Test Site	398.0
Denver, CO	Idaho National Engineering Laboratory	717.0
Denver, CO	Hanford Site	1133.0
Denver, CO	Savannah River Site	1613.0
Denver, CO	Oak Ridge Reservation	1340.0
Denver, CO	Nevada Test Site	819.0
McClellan AFB, CA	Idaho National Engineering Laboratory	875.0
McClellan AFB, CA	Hanford Site	830.0
McClellan AFB, CA	Savannah River Site	2780.0
McClellan AFB, CA	Oak Ridge Reservation	2517.0
McClellan AFB, CA	Nevada Test Site	735.0
Pleasanton, CA	Idaho National Engineering Laboratory	965.0
Pleasanton, CA	Hanford Site	1002.0
Pleasanton, CA	Savannah River Site	3170.0
Pleasanton, CA	Oak Ridge Reservation	3029.0
Pleasanton, CA	Nevada Test Site	838.0
Gaithersburg, MD	Idaho National Engineering Laboratory	2335.0
Gaithersburg, MD	Hanford Site	2881.0
Gaithersburg, MD	Savannah River Site	659.0
Gaithersburg, MD	Oak Ridge Reservation	819.0
Gaithersburg, MD	Nevada Test Site	2767.0
San Ramon, CA	Idaho National Engineering Laboratory	965.0
San Ramon, CA	Hanford Site	1002.0
San Ramon, CA	Savannah River Site	3170.0
San Ramon, CA	Oak Ridge Reservation	3029.0
San Ramon, CA	Nevada Test Site	838.0
Midland, MI	Idaho National Engineering Laboratory	1961.0
Midland, MI	Hanford Site	2507.0
Midland, MI	Savannah River Site	996.0

Midland, MI	Oak Ridge Reservation	645.0
Midland, MI	Nevada Test Site	2392.0
San Diego, CA	Idaho National Engineering Laboratory	1076.0
San Diego, CA	Hanford Site	1622.0
San Diego, CA	Savannah River Site	3274.0
San Diego, CA	Oak Ridge Reservation	2709.0
San Diego, CA	Nevada Test Site	518.0
Denver, CO	Idaho National Engineering Laboratory	708.0
Denver, CO	Hanford Site	1254.0
Denver, CO	Savannah River Site	2125.0
Denver, CO	Oak Ridge Reservation	1560.0
Denver, CO	Nevada Test Site	1140.0
McClellan AFB, CA	Idaho National Engineering Laboratory	853.0
McClellan AFB, CA	Hanford Site	890.0
McClellan AFB, CA	Savannah River Site	3160.0
McClellan AFB, CA	Oak Ridge Reservation	2747.0
McClellan AFB, CA	Nevada Test Site	827.0

I-3.2 Spent Nuclear Fuel Shipments

In the transportation analyses, SNF was divided into a number of categories: DOE research, (c) foreign research reactor, (d) graphite, (e) N Reactor, (f) naval-Site production reactor, and (h) university research reactor. More details on thes Appendix J of Volume 1 of this EIS. The estimated number of SNF shipments are pres origin-destination pair, and transport mode for each alternative in Tables I-2 and Each shipment, whether by truck or rail, was assumed to consist of one shipping con of shipping container was variable, depending on the type of SNF and the transport this time, insufficient data exist to determine the transport mode for all shipment truck or rail shipments was based on either 100 percent transport by truck or 100 p bound potential impacts.

The shipments in this appendix include offsite transport of naval-type SNF st Chemical Processing Plant as of June 1995 to storage locations at other sites as id Transport of naval SNF from shipyards and prototypes to the equivalent Expended Cor alternative sites are addressed in Appendix D of Volume 1 of this EIS, along with t specimens.

This appendix also includes transport of foreign research reactor SNF from th identified in the Implementation Plan for this EIS (Hampton Roads, Virginia; Charle Savannah, Georgia; Seattle-Tacoma, Washington; Portland, Oregon; and Oakland, Calif identified in the alternatives. Impacts of shipments to the Military Ocean Termina Carolina, were analyzed because this terminal was recently used for foreign researc Impacts of shipments to Galveston, Texas, were analyzed because this point of entry

has container-handling experience. The ocean-going portion of foreign research re a detailed evaluation of point of entry activities are not assessed in this EIS, bu Environmental Impact Statement on a Proposed Nuclear Nonproliferation Policy Concer Research Reactor Spent Nuclear Fuel.

The No Action alternative considers only transport of naval SNF and test spec shipments are addressed in Appendix D of Volume 1 of this EIS. For the Decentraliz university research reactor, foreign research reactor, and non-DOE research reactor to the Idaho National Engineering Laboratory or the Savannah River Site.

For the 1992/1993 Planning Basis alternative, commercial, DOE research, and g be transported to the Idaho National Engineering Laboratory or the Savannah River S reactor, foreign research reactor, and non-DOE research reactor SNF would also cont the Idaho National Engineering Laboratory or the Savannah River Site.

For the Regionalization alternatives, SNF would be consolidated based on fuel More shipments of SNF would occur than for the 1992/1993 Planning Basis alternative would be transported. For the Regionalization by Fuel Type alternative, N-Reactor SNF, naval-type SNF, and Savannah River Site production reactor SNF and t transported. Generally, aluminum SNF would be transported to the Savannah River Si SNF would be transported to the Idaho National Engineering Laboratory. For the Reg Geography alternative, SNF from west of the Mississippi River would be transported Idaho National Engineering Laboratory, or the Nevada Test Site. SNF from east of t would be transported to the Savannah River Site or the Oak Ridge Reservation.

For the Centralization alternatives, all SNF would be transported to the Hanf National Engineering Laboratory, the Savannah River Site, the Oak Ridge Reservation Site. The primary difference between these alternatives, in terms of shipments, is SNF, naval-type SNF, and Savannah River Site production reactor SNF and targets. F Idaho National Engineering Laboratory, the Savannah River Site, the Oak Ridge Reser Test Site, N-Reactor SNF would be transported from the Hanford Site. For Centraliz Site, the Idaho National Engineering Laboratory, the Oak Ridge Reservation, or the Savannah River Site production reactor SNF and targets would be transported. For C Hanford Site, the Savannah River Site, the Oak Ridge Reservation, or the Nevada Tes would be transported from the Idaho National Engineering Laboratory. For Centraliz Reservation or the Nevada Test Site, N-Reactor SNF, naval-type SNF, and Savannah Ri reactor SNF and targets would be transported.

Table I-2. Spent nuclear fuel shipments for the Decentralization, 1992/1993 Planni alternatives.

Origin	Destination	Decentralizati		1992/1993 Planning Basis		Regionalization by Fuel Type		Centralization HS		SRS
		truck	rail	truck	rail	truck	rail	truck	rail	tru
Naval-Type										
INEL	HS							383	104	
	NTS									
	ORR									
	SRS									383
Savannah River Production										
SRS	HS							484	97	
	INEL									
	ORR									
	NTS									
ORR	SRS					1	1			
Hanford Production										
HS	INEL									
	SRS									119
	ORR									
	NTS									
ORR	INEL					1	1			
Graphite										
FSV	HS							244	35	
	INEL			244	35	244	35			
	SRS									244

	ORR									
	NTS									
INEL	HS							162	23	
	SRS									162
	ORR									
	NTS									
Domestic non-DOE										
AFRRI	HS							3	3	
	INEL			3	3	3	3			
	SRS	3	3							3
	ORR									
	NTS									
USGS	HS							6	6	
	INEL	6	6	6	6	6	6			
	SRS									6
	ORR									
	NTS									
Domestic non-DOE										
NIST	HS							185	185	
	INEL									
	SRS	185	185	185	185	18	185			185
	ORR									
	NTS									
USAF	HS							3	3	
	INEL	3	3	3	3	3	3			
	SRS									3
	ORR									
	NTS									
DOW	HS							3	3	
	INEL	3	3	3	3	3	3			
	SRS									3
	ORR									
	NTS									
GE	HS							4	4	
	INEL	4	4	4	4					
	SRS					4	4			4
	ORR									
	NTS									
GA	HS							8	8	
	INEL	8	8	8	8	8	8			
	SRS									8
	ORR									
	NTS									
AERO	HS							3	3	
	INEL	3	3	3	3	3	3			
	SRS									3
	ORR									
	NTS									
Universities										
Universiti	HS							519	519	
	INEL	261	261	261	261	116	116			
	SRS	258	258	258	258	403	403			519
	ORR									
	NTS									
WVDP	HS							83	4	
	INEL			83	4	83	4			
	SRS									83
	ORR									
	NTS									
B&W	HS							2	2	
	INEL			2	2	2	2			
	SRS									2
	ORR									
	NTS									

ORR	HS							7	2	
	INEL					7	2			
	SRS									7
	NTS									
SRS	HS							27	5	
	INEL					27	5			
	ORR									
	NTS									
HS	INEL					6	2			
	SRS									6
	ORR									
	NTS									
Commercial										
ANL-E	HS							1	1	
	INEL					1	1			
	SRS									1
	ORR									
	NTS									
INEL	HS							370	74	
	SRS									370
	ORR									
	NTS									
DOE Research										
ORR	HS							113	24	
	INEL					46	10			
	SRS			67	14	67	14			113
	NTS									
BNL	HS							71	14	
	INEL			35	7					
	SRS			35	7	71	14			71
	ORR									
	NTS									
SNL	HS							27	6	
	INEL			12	3	12	3			
	SRS			15	3	15	3			27
	ORR									
	NTS									
LANL	HS							17	4	
	INEL			17	4					
	SRS					17	4			17
	ORR									
	NTS									
ANL-E	HS							10	2	
	INEL			10	2	10	2			
	SRS									10
	ORR									
	NTS									
HS	INEL			5	1	518	39			
	SRS									518
	ORR									
	NTS									
INEL	HS							1003	165	
	SRS					114	23			100
	ORR									
	NTS									
SRS	HS							353	71	
	INEL					94	19			
	ORR									
	NTS									
Foreign Points of Entry	HS							1008	1008	
	SRS	546	546	546	546	838	838			100
	INEL	462	462	462	462	170	170			

	ORR								
	NTS								
	TOTAL	1,742	1,742	2,267	1,824	3,078	1,926	5,099	2,375	5,9

Acronyms
AERO Aerotest San Ramon, CA
AFRRI Armed Forces Radiobiology Research Institute Bethesda, MD
ANL-E Argonne National Laboratory-East
B&W Babcock & Wilcox Company Lynchburg, VA
BNL Brookhaven National Laboratory
DOE Department of Energy
DOW Dow North America Midland, MI
FSV Fort St. Vrain Nuclear Generating Station
GA General Atomics San Diego, CA
GE General Electric Pleasanton, CA
HS Hanford Site
INEL Idaho National Engineering
LANL Los Al
NIST National Institute of
NTS Nevada Test Site
ORR Oak Ridge Reservation
SNL Sandia National Laboratories
SRS Savannah River Site
USAF United States Air
USGS United States Geological Sur
WVDP West Valley Demonstration P

Table I-3. Spent nuclear fuel shipments for the Regionalization
Regionalization by Geography

Origin	Destination	HS and SRS truck	HS and SRS rail	INEL and SRS truck	INEL and SRS rail	NTS and SRS truck	NTS and SRS rail	HS and truck
Naval-Type								
INEL	HS	383	104					383
	NTS					383	104	
	ORR							
	SRS							
Savannah River Production								
SRS	HS							
	INEL							
	ORR							484
	NTS							
ORR	SRS							
Hanford Production								
HS	INEL			1192	605			
	SRS							
	ORR							
	NTS					1192	605	
ORR	INEL							
Graphite								
FSV	HS	244	35					244
	INEL			244	35			
	SRS							
	ORR							
	NTS					244	35	
INEL	HS	162	23					162
	SRS							
	ORR							
	NTS					162	23	
Domestic non-DOE								
AFRRI	HS							
	INEL							
	SRS	3	3	3	3	3	3	
	ORR							3
	NTS							
USGS	HS	6	6					6
	INEL			6	6			
	SRS							
	ORR							
	NTS					6	6	
Domestic non-DOE								
NIST	HS							
	INEL							

	SRS	185	185	185	185	185	185	
	ORR							185
	NTS							
USAF	HS	3	3					3
	INEL			3	3			
	SRS							
	ORR							
	NTS					3	3	
DOW	HS							
	INEL							
	SRS	3	3	3	3	3	3	
	ORR							3
	NTS							
GE	HS	4	4					4
	INEL			4	4			
	SRS							
	ORR							
	NTS					4	4	
GA	HS	8	8					8
	INEL			8	8			
	SRS							
	ORR							
	NTS					8	8	
AERO	HS	3	3					3
	INEL			3	3			
	SRS							
	ORR							
	NTS					3	3	
Universities								
UniversitiHS		209	209					209
	INEL			209	209			
	SRS	310	310	310	310	310	310	
	ORR							310
	NTS					209	209	
WVDP	HS							
	INEL							
	SRS	83	4	83	4	83	4	
	ORR							83
	NTS							
B&W	HS							
	INEL							
	SRS	2	2	2	2	2	2	
	ORR							2
	NTS							
ORR	HS							
	INEL							
	SRS	7	2	7	2	7	2	
	NTS							
SRS	HS							
	INEL							
	ORR							27
	NTS							
HS	INEL			6	2			
	SRS							
	ORR							
	NTS					6	2	
Commercial								
ANL-E	HS							
	INEL							
	SRS	1	1	1	1	1	1	
	ORR							1
	NTS							
INEL	HS	370	74					370
	SRS							

	ORR							
	NTS					370	74	
DOE Research								
ORR	HS							
	INEL							
	SRS	113	24	113	24	113	24	
	NTS							
BNL	HS							
	INEL							
	SRS	71	14	71	14	71	14	
	ORR							71
	NTS							
SNL	HS	27	6					27
	INEL			27	6			
	SRS							
	ORR							
	NTS					27	6	
LANL	HS	17	4					17
	INEL			17	4			
	SRS							
	ORR							
	NTS					17	4	
ANL-E	HS							
	INEL							
	SRS	10	2	10	2	10	2	
	ORR							10
	NTS							
HS	INEL			518	39			
	SRS							
	ORR							
	NTS					518	39	
INEL	HS	1003	165					1003
	SRS							
	ORR							
	NTS					1003	165	
SRS	HS							
	INEL							
	ORR							353
	NTS							
Foreign Points of Entry	HS	230	230					230
	SRS	778	778	778	778	778	778	
	INEL			230	230			
	ORR							778
	NTS							
	TOTAL	4,235	2,202	4,033	2,482	5,951	2,848	4,979

Acronyms

AERO Aerotest San Ramon, CA INEL Idaho National Engineering Laborat
AFRRI Armed Forces Radiobiology Research Institute Bethesda, MD LANL Los Alamos N
ANL-E Argonne National Laboratory-East NIST National Institute of Standa
B&W Babcock & Wilcox Company Lynchburg, VA Gaithersburg, MD
BNL Brookhaven National Laboratory NTS Nevada Test Site
DOE Department of Energy ORR Oak Ridge Reservation
DOW Dow North America Midland, MI SNL Sandia National Laboratories
FSV Fort St. Vrain Nuclear Generating Station SRS Savannah River Site
GA General Atomics San Diego, CA USAF United States Air Force McClellan, CA
GE General Electric Pleasanton, CA USGS United States Geological Survey D
HS Hanford Site WVDP West Valley Demonstration Project

I-4 INCIDENT-FREE TRANSPORTATION RISKS FOR SPENT NUCLEAR FUEL

I-4.1 Methodology

Radiological dose during normal, incident-free transportation of SNF results external radiation field that surrounds the shipping containers. The dose is a fun people exposed, their proximity to the containers, their length of time of exposure radiation field surrounding the containers.

Radiological impacts were determined for crew workers and the general populat incident-free transportation. For truck shipments, the crew were the drivers of th shipments, the crew were workers in close proximity to the shipping containers duri classification of railcars. The general population was persons within 800 meters (railway (off-link), persons sharing the road or railway (on-link), and persons at s

Collective doses for the crew and general population were calculated using th computer code (Neuhauser and Kanipe 1992). SNF was assigned a dose rate of 14 mill meter (3.28 feet) from the shipping container. This dose rate yields a dose rate o meters (6.56 feet) from the vehicle, which is the regulatory maximum based on an ex Madsen et al. 1986). A dose rate of 1 millirem per hour at 1 meter (3.28 feet) was shipments, based on measured dose rates from previous naval SNF shipments. Three p zones (rural, suburban, and urban) were used. These zones correspond to mean popul 6,719, and 3,861 persons per square kilometer, respectively (Neuhauser and Kanipe 1

Calculating the collective doses is based on developing unit risk factors. U estimate of the impact from transporting one shipment of radioactive material over a given population density zone. The unit risk factors may be combined with routin transport distances in various population density zones, to determine the risk for shipment risk factor) between a given origin and destination. Cashwell et al. (198 explanation of the use of unit risk factors.

Unit risk factors were developed based on travel within rural, suburban, and using RADTRAN 4, using default data (see Neuhauser and Kanipe 1992). Table I-4 con factors for offsite truck and rail shipments of SNF. Table I-5 contains the unit r and rail shipments of naval-type SNF. Shipment risk factors were also developed fo combining the unit risk factors with routing information derived from the HIGHWAY a computer codes.

Table I-4. Incident-free unit risk factors for offsite truck and rail shipments of

		Unit risk factors (person-rem per kilometer		
Mode	Exposure group	Rural	Suburban	Urba
Truck				
	Occupational	4.6 X 10^-5	1.0 X 10^-4	1.7
	General population			
	Off-link(b)	1.2 X 10^-7	1.6 X 10^-5	1.1
	On-link(c)	5.0 X 10^-6	1.5 X 10^-5	1.5
	Stops	1.2 X 10^-4	1.2 X 10^-4	1.2
	General population total	1.3 X 10^-4	1.5 X 10^-4	3.8
Rail				
	Occupationald	1.0 X 10^-5	1.0 X 10^-5	1.0
	General population			

Off-link(b)	1.7 X 10^-7	3.3 X 10^-5	2.9
On-link(c)	6.6 X 10^-8	8.5 X 10^-7	2.4
Stopse	4.8 X 10^-6	4.8 X 10^-6	4.8
General population total	5.0 X 10^-6	3.8 X 10^-5	3.0

a. The methodology, equations, and data used to develop the unit risk factors are al. (1986) and Neuhauser and Kanipe (1992). Cashwell et al. (1986) contains a deta use of unit risk factors.
b. Off-link general population were persons within 800 meters (2,625 feet) of the
c. On-link general population were persons sharing the road or railway.
d. The nonlinear component of incident-free rail dose for crew workers because of classifications is 0.011 person-rem per shipment. Ostmeyer (1986) contains a detai rail exposure model.
e. The nonlinear component of incident-free rail dose for the general population b inspections and classifications is 0.0087 person-rem per shipment. Ostmeyer (1986) explanation of the rail exposure model.

Table I-5. Incident-free unit risk factors for truck and rail shipments of naval-t

		Unit risk factors (person-rem per kilometer)(a		
Mode	Exposure group	Rural	Suburban	Urba
Truck				
	Occupational	1.5 X 10^-5	3.3 X 10^-5	5.4
	General population			
	Off-link(b)	8.8 X 10^-9	1.2 X 10^-6	7.7
	On-link(c)	3.6 X 10^-7	1.0 X 10^-6	1.1
	Stops	4.3 X 10^-6	4.3 X 10^-6	4.3
	General population total	4.7 X 10^-7	6.5 X 10^-6	2.3
Rail				
	Occupationald	7.2 X 10^-7	7.2 X 10^-7	7.2
	General population			
	Off-link(b)	1.2 X 10^-8	2.3 X 10^-6	2.1
	On-link(c)	4.7 X 10^-9	6.1 X 10^-8	1.7
	Stopse	3.4 X 10^-7	3.4 X 10^-7	3.4
	General population total	3.6 X 10^-7	2.7 X 10^-6	2.1

a. The methodology, equations, and data used to develop the unit risk factors are al. (1986) and Neuhauser and Kanipe (1992). Cashwell et al. (1986) contains a deta use of unit risk factors.
b. Off-link general population were persons within 800 meters (2,625 feet) of the
c. On-link general population were persons sharing the road or railway.
d. The nonlinear component of incident-free rail dose for crew workers because of classifications is 0.00080 person-rem per shipment. Ostmeyer (1986) contains a det the rail exposure model.
e. The nonlinear component of incident-free rail dose for the general population b inspections and classifications is 0.00062 person-rem per shipment. Ostmeyer (1986 explanation of the rail exposure model.

Incident-free nonradiological fatalities were also estimated using unit risk factors account for the fatalities associated with exhaust emissions, but the dista impacts must be doubled to reflect the round trip distance because these impacts oc shipment contains radioactive material. Two sets of data were evaluated: (a) data Radiological Impacts of Transporting Radioactive Material (Rao et al. 1982), and (b Vehicle-Related Air Toxics Study (EPA 1993). In Rao et al. (1982), the nonradiolog trucks was 1.0 10-7 fatalities per kilometer and the nonradiological unit risk fa fatalities per kilometer. These unit risk factors are applicable only in urban are risk factor was calculated to be 7.2 10-11 fatalities per kilometer; this unit ris

areas (i.e., rural, suburban, and urban). Based on the routes analyzed in this EIS Rao et al. (1982) were found to overestimate impacts by about 20 to 30 times relati from EPA (1993). Therefore, the unit risk factors from Rao et al. (1982) were used estimate of the incident-free nonradiological fatalities presented in this EIS. It risk factors from Rao et al. (1982) account for all fatalities, not just cancer fat exposure to diesel exhaust emissions have been followed in occupationally exposed w are insufficient to make a correlation between the effects and the exposure experie Therefore, these impacts were not estimated in this EIS.

I-4.1.1 Maximally Exposed Individual Exposure Scenarios

Maximum individual doses were calculated using the RISKIND computer code (Yua The maximum individual doses for the routine transport offsite were estimated for t well as members of the general population. For rail shipments, the three general p (a) a railyard worker working at a distance of 10 meters (32.8 feet) from the shipp (b) a resident living 30 meters (98.4 feet) from the rail line where the shipping c transported, and (c) a resident living 200 meters (656.2 feet) from a rail stop whe was sitting for 20 hours. For train shipments, the maximum exposed transportation in a railyard who spent a time- and distance-weighted average of 0.16 hours inspect repairing railcars (Wooden 1986).

For offsite truck shipments, the three scenarios for the general population w in traffic and located 1 meter (3.28 feet) away from the surface of the shipping co (b) a resident living 30 meters (98.4 feet) from the highway used to transport the service station worker working at a distance of 20 meters (65.6 feet) from the ship The hypothetical maximum exposed individual radiological doses were accumulated ove However, for the situation involving an individual caught in traffic next to a truc were calculated for only one event because it was considered unlikely that the same caught in traffic next to all containers for all shipments. For truck shipments, t transportation worker is the driver who was assumed to drive shipments for up to 2,

I-4.2 Results of Calculations

This section summarizes the results of the incident-free transportation analy that occur outside the boundaries of U.S. Department of Energy sites (offsite). Th the impacts of SNF shipments within the boundaries of DOE sites (onsite). Onsite t addressed in site-specific Appendices A, B, C, D, and F of this EIS.

This section includes the impacts of offsite transport of naval-type SNF stor Processing Plant as of June 1995 to storage locations at other DOE sites, as identi Shipments of naval SNF and test specimens are addressed in Appendix D of Volume 1 o

I-4.2.1 Impacts from the No Action Alternative

Under the No Action alternative, the only offsite transport of SNF involves s and test specimens. These shipments are addressed in Appendix D of Volume 1 of thi

I-4.2.2 Impacts from the Decentralization Alternative

For the Decentralization alternative, the incident-free transportation of SNF

0.11 to 0.34 fatalities over the 40-year period 1995 through 2035 (see Table I-6). fatalities were the sum of the estimated number of radiation-related latent cancer number of nonradiological fatalities from vehicular emissions. A range of fataliti option of using truck or rail transport for SNF shipments.

The estimated number of radiation-related latent cancer fatalities for transp from 0.023 to 0.082. The estimated number of radiation-related latent cancer fatal population ranged from 0.041 to 0.24. The estimated number of nonradiological fata emissions ranged from 0.017 to 0.044.

I-4.2.3 Impacts from the 1992/1993 Planning Basis Alternative

For the 1992/1993 Planning Basis alternative, the incident-free transportatio to result in total fatalities that ranged from 0.11 to 0.42 over the 40-year period Table I-7). These fatalities were the sum of the estimated number of radiation-rel and the estimated number of nonradiological

Table I-6. Cumulative doses and health effects from incident-free transportation o alternative (1995 to 2035).

	Spent nuclear f			
	University[a]		Foreign[b]	
	Truck	Rail	Truck	R
Occupational				
Maximum individual dose (rem)	48	1.8	93	3
Collective dose (person-rem)	59	16	130	3
Estimated latent cancer fatalities	0.024	0.0064	0.052	0
General population				
Maximum individual dose (rem)	0.21	0.87	0.41	1
Collective dose (person-rem)	140	29	310	4
Estimated latent cancer fatalities	0.070	0.015	0.16	0
Estimated nonradiological fatalities	0.0050	0.012	0.010	0

a. Maheras (1995a).

b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

Table I-7. Cumulative doses and health effects from incident-free transportation o Basis alternative (1995 to 2035).

	Spent nuclear fuel type				
	University[a]		Foreign[b]		
	Truck	Rail	Truck	Rail	Tr
Occupational					
Maximum individual dose (rem)	37	1.8	71	3.4	52
Collective dose (person-rem)	59	16	130	37	66
Estimated latent cancer fatalities	0.024	0.0064	0.052	0.015	0.
General population					
Maximum individual dose (rem)	0.21	0.87	0.41	1.7	0.

Collective dose (person-rem)	140	29	310	43	14
Estimated latent cancer fatalities	0.070	0.015	0.16	0.022	0.
Estimated nonradiological fatalities	0.0050	0.012	0.010	0.027	0.

a. Maheras (1995a).

b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

fatalities from vehicular emissions. Again, a range of fatalities occurred because or rail transport for SNF shipments.

The estimated number of radiation-related latent cancer fatalities for transp from 0.024 to 0.10. The estimated number of radiation-related latent cancer fatali population ranged from 0.043 to 0.30. The estimated number of nonradiological fata emissions ranged from 0.020 to 0.046.

I-4.2.4 Impacts from the Regionalization Alternative

I-4.2.4.1 Impacts from Regionalization by Fuel Type. For the Regionalization by Fuel

Type, the incident-free transportation of SNF was estimated to result in total fata to 0.58 over the 40-year period 1995 through 2035 (see Table I-8). These fataliti estimated number of radiation-related latent cancer fatalities and the estimated nu fatalities from vehicular emissions. The reason for a range of fatalities was beca truck or rail transport for SNF shipments.

The estimated number of radiation-related latent cancer fatalities for transp from 0.026 to 0.14. The estimated number of radiation-related latent cancer fatali population ranged from 0.053 to 0.41. The estimated number of nonradiological fata emissions ranged from 0.027 to 0.059.

I-4.2.4.2 Impacts from Regionalization by Geography. For the six Regionalization by

Geography alternatives, the incident-free transportation of SNF was estimated to re ranged from 0.10 for regionalization at the Idaho National Engineering Laboratory a Reservation to 0.85 for regionalization at the Nevada Test Site and the Oak Ridge R 9 through I-14). These fatalities were over the 40-year period 1995 through 2035 a estimated number of radiation-related latent cancer fatalities and the estimated nu fatalities from vehicular emissions.

The reason for a range of fatalities was because of two factors: (a) the opt transport for SNF shipments, and (b) the six regionalization by geography alternati

For regionalization at the Idaho National Engineering Laboratory and Oak Ridg estimated number of radiation-related latent cancer fatalities for transportation w estimated number of radiation-related latent cancer fatalities for the general popu estimated number of nonradiological fatalities from vehicular emissions was 0.034.

For regionalization at the Nevada Test Site and the Oak Ridge Reservation, th radiation-related latent cancer fatalities for transportation workers was 0.20. Th

Table I-8. Cumulative doses and health effects from incident-free transportation o Fuel Type (1995 to 2035).

	Spent nuclear fu				
	Universitya		Foreignb		
	Truck	Rail	Truck	Rail	T
Occupational					
Maximum individual dose (rem)	27	1.8	52	3.4	8
Collective dose (person-rem)	54	15	150	41	1
Estimated latent cancer fatalities	0.022	0.0060	0.060	0.016	0
General population					
Maximum individual dose (rem)	0.21	0.87	0.41	1.7	0
Collective dose (person-rem)	120	33	350	54	3
Estimated latent cancer fatalities	0.060	0.017	0.18	0.027	0
Estimated nonradiological fatalities	0.0051	0.014	0.012	0.037	0

a. Maheras (1995a).

b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

Table I-9. Cumulative doses and health effects from incident-free transportation o by Geography at the Hanford Site and Savannah River Site (1995 to 2035).

	Spent nuclear				
	Universitya		Foreignb		
	Truck	Rail	Truck	Rail	
Occupational					
Maximum individual dose (rem)	20	1.8	38	3.4	10
Collective dose (person-rem)	60	17	99	31	15
Estimated latent cancer fatalities	0.024	0.0068	0.040	0.012	0.
General population					
Maximum individual dose (rem)	0.21	0.87	0.41	1.7	1.
Collective dose (person-rem)	140	30	230	44	33
Estimated latent cancer fatalities	0.070	0.015	0.012	0.022	0.
Estimated nonradiological fatalities	0.0050	0.012	0.0076	0.031	0.

a. Maheras (1995a).

b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

Table I-10. Cumulative doses and health effects from incident-free transportation by Geography at the Idaho National Engineering Laboratory and Savannah River Site (

Spent nuclear fu

	Universitya		Foreignb		Tr
	Truck	Rail	Truck	Rail	Tr
Occupational					
Maximum individual dose (rem)	21		1.8	40	
Collective dose (person-rem)	54		15	100	
Estimated latent cancer fatalities	0.022		0.0060	0.040	
General population					
Maximum individual dose (rem)	0.21		0.87	0.41	
Collective dose (person-rem)	120		28	230	
Estimated latent cancer fatalities	0.060		0.014	0.12	
Estimated nonradiological fatalities	0.0046		0.011	0.0081	

a. Maheras (1995a).

b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

Table I-11. Cumulative doses and health effects from incident-free transportation by Geography at the Nevada Test Site and Savannah River Site (1995 to 2035).

	Spent nuclear fue			
	Universitya		Foreignb	
	Truck	Rail	Truck	Rail
Occupational				
Maximum individual dose (rem)	14	1.8	27	3.4
Collective dose (person-rem)	56	17	110	31
Estimated latent cancer fatalities	0.022	0.0068	0.044	0.012
General population				
Maximum individual dose (rem)	0.21	0.87	0.41	1.7
Collective dose (person-rem)	130	29	250	45
Estimated latent cancer fatalities	0.065	0.015	0.13	0.023
Estimated nonradiological fatalities	0.0053	0.012	0.0076	0.031

a. Maheras (1995a).

b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

Table I-12. Cumulative doses and health effects from incident-free transportation by Geography at the Hanford Site and Oak Ridge Reservation (1995 to 2035).

	Spent nuclear fuel t	
	Universitya	Foreignb

	Truck	Rail	Truck	Rail	Tr
Occupational					
Maximum individual dose (rem)	17	1.8	32	3.4	11
Collective dose (person-rem)	56	16	94	29	17
Estimated latent cancer fatalities	0.022	0.0064	0.038	0.012	0.
General population					
Maximum individual dose (rem)	0.21	0.87	0.41	1.7	1.
Collective dose (person-rem)	130	26	220	33	39
Estimated latent cancer fatalities	0.065	0.013	0.11	0.017	0.
Estimated nonradiological fatalities	0.0049	0.0087	0.0066	0.020	0.

a. Maheras (1995a).

b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

Table I-13. Cumulative doses and health effects from incident-free transportation by Geography at the Idaho National Engineering Laboratory and Oak Ridge Reservation

	Spent nuclear fuel ty				
	Universitya		Foreignb		
	Truck	Rail	Truck	Rail	T
Occupational					
Maximum individual dose (rem)	17	1.8	34	3.4	1
Collective dose (person-rem)	50	15	95	29	1
Estimated latent cancer fatalitie	0.020	0.0060	0.038	0.012	0
General population					
Maximum individual dose (rem)	0.21	0.87	0.41	1.7	1
Collective dose (person-rem)	110	23	220	30	3
Estimated latent cancer fatalitie	0.055	0.012	0.11	0.015	0
Estimated nonradiological fatalit	0.0046	0.0077	0.0071	0.017	0

a. Maheras (1995a).
b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

Table I-14. Cumulative doses and health effects from incident-free transportation by Geography at the Nevada Test Site and Oak Ridge Reservation (1995 to 2035).

	Spent nuclear fu				
	Universitya		Foreignb		
	Truck	Rail	Truck	Rail	Tr

Occupational					
Maximum individual dose (rem)	12	1.8	24	3.4	12
Collective dose (person-rem)	52	16	100	29	36
Estimated latent cancer fatalities	0.021	0.0064	0.040	0.012	0.
General population					
Maximum individual dose (rem)	0.21	0.87	0.41	1.7	2.
Collective dose (person-rem)	120	25	240	33	84
Estimated latent cancer fatalities	0.060	0.013	0.12	0.017	0.
Estimated nonradiological fatalities	0.0052	0.0083	0.0066	0.021	0.

a. Maheras (1995a).

b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

number of radiation-related latent cancer fatalities for the general population was number of nonradiological fatalities from vehicular emissions was 0.054.

I-4.2.5 Impacts from the Centralization Alternatives

For the five Centralization alternatives, the incident-free transportation of estimated to result in total fatalities that ranged from 0.16 for centralization at 1.7 for centralization at the Savannah River Site (see Tables I-15 through I-19). the 40-year period 1995 through 2035 and were the sum of the estimated number of ra cancer fatalities and the estimated number of nonradiological fatalities from vehic

The reason for a range of fatalities was because of two factors: (a) the opt transport for SNF shipment and (b) the five Centralization options.

For centralization at the Oak Ridge Reservation, the estimated number of radi cancer fatalities for transportation workers was 0.042. The estimated number of ra cancer fatalities for the general population was 0.067. The estimated number of no from vehicular emissions was 0.055.

For centralization at the Savannah River Site, the estimated number of radiat fatalities for transportation workers was 0.42. The estimated number of radiation-fatalities for the general population was 1.2. The estimated number of nonradiolog vehicular emissions was 0.074.

I-4.2.6 Impacts of Using Alternate Points of Entry for Foreign Research Reactor Spent

Nuclear Fuel Shipments

For incident-free transportation (radiological and vehicle-related), shipment Florida, and Wilmington, North Carolina, to the Hanford Site, Idaho National Engine Savannah River Site, Oak Ridge Reservation, and Nevada Test Site would yield lower shipments from Charleston, South Carolina, Galveston, Texas, Hampton Roads, Virgini Georgia, and the Military Ocean Terminal, Sunny Point, North Carolina, to these sam

Table I-15. Cumulative doses and health effects from incident-free transportation the Hanford Site alternative (1995 to 2035).

	Spent nuclear fuel t	
	Universitya	Foreignb

	Truck	Rail	Truck	Rail	Tr
Occupational					
Maximum individual dose (rem)	16	1.8	32	3.4	11
Collective dose (person-rem)	100	26	220	56	43
Estimated latent cancer fatalities	0.040	0.010	0.088	0.022	0.
General population					
Maximum individual dose (rem)	0.21	0.87	0.41	1.7	1.
Collective dose (person-rem)	250	38	560	56	99
Estimated latent cancer fatalities	0.13	0.019	0.28	0.028	0.
Estimated nonradiological fatalities	0.0057	0.014	0.016	0.035	0.

a. Maheras (1995a).

b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

Table I-16. Cumulative doses and health effects from incident-free transportation the Idaho National Engineering Laboratory alternative (1995 to 2035).

	Spent nuclear fuel typ				
	Universitya		Foreignb		
	Truck	Rail	Truck	Rail	Tru
Occupational					
Maximum individual dose (rem)	17	1.8	33	3.4	11
Collective dose (person-rem)	86	22	190	49	38
Estimated latent cancer fatalities	0.034	0.0088	0.076	0.020	0.
General population					
Maximum individual dose (rem)	0.21	0.87	0.41	1.7	1.
Collective dose (person-rem)	210	33	490	49	88
Estimated latent cancer fatalities	0.11	0.017	0.25	0.025	0.
Estimated nonradiological fatalities	0.0049	0.012	0.015	0.031	0.

a. Maheras (1995a).

b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

Table I-17. Cumulative doses and health effects from incident-free transportation at the Savannah River Site alternative (1995 to 2035).

	Spent nuclear fuel				
	Universitya		Foreignb		
	Truck	Rail	Truck	Rail	Tru

Occupational					
Maximum individual dose (rem)	14	1.8	27	3.4	120
Collective dose (person-rem)	53	15	140	40	840
Estimated latent cancer fatalities	0.021	0.006	0.056	0.016	0.3
General population					
Maximum individual dose (rem)	0.21	0.87	0.41	1.7	1.8
Collective dose (person-rem)	110	34	330	54	190
Estimated latent cancer fatalities	0.055	0.017	0.17	0.027	0.9
Estimated nonradiological fatalities	0.0050	0.014	0.012	0.037	0.0

a. Maheras (1995a).

b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

Table I-18. Cumulative doses and health effects from incident-free transportation the Oak Ridge Reservation alternative (1995 to 2035).

	Spent nuclear fuel type				
	Universitya		Foreignb		
	Truck	Rail	Truck	Rail	T
Occupational					
Maximum individual dose (rem)	12	1.8	24	3.4	1
Collective dose (person-rem)	42	13	130	36	7
Estimated latent cancer fatalities	0.017	0.0052	0.052	0.014	0
General population					
Maximum individual dose (rem)	0.21	0.87	0.41	1.7	2
Collective dose (person-rem)	91	25	310	39	1
Estimated latent cancer fatalities	0.046	0.013	0.16	0.02	0
Estimated nonradiological fatalities	0.0042	0.0091	0.0097	0.023	0

a. Maheras (1995a).

b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

Table I-19. Cumulative doses and health effects from incident-free transportation Nevada Test Site alternative (1995 to 2035).

	Spent nuclear fuel type				
	Universitya		Foreignb		
	Truck	Rail	Truck	Rail	Tr
Occupational					
Maximum individual dose (rem)	12	1.8	24	3.4	
Collective dose (person-rem)	94	25	230	54	

Estimated latent cancer fatalities	0.038	0.010	0.092	0.022
General population				
Maximum individual dose (rem)	0.21	0.87	0.41	1.7
Collective dose (person-rem)	230	37	540	56
Estimated latent cancer fatalities	0.12	0.019	0.27	0.028
Estimated nonradiological fatalities	0.0066	0.013	0.016	0.037

a. Maheras (1995a).

b. Maheras (1995b).

c. Maheras (1995c).

d. DOE SNF includes special-case commercial, DOE research, other domestic research River production reactor SNF (see Tables I-2, I-3).

e. Occupational incident-free nonradiological fatalities are included with the gen fatalities.

I-5 SPENT NUCLEAR FUEL TRANSPORTATION ACCIDENT RISKS AND MAXIMUM REASONABLY FORESEEABLE CONSEQUENCES

I-5.1 Methodology

The offsite SNF transportation accident analysis considers the impacts of acc transportation of SNF by truck or rail. SNF is transported in specially designed c Department of Transportation and U.S. Nuclear Regulatory Commission Type B packagin 10 CFR Part 71 (CFR 1994b).

Under accident conditions, impacts to human health and the environment may re and dispersal of radioactive material. Because of the rigorous design specificatio the U.S. Nuclear Regulatory Commission has estimated that casks will withstand 99.4 accidents without sustaining damage sufficient to breach the cask (Fischer et al. 1 accidents that could potentially breach the cask are represented by a spectrum of a radioactive release conditions. Accident analysis methodology has been developed b Regulatory Commission for calculating the probabilities and consequences from this accidents, but it is not possible to predict where along the shipping route such ac

To provide DOE and the public a reasonable assessment of SNF transportation a types of analyses were performed. First, an accident risk assessment was performed the probabilities and consequences of a spectrum of accident severities using metho U.S. Nuclear Regulatory Commission (Fischer et al. 1987). The accident risk assess information for accident rates and population densities. For the spectrum of accid analysis, accident consequences in terms of collective dose to the population withi were multiplied by the accident probabilities to yield dose risk using the RADTRAN Second, to represent the maximum reasonably foreseeable impacts to individuals and accident occur, radiological consequences were calculated for an accident of maximu severity in each population zone. An accident is considered reasonably foreseeable

occurrence is greater than 1 10-7 per year. The accident consequence assessment f individuals and population groups was performed using the RISKIND computer code.

An important variable in the assessment of impacts from SNF transportation ac SNF. A wide range of SNF types exists within the DOE complex with significant diff material content, fuel material design, cladding design, reactor operating history, history. These differences among SNF types translate into different radioactive ma characteristics under accident conditions. To account for the variation in SNF typ for the following representative SNF types: (a) naval reactor fuels, (b) Savannah fuels, (c) Hanford N-Reactor fuels, (d) graphite fuels, (e) special-case commercial research/test reactor fuels, (g) DOE research/test reactor fuels, (h) foreign resea DOE research reactor fuels.

The impacts for specific alternatives were calculated in units of dose (perso and destination pair associated with each representative SNF type. The impacts are health risks in terms of latent cancer fatalities in exposed populations. The hea used were derived from International Commission on Radiological Protection Publicat

I-5.1.1 Accident Rates

For calculating accident shipment-risk factors, state-level accident rates we provided in Saricks and Kvitek (1994) for rail and heavy combination trucks. For t separate accident rates were used for rural, suburban, and urban population density average accident rate was used for each state for rail transportation. For truck t risks were based on state-level rates for interstate highways in urban and rural ar 1994). Accident fatality risks for rail transportation were calculated using a nat 10-8 fatalities per rail-kilometer (Cashwell et al. 1986).

I-5.1.2 Accident Severity Categories and Conditional Probabilities

Accident severity categories for potential SNF transportation accidents are d Nuclear Regulatory Commission report commonly referred to as the Modal Study (Fisch Modal Study classification scheme for both truck and rail transportation is shown i described as a function of the magnitudes of the mechanical forces (impact) and the a cask may be subjected during an accident. Because all accidents can be described independent of the specific accident sequence. In other words, any sequence of eve accident in which a cask is subjected to forces within a certain range of values is severity category associated with that range. The accident severity scheme is desi reasonably foreseeable transportation accidents, including accidents with low proba consequences and those with high probability but low consequences.

The severity category matrix represents a set of scenarios defined by a combi and thermal forces. A conditional probability is assigned in each category as show example, Category R(1,1) accidents are the least severe but most frequent, whereas accidents are very severe but very infrequent. To determine the expected frequency the conditional probability in each category was multiplied by the baseline acciden density zone has a distinct baseline accident rate and distribution

Figure I-1. Matrix of cask response regions for combined mechanical and thermal

Figure I-2. Fraction of truck and rail accidents expected within each severity c

of accident severities related to differences in average vehicle velocity, traffic including rural, suburban, or urban location.

For the accident risk assessment, accident risk was generically defined as th accident multiplied by the probability of the occurrence of that accident, an appro methodology suggested by the existing RADTRAN computer code. Accident unit-risk fa calculated using the RADTRAN 4 computer code, then summed over the accident conditi and route characteristics for the origin and destination pairs to yield risk per sh accident risk factors take into account the entire spectrum of reasonably foreseeab including low probability accidents that have high consequences and high probabilit consequences.

For the maximum reasonably foreseeable accident consequence assessment, the d for populations and individuals assuming the most severe accident scenario with a p

1 X 10^-7 per year. In terms of the radioactivity released to the environment, the foreseeable accident is represented by eight accident severity categories [R(4,1) t through R(3,5)]. Each of the eight most severe accident categories result in the s radioactive material, but the conditional probabilities of occurrence vary. Theref consequence assessment is based on a maximum reasonably foreseeable release of radi conditional probability that is the sum of the conditional probabilities of the eig categories. Accidents of this severity are extremely rare, occurring approximately 10,000 rail accidents involving a SNF shipment.

I-5.1.3 Atmospheric Conditions

Because it is impossible to predict the specific location of an offsite trans atmospheric conditions were selected for the risk and consequence assessments. For assessment, neutral weather conditions (Pasquill Stability Class D) were assumed. conditions are typified by moderate windspeeds, vertical mixing within the atmosphe of atmospheric contaminants. Because neutral meteorological conditions compose the occurring atmospheric stability condition in the United States, these conditions ar in the event of an accident involving a SNF shipment. On the basis of observations Service surface meteorological stations at over 300 locations in the United States, neutral conditions (Pasquill Class C and D) occur 50 percent of the time, while sta F) and unstable (Pasquill Class A and B) conditions occur 33 percent and 17 percent (Doty et al. 1976). The neutral category predominates in all seasons, but most fre (nearly 60 percent of the observations). For the accident consequence assessment, both neutral (Class D with 4 meters per second windspeed) and stable (Class F with windspeed) atmospheric conditions. Stable weather conditions are typified by low w vertical mixing within the atmosphere, and poor dispersion of atmospheric contamina meteorology in combination with windspeeds of 1 meter per second generally occur no the time. Results calculated for neutral conditions represent the most likely cons stable conditions represent a worst-case weather situation.

I-5.1.4 Population Density Zones

Three population density zones (rural, suburban, and urban) were used for the assessment. These zones respectively correspond to mean population densities of 6, per square kilometer. The three population density zones are based on an aggregati density zones provided in the HIGHWAY and INTERLINE output. For calculating, popul information was generated at the state level and used as RADTRAN input for the orig

I-5.1.5 Exposure Pathways

Radiological doses were calculated for an individual located near the scene o populations within 50 miles (80 kilometers) of the accident. Rural, suburban, and were assessed. Dose calculations considered a variety of exposure pathways, includ exposure (cloudshine) from the passing cloud, ingestion from contaminated crops, di (groundshine) from radioactivity deposited on the ground, and inhalation of resuspe from the ground.

I-5.1.6 Health Risk Conversion Factors

The health risk conversion factors used to estimate expected latent cancer fa exposures were derived from International Commission on Radiological Protection Pub 1991): 5.0 10-4 and 4.0 10-4 latent fatal cancer cases per person-rem for membe

workers, respectively.

I-5.2 Spent Nuclear Fuel Characterization and

Radioactive Release Characteristics

I-5.2.1 Characterization of Representative Spent Nuclear Fuel Types

Shipments of naval reactor SNF are addressed in Appendix D of Volume 1 of thi exception of naval-type SNF that has been transferred from the U.S. Navy to the DOE storage at the Idaho National Engineering Laboratory Idaho Chemical Processing Plan data for naval-type SNF were derived from Appendix D of Volume 1 of this EIS.

Savannah River Site production reactor SNF was assumed to include both the sp to power the production reactors, as well as the quantities of irradiated plutonium storage at the Savannah River Site. Spent driver fuel stored at the Savannah River tritium and plutonium production. Analysis of these two fuel types showed that typ SNF contains a higher fission product and transuranic inventory than plutonium prod the characteristics of typical irradiated plutonium target material also showed tha would be bounded by the inventory in spent tritium production driver fuel. Therefo both spent driver fuel and irradiated plutonium target material at the Savannah Riv have the characteristics of spent tritium production driver fuel. Table I-20 shows developed to represent Savannah River Site production reactor SNF based on publishe 1991; WSRC 1990).

Characterization data for Hanford N-Reactor SNF were based on Mark IA fuel ir average burnup of 3,000 megawatt-days per metric ton uranium and assuming a 10-year removal from the reactor. The 10-year cooling time is conservative because the Han operated in 1987 and SNF of this type is expected to be at least 10 years old by th begin. Table I-21 shows the radionuclide inventory used to represent Hanford N-Rea

Most of the graphite SNF under the responsibility of the DOE is from the Fort owned by Public Service of Colorado. Some Fort St. Vrain SNF is already in storage Engineering Laboratory, but most SNF is still in storage at the Fort St. Vrain site DOE facility. In addition to the Fort St. Vrain SNF, smaller amounts of other grap storage at the Idaho National Engineering Laboratory. Characteristics for graphite on Fort St. Vrain SNF. Table I-22 shows the radionuclide inventory used to represe based on six Fort St. Vrain fuel blocks irradiated to an average burnup of 70,000 m ton uranium and assuming a cooling time of 1,600 days (Block 1993). The 1,600-day cooling time is conservative because the Fort St. Vrain reactor was shut down in Au will not be made before June 1995.

SNF from various commercial reactors is currently in storage at various DOE s Idaho National Engineering Laboratory. Special-case commercial SNF currently in st National Engineering Laboratory includes core debris from the damaged Three Mile Is Commercial SNF includes both boiling water reactor and pressurized water reactor SN reactor SNF was chosen as most representative because it is most prevalent and typi levels of radioactivity (Fischer et al. 1987). Table I-23 shows the radionuclide i commercial SNF based on one pressurized water reactor fuel assembly irradiated to a 33,000 megawatt-days per metric ton uranium and assuming a cooling time of 10 years The 10-year cooling time is conservative because the majority of special-case comme storage at DOE sites will be at least 10 years old by June 1995.

Table I-20. Radionuclide inventory for representative Savannah River Site producti fuel.(a)

Isotope	Inventory (curie)
H-3	1.21 X 10^1
Kr-85	2.62 X 10^2

Sr-90	3.21 X 10^3
Y-90	3.21 X 10^3
Ru-106	7.64 X 10^0
Rh-106	7.64 X 10^0
Cs-134	1.48 X 10^2
Cs-137	3.18 X 10^3
Ba-137m	3.01 X 10^3
Ce-144	1.51 X 10^1
Pr-144	1.51 X 10^1
Pm-147	1.07 X 10^2
Pu-238	6.84 X 10^1
Pu-239	7.69 X 10^-1
Pu-240	5.23 X 10^-1
Pu-241	9.52 X 10^1
Am-241	1.97 X 10^0

a. Inventory based on one fuel assembly from a tritium producing charge, 10 years

Table I-21. Radionuclide inventory for representative Hanford N-Reactor spent nucl

Isotope	Inventory (curie per metric ton uranium)
H-3	3.09 X 10^1
Kr-85	5.89 X 10^2
Sr-90	6.80 X 10^3
Y-90	6.80 X 10^3
Ru-106	5.56 X 10^1
Sb-125	1.26 X 10^2
Cs-134	1.49 X 10^2
Cs-137	8.39 X 10^3
Ba-137m	7.94 X 10^3
Ce-144	3.24 X 10^1
Pm-147	2.24 X 10^3
Pu-238	5.06 X 10^1
Pu-239	1.10 X 10^2
Pu-240	5.97 X 10^1
Pu-241	4.47 X 10^3
Am-241	9.33 X 10^1

a. Inventory based on Mark IA N-Reactor fuel, 10 years cooling out of reactor, ave megawatt-days per metric ton uranium.

Table I-22. Radionuclide inventory for representative graphite reactor spent nucle

Isotope	Inventory (curie)
Kr-85	2.35 X 10^3
Sr-90	1.57 X 10^4
Rh-106	5.94 X 10^2
Ru-106	5.94 X 10^2
Sb-125	3.36 X 10^2
Cs-134	7.45 X 10^3
Cs-137	1.65 X 10^4
Ce-144	3.77 X 10^3
Pr-144	3.77 X 10^3
Pm-147	6.32 X 10^3
Sm-151	5.4 X 10^1
Eu-154	9.48 X 10^2
Eu-155	1.38 X 10^2
U-232	1.8 X 10^1
U-233	2.4 X 10^1
Pu-238	4.20 X 10^2

Pu-241	3.06 X 10^2

a. Inventory based on six Fort St. Vrain fuel blocks, 1600 days cooling out of rea 70,000 megawatt-days per metric ton uranium.

Table I-23. Radionuclide inventory for representative special-case commercial spen

Isotope	Inventory (curie)
Co-60	6.28 X 10^2
Kr-85	2.23 X 10^3
Sr-90	2.75 X 10^4
Y-90	2.73 X 10^4
Ru-106	2.52 X 10^2
I-129	1.48 X 10^-2
Cs-134	4.85 X 10^3
Cs-137	3.85 X 10^4
Ba-137m	3.62 X 10^4
Ce-144	9.01 X 10^1
Pu-238	1.36 X 10^3
Pu-239	1.67 X 10^2
Pu-240	2.06 X 10^2
Pu-241	4.32 X 10^4
Am-241	9.66 X 10^2
Cm-244	6.90 X 10^2

a. Inventory based on one pressurized water reactor fuel assembly, 10 years coolin burnup 33,000 megawatt-days per metric ton uranium.

Domestic university research and test reactors represent a variety of reactor High-enriched training, research, and isotope reactor (TRIGA) SNF was chosen as rep university reactor SNF because it is one of the largest groups of university SNF to it is a rod-type fuel that would be expected to have the highest release of fission accident conditions. The radionuclide inventory of high-enriched TRIGA fuel was ca ORIGEN2 computer code (Croff 1980) assuming a 17-year reactor operating cycle based Texas A&M University TRIGA reactor. To facilitate the modeling of accident consequ radionuclide inventory generated by the ORIGEN2 program was truncated to eliminate dose. The radionuclides eliminated accounted for less than 1 percent of the total available in Enyeart (1995). Table I-24 shows the radionuclide inventory represent research and test reactor SNF based on 19 TRIGA fuel rods irradiated to an average and assuming a cooling time of 1 year.

DOE research and test reactors are also represented by a variety of reactor t Experimental Breeder Reactor-II Mark-V SNF was chosen as representative of DOE rese reactors because the reactor at the Idaho National Engineering Laboratory is one of test reactors still operating. Mark-V fuel is the current generation of Experiment types. The high plutonium content of Mark-V fuel increases the relative hazard of compared to other DOE SNF types. The radionuclide inventory of the Mark-V fuel was ORIGEN2 computer code assuming a typical Experimental Breeder Reactor-II operating the modeling of accident consequences, the radionuclide inventory generated by the truncated to eliminate minor contributors to dose. The radionuclides eliminated ac percent of the total dose. Additional details are available in Enyeart (1995). Ta radionuclide inventory representative of DOE research and test reactor SNF based on assembly irradiated to a burnup of 7.88 percent and assuming a cooling time of 1 ye

Foreign research and test reactors use a number of different fuel designs. D characteristics of foreign research reactor SNF types in a separate EIS on a Propos Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel. Ba a shipment of 40 TRIGA-type SNF elements was determined to result in the highest po radioactivity in the event of an accident. To provide a bounding analysis for this SNF was selected as representative of all foreign research reactor SNF. To facilit consequences, the radionuclide inventory generated by the ORIGEN2 program was trunc minor contributors to dose. The radionuclides eliminated accounted for less than 1 The radionuclide inventory of a single shipping cask, shown in Table I-26, is based period of 3 years, with a burnup of 31 grams of uranium-235 per fuel element, follo

of 1 year.

Table I-24. Radionuclide inventory for representative university research/test rea

Isotope	Inventory (curie)	Isotope	Inventory (curie)
H-3	3.25 X 10^0	Cs-137	9.72 X 10^2
Kr-85	8.60 X 10^1	Ba-137M	9.20 X 10^2
Sr-89	4.28 X 10^1	Ce-141	3.86 X 10^0
Sr-90	9.30 X 10^2	Ce-144	1.47 X 10^3
Y-90	9.30 X 10^2	Pr-144	1.47 X 10^3
Y-91	9.77 X 10^1	Pm-147	8.81 X 10^2
Zr-95	1.48 X 10^2	U-235	4.00 X 10^-
Nb-95	3.20 X 10^2	U-236	5.50 X 10^-
Ru-103	7.47 X 10^0	Pu-238	1.00 X 10^0
Rh-103m	6.74 X 10^0	Pu-239	1.57 X 10^-
Ru-106	1.36 X 10^2	Pu-240	6.70 X 10^-
Te-125m	4.11 X 10^0	Pu-241	5.88 X 10^0
Te-127	2.08 X 10^0	Am-241	4.57 X 10^-
Te-127m	2.12 X 10^0	Cm-242	1.81 X 10^-
Cs-134	1.10 X 10^2		

a. Inventory based on 19 TRIGA fuel rods (70 percent enrichment; 122 g/rod uranium life), 1 year cooling out of reactor, 20.2 percent average burnup.

Table I-25. Radionuclide inventory for representative DOE research/test reactor sp

Isotope	Inventory (curie per assembly)	Isotope	Inventory (curie per a
H-3	7.98 X 10^0	Te-127	3.32 X 10^1
Mn-54	7.48 X 10^2	Te-129m	1.14 X 10^0
Fe-55	6.12 X 10^2	Cs-134	9.15 X 10^1
Co-58	1.25 X 10^2	Cs-137	1.04 X 10^3
Co-60	3.55 X 10^0	Ba-137m	9.80 X 10^2
Kr-85	9.75 X 10^1	Ce-141	1.49 X 10^1
Sr-89	1.45 X 10^2	Ce-144	7.76 X 10^3
Sr-90	7.23 X 10^2	Pr-144m	1.11 X 10^2
Y-90	7.23 X 10^2	Pr-144	7.76 X 10^3
Y-91	3.67 X 10^2	Pm-147	2.65 X 10^3
Zr-95	7.00 X 10^2	Sm-151	2.91 X 10^1
Nb-95	1.52 X 10^3	Eu-155	1.00 X 10^2
Ru-103	4.88 X 10^1	U-235	2.90 X 10^-
Rh-103m	4.40 X 10^1	U-236	3.34 X 10^-
Ru-106	3.65 X 10^3	Pu-238	1.48 X 10^0
Rh-106	3.65 X 10^3	Pu-239	4.05 X 10^1
Sn-123	2.48 X 10^1	Pu-240	3.61 X 10^1
Sb-125	1.21 X 10^2	Pu-241	1.39 X 10^3
Te-125m	2.96 X 10^1	Am-241	4.74 X 10^0
Te-127m	3.37 X 10^1		

a. Inventory based on EBR-II Mark-V fuel, 1 year cooling out of reactor, total bur days.

Table I-26. Radionuclide inventory for representative foreign research/test reacto

Isotope	Inventory (curie)	Isotope	Inventory (curie)
H-3	1.31 X 10^1	Ce-141	6.97 X 10^2
Kr-85	3.63 X 10^2	Ce-144	2.55 X 10^4
Sr-89	2.75 X 10^3	Pr-144	2.55 X 10^4
Sr-90	3.16 X 10^3	Pm-147	7.02 X 10^3

Y-90	3.16 X 10^3	Pm-148m	4.68 X 10^1
Y-91	4.56 X 10^3	Eu-154	4.18 X 10^1
Zr-95	6.48 X 10^3	Eu-155	2.27 X 10^1
Nb-95	1.28 X 10^4	U-234	1.81 X 10^-
Ru-103	8.44 X 10^2	U-235	7.91 X 10^-
Rh-103m	8.44 X 10^2	U-238	6.51 X 10^-
Ru-106	2.54 X 10^3	Pu-238	3.03 X 10^0
Rh-106m	2.54 X 10^3	Pu-239	5.50 X 10^-
Sn-123	2.71 X 10^1	Pu-240	2.09 X 10^0
Sb-125	1.19 X 10^2	Pu-241	2.13 X 10^2
Te-125m	2.87 X 10^1	Am-241	4.07 X 10^-
Te-127m	5.57 X 10^1	Am-242m	9.00 X 10^-
Te-129m	2.31 X 10^1	Am-243	4.38 X 10^-
Cs-134	1.16 X 10^3	Cm-244	7.14 X 10^-
Cs-137	3.19 X 10^3	Cm-242	5.25 X 10^0

a. Inventory based on 40 foreign TRIGA fuel elements, 1 year cooling out of reacto 31 grams uranium-235 per fuel element.

Non-DOE research reactor types are generally similar to domestic university researc Therefore, TRIGA reactor SNF was also chosen as representative of non-DOE research

I-5.2.2 Radioactive Release Characteristics

Radiological consequences were calculated by assigning cask release fractions severity category for each chemically and physically distinct radioisotope. The re the fraction of the radioactivity in the cask that could be released from the cask Release fractions vary according to SNF type and the physical/chemical properties o solid radionuclides in SNF are nonvolatile and are, therefore, relatively nondisper radionuclides, such as krypton-85, are relatively easy to release if the fuel cladd compromised.

Representative cask release fractions were developed for each of the represen U.S. Nuclear Regulatory Commission Modal Study developed release fractions for comm water reactor SNF. The Modal Study release fractions, shown in Table I-27, are bas judgment and are conservative for most SNF types. For this analysis, the release f the Modal Study were applied only to commercial pressurized-water reactor SNF and T which are rod-type fuels. Because of the significant differences in fuel designs a appropriate fuel-specific release characterization data, less conservative release other representative SNF types.

Release fractions for aluminum fuels (aluminum alloy fuel, aluminum cladding) laboratory measurements of release fractions from aluminum fuels at high temperatur and the U.S. Nuclear Regulatory Commission Modal Study (Fischer et al. 1987). Beca melting point of aluminum compared to metals used in other metallic fuels, the alum fractions are considered bounding for metallic fuels (that is, Savannah River Produ Reactor, and EBR-II Mark V SNF). Release fractions for the aluminum and other meta listed in Table I-28.

Release fractions for graphite fuels, specifically Fort St. Vrain SNF, were b analyses. Fort St. Vrain fuel is in the form of carbide particles, encased within ceramic coating. Stress analysis tests have shown that the fuel particles can with of those that might be encountered in severe accidents. Thermal diffusion across t extreme temperature conditions is the only significant mechanism for release of fis Fort St. Vrain fuel. Fuel particles that have failed during reactor operation (les inventory) are vulnerable to vaporization and impact-induced releases of particulat products would have been released within the extreme thermal environment of the ope 29 summarizes the release fractions applied to Fort St. Vrain SNF, assuming 1 perce reactor operations.

Table I-27. Release fractions for transportation accidents involving special-case research reactor spent nuclear fuel types for the U.S. Nuclear Regulatory Commissio

	Release fractiona

Cask response region	Inert gas	Iodine	Cesium	Ruthenium	
R(1,1)	0.0	0.0	0.0	0.0	
R(1,2),R(1,3)	9.9 10-3	7.5 10-5	6.0 10-6	8.1 10-7	6.0
R(2,1),R(2,2),R(2,3)	3.3 10-2	2.5 10-4	2.0 10-5	2.7 10-6	2.0
R(1,4),R(2,4),R(3,4)	3.9 10-1	4.3 10-3	2.0 10-4	4.8 10-5	2.0
R(3,1),R(3,2),R(3,3)	3.3 10-1	2.5 10-3	2.0 10-4	2.7 10-5	2.0
R(1,5),R(2,5),R(3,5),R (4,5),R(4,1),R(4,2), R(4,3),R(4,4)	6.3 10-1	4.3 10-2	2.0 10-3	4.8 10-4	2.0

a. U.S. Nuclear Regulatory Commission Modal Study (Fischer et al. 1987).

Table I-28. Release fractions for transportation accidents involving aluminum and for the U.S. Nuclear Regulatory Commission Modal Study cask response regions.

	Release fractionb			
Cask response region	Inert gas	Iodine	Cesium	Ruthenium
R(1,1)	0.0	0.0	0.0	0.0
R(1,2),R(1,3)	9.9 10^-3	1.1 10^-7	3.0 10^-8	4.1 10^-9
R(2,1),R(2,2),R(2,3)	3.3 10^-2	3.5 10^-7	1.0 10^-7	1.4 10^-8
R(1,4),R(2,4),R(3,4)	3.9 10^-1	6.0 10^-6	1.0 10^-6	2.4 10^-7
R(3,1),R(3,2),R(3,3)	3.3 10^-1	3.5 10^-6	1.0 10^-6	1.4 10^-7
R(1,5),R(2,5),R(3,5) (4,5),R(4,1),R(4,2), R(4,3),R(4,4)	6.3 10^-1	6.0 10^-5	1.0 10^-5	2.4 10^-6

a. These release fractions are applicable to the following SNF types:
  1. N Reactor
  2. Savannah River Site production reactor
  3. DOE research/test reactor

b. Derived from Shibata et al. (1984) and U.S. Nuclear Regulatory Commission Modal

Table I-29. Release fractions for transportation accidents involving graphite spen Commission Modal Study cask response regions.

	Release fraction				
Cask response region	Inert gasa	Strontium, ceriumb	Antimonyc	Cesiumb	
R(1,1)	0.0	0.0	0.0	0.0	
R(1,2),R(1,3),R(1,4),R (2,1),R(2,2),R(2,3),R(2 ,4),R(3,1),R(3,2),R),R(3,4),R(4,1),R(4,2), R(4,3),R(4,4)	5.3 10^-3	3.7 10^-7	1.0 10^-6	2.4 10^-7	7.
R(1,5),R(2,5),R(3,5 (4,5)	1.2 10^-2	5.0 10^-6	1.0 10^-6	9.1 10^-6	7.

a. Thermally induced, from NUREG/CR-0722, Table 40, all fuel (Lorenz et al. 1980).

b. Empirical data from the Fort St. Vrain Final Safety Analysis Report, Rev. 8, Ta

c. Thermally induced semivolatiles from incore failed fuel; 1 percent fuel failure from Lorenz et al. (1980).

d. Impact induced nonvolatiles, 1 percent incore failed fuel, 5 percent respirable Wilmot (1981).

I-5.3 Results of Calculations

I-5.3.1 Impacts from the No Action Alternative

There are no offsite shipments of DOE, university, foreign, or non-DOE resear this alternative. Consequently, there are no transportation accident impacts. The fuel shipments made under the No Action alternative are covered in Appendix D of Vo

I-5.3.2 Impacts from the Decentralization Alternative

The SNF shipments included under this alternative are those of domestic unive non-DOE research reactor SNF to the Idaho National Engineering Laboratory and Savan Naval fuel shipments made under different options of the Decentralization alternati Appendix D of Volume 1 of this EIS. Shipments are expected to be made by truck, bu also assessed transportation by rail. The same shipping cask was assumed to be use shipments, and a single shipping cask was assumed for each shipment.

The cumulative accident risk for transportation by truck was calculated to be fatality and 0.15 traffic fatality. The cumulative accident risk measures the tota accidents over the entire shipment campaign (1995 to 2035). The cumulative acciden by rail was calculated to be 0.0003 latent cancer fatality and 0.21 traffic fatalit transportation accident risks for the Decentralization alternative.

As shown in Table I-31, the maximum reasonably foreseeable transportation acc probability of occurrence of about 1.6 10-7 per year for a suburban population zon (neutral) weather conditions, the total population dose is estimated to be about 14 be expected to result in less than one latent cancer fatality in the exposed popula same population would be expected to experience about 100,000 latent fatal cancers probability of this accident occurring in an urban population zone, or occurring un conditions in any population zone, is less than 1 10-7 per year.

I-5.3.3 Impacts from the 1992/1993 Planning Basis Alternative

This alternative includes the transport of five types of SNF. It assumes tha currently in storage in Colorado is transported to the Idaho National Engineering L special-case commercial SNF currently stored at West Valley is transported to the I Engineering Laboratory. DOE research and test reactor SNF is transported to either Engineering Laboratory or Savannah River Site, with most going to the

Table I-30. SNF transportation accident risks for the Decentralization alternative

Transport mode	Dose risk (person-rem)	Latent cancer fatalities(a
Truck	1.7	0.0009
Rail	0.57	0.0003

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac impact.

Table I-31. Health effects from maximum reasonably foreseeable offsite SNF transpo

the Decentralization alternative (1995 to 2035).

Alternative: Decentralization
Maximum reasonably foreseeable accident: University research reactor SNF shipment
Population zone: Suburbana
Maximum reasonably foreseeable accident probability: 1.6 10-7 per year with neutr
1 X 10^-7 per year with stable meteorology

Doses and health effects	Transport mode	Population		Maximum exposed ind
		Neutral(b)	Stable(c)	Neutral(b)
Dose	Rail	14 person-rem	(e)	0.032 rem
Latent cancer fatalities(d)	Rail	0.007	(e)	1.6 X 10^-5

a. The maximum reasonably foreseeable accident occurs in a suburban population zon occurring in an urban population zone is less than 1 10-7 per year. In a rural po approximately 9 percent of the suburban population dose.

b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t radiation dose; for the maximally exposed individual, results express the probabili radiation dose. Fatal cancer risk factor: 5 10-4 fatal cancers per person-rem (I

e. Consequences not developed for accidents with probabilities less than 1 10-7 p

Idaho National Engineering Laboratory. Shipments of university, foreign, and non-D SNF are split between the Idaho National Engineering Laboratory and the Savannah Ri could be by truck or rail, so the analysis addresses the two extremes of all shipme by rail.

The cumulative accident risk for transportation by truck was calculated to be fatality and 0.19 traffic fatality. The cumulative accident risk measures the to accidents over the entire shipment campaign (1995 to 2035). The cumulative acciden by rail was calculated to be 0.0003 latent cancer fatality and 0.22 traffic fatalit transportation accident risks for the 1992/1993 Planning Basis alternative.

The maximum reasonably foreseeable transportation accident involves a rail sh commercial SNF. The accident has a probability of occurrence of about 2.0 X 10^-7 population zone. Under normal (neutral) weather conditions, the total population d about 13,000 person-rem (average dose of 26 millirem per person), which could resul latent fatal cancers in the exposed population. For comparison, the same populatio experience about 100,000 latent fatal cancers from other causes. The probability o an urban population zone, or occurring under stable weather conditions in any popul X 10^-7 per year. Table I-33 summarizes the doses and health effects from the maxi foreseeable consequence assessment.

I.5.3.4 Impacts from the Regionalization Alternative

This alternative includes Regionalization 4A (by fuel type) and Regionalizati Under Regionalization by Fuel Type, the same SNF types are transported as in the 19 alternative with differences occurring in the destinations of some SNF based on fue test reactor SNF is transported to either the Idaho National Engineering Laboratory Site, with most SNF going to the Idaho National Engineering Laboratory. Graphite-t commercial SNF is transported to the Idaho National Engineering Laboratory. As wit Planning Basis alternative, shipments could be by truck or rail, and the analysis e either of two extremes: all shipments by truck or all shipments by rail.

Under Regionalization by Fuel Type, the cumulative accident risk for transpor calculated to be 0.0010 latent cancer fatality and 0.26 traffic fatality. The cumu the total impact of transportation accidents over the entire shipment campaign (199 cumulative accident risk for transportation by rail was calculated to be 0.0003 lat
Table I-32. SNF transportation accident risks for the 1992/1993 Planning Basis alt (1995 to 2035).

Transport mode	Dose risk (person-rem)	Latent cancer fatalitiesa
Truck	1.9	0.0009
Rail	0.61	0.0003

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac

Table I-33. Health effects from maximum reasonably foreseeable offsite SNF transpo the 1992/1993 Planning Basis alternative (1995 to 2035).

Alternative: 1992/1993 Planning Basis
Maximum reasonably foreseeable accident: Special-case commercial SNF shipment by r
Population zone: Suburbana
Maximum reasonably foreseeable accident probability: 2.0 10-7 per year with neutr 1.0 X 10^-7 per year with stable meteorology

Doses and health effects	Transport mode	Population		Maximum
		Neutral(b)	Stable(c)	Neutral(b)
Dose	Rail	13,000 person-rem(e)		54 rem
Latent cancer fatalities(d)	Rail	7	(e)	0.027

a. The maximum reasonably foreseeable accident occurs in a suburban population zon the accident occurring in an urban population zone is less than 1 X 10^-7 per year. zone, the dose would be approximately 3 percent of the suburban population dose.

b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu dispersion of radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t a result of the radiation dose; for the maximally exposed individual, results expre contracting fatal cancer as a result of the radiation dose. Fatal cancer risk fact per person-rem (ICRP 1991).

e. Consequences not developed for accidents with probabilities less than 1 X 10^-7

cancer fatality and 0.25 traffic fatality. Table I-34 summarizes the transportatio Regionalization by Fuel Type.

As in the 1992/1993 Planning Basis alternative, the maximum reasonably forese accident involves a rail shipment of special-case commercial SNF. The accident has occurrence of about 2.8 10-7 per year for a suburban population zone. The consequ (neutral) weather conditions are the same as those described under the 1992/1993 Pl Table I-35 summarizes the doses and health effects from the maximum reasonably fore assessment.

The maximum reasonably foreseeable accident under stable weather conditions h than 1 X 10^-7 per year for all population zones except rural. A total population estimated for the rural population zone (average dose of 2 rem per person), which c two latent fatal cancers in the exposed population. For comparison, the same popul

to experience about 350 latent fatal cancers from other causes.

The Regionalization by Geography alternative contains six separate alternativ transportation impacts of each option have been analyzed for comparison. Under thi SNF types are transported as under the 1992/1993 Planning Basis alternative with di the destinations of the SNF based on geographical considerations. Non-Navy SNF ori United States locations or points of entry would be transported to the Idaho Nation Hanford Site, or the Nevada Test Site. Non-Navy SNF originating from eastern Unite points of entry would be transported to the Savannah River Site or the Oak Ridge Re would not be split on an east-west basis because the Navy would operate a facility at only one of the DOE sites.

Cumulative accident risks for transportation by truck range from 0.0009 laten 0.21 traffic fatality for Regionalization at the Idaho National Engineering Laborat Site, to 0.0011 latent cancer fatality and 0.39 traffic fatality for Regionalizatio the Oak Ridge Reservation. Cumulative accident risks for transportation by rail ra cancer fatality and 0.21 traffic fatality for Regionalization at the Idaho National the Oak Ridge Reservation to 0.0003 latent cancer fatality and 0.30 traffic fatalit Nevada Test Site and the Savannah River Site.

As in Regionalization by Fuel Type, the maximum reasonably foreseeable transp involves a rail shipment of special-case commercial SNF. The consequences of the m foreseeable accident are the same for each of the six Regionalization by Geography maximum reasonably foreseeable accident under neutral weather conditions occurs in zone because the accident probability for an urban

Table I-34. SNF transportation accident risks for Regionalization by Fuel Type (19

Transport mode	Dose risk (person-rem)	Latent cancer fatalities(a)
Truck	2.0	0.0010
Rail	0.65	0.0003

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac physical impact.

Table I-35. Health effects from maximum reasonably foreseeable offsite SNF transpo Regionalization by Fuel Type (1995 to 2035).

Alternative: Regionalization by Fuel Type
Maximum reasonably foreseeable accident: Special-case commercial SNF shipment by r
Population zone: Suburban (neutral) and rural (stable)a
Maximum reasonably foreseeable accident probability: 2.8 X 10^-7 per year with neu 1.1 X 10^-7 per year with stable meteorology

Doses and health effects	Transport mode	Population		Maximum e
		Neutral(b)	Stable(c)	Neutral(b)
Dose	Rail	13,000 person-rem	3,500 person-rem	54 rem
Latent cancer fatalities(d)	Rail	7	2	0.027

a. The maximum reasonably foreseeable accident occurs in a suburban population zon conditions. The accident probability is less than 1 X 10^-7 per year under stable except in a rural population zone. For urban population zones, the accident probab X 10^-7 per year for both neutral and stable weather conditions.

b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu dispersion of radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t

a result of the radiation dose; for the maximally exposed individual, results expre contracting fatal cancer as a result of the radiation dose. Fatal cancer risk fact cancers per person-rem (ICRP 1991).

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population zone is less than 1 10-7 per year. The total population dose is estima person-rem (average dose of 26 millirem per person), which could result in an estim cancers in the exposed population. For comparison, the same population would be ex about 100,000 latent fatal cancers from other causes.

The probability of the maximum reasonably foreseeable transportation accident among the six Regionalization by Geography alternatives. The maximum reasonably fo a suburban population zone has an estimated probability of occurrence ranging from for Regionalization at the Hanford Site and Savannah River Site, to about 3.7 X 10^ Regionalization at the Nevada Test Site and Savannah River Site. The maximum reaso accident in a rural population zone has an estimated probability of occurrence rang per year for Regionalization at the Hanford Site and Savannah River Site, to about Regionalization at the Nevada Test Site and Oak Ridge Reservation.

Tables I-36 through I-47 summarize the doses and health effects from the acci and the maximum reasonably foreseeable consequence assessment for each of the Regio Geography alternatives.

I-5.3.5 Impacts from the Centralization Alternatives

The impacts from centralization at the Hanford Site, Idaho National Engineeri Savannah River Site, Oak Ridge Reservation, and the Nevada Test Site are presented

I-5.3.5.1 Centralization at the Hanford Site. Under this alternative, SNF currently stored at

other DOE sites, Fort St. Vrain, university, foreign, and non-DOE research reactors to the Hanford Site. The analysis evaluates impacts assuming either all shipments by rail.

The cumulative accident risk for transportation by truck was calculated to be fatality and 0.57 traffic fatality. The cumulative accident risk measures the tota accidents over the entire shipment campaign (1995 to 2035). The cumulative acciden by rail was calculated to be 0.0013 latent cancer fatality and 0.52 traffic fatalit transportation accident risks for the Centralization at the Hanford Site alternativ

As in the 1992/1993 Planning Basis and Regionalization alternatives, the maxi foreseeable transportation accident involves a rail shipment of special-case commer has a probability of occurrence of about 5.1 10-7 per year under neutral (normal) X 10^-7 per year under stable (worst-case) weather conditions. The consequences ar described under the Regionalization by Geography alternative. Table I-49

Table I-36. SNF transportation accident risks for Regionalization by Geography (Id Engineering Laboratory and Savannah River Site) (1995 to 2035).

Transport mode	Dose risk (person-rem)	Latent cancer fatalities(a
Truck	1.7	0.0009
Rail	0.59	0.0003

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac physical impact.

Table I-37. Health effects from maximum reasonably foreseeable offsite SNF transpo Regionalization by Geography (Idaho National Engineering Laboratory and Savannah Ri 2035).

Alternative: Regionalization by Geography (INEL & SRS)

Maximum reasonably foreseeable accident: Special-case commercial SNF shipment by r
Population zone: Suburban (neutral) and rural (stable)(a)
Maximum reasonably foreseeable accident probability: 3.0 X 10^-7 per year with neu
10^-7 per year with stable meteorology

Doses and health effects	Transport mode	Population(a)		Maximum
		Neutral(b)	Stable(c)	Neutral(b)
Dose	Rail	13,000 person-rem	3,500 person-rem	54 rem
Latent cancer fatalitiesd	Rail	7	2	0.027

a. The maximum reasonably foreseeable accident occurs in a suburban population zon conditions. The accident probability is less than 1 10-7 per year under stable we except in a rural population zone. For urban population zones, the accident probab 10^-7 per year for both neutral and stable weather conditions.

b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu dispersion of radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t as a result of the radiation dose; for the maximally exposed individual, results ex of contracting fatal cancer as a result of the radiation dose. Fatal cancer risk f cancers per person-rem (ICRP 1991).

Table I-38. SNF transportation accident risks for Regionalization by Geography (Id Engineering Laboratory and Oak Ridge Reservation) (1995 to 2035).

Transport mode	Dose risk (person-rem)	Latent cancer fatalities(a)
Truck	1.8	0.0009
Rail	0.40	0.0002

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac physical impact.

Table I-39. Health effects from maximum reasonably foreseeable offsite SNF transpo Regionalization by Geography (Idaho National Engineering Laboratory and Oak Ridge R 2035).

Alternative: Regionalization by Geography (INEL & ORR)
Maximum reasonably foreseeable accident: Special-case commercial SNF shipment by r
Population zone: Suburban (neutral) and rural (stable)a
Maximum reasonably foreseeable accident probability: 3.0 X 10^-7 per year with neu
10^-7 per year with stable meteorology

Doses and health effects	Transport mode	Population(a)		Maximum
		Neutral(b)	Stable(c)	Neutral(b
Dose	Rail	13,000 person-rem	3,500 person-rem	54 rem
Latent cancer fatalities(d)	Rail	7	2	0.027

a. The maximum reasonably foreseeable accident occurs in a suburban population zon conditions. The accident probability is less than 1 X 10^-7 per year under stable

except in a rural population zone. For urban population zones, the accident probab per year for both neutral and stable weather conditions.

b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu dispersion of radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t a result of the radiation dose; for the maximally exposed individual, results expre contracting fatal cancer as a result of the radiation dose. Fatal cancer risk fact per person-rem (ICRP 1991).

Table I-40. SNF transportation accident risks for Regionalization by Geography (Ha Savannah River Site) (1995 to 2035).

Transport mode	Dose risk (person-rem)	Latent cancer fatalities(a)
Truck	1.8	0.0009
Rail	0.62	0.0003

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac physical impact.

Table I-41. Health effects from maximum reasonably foreseeable offsite SNF transpo Regionalization by Geography (Hanford Site and Savannah River Site) (1995 to 2035).

Alternative: Regionalization by Geography (HS & SRS)
Maximum reasonably foreseeable accident: Special-case commercial SNF shipment by r
Population zone: Suburban (neutral) and rural (stable)a
Maximum reasonably foreseeable accident probability: 2.7 10-7 per year with neutr 10^-7 per year with stable meteorology

Doses and health effects	Transport mode	Population(a)		Maximum
		Neutral(b)	Stable(c)	Neutral(b)
Dose	Rail	13,000 person-rem	3,500 person-rem	54 rem
Latent cancer fatalitiesd	Rail	7	2	0.027

a. The maximum reasonably foreseeable accident occurs in a suburban population zon conditions. The accident probability is less than 1 10-7 per year under stable we except in a rural population zone. For urban population zones, the accident probab per year for both neutral and stable weather conditions.
b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu dispersion of radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t a result of the radiation dose; for the maximally exposed individual, results expre contracting fatal cancer as a result of the radiation dose. Fatal cancer risk fact per person-rem (ICRP 1991).

Table I-42. SNF transportation accident risks for Regionalization by Geography (Ha Ridge Reservation) (1995 to 2035).

Transport mode	Dose risk (person-rem)	Latent cancer fatalities(a)

Truck	1.9	0.0009
Rail	0.43	0.0002

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac physical impact.

Table I-43. Health effects from maximum reasonably foreseeable offsite SNF transpo Regionalization by Geography (Hanford Site and Oak Ridge Reservation) (1995 to 2035

Alternative: Regionalization by Geography (HS & ORR)
Maximum reasonably foreseeable accident: Special-case commercial SNF shipment by r
Population zone: Suburban (neutral) and rural (stable)a
Maximum reasonably foreseeable accident probability: 2.7 10-7 per year with neutr 10^-7 per year with stable meteorology

Doses and health effects	Transport mode	Population(a)		Max
		Neutral(b)	Stable(c)	Neutral(b)
Dose	Rail	13,000 person-rem	3,500 person-rem	54 rem
Latent cancer fatalitiesd	Rail	7	2	0.027

a. The maximum reasonably foreseeable accident occurs in a suburban population zon conditions. The accident probability is less than 1 X 10^-7 per year under stable a rural population zone. For urban population zones, the accident probability is l for both neutral and stable weather conditions.

b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu dispersion of radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t result of the radiation dose; for the maximally exposed individual, results express fatal cancer as a result of the radiation dose. Fatal cancer risk factor: 5 X 10^ (ICRP 1991).

Table I-44. SNF transportation accident risks for Regionalization by Geography (Ne Savannah River Site) (1995 to 2035).

Transport mode	Dose risk (person-rem)	Latent cancer fatalities(a
Truck	2.0	0.0010
Rail	0.61	0.0003

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac physical impact.

Table I-45. Health effects from maximum reasonably foreseeable offsite SNF transpo Regionalization by Geography (Nevada Test Site and Savannah River Site) (1995 to 20

Alternative: Regionalization by Geography (NTS & SRS)
Maximum reasonably foreseeable accident: Special-case commercial SNF shipment by r
Population zone: Suburban (neutral) and rural (stable)a
Maximum reasonably foreseeable accident probability: 3.7 X 10^-7 per year with neu per year with stable meteorology

Doses and health effects	Transport mode	Population(a)		Maxim
		Neutral(b)	Stable(c)	Neutral(b)
Dose	Rail	13,000 person-rem	3,500 person-rem	54 rem
Latent cancer fatalitiesd	Rail	7	2	0.027

a. The maximum reasonably foreseeable accident occurs in a suburban population zon conditions. The accident probability is less than 1 10-7 per year under stable we except in a rural population zone. For urban population zones, the accident probab per year for both neutral and stable weather conditions.
b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu dispersion of radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t as a result of the radiation dose; for the maximally exposed individual, results ex contracting fatal cancer as a result of the radiation dose. Fatal cancer risk fact cancers per person-rem (ICRP 1991).

Table I-46. SNF transportation accident risks for Regionalization by Geography (Ne Ridge Reservation) (1995 to 2035).

Transport mode	Dose risk (person-rem)	Latent cancer fatalities(a)
Truck	2.1	0.0011
Rail	0.42	0.0002

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac impact.

Table I-47. Health effects from maximum reasonably foreseeable offsite SNF transpo Regionalization by Geography (Nevada Test Site and Oak Ridge Reservation) (1995 to

Alternative: Regionalization by Geography (NTS & ORR)
Maximum reasonably foreseeable accident: Special-case commercial SNF shipment by r
Population zone: Suburban (neutral) and rural (stable)(a)
Maximum reasonably foreseeable accident probability: 3.6 X 10^-7 per year with neu per year with stable meteorology

Doses and health effects	Transport mode	Population(a)		Maximum e
		Neutral(b)	Stable(c)	Neutral(b
Dose	Rail	13,000 person-rem	3,500 person-rem	54 rem
Latent cancer fatalitiesd	Rail	7	2	0.027

a. The maximum reasonably foreseeable accident occurs in a suburban population zon conditions. The accident probability is less than 1 X 10^-7 per year under stable in a rural population zone. For urban population zones, the accident probability i year for both neutral and stable weather conditions.

b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu

dispersion of radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t a result of the radiation dose; for the maximally exposed individual, results expre contracting fatal cancer as a result of the radiation dose. Fatal cancer risk fact per person-rem (ICRP 1991).

Table I-48. SNF transportation accident risks for the Centralization at the Hanfor 2035).

Transport mode	Dose risk (person-rem)	Latent cancer fatalities(a)
Truck	9.9	0.0050
Rail	2.5	0.0013

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac impact.

Table I-49. Health effects from maximum reasonably foreseeable offsite SNF transpo the Centralization at the Hanford Site alternative (1995 to 2035).

Alternative: Centralization at the Hanford Site
Maximum reasonably foreseeable accident: Special-case commercial SNF shipment by r
Population zone: Suburban (neutral) and Rural (stable)a
Maximum reasonably foreseeable accident probability: 5.1 X 10^-7 per year with neu per year with stable meteorology

Doses and health effects	Transport mode	Population(a)		Maximum
		Neutral(b)	Stable(c)	Neutral(b)
Dose	Rail	13,000 person-rem	3,500 person-rem	54 rem
Latent cancer fatalitiesd	Rail	7	2	0.027

a. The maximum reasonably foreseeable accident occurs in a suburban population zon conditions. The accident probability is less than 1 X 10^-7 per year under stable in a rural population zone. For urban population zones, the accident probability i year for both neutral and stable weather conditions.

b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu dispersion of radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t a result of the radiation dose; for the maximally exposed individual, results expre contracting fatal cancer as a result of the radiation dose. Fatal cancer risk fact per person-rem (ICRP 1991).
summarizes the doses and health effects from the maximum reasonably foreseeable con

I-5.3.5.2 Centralization at the Idaho National Engineering Laboratory. Under this

alternative, all SNF currently stored at other DOE sites, Fort St. Vrain, and unive research reactors is eventually transported to the Idaho National Engineering Labor evaluates impacts assuming either all shipments by truck or all shipments by rail.

The cumulative accident risk for transportation by truck was calculated to be fatality and 0.49 traffic fatality. The cumulative accident risk measures the tota accidents over the entire shipment campaign (1995 to 2035). The cumulative acciden

by rail was calculated to be 0.0012 latent cancer fatality and 0.44 traffic fatalit transportation accident risks for the Centralization at the Idaho National Engineer

As in the 1992/1993 Planning Basis and Regionalization 4A and 4B alternatives reasonably foreseeable transportation accident involves a rail shipment of special- accident has a probability of occurring of about 4.7 X 10^-7 per year under neutral and about 3.3 X 10^-7 per year under stable (worst-case) weather conditions. The c as those described under Regionalization by Geography alternative. Table I-51 summ health effects from the maximum reasonably foreseeable consequence assessment.

I-5.3.5.3 Centralization at Savannah River Site. Under this alternative, SNF currently stored

at other DOE sites, Fort St. Vrain, university, foreign, and non-DOE research react transported to the Savannah River Site. The analysis evaluates impacts assuming ei truck or all shipments by rail.

The cumulative accident risk for transportation by truck was calculated to be fatality and 0.84 traffic fatality. The cumulative accident risk measures the tota accidents over the entire shipment campaign (1995 to 2035). The cumulative acciden by rail was calculated to be 0.0004 latent cancer fatality and 0.49 traffic fatalit transportation accident risks for the Centralization at Savannah River Site alterna

As in the 1992/1993 Planning Basis and Regionalization alternatives, the maxi foreseeable transportation accident involves a rail shipment of special-case commer reasonably foreseeable accident under neutral (normal) weather conditions occurs in and has a probability of occurrence of about 1.7 X 10^-7 per year. A total populat rem was estimated (average dose of 27 millirem per person), which

Table I-50. SNF transportation accident risks for the Centralization at the Idaho Laboratory alternative (1995 to 2035).

Transport mode	Dose risk (person-rem)	Latent cancer fatalities(a)
Truck	9.5	0.0048
Rail	2.4	0.0012

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac impact.

Table I-51. Health effects from maximum reasonably foreseeable offsite SNF transpo the Centralization at the Idaho National Engineering Laboratory alternative (1995 t

Alternative: Centralization at the Idaho National Engineering Laboratory
Maximum reasonably foreseeable accident: Special-case commercial SNF shipment by r
Population zone: Suburban (neutral) and rural (stable)a
Maximum reasonably foreseeable accident probability: 4.7 X 10^-7 per year with neu per year with stable meteorology

Doses and health effects	Transport mode	Population(a)		Maxim
		Neutral(b)	Stable(c)	Neutral(b)
Dose	Rail	13,000 person-rem	3,500 person-rem	54 rem
Latent cancer facilitiesd	Rail	7	2	0.027

a. The maximum reasonably foreseeable accident occurs in a suburban population zon conditions. The accident probability is less than 1 X 10^-7 per year under stable in a rural population zone. For urban population zones, the accident probability i year for both neutral and stable weather conditions.

b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu dispersion of radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t result of the radiation dose; for the maximally exposed individual, results express contracting fatal cancer as a result of the radiation dose. Fatal cancer risk fact per person-rem (ICRP 1991).

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could result in an estimated 36 latent cancer fatalities. For comparison, the same expected to experience about 540,000 latent cancer fatalities from other causes.

The maximum reasonably foreseeable accident under stable (worst-case) weather in a suburban population zone and has a probability of occurring of about 1.2 10- population dose of 110,000 person-rem was estimated (average dose of 0.53 rem per p result in an estimated 55 latent cancer fatalities. For comparison, the same popul experience about 42,000 latent cancer fatalities from other causes.

Table I-53 summarizes the doses and health effects from the maximum reasonabl consequence assessment.

I-5.3.5.4 Centralization at Oak Ridge Reservation. Under this alternative, SNF currently

stored at other DOE sites, Fort St. Vrain, university, foreign, and non-DOE researc transported to the Oak Ridge Reservation. The analysis evaluates impacts assuming truck or all shipments by rail.

The cumulative accident risk for transportation by truck was calculated to be fatality and 0.78 traffic fatality. The cumulative accident risk measures the tota accidents over the entire shipment campaign (1995 to 2035). The cumulative acciden by rail was calculated to be 0.0003 latent cancer fatality and 0.43 traffic fatalit transportation accident risks for the Centralization at Oak Ridge Reservation alter

As in the 1992/1993 Planning Basis and Regionalization alternatives, the maxi foreseeable transportation accident involves a rail shipment of special-case commer reasonably foreseeable accident under neutral (normal) weather conditions occurs in and has a probability of occurring of about 1.1 10-7 per year. The accident conse those described for the urban zone accident under the Centralization at Savannah Ri

The maximum reasonably foreseeable accident under stable (worst-case) weather in a rural population zone and has a probability of occurring of about 5.7 10-7 pe consequences are the same as those described for the rural zone accident under the Geography alternative.

Table I-55 summarizes the doses and health effects from the maximum reasonabl consequence assessment.

Table I-52. SNF transportation accident risks for the Centralization at the Savann (1995 to 2035).

Transport mode	Dose Risk (person-rem)	Latent cancer fatalities(a)
Truck	3.1	0.0016
Rail	0.80	0.0004

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac physical impact.

Table I-53. Health effects from maximum reasonably foreseeable offsite SNF transpo the Centralization at the Savannah River Site alternative (1995 to 2035).

Alternative: Centralization at the Savannah River Site
Maximum reasonably foreseeable accident: Special-case commercial SNF shipment by r
Population zone: Urban (neutral) and Suburban (stable)a
Maximum reasonably foreseeable accident probability: 1.7 X 10^-7 per year with neu per year with stable meteorology

Doses and health effects	Transport mode	Population(a)		Ma
		Neutral(b)	Stable(c)	Neutral(b)
Dose	Rail	72,000 person-rem	110,000 person-rem	54 rem
Latent cancer fatalitiesd	Rail	36	55	0.027

a. The maximum reasonably foreseeable accident occurs in an urban population zone conditions. The probability of the accident in an urban zone under stable weather 1 X 10^-7 per year. The maximum reasonably foreseeable accident for stable weather a suburban population zone.

b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu dispersion of radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t as a result of the radiation dose; for the maximally exposed individual, results ex of contracting fatal cancer as a result of the radiation dose. Fatal cancer risk f cancers per person-rem (ICRP 1991).

Table I-54. SNF transportation accident risks for the Centralization at the Oak Ri alternative (1995 to 2035).

Transport mode	Dose Risk (person-rem)	Latent cancer fatalities(a)
Truck	2.8	0.0014
Rail	0.52	0.0003

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac physical impact.

Table I-55. Health effects from maximum reasonably foreseeable offsite SNF transpo the Centralization at the Oak Ridge Reservation alternative (1995 to 2035).

Alternative: Centralization at the Oak Ridge Reservation
Maximum reasonably foreseeable accident: Special-case commercial SNF shipment by r
Population zone: Urban (neutral) and rural (stable)a
Maximum reasonably foreseeable accident probability: 1.1 X 10^-7 per year with neu per year with stable meteorology

Doses and health effects	Transport mode	Population(a)		Maximum
		Neutral(b)	Stable(c)	Neutral(b)
Dose	Rail	72,000 person-rem	3,500 person-rem	54 rem
Latent cancer fatalities(d)	Rail	36	2	0.027

a. The maximum reasonably foreseeable accident occurs in an urban population zone conditions. The accident probability under stable weather conditions is less than in a rural population zone.

b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu

dispersion of radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t a result of the radiation dose; for the maximally exposed individual, results expre contracting fatal cancer as a result of the radiation dose. Fatal cancer risk fact per person-rem (ICRP 1991).

I-5.3.5.5 Centralization at Nevada Test Site. Under this alternative, SNF currently

stored at other DOE sites, Fort St. Vrain, university, foreign, and non-DOE researc transported to the Nevada Test Site. The analysis evaluates impacts assuming eithe or all shipments by rail.

The cumulative accident risk for transportation by truck was calculated to be fatality and 0.72 traffic fatality. The cumulative accident risk measures the tota accidents over the entire shipment campaign (1995 to 2035). The cumulative acciden by rail was calculated to be 0.0012 latent cancer fatality and 0.58 traffic fatalit transportation accident risks for the Centralization at Nevada Test Site alternativ

As in the 1992/1993 Planning Basis and Regionalization alternatives, the maxi foreseeable transportation accident involves a rail shipment of special-case commer has a probability of occurring of about 1.0 10-7 per year under neutral (normal) w suburban population zone and about 5.0 10-7 per year under stable (worst-case) wea rural population zone. The consequences are the same as those described under the Geography alternative. Table I-57 summarizes the doses and health effects from the foreseeable consequence assessment.

I-5.3.6 Impacts of Using Alternate Points of Entry for Foreign Research Reactor Spent

Nuclear Fuel Shipments

For transportation accident risks (radiological and vehicle-related), shipmen Florida, to the Hanford Site, Idaho National Engineering Laboratory, Savannah River Reservation, and Nevada Test Site would yield lower impacts than shipments from Cha Carolina, Galveston, Texas, Hampton Roads, Virginia, Savannah, Georgia, and the Mil Sunny Point, North Carolina, to these same sites. Shipments from Wilmington, North Savannah River Site and Oak Ridge Reservation would also yield lower impacts than s Charleston, South Carolina, Galveston, Texas, Hampton Roads, Virginia, Savannah, Ge Military Ocean Terminal Sunny Point, North Carolina, to these same sites. Shipment Wilmington, North Carolina, to the Hanford Site, Idaho National Engineering Laborat Site would yield slightly higher impacts (about 6 percent) than shipments from Char Galveston, Texas, Hampton Roads, Virginia, Savannah, Georgia, and the Military Ocea Point, North Carolina, to these same sites.

Table I-56. SNF transportation accident risks for the Centralization at the Nevada (1995 to 2035).

Transport mode	Dose Risk (person-rem)	Latent cancer fatalities(a)
Truck	10.0	0.0050
Rail	2.4	0.0012

a. Estimated number of latent fatal cancers as a result of radiation dose from tra

b. Estimated number of fatalities from nonradiological effect of transportation ac physical impact.

Table I-57. Health effects from maximum reasonably foreseeable offsite SNF transpo the Centralization at the Nevada Test Site alternative (1995 to 2035).

Alternative: Centralization at the Nevada Test Site

Maximum reasonably foreseeable accident: Special-case commercial SNF shipment by r
Population zone: Urban (neutral) and Rural (stable)a
Maximum reasonably foreseeable accident probability: 1.0 X 10^-7 per year with neu
10^-7 per year with stable meteorology

Doses and health effects	Transport mode	Population(a)		Maximum ex
		Neutral(b)	Stable(c)	Neutral(b)
Dose	Rail	72,000 person-rem	3,500 person-rem	54 rem
Latent cancer fatalitiesd	Rail	36	2	0.027

a. The maximum reasonably foreseeable accident occurs in an urban population zone conditions. The accident probability is less than 1 X 10^-7 per year under stable in a rural population zone.

b. Neutral meteorological conditions occur greater than 50 percent of the time.

c. Stable meteorological conditions occur less than 5 percent of the time and resu dispersion of radioactivity released to the atmosphere.

d. Results expressed as the estimated number of latent fatal cancers expected in t as a result of the radiation dose; for the maximally exposed individual, results ex contracting fatal cancer as a result of the radiation dose. Fatal cancer risk fact cancers per person-rem (ICRP 1991).

I-6 POTENTIAL MITIGATION MEASURES

The possible impacts from transportation associated with the alternatives cou number of different ways. For example, the routes used for truck shipments could b Department of Transportation routing guidelines. These guidelines are designed to impacts associated with transportation. The guidelines consider as primary factors from incident-free transport, (b) the risk to general population from an accidental material, and (c) the economic risk from an accidental release of radioactive mater as secondary factors (a) emergency response effectiveness, (b) evacuation capabilit facilities such as schools or hospitals, and (d) traffic fatalities and injuries un of the cargo.

Impact mitigation is also provided through the use of approved shipping conta containing large amounts of radioactivity, such as SNF, Type B containers will be u designed to withstand normal transport conditions and hypothetical accident conditi

If an accident did occur, Federal, state, local, and Tribal authorities are t response. For example, the Shoshone-Bannock Tribes, the State of Idaho, Bingham Co Memorial Hospital, Bannock Regional Medical Center, Pocatello Regional Medical Cent Company, Intermountain Gas Company, and the U.S. Department of Energy participated cooperative Transportation Accident Exercise held in Idaho in 1992 (TRANSAX '92).

The U.S. Environmental Protection Agency has developed protective action guid protective actions that are designed to limit doses in the event of a nuclear incid actions also mitigates the impacts of transportation accidents involving radioactiv

I-7 SPENT NUCLEAR FUEL TRANSPORTATION BY BARGE

As an alternative to truck or rail transport of SNF, barge transport of 71 SN Brookhaven National Laboratory, located on Long Island, New York, to the Savannah R evaluated. This section summarizes the impacts from transporting the 71 shipments National Laboratory to the Savannah River Site.

I-7.1 Transportation Routes

Several routing options were evaluated for the barge shipments from Brookhave Laboratory to the Savannah River Site:

- Truck transport from Brookhaven National Laboratory to the Shoreham, Ne Port Jefferson, New York. Shoreham and Port Jefferson are both located near Brookhaven National Laboratory.
- Barge transport from Shoreham or Port Jefferson, New York, to Hampton R the Military Ocean Terminal, Sunny Point, North Carolina; Charleston, S Savannah, Georgia; or directly to the Savannah River Site.
- Truck transport from Hampton Roads, Virginia; the Military Ocean Termin North Carolina; Charleston, South Carolina; or Savannah, Georgia to the Site.

The HIGHWAY computer code (Johnson et al. 1993a) was used to estimate the tru INTERLINE computer code (Johnson et al. 1993b) was used to estimate the barge route barge routes are summarized in Pippen (1995).

I-7.2 Incident-Free Transportation

Incident-free transportation assessments were conducted for barge shipments f National Laboratory to the Savannah River Site and included transport by truck, tra intermodal transfers (e.g., truck to barge and barge to truck transfers). The meth the radiological and nonradiological impacts of these shipments are discussed in Pi

For barge shipments using the Shoreham, New York, dock as a point of departur the cumulative number of total fatalities (radiological plus nonradiological fatali 0.0092. The lower number of fatalities was estimated when the barge shipments were Savannah River Site. The larger number of fatalities was estimated when the barge from Brookhaven National Laboratory to Shoreham, New York, to Hampton Roads, Virgin Savannah River Site.

For barge shipments using Port Jefferson, New York, as a point of departure f cumulative number of total fatalities (radiological plus nonradiological fatalities 0.0093. The lower number of fatalities was estimated when the barge shipments were Savannah River Site. The larger number of fatalities was estimated when the barge from Brookhaven National Laboratory to Port Jefferson to Hampton Roads, Virginia, t Site.

I-7.3 Transportation Accidents

Transportation accident assessments were conducted for barge shipments from B Laboratory to the Savannah River Site. These assessments included evaluations of a radiological risks and traffic fatalities) and accident consequences. The methods the accident risks and consequences of these shipments are discussed in Pippen (199

For barge shipments using the Shoreham, New York, dock as a point of departur the cumulative accident risk (radiological plus nonradiological fatalities) ranged lower number of fatalities was estimated when the barge shipments were made directl Site. The larger number of fatalities was estimated when the barge shipments were National Laboratory to Shoreham, New York, to Hampton Roads, Virginia, to the Savan

For barge shipments using Port Jefferson, New York, as a point of departure f cumulative accident risk (radiological plus nonradiological fatalities) ranged from lower number of fatalities was estimated when the barge shipments were made directl Site. The larger number of fatalities was estimated when the barge shipments were National Laboratory to Shoreham, New York, to Hampton Roads, Virginia, to the Savan

The consequences of the maximum reasonably foreseeable accident for barge shi than the consequences of the maximum reasonably foreseeable accident for truck ship Section I-5. This was because the barge routes are further from populations than t

I-8 TRANSPORTATION IMPACTS OF FOREIGN PROCESSING OF SPENT NUCLEAR FUEL CURRENTLY LOCATED AT THE HANFORD SITE

This section summarizes the transportation impacts of processing the Hanford at a foreign processing facility. The detailed assessment of this transportation o of the foreign processing option and the methods and assumptions used in the analys Volume 1, Appendix A, Attachment B of this EIS.

I-8.1 Radiological Dose to Workers

This subsection describes expected radiological consequences to workers durin Reactor SNF currently stored at the Hanford Site. The transportation analysis incl Hanford Site to representative West and East Coast points of entry (Portland, Orego and Norfolk, Virginia) followed by overseas transport to a representative commercia the United Kingdom. Overland shipment by barge, truck, or rail was considered as a of entry.

I-8.1.1 Worker Dose from Shipment Preparation Activities at the Hanford Site

Packaging of the K Basin fuel for overseas shipment was estimated to result i approximately 140 person-rem (5.5 10-2 latent cancer fatalities) over a period of However, if stabilization of the fuel before transport were necessary, an additiona accumulated by onsite workers over a 4-year period, resulting in 7.0 10-2 latent c Consequences of fuel-handling accidents of the K basins are addressed in Volume 1,

I.8.1.2 Worker Doses from Transportation

Collective worker impacts from incident-free transportation were estimated to 1.3 X 10^-3 latent cancer fatalities for barge transportation between the Hanford S Portland, Oregon, to 4.3 X 10^-2 latent cancer fatalities for the option of transpo Hanford Site and the point of entry at Norfolk, Virginia. These impacts account fo the Hanford Site as well as the return transport of high-level waste, plutonium oxi

Radiological consequences to workers from activities at the point of entry fo United Kingdom were evaluated based on commercial experience during the last 9 mont consequences for loading and unloading 408 casks during shipment from the United St Kingdom were estimated to be approximately 1.2 person-rem to all workers over the e campaign. An additional two fuel-handling activities per cask at the Hanford Site process facility would approximately double that estimate, resulting in a collectiv and a potential for 9.8 X 10^-4 latent cancer fatalities for all shipments. The ma worker, assuming that worker was involved in handling all 408 casks at one point in would be approximately 0.4 rem over 5 years.

The consequences to a nearby worker were evaluated for accidents at, or on th representative points of entry considered in the overland transportation analysis. entry at Newark, New Jersey, was included in this part of the analysis because of i population (it is adjacent to New York City) whereas the other points of entry are population centers. The consequences of the maximum reasonably foreseeable acciden per year) to a worker at a distance of 100 meters (328 feet) ranged from 1.7 rem (6 fatalities) at Seattle/Tacoma, Washington, to 2.1 rem (8.4 10-4 latent cancer fata or Norfolk, Virginia. The corresponding total risks from accidents of all severity shipments were 8.0 x 10^-9 latent cancer fatalities at Seattle/Tacoma to 1.0 10-8 Norfolk or Portland.

Radiological consequences were estimated for workers as a result of normal tr accidents during overseas shipments of SNF from the Hanford Site to the United King impact of routine (incident-free) marine transport of SNF would be potential radiol members of the ships used to carry the casks. While at sea, the crew dose would be individuals who may enter the ship's hold during transit and receive external radia packaged fuel. The consequences to crew members would depend on the duration of th spent inspecting each cask. Assuming surface dose rates at the regulatory limit, t inspection crew from all SNF shipments could range from 2.4 to 12 person-rem, depen Return shipments of high-level waste, uranium, and plutonium would result in lower doses to individual crew members would be within administrative control and regulat workers. Actual commercial experience indicates that worker consequences could be bounding estimates.

The consequences of accidents during ocean transit would likely be similar to workers who are near the scene of an accident. Individuals in the immediate vicini probably not survive an accident severe enough to release radioactive materials fro Effects on the ocean environment would not be expected to be discernable because of airborne release.

The frequency of accidents on the open ocean was estimated to be 4.6 X 10^-5 voyage of approximately 20 days to transport SNF from foreign research reactors to frequency of accidents for overseas shipment of SNF and process materials via ships would likely be within a factor of 2 or 3 of this estimate.

I-8.2 Consequences to Members of the Public

This subsection describes expected consequences to the public from activities N-Reactor SNF to the United Kingdom.

I-8.2.1 Public Impacts from Shipment Preparation Activities at the Hanford Site

Activities at the Hanford Site before and during preparation for shipment of result in generally small consequences to the public, as discussed in Volume 1, App Removal and packaging of SNF at the K Basins was estimated to result in offsite con to those observed during initial segregation of the fuel, or less than 3 X 10^-7 re latent cancer fatalities) to the maximally exposed offsite individual. The risk fr handling of N-Reactor fuel at the K Basins is presented in Volume 1, Appendix A, of

I-8.2.2 Public Impacts from Transportation Activities

Members of the public exposed to radiation during transportation include pers railroad, or waterway with the shipment; persons residing near these transport link intermediate stops along the route (such as refueling stops and stops at rail class

Public impacts from incident-free transportation include radiological impacts well as nonradiological impacts from vehicle emissions. Radiological impacts from transportation were estimated to range from 2.1 X 10^-4 latent cancer fatalities fo between the Hanford Site and the point of entry at Portland, Oregon, to 1.3 X 10^-1 the option of transport by truck between the Hanford Site and the point of entry at Nonradiological impacts from incident-free transportation were estimated to range f cancer fatalities for the option of truck transport from the Hanford Site to the po Seattle/Tacoma, Washington, to 1.6 X 10^-2 latent cancer fatalities for the option Hanford Site to the point of entry at Norfolk, Virginia.

Public impacts from potential transportation accidents include radiological r materials that could be released to the environment as well as nonradiological risk accidents (i.e., vehicle collisions). Cumulative radiological transportation accid latent cancer fatalities for the option of rail transport between the Hanford Site Seattle/Tacoma, Washington, to 4.2 X 10^-5 latent cancer fatalities for either truc Hanford Site and the point of entry at Norfolk, Virginia. Traffic accident risks r for the option of truck transport between the Hanford Site and the point of entry a Washington, to 1.3 X 10^-1 fatalities for the option of truck transport between the entry at Norfolk, Virginia.

The maximum reasonably foreseeable transportation accident involves a return level waste transported by rail from the point of entry at Seattle/Tacoma, Washingt this accident were to occur in an urban population zone, it could result in an esti fatality within the affected population. The probability of this accident is about

Normal port activities during transport of N-Reactor SNF are not expected to for members of the public other than point of entry workers. The consequences to t during point of entry transit were estimated using the same assumptions as for work highest risk to the public from point of entry activities was estimated to result f Under stable atmospheric dispersion conditions, the maximum risk to the public was 5 latent cancer fatalities. The maximum foreseeable accident resulted in an estima fatalities in the population within 80 kilometers (50 miles) of Newark, New Jersey. of this accident was 2.2 X 10^-7 for 17 overseas shipments of SNF.

There is not expected to be any dose to members of the public or marine life free ocean transport of N-Reactor SNF to the United Kingdom. The effects of losing estimated to be comparable to those evaluated for transporting foreign research rea States based on similar shipping inventories of long-lived radionuclides per cask. individual for a cask lost in coastal waters was expected to be 11 millirem per yea place until all its contents dispersed. The corresponding consequences to marine b year for fish, 0.32 millirad per year for crustaceans, and 13 millirad per year for resulting from loss of a cask in the deep ocean would be many orders of magnitude l for coastal waters.

I-9 HISTORICAL SPENT NUCLEAR FUEL TRANSPORTATION ACCIDENTS

Transportation incidents for 1949 through 1970 were surveyed using summary re the U.S. Atomic Energy Agency (AEC 1957, Patterson and DeFatta 1962, Patterson and 1966, McCluggage 1971). In these summary reports, incidents are classified into si extent of radioactive material release (Patterson and DeFatta 1962) and accidents a differentiated. For 1949 through 1970, there were 14 incidents involving irradiate packages approximating a Type B shipping cask were breached as a result of these in 1971). Two representative incidents are summarized below.

On November 15, 1960, a tractor-trailer carrying 7 steel-jacketed lead casks fuel elements was involved in an accident with a station wagon. The station wagon demolished and the driver killed. The tractor was badly damaged and the driver suf abrasions. The irradiated fuel elements were undisturbed. This incident was class release, which means that no radioactive material was released and there was no los package.

In another case (June 2-6, 1960), leakage of contaminated cooling water from consisting of irradiated fuel elements and some ruptured elements in aluminum cans of three railroad yards. This incident was classified as a Class IV radiation rele radioactive material was released to the ground or trafficway with no runoff or aer no injuries associated with this incident.

Spent nuclear fuel transportation accidents for 1971 through 1993 were survey the Radioactive Materials Incident Report database. This database contains informa materials transportation incidents and accidents from the U.S. Department of Transp Regulatory Commission, U.S. Department of Energy, state radiation control offices, radioactive materials transportation incidents and accidents (Cashwell and McClure Materials Incident Report database contains information on transportation accidents reported incidents; this discussion is limited to transportation accidents involvin

Between 1971 and 1993, there were seven transportation accidents involving SN accidents involved rail shipments, and four of these accidents involved truck shipm were summarized in Cashwell and McClure (1992). Only one of these accidents result damage to the SNF cask. On December 8, 1971, a truck transporting a SNF element in cask on U.S. Highway 25 in Tennessee swerved to avoid a head-on collision with anot forced off the road. The driver of the truck was killed by the impact and the SNF ditch. The DOE Radiological Assistance Team from Oak Ridge, Tennessee, arrived and that the structural integrity of the cask was intact and there was no release of co

I-10 CUMULATIVE IMPACTS OF TRANSPORTATION

I-10.1 Radiological Impacts

The cumulative impacts of the transportation of SNF consist of impacts from (of SNF to the Hanford Site, Savannah River Site, Idaho National Engineering Laborat Reservation, and the Nevada Test Site; (b) the alternatives evaluated in this EIS; foreseeable actions that include transportation of radioactive material; and (d) ge transportation that is not related to a particular action. The discussion of cumul concentrates on the cumulative impacts of offsite transportation, because offsite t potential doses to a greater portion of the general population than does onsite tra dose to the general population and workers is the measure used to quantify cumulati impacts. This measure of impact was chosen because it can be directly related to l a cancer risk coefficient and because of the difficulty in identifying a maximally shipments throughout the United States spanning the period 1943 through 2035 (93 ye

Collective doses from historical shipments of SNF to the Hanford Site, Savann Ridge Reservation, and the Nevada Test Site were summarized in Jones and Maheras (1 1994d). Data for these shipments were available for 1971 through 1993 and were lin to the start of operations at each site because data before 1971 were not available Oak Ridge Reservation, the start of operations was 1943; for the Savannah River Sit was 1953; and for the Nevada Test Site, the start of operations was 1951. The resu summarized in Table I-58.

The historical shipments of SNF to the Idaho National Engineering Laboratory shipments of naval SNF and test specimens from 1957 through 1995 (see Attachment A Volume 1 of this EIS). Extrapolation of naval shipments was not necessary because accounted for all shipments. Historical SNF also consisted of shipments of other D National Engineering Laboratory besides naval shipments, such as research reactor S commercial SNF (Maheras 1994). Data for these shipments were available for 1973 th linearly extrapolated back to 1953, the start of operations at the Idaho Chemical P data for 1953 through 1972 were not available. The results of these analyses are a 58.

There are considerable uncertainties in these historical estimates of collect population densities and transportation routes used in the dose assessments were ba 1990 and the United States highway and rail system as it existed in 1993.

Table I-58. Cumulative transportation-related radiological collective doses and la to 2035).

Category	Collective occupational dose (person-rem)
Historical spent nuclear fuel	
Hanford Site (1943 to 1993)	52
Savannah River Site (1953 to 1993)	50
Idaho National Engineering Laboratory (1953 to 1993)	
DOE spent nuclear fuel	56
Naval spent nuclear fuel	62
Oak Ridge Reservation (1943 to 1993)	35
Nevada Test Site(a) (1951 to 1993)	1.4
Spent nuclear fuel shipments for Alternatives 1-5	
Naval(b)	1.5 to 15
DOE truck (100%)(c) (1995 to 2035)	0.0 to 1,000
DOE train (100%)(c) (1995 to 2035)	0.0 to 130
Reasonably foreseeable actions	
Geologic repository(c,d)	

Truck (100%)	8,600
Train (100%)	750
Waste Isolation Pilot Plante	
Test phase (100% truck)	110
Disposal phase	
Truck (100%)	1,800
Train (maximum)(f)	68
Submarine reactor compartment disposalg	--
Return of cesium-137 isotope capsulesh	0.42
Uranium billets(i)	0.50
General transportation	
1943 to 1982	220,000
1983 to 2035	89,000
Summary	
Historical	200
Spent nuclear fuel shipments for Alternatives 1-5	
Truck	1.5 to 1,000
Train	1.5 to 150
Reasonably foreseeable actions	
Truck	11,000
Train	820
General transportation (1943 to 2035)	310,000
Total collective dose	320,000
Total latent cancer fatalities	130

a. Shipments from Turkey Point Power Plant in Florida to the Engine Maintenance, A Facility at the Nevada Test Site.

b. Naval SNF and test specimen shipments based on a combination of truck and rail

c. Shipments based on 100 percent transport by truck or 100 percent transport by r

d. Reference: DOE (1986)

e. Reference: DOE (1990)

f. The maximum rail case is based on rail transport where rail access is available where rail access is not available.

g. Reference: USN (1984)

h. Reference: DOE (1994).

i. Reference: DOE (1992).

Using census data for 1990 overestimates historical collective doses because the Un continuously increased over the time covered in these assessments. Basing collecti United States highway and rail system as it existed in 1993 may slightly underestim that occurred in the 1940s, 1950s, and 1960s, because a larger portion of the trans been on non-interstate highways where the population may have been slightly closer not available that correlated transportation routes and population densities for th 1970s; therefore, it was necessary to use more recent data to make dose estimates. structure of the interstate highway system was largely fixed and most shipments wou interstates.

Shipment data were linearly extrapolated for years when data were unavailable uncertainty. However, this technique was validated by linearly extrapolating the d 1973 through 1989 to estimate the number of shipments that took place during the ti 1972 (also contained in SAIC 1991). The 1973 through 1989 time period corresponded when data were available for the Idaho Chemical Processing Plant. The data in SAIC used directly because only shipment counts are presented for 1964 through 1982 and destinations were listed for years before 1983. Based on the data in SAIC (1991),

data for 1973 through 1989 overestimates the shipments for 1964 through 1972 by 20 compared to the actual shipment counts for 1964 through 1972.

Collective doses for SNF shipments associated with Alternatives 1 through 5 w previously in this appendix and in Appendix D of Volume 1 of this EIS (for naval sp truck shipments, the collective dose to workers ranged from 1.5 person-rem (the No 1,000 person-rem (Centralization at Savannah River), or 0.00060 to 0.40 latent canc dose to the general population ranged from 0.34 person-rem (the No Action alternati (Centralization at Savannah River), or 0.00017 to 1.2 latent cancer fatalities. Th fatalities include shipments of naval SNF and test specimens.

For train shipments, the collective dose to workers ranged from 1.5 person-re Alternative) to 150 person-rem (Centralization at Nevada Test Site), or 0.00060 to fatalities. Collective dose to the general population ranged from 0.34 person-rem to 190 person-rem (Centralization at Savannah River), or 0.00017 to 0.095 latent ca doses and latent cancer fatalities include shipments of naval SNF and test specimen

Transportation impacts may also result from reasonably foreseeable projects. projects that involve extensive transportation of radioactive material are: (a) shi high-level waste to a geologic repository, and (b) shipments of transuranic waste t Plant, located in Carlsbad, New Mexico. DOE is presently determining the suitabili Nevada, as a site for a geologic repository for commercial SNF and defense high-lev geologic repository was assumed to be located in Yucca Mountain, Nevada, for the tr impacts analysis.

Based on the transportation dose assessments presented in DOE (1986), the wor for truck shipments to a repository was 8,600 person-rem or 3.4 latent cancer fatal to the general population from truck shipments to a repository was 48,000 person-re fatalities. The worker collective dose for train shipments to a repository was 750 cancer fatalities. The collective dose to the general population from train shipme 740 person-rem or 0.37 latent cancer fatalities.

Based on the transportation dose assessments presented in DOE (1990), the wor from truck shipments to the Waste Isolation Pilot Plant was 1,900 person-rem or 0.7 The collective dose to the general population from truck shipments to the Waste Iso 1,500 person-rem or 0.75 latent cancer fatalities. The worker collective dose from Waste Isolation Pilot Plant was 180 person-rem or 0.072 latent cancer fatalities. general population from train shipments to the Waste Isolation Pilot Plant was 990 cancer fatalities. These collective doses include the 5-year Test Phase and the 20

There are three other reasonably foreseeable projects that involve limited tr radioactive material: (a) 100 shipments of submarine reactor compartments from the Shipyard to the Hanford Site for burial, (b) return of cesium-137 isotope capsules transport of uranium billets from the Hanford Site to the United Kingdom. The tran reactor compartments is an ongoing activity that is not yet completed; therefore, i reasonably foreseeable action. The doses for these actions are presented in Table

There are also general transportation activities that take place that are unr evaluated in this EIS or to reasonably foreseeable actions. Examples of these acti radiopharmaceuticals to nuclear medicine laboratories and shipments of commercial l waste to commercial disposal facilities. The U.S. Nuclear Regulatory Commission ev shipments based on a survey of radioactive materials transportation published in 19 Categories of radioactive material evaluated in NRC (1977) included: (a) limited qu medical, (c) industrial, (d) fuel cycle, and (e) waste.

The U.S. Nuclear Regulatory Commission estimated that the annual collective w shipments was 5,600 person-rem or 2.2 latent cancer fatalities. The annual collect for these shipments was estimated to be 4,200 person-rem or 2.1 latent cancer fatal comprehensive transportation doses were not available, these collective dose estima transportation collective doses for 1943 through 1982 (40 years). These dose estim radioactive waste shipments and truck and rail shipments.

Based on the transportation dose assessments in NRC (1977), the cumulative tr collective doses for 1943 through 1982 were 220,000 person-rem for workers and 170, the general population. These collective doses correspond to 88 latent cancer fata latent cancer fatalities for the general population.

In 1983, another survey of radioactive materials transportation in the United (Javitz et al. 1985). This survey included U.S. Nuclear Regulatory Commission and licensees and the U.S. Department of Energy. Both SNF and radioactive waste shipme the survey. Weiner et al. (1991a, b) used the survey by Javitz et al. (1985) to es general transportation. The transportation dose assessments in Weiner et al. (1991 transportation doses for 1983 through 2035 (53 years). The interval 1995 through 2 interval of time associated with the spent nuclear fuel management activities evalu

Weiner et al. (1991a) evaluated eight categories of radioactive material ship industrial, (b) radiography, (c) medical, (d) fuel cycle, (e) research and developm (f) unknown, (g) waste, and (h) other. Based on a median external exposure rate, a dose of 1,400 person-rem and an annual collective general population dose of 1,400 estimated. These collective doses correspond to 0.56 and 0.70 latent cancer fatali and the general population, respectively. Over the 53-year time period from 1983 t collective worker and general population doses would be 74,000 person-rem or 30 and fatalities for workers and the general population, respectively.

Weiner et al. (1991b) also evaluated six categories of radioactive material s industrial, (b) radiography, (c) medical, (d) research and development, (e) unknown a median external exposure rate, an annual collective worker dose of 290 person-rem general population dose of 450 person-rem were estimated. These collective doses c 0.23 latent cancer fatalities per year for workers and the general population, resp time period from 1983 through 2035, the collective worker dose would be 15,000 pers population collective dose would be 24,000 person-rem or 6.0 and 12 latent cancer f the general population, respectively.

Like the historical transportation dose assessments, the estimates of collect general transportation also exhibit considerable uncertainty. For example, data fo general transportation activities from 1943 through 1982. This approach probably o because the amount of radioactive material that was transported in the 1950s and 19 amount transported in the 1970s. For example, in 1968, the shipping rate for radio was estimated to be 300,000 packages per year (Patterson 1968); in 1975 this rate w 2,000,000 packages per year (NRC 1977). However, because comprehensive data that w realistic transportation dose assessment are not available, the dose estimates deve Regulatory Commission were used.

The total worker and general population collective doses are summarized in Ta collective worker doses from all types of shipments (historical, the alternatives, actions, and general transportation) were estimated to be 320,000 person-rem (130 l for the period of time 1943 through 2035 (93 years). Total general population coll estimated to be 320,000 person-rem (160 latent cancer fatalities). The majority of workers and the general population was because of general transportation of radioac number of latent cancer fatalities over the time period 1943 through 2035 was estim same period of time (93 years), approximately 28,000,000 people would die from canc latent cancer fatalities per year (NRC 1977). It should be noted that the estimate related latent cancer fatalities would be indistinguishable from other latent cance transportation-related latent cancer fatalities are 0.0010 percent of the total num

I-10.2 Vehicular Accident Impacts

Fatalities involving the transport of radioactive materials were surveyed for using the Radioactive Material Incident Report database. For 1971 through 1993, 21 involving 36 fatalities occurred. These fatalities resulted from vehicular acciden with the radioactive nature of the cargo. No radiological fatalities because of tr ever occurred in the United States. During the same period of time, over 1,000,000 vehicular accidents in the United States.

For Alternatives 1 through 5, 0.047 to 1.4 vehicular accident fatalities are During the 40-year time period from 1995 through 2035, approximately 1,600,000 peop vehicular accidents in the United States.

I-11 REFERENCES

AEC (U.S. Atomic Energy Commission), 1957, A Summary of Transportation Incidents in Activities, 1949-1956, AECU-3613, U.S. Atomic Energy Commission (available fr Department of Energy), Washington, D.C., December.

AEC (U.S. Atomic Energy Commission), 1966, A Summary of Incidents Involving USAEC S Radioactive Material, 1963-1964, TID-16764 (Supplement 2), U.S. Atomic Energy (available from U.S. Department of Energy), Washington, D.C.

Block, M., 1993, Project Engineer, Public Service Company of Colorado, Denver, Colo Pippen, Science Applications International Corporation, Idaho Falls, Idaho, r Cask Characteristics," January 24.

Cashwell, J. W., K. S. Neuhauser, P. C. Reardon, G. W. McNair, 1986, Transportation Commercial Radioactive Waste Management Program, SAND--85-2715, Sandia Nation Laboratories, Albuquerque, New Mexico, December.

Cashwell, C. E. and J. D. McClure, 1992, "Transportation Accidents/Incidents Involv Materials (1971-1991)," presented at PATRAM '92, 10th International Symposium Packaging and Transportation of Radioactive Materials, September 13-18, 1992, Japan.

CFR (Code of Federal Regulations), 1994a, 49 CFR 177, "Carriage by Public Highway," Federal Register, Washington, D.C., October.

CFR (Code of Federal Regulations), 1994b, 10 CFR 71, "Packaging and Transportation Material," Office of the Federal Register, Washington, D.C., January.

Croff, A. G., 1980, ORIGEN2 - A Revised and Updated Version of the Oak Ridge Isotop Depletion Code, ORNL-5621, Oak Ridge National Laboratory, Oak Ridge, Tennesse

DOE (U.S. Department of Energy), 1986, Environmental Assessment, Yucca Mountain Sit Research and Development Area, Nevada, DOE/RW-0073, U.S. Department of Energy Washington, D.C., May.

DOE (U.S. Department of Energy), 1990, Waste Isolation Pilot Plant: Final Supplemen Impact Statement, DOE/EIS-0026-FS, U.S. Department of Energy, Washington, D.C

DOE (U.S. Department of Energy), 1992, Environmental Assessment for the Shipment of Uranium Billets to the United Kingdom from the Hanford Site, Richland, Washin 0787, U.S. Department of Energy, Washington, D.C. August.

DOE (U.S. Department of Energy), 1994, Environmental Assessment for Return of Isoto Waste Encapsulation and Storage Facility, DOE/EA-0942, U.S. Department of Ene Washington, D.C., May.

Doty, S. R., B. L. Wallace, G. C. Holzworth, 1976, A Climatological Analysis of Pas Categories Based on 'STAR' Summaries, National Oceanic and Atmospheric Admini National Climatic Center, Asheville, North Carolina, April.

Enyeart, T., 1995, Maximum Reasonably Foreseeable Accidents for Offsite Transportat Nuclear Fuel, Engineering Design File EIS-TRANS-34, Rev. 1, Science Applicati Corporation, Idaho Falls, Idaho, March.

EPA (U.S. Environmental Protection Agency), 1991, Manual of Protective Action Guide Actions for Nuclear Incidents, EPA 400-R-92-001, U.S. Environmental Protectio Washington D.C., October.

EPA (U.S. Environmental Protection Agency), 1993, Motor Vehicle-Related Toxics Stud 005, U.S. Environmental Protection Agency, Ann Arbor, Michigan, April.

Fischer, L. E., C. K. Chou, M. A. Gerhard, C. Y. Kimura, R. W. Martin, R. W. Mensin Witte, 1987, Shipping Container Response to Severe Highway and Railway Accide NUREG/CR-4829, UCID-20733, Lawrence Livermore National Laboratory, Berkeley,

February.

Heiselmann, H. W., 1995, DOE Complex Wide Spent Nuclear Fuel Shipment Estimates for Programmatic Spent Nuclear Fuel Management Environmental Impact Statement, En Design File EIS-TRANS-20, Rev. 2, Science Applications International Corporat Idaho, March.

ICRP (International Commission on Radiological Protection), 1991, "1990 Recommendat International Commission on Radiological Protection," ICRP Publication 60, An 21, 1-3, Elmsford, New York: Pergamon Press.

Javitz, H. S., T. R. Lyman, C. Maxwell, E. L. Myers, C. R. Thompson, 1985, Transpor Material in the United States: Results of a Survey to Determine the Magnitude Characteristics of Domestic, Unclassified Shipments of Radioactive Materials, Sandia National Laboratories, Albuquerque, New Mexico, April.

Johnson, P. E., D. S. Joy, D. B. Clarke, J. M. Jacobi, 1993a, HIGHWAY 3.1 - An Enha Routing Model: Program Description, Methodology, and Revised User's Manual, ORNL/TM-12124, Oak Ridge National Laboratory, Oak Ridge, Tennessee, March.

Johnson, P. E., D. S. Joy, D. B. Clarke, J. M. Jacobi, 1993b, INTERLINE 5.0 - An Ex Routing Model: Program Description, Methodology, and Revised User's Manual, ORNL/TM-12090, Oak Ridge National Laboratory, Oak Ridge, Tennessee, March.

Jones, S. and S. J. Maheras, 1994a, Summary of Doses and Health Effects From Histor Nuclear Fuel Shipments to the Hanford Site, Engineering Design File EIS-TRANS Science Applications International Corporation, Idaho Falls, Idaho, August 23

Jones, S. and S. J. Maheras, 1994b, Summary of Doses and Health Effects From Histor Nuclear Fuel Shipments to the Savannah River Site, Engineering Design File EI 0, Science Applications International Corporation, Idaho Falls, Idaho, August

Jones, S. and S. J. Maheras, 1994c, Summary of Doses and Health Effects From Histor Nuclear Fuel Shipments to Oak Ridge, Engineering Design File EIS-TRANS-30, Re Applications International Corporation, Idaho Falls, Idaho, August 23.

Jones, S. and S. J. Maheras, 1994d, Summary of Doses and Health Effects From Histor Nuclear Fuel Shipments to the Nevada Test Site, Engineering Design File EIS-T Science Applications International Corporation, Idaho Falls, Idaho, August 22

Lorenz, R. A., J. L. Collins, A. P. Malinauskas, O. L. Kirkland, R. L. Towns, 1980, from Highly Irradiated LWR Fuel, NUREG/CR-0722, U.S. Nuclear Regulatory Commi Washington, D.C., February.

Madsen, M. M., J. M. Taylor, R. M. Ostmeyer, P. C. Reardon, 1986, RADTRAN III, SAND National Laboratories, Albuquerque, New Mexico, February.

Maheras, S. J., 1994, Summary of Doses and Health Effects From Historical Offsite S and Waste Shipments to the INEL, Engineering Design File EIS-TRANS-26, Rev. 0 Applications International Corporation, Idaho Falls, Idaho, May 25.

Maheras, S. J., 1995a, Doses and Health Effects From Incident-Free Transportation o Research Reactor Spent Nuclear Fuel For Alternatives 1-5, Engineering Design 14, Rev. 2, Science Applications International Corporation, Idaho Falls, Idah

Maheras, S. J., 1995b, Doses and Health Effects From Incident-Free Transportation o Reactor Spent Nuclear Fuel From Ports to INEL, Savannah River and Hanford For 1-5, Engineering Design File EIS-TRANS-15, Rev. 2, Science Applications Inter Corporation, Idaho Falls, Idaho, March.

Maheras, S. J., 1995c, Doses and Health Effects From Incident-Free Transportation o Nuclear Fuel For Alternatives 1-5, Engineering Design File EIS-TRANS-18, Rev. Applications International Corporation, Idaho Falls, Idaho, March.

McCluggage, W. C., 1971, "The AEC Accident Record and Recent Changes in AEC Manual

International Journal of Radiation Engineering, 1, 4, 387-398, October.

Neuhauser, K. S. and F. L. Kanipe, 1992, RADTRAN 4 User Guide, SAND89-2370, Sandia Laboratories, Albuquerque, New Mexico, January.

NRC (U.S. Nuclear Regulatory Commission), 1977, Final Environmental Impact Statemen Transportation of Radioactive Materials By Air and Other Modes, NUREG-0170, U Regulatory Commission, Washington D.C., December.

Ostmeyer, R. M., 1986, A Revised Rail-Stop Exposure Model for Incident-Free Transpo Waste, SAND85-2149, Sandia National Laboratories, Albuquerque, New Mexico, Fe

Patterson, D. E. and V. P. DeFatta, 1962, A Summary of Incidents Involving USAEC Sh Radioactive Material, 1957-1961, TID-16764, U.S. Atomic Energy Commission (av U.S. Department of Energy), Washington, D.C.

Patterson, D. E. and A. Mehn, 1963, A Summary of Incidents Involving USAEC Shipment Material, 1962, TID-16764 (Supplement 1), U.S. Atomic Energy Commission (avai Department of Energy), Washington, D.C.

Patterson, D. E., 1968, "The Accident Experience of the USAEC in the Shipment of Ra Proceedings of the Second International Symposium on Packaging and Transporta Radioactive Materials, October 14-18, 1968, Gatlinburg, Tennessee, CONF-68100

Pippen, H. K., T. W. Wierman, M. A. Hall, 1995, Scoping Evaluation for the Option o Nuclear Fuel by Barge, Engineering Design File EIS-TRANS-39, Rev. 0, Science International Corporation, Idaho Falls, Idaho, April.

PSC (Public Service Company of Colorado), no date, Ft. St. Vrain Nuclear Generating Final Safety Analysis Report, (FSAR), Revision 2, Public Service Company of C Colorado.

Rao, R. K., E. L. Wilmot, R. E. Luna, 1982, Non-Radiological Impacts of Transportin Material, SAND81-1703, Sandia National Laboratories, Albuquerque, New Mexico,

SAIC (Science Applications International Corporation), 1991, Historical Overview of Shipments--Update, DE91 016051, U/S. Department of Energy, Oak Ridge, Tenness

Saricks, C. and T. Kvitek, 1994, Longitudinal Review of State-Level Accident Statis Interstate Freight, ANL/ESD/TM-68, Argonne National Laboratory, Argonne, Illi

Shibata, T., T. Tamai, M. Hayashi, 1984, "Release of Fission Products from Irradiat High Temperatures," Nuclear Science and Engineering, 87, pp. 405-417.

USN (U.S. Department of the Navy), 1984, Final Environmental Impact Statement on th Decommissioned, Defueled Naval Submarine Reactor Plants, PB90-193855, U.S. De the Navy, Washington, D.C., May.

Weiner, R. F., P. A. LaPlante, J. P. Hageman, 1991a, "An Approach to Assessing the Free Transportation of Radioactive Materials: II. Highway Transportation," Ri No. 4, pp. 661-666.

Weiner, R. F., P. A. LaPlante, J. P. Hageman, 1991b, "An Approach to Assessing the Free Transportation of Radioactive Materials: I. Air Transportation," Risk An 660.

Wilmot, E. L., 1981, Transportation-Accident Scenarios for Commercial Spent Fuel, S Sandia National Laboratories, Albuquerque, New Mexico, February.

Wooden, D. G., 1986, Railroad Transportation of Spent Nuclear Fuel, SAND86-7083, Sa Laboratories, Albuquerque, New Mexico, March.

WSRC (Westinghouse Savannah River Company), 1990, Reactor Operation Safety Informat (U), WSRC-RP-89-820, Westinghouse Savannah River Company, Aiken, South Caroli

WSRC (Westinghouse Savannah River Company), 1991, Support Facilities Descriptions f Production Reactor at Savannah River, Volume 1, Heavy Water Reactor (U), WSRC Vol. 1, Version 4, Westinghouse Savannah River Company, Aiken, South Carolina

Yuan, Y. C., S. Y. Chen, D. J. LePoire, R. Rothman, 1993, RISKIND - A Computer Prog Calculating Radiological Consequences and Health Risks from Transportation of Fuel, ANL/EAIS-6, Rev. 0, Argonne National Laboratory, Argonne, Illinois, Feb

APPENDIX J Spent Nuclear Fuel Management

CONTENTS

FIGURES

TABLES

Appendix J

Spent Nuclear Fuel Management

This appendix describes a range of technologies potentially available for man nuclear fuel (SNF) and the status of each technology. The identified technologies programmatic objective to define a management path and proceed toward ultimate disp Department of Energy (DOE) SNF. Included are technologies for fuel preparation, st where appropriate, direct interim storage. The stabilization and direct storage te applicable to ultimate disposition in some instances. The stabilization technologi range from the minimal to the extensive stabilization processing technologies that the SNF for extended interim storage or ultimate disposition. In addition, program factors, which are considerations in the selection of technology options for applic presented is a brief description of the types of DOE SNF, particularly as their cha technology options.

J-1 BACKGROUND

During the last 40 years, DOE and its predecessor agencies have generated, tr stored, and reprocessed SNF at facilities in the nationwide DOE complex. This SNF various sources, including DOE production reactors; the Naval Nuclear Propulsion Pr university, and other research and test reactors; special-case commercial power rea reactors. Production reactors were constructed and operated at the Hanford and Sav provide special nuclear material and other radioactive isotopes for the DOE's defen production reactors are no longer operated. Naval Nuclear Propulsion Program react research reactors are still operating. DOE has reprocessed SNF at the Idaho Nation Laboratory, Hanford Site, and Savannah River Site to recover fissile materials (ura plutonium-239) and other valuable radionuclides.

More than 100,000 metric tons of heavy metal (MTHM) of SNF was produced by DO predecessor agencies since 1943. In the past, most of the SNF was chemically proce materials, largely uranium-235 and plutonium-239, either for the national defense p research and development.

With the end of the Cold War, DOE and the U.S. Department of Defense reevalua their weapons production, nuclear propulsion, and research missions. Because of th

additional fissile materials, DOE decided in 1992 to phase out reprocessing for the materials. Approximately 2,700 MTHM of SNF remains that has not been processed. A approximately 100 MTHM of DOE SNF is expected to be generated in the next 40 years. which is in a wide range of enrichments and physical conditions, is stored at vario States and overseas. This material requires management until a decision regarding reached.

Most of the existing fuel is currently stored in 10- to 40-year-old water poo temporary storage of SNF until it could be reprocessed) at several locations at the National Engineering Laboratory, and Savannah River Site. Smaller quantities are s 60 locations nationwide, including 55 non-DOE United States research reactor facili associated with the storage of SNF are identified in a recent DOE report to the Sec Spent Fuel Working Group Report on Inventory and Storage of the Department's Spent Other Reactor Irradiated Nuclear Materials and Their Environment, Safety, and Healt (DOE 1993). A DOE plan of action (Phases I, II, and III) to address these vulnerab (DOE 1994a, b, c).

J-2 SPENT NUCLEAR FUEL

Individual fuel elements and assemblies in nuclear reactors are constructed i but they generally consist of the fuel matrix, cladding, and structural hardware. structural hardware constitute the reactor core. Section 1.1.1 of Volume 1 of this description of SNF.

The fuel matrix contains the fissile material (typically uranium as a metal, For water-cooled reactors, the matrix form is typically plates or cylindrical pelle reactors, the matrix is particles, which are an oxide or carbide composite of the f a ceramic coating.

Cladding materials surrounding the fuel matrix serve two principal functions: fuel matrix from corrosion by the fluid that removes heat from the reactor core, an radioactive fission products generated within the fuel during reactor operation. T cladding corrosion varies with reactor design.

The structural hardware serves both to support the fuel assemblies and to mai for the fissile materials in the reactor core. For example, structural materials f elements relative to one another in a fuel assembly and also fix the location of th one another in the reactor core. Structural hardware also provides mechanical supp the core, as well as providing defined paths for cooling the core. These functions nuclear reactions in the reactor core and ensure that adequate cooling is provided regions of the reactor core.

The characteristics of the fuel elements in a reactor are tailored to the pur Two examples, important to SNF management, are discussed below. One example is for integrity cladding and the other is for fuel with lesser cladding integrity. Integ resistance of the fuel to the reactor coolant and/or to its corrosion resistance in stored.

- High-Integrity Fuels Used in Naval Reactors and Nuclear Power Plants. N highly enriched uranium, while nuclear power plant fuels generally use uranium. These types of reactors use water for cooling the fuel assemb operated at high coolant temperatures and pressures. The design object commercial fuel and these reactor types are to maximize power output an spent refueling. For naval reactors, other design objectives are also withstand battleshock, ability to preclude release of any fission produ personnel must live and work in close proximity to the reactor, and abi power levels quickly so the ship can alter speed when needed. As a res materials are selected to be very corrosion resistant at high temperatu is used). Long-term fuel element integrity is emphasized. From the st management, such fuel element designs are well-suited for direct storag wet or dry) without additional stabilization. Aggressive (concentrated mechanical means are required to remove cladding if fuel processing is option for stabilization.

Savannah River Production Reactor Fuels (and targets). The Savannah Riv production reactors also used water for cooling fuel assemblies. Howev operated at relatively low temperatures and essentially at atmospheric of these production reactor cores was optimized for production of speci and other valuable radioactive isotopes. Fuel irradiation times were g a few months. Fuel element cooling times prior to reprocessing were re the fuel elements were designed for special nuclear materials productio high degree of corrosion resistance for the cladding was not part of th cladding was selected so that the fuel elements could be dissolved for highly concentrated chemical solutions than for fuel with higher integr Therefore, this fuel type is not as suitable for long-term storage (eit higher integrity fuels.

The DOE SNF represents a broad spectrum of fuel element designs, both for the and the cladding. To provide perspective, the characteristics of the principal typ discussed below. Inventories for the various types (current and projected), in uni summarized in Table J-1, along with a qualitative statement regarding fuel element integrity.

J-2.1 Category 1-Naval Fuel

This SNF type includes the fuel from the Naval Nuclear Propulsion Program, in submarines, surface vessels, and prototype reactors. Naval fuel is highly enriched zirconium alloy. This fuel design is structurally strong (able to withstand battle 50 times the force of gravity), the cladding is highly corrosion-resistant (no rele the fuel is designed to operate for more than 20 years.

J-2.2 Category 2-Aluminum-Clad Production Reactor Fuel

The principal source of DOE aluminum-clad SNF was target and driver fuel from River Site defense production reactors. The driver fuel is highly enriched aluminu aluminum. Most of the targets are depleted uranium metal (containing less uranium- uranium), also clad with aluminum. Corrosion resistance of the cladding
Table J-1. Spent nuclear fuel inventories and corrosion resistance is moderate. quality. Also, this category is used for SNF from the Advanced Test Reactor at the Engineering Laboratory, some domestic and foreign research reactors SNF, and some p at the Hanford Site. With proper water quality, this fuel has been stored for more cladding corrosion problems.

Some of the fuel and targets have been in storage in water pools (with poor w 1989. Fuel is showing signs of corrosion, and targets are heavily corroded.

J-2.3 Category 3-Zirconium-Clad Production Reactor Fuel

All fuel in this category is from the Hanford Site N Reactor. It consists of alloy fuel matrix, clad with a zirconium alloy. The fuel irradiation times were su concentrations of fissile plutonium were produced.

Some of the N-Reactor's SNF has been in storage for over 20 years and a large elements have holes in the cladding (breached), which permits corrosion of the fuel contamination of the water in the storage pools at the Hanford Site. With respect cladding, it is known that the irradiated metallic uranium can undergo reactions wi uranium hydrides. The hydrided, irradiated uranium can be pyrophoric (subject to s is permitted to dry out and is exposed to air (ITAT 1994). The potential pyrophori important consideration as management strategies for this fuel (including stabiliza evaluated.

J-2.4 Category 4-High-Temperature Gas-Cooled Graphite Reactor Fuel

Graphite-matrix fuel was primarily used in two gas-cooled, commercial reactor Peach Bottom. This type of fuel consists of small pellets of highly enriched urani by layers of pyrolytic carbon and protective layers of other carbide compounds that cladding. The pellets are dispersed in much larger graphite structures that provid secondary containment. The fuel has high corrosion resistance when stored dry. Ho amenable to wet storage.

J-2.5 Category 5-Commercial Reactor Research and Development Fuel

DOE has participated in numerous commercial reactor and SNF safety investigat activities have resulted in accumulations by DOE of SNF elements from a number of c Typically, this SNF consists of zirconium-alloy-clad, low-enriched uranium oxide fu elements were examined in DOE analytical facilities; others were used in test react in simulated accidents. The damaged core from the Three Mile Island-Unit 2 reactor extensively by DOE, under cooperative research and development agreements, at sever damaged fuel is also included in this category.

J-2.6 Category 6-Test and Experimental Reactor Fuels

This is a category of fuels of broad description. The fuels range from low t encompass metal, metal alloy, and oxide fuel matrices. The fuel can be divided int

J-2.6.1 Category 6a-Stainless-Steel-Clad Fuels from Experimental Reactors

Uranium enrichments are generally high in fuels from these reactors, but low- included as well. Fuel matrices consist of uranium-zirconium hydride, uranium diox plutonium alloy, uranium carbide, uranium metal, and uranium alloys. The principal category are the Experimental Breeder Reactor-II and Zero Power Physics Reactor at Engineering Laboratory, Hanford Fast Flux Test Facility, and the blanket assemblies reactor.

J-2.6.2 Category 6b-Zirconium-Alloy-Clad Spent Nuclear Fuel from Experimental Reactors

Typically, fuel in this category has a uranium dioxide fuel matrix, but there alloy fuel also in this inventory. Enrichment can be either high or low. Most of Shippingport Power Reactor where the light water breeder reactor concept was tested uranium-233 fuels are found in this category.

J-2.6.3 Category 6c-Miscellaneous Fuel

Fuel in this miscellaneous category is derived mainly from the Molten Salt Re Oak Ridge Reservation. That fuel is now stored in the salt storage tanks beneath t

J-3 SPENT NUCLEAR FUEL INTERIM MANAGEMENT OPTIONS

In 1992, the Secretary of Energy directed the DOE to develop an integrated lo management program. The program is assessing DOE's current SNF inventory and SNF s integrating DOE's many existing SNF activities into one program, developing an inte and policy basis for SNF operations, and ensuring that all issues associated with S cost effectively.

Until ultimate disposition is determined, it is not possible to define the SN for ultimate disposition. Pending selection of an ultimate disposition, SNF must b storage. Solutions to the storage questions may require changes in management stra including such options as the construction of new facilities and stabilization of c

Technologies for SNF management are required to ensure safe, environmentally management until ultimate disposition is implemented. There are a number of techno for accomplishing these objectives. Key design factors to be considered include th integrity of the fuel, degree of corrosion of the cladding, fuel enrichment, and th cladding and the fuel matrix. The principal technology option categories for stora way on a flow chart (Figure J-1).

The options for SNF management include direct storage (high-integrity fuels) preparation for continued storage. Technologies included under SNF stabilization a processing without separation of fissile materials, and processing in which there i material. The status of technologies for each of the approaches are discussed in S institutional factors associated with implementing the various management approache Section J-5.

Figure J-1. Technology options for preparing spent nuclear fuel for interim stor

In 1992, DOE had proposed to engage in research and development activities fo development and demonstration required to ensure that SNF could be appropriately pr in a geologic repository. Any such repository is not expected to be available unti Therefore, DOE has changed its focus in this effort to better define the SNF resear program. The DOE is utilizing a system approach (a logical, structured approach to to technology development for preparing SNF for safe interim storage and ultimate d repository.

Figure J-1 summarizes the technology options available for preparing SNF for Indicated under each of the four general categories on the figure is a range of rep options. This section describes technology options listed on Figure J-1 and discus

The option (describes what it involves)

Applicable fuel types

Maturity (demonstrated technology, early stages, or developmental)

Status of commercial and foreign applications/development that may be ap SNF management

References that contain more detail on the technology.

When evaluating SNF management options, criticality control is an important f SNF with enriched uranium fuel.

Criticality considerations apply for both direct storage and stabilization. meet applicable requirements governing nuclear criticality, which specify that the ensure that a nuclear criticality is not possible unless at least two independent (changes occur in the systems essential to the control of nuclear criticality.

Also important in selecting management options for SNF are the characteristic the physical condition of the fuel. For specific types of fuel, characterization m the extent of stabilization required and/or the most suitable stabilization process SNF into interim storage.

J4

J-4.1 Direct Storage

Direct storage means storing SNF in essentially the same physical form in whi the reactor (that is, little or limited stabilization of the fuel elements). Fuel amenable to direct storage provided criticality issues can be adequately addressed interval (IAEA 1988). Specific examples are naval SNF and SNF removed from most ty nuclear electric generating stations (both in the United States and foreign countri

If a reactor that has operated at high power has fuel removed soon after shut level of heat generation associated with fission product decay may be sufficient to the fuel if the fuel assembly is not cooled adequately. In addition, radiation lev fission products and radionuclides in the irradiated structural materials. Thus, b effective shielding of the stored SNF are essential. Common practice is to place t at least a period of time, following removal from the reactor. The level of heat g decay associated with SNF decreases with time after removal from the reactor. With possible and may be desirable to transfer SNF from a wet to a dry storage mode beca and potential environmental safety and health vulnerabilities associated with dry s associated with wet storage (Lopez 1994, Taylor and Shikashio 1993). The status of technologies is discussed in the following two subsections.

J-4.1.1 Wet Storage

Water pools (or water pits) are part of the design of nearly all nuclear reac used to provide a storage location for SNF when it is removed from the reactor. Th designed to store the inventory of fuel removed from a reactor for a number of year to provide shielding for personnel working in the region of the water pool. The wa includes a subsystem for water chemistry control with a purpose of maintaining the the pool so cladding corrosion is minimized, water in the pool is clean enough that underwater during fuel movement and fuel removal operations, and chloride content i pool liner integrity. The water pools usually are of concrete construction and lin to minimize the potential accumulation of radioactivity on or under the surface of

Wet storage systems generally have more heat removal capability than dry stor heat transfer to liquids is more efficient than to gases, such as air or nitrogen.

Design, construction, and operation of water pools for SNF storage is a matur DOE and for commercial nuclear power plants (Tak-ts 1994). Wet storage system desi usually center around re-racking the fuel in a pool to permit more fuel to be store element spacing in rack designs is carefully analyzed to ensure that there is an ad criticality prevention for existing or contemplated SNF to be stored in the racks i

J-4.1.2 Dry Storage Systems

In a dry storage system, cooling is provided by heat transfer to the inner wa with eventual heat rejection to the air surrounding the storage system. Dry storag technologies that are being applied for DOE SNF and for SNF at United States commer nuclear electric generating systems (Schneider et al. 1992).

Dry storage system options generally are of three types: (a) stand-alone mod vault arrays, and (c) multiple-unit vault storage systems. Hot cells are also empl considered cost efficient for storing significant quantities of SNF. Multiple exam types have been built and are storing SNF at the present time in DOE, commercial, a

Stand-Alone Modular Casks. A number of large stand-alone casks are avai DOE system and in commercial applications. The casks are top- or end-l a variety of materials, and have been developed primarily in North Amer (Monthey and Bergsman 1994). Some cask designs are licensed for offsit

and others are used principally for onsite fuel movement.

There are also a variety of smaller stand-alone casks that are designed transportation and storage of specific irradiated fuels and other mater documentation for these casks can be found in accompanying safety analy example, Saito 1992).

Modular Vault Arrays. A second type of dry storage system uses a basic with an arrangement of openings in the concrete. Canisters containing openings. The concrete housing provides supplementary shielding and pr unauthorized access to the SNF. Depending on the design, fuel can be s vertically or horizontally in canisters.

Multiple-Unit Vault Storage Systems. Multiple-unit vault systems tend t facilities that contain cask unloading stations, fuel handling cells, v office space (Carter 1994). In the main storage area array, fuel assem assemblies in canisters are stored vertically in floor wells topped wit Insertion or removal of a canister containing the fueled component is a shielded, floor-supported machine or a wall-mounted, unshielded bridge

J-4.2 Containerization

Some SNF has deteriorated because of past storage conditions, fuel damage dur destructive tests, or use of cladding materials that are quite susceptible to deter wet storage without adequate protection. To provide adequate protection for the pu facility workers, containerization technologies have been employed to (a) add addit SNF, (b) provide a passivating environment for the spent fuel (a passivating enviro corrosion is minimized), or (c) place the spent fuel into an inert atmosphere to re element deterioration process. These technologies are described below.

J-4.2.1 Canning

Canning is the technology whereby the SNF is placed into an engineered metal usually sealed. This technology (commonly called overpacking) is usually done in a Overpacking is used as a temporary corrective action if the SNF is releasing fissio refinements include blowing the water out of the overpack canister while it is stil evacuating the canister (vacuum) to evaporate the remaining water. An inert gas, s can also be added. Another refinement to this technology involves adding a chemica water inside the canister to retard the corrosion of the SNF by the water. This ap at the K-West Basin at the Hanford Site; however, its effectiveness is unknown beca inspected since it was canned. Small vents in the lid of the can, which allow rele radiolysis or corrosion, have also been used.

Canning can also be carried out in a shielded, dry cell having remote-handlin is brought into the remote cell and dried, either by normal drip-drying or employin the drying process. The SNF can be visually inspected in the remote cell and then that is welded closed. Inert gas can be added; high quality inspection of the clos

This technology has been used extensively throughout DOE and foreign countrie The commercial industry has not done a significant amount of direct canning because fuels have been designed for high integrity and so rarely require an overpack.

J-4.2.2 Passivation

The passivation approach is applicable to SNF that may contain regions that c chemical reactions if exposed to air or moisture during dry storage. Passivation i fuel by reducing its reaction rate with air or other oxidants. Consequently, if th

exposed to air during dry storage, the heat generated would be less than the minimu thus minimizing the chances of a fuel fire or rapid adverse chemical reactions. Th be used to stabilize metallic fuel with damaged cladding, such as Hanford Site N-Re

Passivation could also include preparatory steps such as SNF cleaning, drying controlled environment to remove any bound water or to potentially remove or oxidiz typical process first involves fuel cleaning. When cleaning is completed, a flow o around the fuel, which is maintained at the predetermined elevated temperature. A oxidant is introduced into the flowing inert gas. Reactive regions of the fuel mat amount of oxidant at the elevated temperature to oxidize them and make them nonreac instrumentation indicates that the reaction rate between the oxidant and the fuel (environment) is sufficiently low, the fuel is cooled down and appropriately package must restrain the fuel from excessive movement to prevent the formation or exposure fuel regions.

A passivation process has been used on metallic fuel in a laboratory setting considered it to be a potentially viable method to transition their SNF from wet to being investigated for use on N-Reactor fuel at the Hanford Site.

J-4.2.3 Coating

Coating is a technology whereby the SNF is placed into a metal container, dri and then heated to the casting temperature for particular materials such as lead, c element is covered with the molten material. The intent is to provide monolithic c element to ensure that the SNF will not release any fission products, nor encounter the fuel to degenerate further. To date, this technology has been investigated pri preparing SNF for disposal. Pressing copper around SNF at high pressures has been government.

J-4.3 Processing

For over 40 years, DOE has employed aqueous reprocessing. The purpose for repr separate plutonium and residual uranium materials in the SNF from the radioactive f structural material, including fuel element cladding.

Some of the SNF that is currently in storage at the Savannah River Site, Hanfor National Engineering Laboratory shows signs of degraded cladding. Aqueous processi preventing safety and environmental problems with fuels that have questionable clad 1994a). From the standpoint of SNF stabilization, processing is a technology for w and where there are still capable technical and facility operating personnel to sta operations. By removing part of the SNF inventory from the present wet storage env affords an additional level of stability for the inventory of stored SNF.

Processing of SNF with separation of fissile materials has a long history of op technology is mature and well understood. The primary process used for fissile mat SNF, commercial fuels, and foreign separations processing has been the PUREX (Pluto EXtraction) process or variations of this process. Facilities for PUREX-type proce the United States, a number of European countries, Russia, and Japan. In the Unite operating facilities are owned and operated by DOE. With the end of the cold war, Department of Defense reevaluated the need for additional fissile materials and dec processing for recovery of fissile materials. DOE's processing facilities at the H National Engineering Laboratory are now shut down. One processing facility at the recently been restarted to stabilize aqueous solutions of uranium.

While chemical separation is the only technology currently available, there are could accomplish fuel processing. The following technologies are intended to provi examples of technologies that could be employed for various types of SNF subject to National Environmental Policy Act documentation. All technologies are not applicab

Several processes have been proposed and studied to stabilize SNF that do not uranium and/or plutonium from the other highly radioactive contaminants. These pro the SNF physical and chemical form to make the volume smaller, material less reacti homogeneous. Materials to assist in preventing nuclear criticality (nuclear poison

into the process. Because none of these methods remove fissile material, the possi criticality exists for DOE SNF with a fuel matrix of highly enriched uranium-235, u diluted with uranium-238 or a nuclear poison is added to assist in preventing nucle

J-4.3.1 Oxidation

An oxidation process can be used for two purposes. It can be used to (a) sep cladding, minimize the volume of material to be stored, or prepare the fuel matrix or (b) convert fuel matrix or graphite fuel elements into a stable oxide form. The decladding options include

AIROX-Holes are drilled into the fuel matrix. Uranium dioxide (UO2) is by injecting oxygen gas at 400C (750F). There is an increase in fuel m about 70 percent. The uranium then is reduced back to UO2 using hydrog process is repeated several times until the cladding breaks apart. Thi developmental stages.

RAHYD-Holes are drilled into the fuel matrix. Uranium metal is reduced gas at 225C (435F) to produce uranium trihydride. There is about a 70 increase. The fuel matrix is then converted back to uranium metal by h (1400F). The process is repeated several times until the cladding brea process is in the developmental stages.

CARBOX-Holes are drilled into the fuel matrix. Oxygen is injected into fuel at 400 to 700C (750 to 1300F) to form U3O8. There is about an 85 increase. This process is in the developmental stages.

After the fuel is declad, the fuel matrix material can be consolidated and packaged

Development work was performed on decladding technologies in the late 1950s a connection with dry SNF reprocessing research at Atomics International.

The fuel elements can also be oxidized to convert the cladding and/or the fue One example is the burning of the graphite and metal fuels. The oxidized fuel and uranium, plutonium, and most of the fission products, which then would be consolida storage. Technology for burning graphite fuels is well developed and has been used Engineering Laboratory (WINCO 1992).

J-4.3.2 Chemical Dissolution

The fuel is dissolved chemically by a highly concentrated acid or base soluti nuclear poison can be added to assist in criticality control. Separation of the fi products and cladding material does not occur. The resultant product is converted storage form, such as a glass, oxide, or ceramic, with improved characteristics rel This process applies to all DOE fuel types except graphite fuel. The dissolution t (Long 1978) and has been used throughout the DOE complex and in several foreign cou

J-4.3.3 Mechanical

Several mechanical processes, such as shredding, chopping, grinding, and disa proposed to change the configuration of the fuel. The resultant product can be mix such as glass formers or depleted uranium, for safe interim storage. All DOE fuel method. Choppers have been used at several DOE facilities, and shredders have been National Engineering Laboratory for graphite fuel (WINCO 1992).

J-4.3.4 Aqueous Processing

The primary aqueous extraction processing approach used is called PUREX. Aqu consists of chemically dissolving the fuel in an acid, adjusting the solution pH fo extraction, and contacting (mixing) the acid solution with an organic phase, such a usually with tributyl phosphate added (Long 1978, Benedict 1981). The organic comp with the uranyl ion that is extracted into the organic phase, thus separating the u constituents of the fuel. Depending on the fuel type, the entire fuel element may can be breached by chopping the element to enable the acid to leach the fuel matrix approach, there remains undissolved cladding hulls. The acid solutions used in the fuel type. By adjusting the valence of plutonium, it can be separated from the ura products by a series of water-solution-to-organic-phase extraction steps. The PURE to almost all fuel types, if there is a suitable fuel matrix dissolution (headend) called TRUEX, developed at Argonne National Laboratory, can be used to recover the other than uranium or plutonium.

Aqueous processing of SNF utilizing the basic PUREX separation approach is a and is used world-wide (Leigh 1992). The United States has used PUREX aqueous proc fissile materials from irradiated defense fuels since the 1950s at the Savannah Riv Idaho National Engineering Laboratory. The West Valley Plant in New York, construc extraction from commercial light water reactor fuels, used a PUREX-type process. T France, Russia, and Japan use large-scale aqueous PUREX processing to recover fissi fuels.

J-4.3.5 Electrometallurgical Processing

Electrometallurgical processing employs rapid anhydrous (or water-free) chemi temperature for the extraction of metal from mixtures or concentrates and for refin compounds. The process is based on passing an electrical current through fused sal First, a basket of chopped fuel is made anodic with respect to the electrorefiner c rapid dissolution of the fuel into the electrolyte salts. These salts float on a p Second, a metallic cathode is introduced into the salts and much of the uranium is cathode (which is removed for uranium recovery). Third, a liquid cadmium cathode i remaining uranium, plutonium, and fission products. Zirconium and noble metals rem electrorefiner cadmium pool. Most fission products remain in the electrolyte salts cadmium cathode can be distilled, leaving the fissile materials and uranium/plutoni as appropriate. The process is being developed at Argonne National Laboratory-West demonstrated on a near-commercial pilot-plant scale in the Fuel Cycle Facility at t Engineering Laboratory using sodium-bonded metallic fuel. In principle, other meta electrometallurgically. This developmental process is unique to DOE with no foreig counterparts at the present time.

J-4.3.6 Halide Volatility

A dry chloride volatility process is being developed for separation of the nonr cladding material (e.g., zirconium), fissile uranium, and other fissile or nonfissi SNF. This process is in the conceptual stage (Christian 1994). The process involv of a SNF element. Fuel is exposed to chlorine gas at high temperature [greater tha of the fuel constituents form volatile chlorides. The chloride compounds are separ through a molten zinc chloride bath to remove the fission products and transuranic products and transuranic radionuclides are recovered by evaporating away the zinc c chloride gases are fractionally condensed to separate and recover nonradioactive co iodine, and krypton. The process produces a single waste form (e.g., glass) for ul significant reduction in volume can be achieved. The process can be applied to fue existing claddings (such as zirconium alloys, aluminum, and stainless steel).

J-4.4 Capabilities of Existing Facilities for Processing Each of the Fuel Types

The current DOE SNF inventory was characterized into six categories as discu Section J-2 and Table J-1. Table J-2 summarizes the locations for each category of processing capabilities that might be brought to bear on them. The information in below.

Table J-2. Capabilities of existing facilities for processing each type of spent n

SNF category	Description	Source	Conditioning and stabilization needs for interim storage	Proc tech stat
1	Metallic fuel with zirconium-alloy cladding	Naval fuel	Excellent condition; minimal stabilization required	Prov prod scal
2	Highly enriched metallic fuel with aluminum clad	Fuel from the Savannah River Site production reactors; Idaho National Engineering Laboratory Advanced Test Reactor driver fuel; some domestic and foreign research reactor fuels	Condition varies; stabilization is a near-term issue; fuel in wet storage will degrade further during interim period; long-term dry storage has unresolved questions	Prov prod scal
3	Low enrichment, metallic fuel with zircaloy-clad	Hanford Site N-Reactor fuel	Poor condition and degrading; about half of the SNF has breached cladding with fuel leaching; stabilization is a near-term issue	Prov prod scal
4	Uranium carbide in graphite matrix within a graphite structure UO2 fuel with zirconium	Gas-cooled commercial reactors at Fort St. Vrain and Peachbottom	Excellent condition; minimal stabilization necessary	Prov prod scal ROVE prov prot for grap
5	Zircaloy-clad rods typically with low-enrichment UO2 pellets	DOE tests of commercial reactor fuel; damaged Three-Mile Island core debris	Condition excellent with the exception of Three-Mile Island core debris; minimal stabilization necessary	Prov prod scal

Table J-2. (cont.)

6a	Various stainless-steel clad fuels with either high	Idaho National Engineering	Various and sometimes unknown

	or low enrichment	Laboratory and Hanford Site test reactors	fuel condition. Degradation of some fuels expected because of long storage times
6b	Zircaloy-clad UO2 or U-Mo alloy of high or low enrichment	Shippingport power reactor and various experiment reactors	Various and sometimes unknown fuel condition; degradation of some fuels expected because of long storage times
6c	Liquid uranium-235 in a salt solution, no cladding	Molten salt reactor experiment at Oak Ridge National Laboratory	Unknown; corrosive nature of fuel raises questions regarding present conditions; evidence of corrosion of storage container exists; stabilization will be required

J-5 SPENT NUCLEAR FUEL INSTITUTIONAL CONSIDERATIONS

This section, in a general way, summarizes potential impacts of institutional management. The institutional factors include availability of an infrastructure of and training in SNF management; facility capacity for SNF operations; and availabil facilities, railheads, and roadways for transport of SNF. These factors are import evaluating and selecting technology options for SNF management.

J-5.1 Availability of Technical Personnel Trained in Spent Nuclear Fuel Management

The management of SNF requires personnel qualified and experienced in a numbe skill areas and operations. The skill areas include proficiency in the design, fab tooling; specific training in safety and radiation protection; specific understandi understanding of SNF and SNF handling and shipping operations; and emergency prepar Most operations involving SNF must be performed remotely in hot cells.

The disciplines specific to SNF management include mechanical and structural construction engineering, radiation protection, nuclear safety, industrial safety, physics.

J-5.2 Availability of Facilities for Spent Nuclear Fuel Management Operations

Important facilities factors to be considered in SNF management include avail existing facilities for storing and stabilizing of SNF and the design requirements factors when evaluating existing facilities include fuel type to be handled, fuel i example, wet or dry), stabilization requirements, capacity and condition of dry sto conditioning or processing that could be required for ultimate disposition.

J-5.3 Transport of Spent Nuclear Fuel

Important factors relating to transport of SNF include fuel reactivity or sta shielded casks, availability of cask-handling cranes with adequate capacity, status a particular site, availability of transport equipment and loading and unloading fa qualified roadways and/or railheads, and vehicle tracking and communications capabi

J-5.4 Safeguards and Security

The management of SNF typically requires rigorous safeguards and security con fissile material within the SNF from diversion. In addition, protection of personn environment must be maintained. These requirements result in specific safeguards a include access control to areas where SNF is handled, stored, and processed and the controlled databases to account for fuels and their inventory of fissile materials.

J-5.5 Current Federal and State Agreements

DOE has entered into agreements with state governments that apply to SNF site agreement with the State of New York provides that the SNF will be removed from the another DOE site. An agreement among the DOE, Navy, and State of Idaho regarding t Engineering Laboratory provides for removal of SNF from underwater storage in the n of Building CPP-603 by the end of 1996 and from the south basin of this facility by is also an agreement among the DOE, U.S. Environmental Protection Agency, and State regarding the Hanford Site that requires the removal of SNF and pool sludge from th

J-5.6 Maintaining Flexibility Until Ultimate Disposition is Available

Some stabilization technologies for storage may be undesirable if they could conversion to an acceptable form for ultimate disposition very difficult. For exam interim storage could be precluded from ultimate disposition by certain possible ac

J-6 REFERENCES

Benedict, M., T. H. Pigford, H. W. Levi, 1981, Nuclear Chemical Engineering, Secon York: McGraw Hill.

Carter, C., 1994, "A Review of the International Applications of the Modular Dry Va

of the INMM (Institute for Nuclear Materials Management) Spent Fuel Management Washington, D.C., January 26-28.

Christian, J., T. R. Thomas, G. P. Kessinger, 1994, "A Dry Chloride Volatility Con Nuclear Fuels, "Proceedings of Spectrum '94: International Nuclear and Hazardo Management, Atlanta, Georgia, August 14-18.

DOE (U.S. Department of Energy), 1993, Spent Fuel Working Group Report on Inventory the Department's Spent Nuclear Fuel and other Reactor Irradiated Nuclear Materi Environmental, Safety and Health Vulnerabilities, Volume I, U.S. Department of Washington, D.C., November.

DOE (U.S. Department of Energy), 1994a, Plan of Action To Resolve Spent Nuclear Fue Phase I, Volumes I and II, U.S. Department of Energy, Washington, D.C., Februar

DOE (U.S. Department of Energy), 1994b, Plan of Action To Resolve Spent Nuclear Fue Phase II, U.S. Department of Energy, Washington, D.C., April.

DOE (U.S. Department of Energy), 1994c, Plan of Action to Resolve Spent Nuclear Fu Phase III, U.S. Department of Energy, Washington, D.C., October.

IAEA (International Atomic Energy Agency), 1988, Survey of Experience with Dry Stor Nuclear Fuel and Update of Wet Storage Experience, Topical Report No. 290, Inte Energy Agency, Vienna, Austria.

ITAT (Independent Technical Assessment Team), 1994, Dry Storage of N Reactor Fuel I Technical Assessment, Volumes I and II, MAC Technical Services Company, U.S. D Energy, Richland Operations, Washington, D.C., September.

Leigh, I., 1992, International Nuclear Fuel Cycle Fact Book, PNL-3594, Rev. 12, Pa Laboratory, Richland, Washington, May.

Long, J., 1978, Engineering for Nuclear Fuel Reprocessing, Second Edition, LaGrange American Nuclear Society.

Lopez, J., 1994, Comparison of Dry and Wet Methods to Store Spent Nuclear Fuel, WIN Westinghouse Idaho Nuclear Company, Inc., Idaho Falls, Idaho, April.

Monthey, M. J. and K. H. Bergsman, 1994, Commercially Available Dry Storage Systems Irradiated Fuel on the Hanford Site, WHC-SD-CP-ES-155, Westinghouse Hanford Com Richland, Washington, March.

Saito, G., 1992, Retrievable Storage of Irradiated Fuels in the Solid Waste Burial WHC-SD-WM-SAR-047, Westinghouse Hanford Company, Richland, Washington, July.

Schneider., K. J., S. J. Mitchell, A. B. Johnson, Jr., 1992, "International Statu Fuels," Proceedings of the American Nuclear Society's Third International Conf Level Radioactive Waste Management, Las Vegas, Nevada, April 12-16.

Takats, F., 1994, "International Status and Trends for Spent Fuel Management," Proc Spent Fuel Management Seminar XI, Washington, D.C., January 26-28.

Taylor, L. L. and R. Shikashio, 1993, Preliminary Waste Acceptance Criteria for the Waste Management Technology Development Program, WINCO-1157, Westinghouse Idaho Nuclear Company, Inc., Idaho Falls, Idaho, September.

WINCO (Westinghouse Idaho Nuclear Company, Inc.), 1992, Development and Engineering Graphite Spent Fuels Conditioning Program, WIN-346, Westinghouse Idaho Nuclear Inc., Idaho Falls, Idaho, September.

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APPENDIX K Environmental Consequences Data

Appendix K

Environmental Consequences Data

This appendix presents data that were used to discuss environmental consequen the graphics used in comparing environmental consequences among alternatives (in Ch alternatives and sites (in Chapter 5). These data are taken from Volume 1 Appendic converted as required to different units or time periods. To understand the techni each of the reported data elements, refer to the appropriate site appendix:

Hanford Site	Appendix A
Idaho National Engineering Laboratory	Appendix B
Savannah River Site	Appendix C
Naval Nuclear Propulsion Program	Appendix D
Other Generator/Storage Locations	Appendix E
Nevada Test Site and Oak Ridge Reservation	Appendix F

The appendix contains (a) a key to alternatives, (b) a summary of data by alt summary of data by alternative and site. The key to alternatives defines the site the subalternatives and options and relates these to the columns in Tables K-1 and by alternative in Table K-1 presents the summed (or maximum) impacts across all sit alternative, subalternative, and option. The summary of data by alternative and si data for each site that is affected by that alternative, subalternative, and option particular option are not shown.

Ten categories of data, numbered in the first column of the attached tables, discussions and graphs in Chapter 5 and are summarized by discipline below.

1. Land Use-The value presented is an estimate of the amount of additional acrea disturbed if a particular alternative was implemented. Minimum and maximum v for options within each alternative where available. The maximum percent of would be dedicated to spent nuclear fuel (SNF) management activities was also impacts are discussed in Section 5.2.1 of Volume 1. A detailed discussion on Appendices A through F.

2. Employment Related to SNF Management-The values presented are the projected 1 changes in site employment related to proposed SNF management activities for to 2005. Minimum and maximum values were calculated where data were availabl employment refers to the sitewide employment at June 1995, inclusive of those management activities. The maximum percent of baseline site employment repre incremental change in sitewide employment that might occur because of the pro management activities. SNF-related employment is discussed by alternative in 5, Volume 1. A detailed analysis of socioeconomic impacts is provided in App

3. Population Collective Dose-The radiation dose that would be received by the p kilometers (50 miles) of each site per year from normal operations. It is de appendices and represents the dose for the maximum option within each alterna differences in methods used to generate the data, the estimated SNF managemen sometimes higher than total site doses. The SNF management doses were develo releases from existing and proposed facilities, and sitewide doses were deter of modeling of existing facilities and monitoring data. The monitoring data the modeling approach overestimates expected dose, making the expected dose h probably be realized. Population collective doses are described by alternati 5, Volume 1.

4. Maximally Exposed Individual (MEI)-The MEI is a hypothetical person located d site boundary closest to the facilities that might have radiation releases. calculated by modeling releases from existing and proposed facilities from no on the MEI doses can be found in Appendices A through F and represent the dos option within each alternative.

5. Worker Dose-The dose that would be received by workers at facilities, based o levels at those facilities for normal operations. Sitewide worker doses are monitoring of workers. These values are not particularly useful in comparing alternatives as worker doses are controlled by limiting worker involvement in result in exposures to radiation. Both individual doses and collective doses from Appendices A through F.

6. Water Use-The values represent an estimate of the change in annual consumptio millions of gallons) that may result from the proposed SNF management activit alternative. Minimum and maximum values are provided where available. The b the annual water consumption for a site for all operations. The maximum perc water represents the annual maximum incremental change in water use that woul the proposed SNF management activities. Water impacts are discussed in Secti Volume 1. A detailed discussion of water use and related consequences is pro through F.

7. Electricity Use-The values represent an estimate of the change in annual powe megawatt-hours per year) that would result from the proposed SNF management a given alternative. Minimum and maximum values are provided where available. electricity use is the annual power consumption for a site for all operations of site electricity use represents the annual maximum incremental change in p would occur because of the proposed SNF management activities. Electricity u alternative in Section 5.1, Chapter 5, Volume 1. A detailed discussion of el in Appendices A through F.

8. Sewage-The values represent an estimate of the change in annual rate of waste millions of gallons) that would result from the proposed SNF management activ alternative. Minimum and maximum values are provided where available. The b value represents the annual volume of wastewater generated from total site op maximum percent of baseline site sewage represents the annual maximum increme wastewater generation that would occur because of the proposed SNF management Wastewater generation is discussed in Section 5.2.9 of Volume 1. A detailed wastewater generation is provided in Appendices A through F.

9. Waste Volume Estimates (high-level, transuranic, mixed, and low-level waste)- generation rate of these waste types (in cubic meters per year) from the prop activities is provided. These values represent 10-year cumulative generation Minimum and maximum values are provided where available. The waste volumes a alternative in Section 5.1 of Volume 1. A detailed discussion of the waste-g each site is provided in Appendices A through F.

10. Facility Accidents-For accidents, the individual and collective dose values i the consequences for the accident having the highest radiological risk (dose necessarily the highest dose) to the public or to workers. The accidents sel necessarily the same for workers and the general population. In each categor highest risk was selected, which may be different for workers and the general risks in Table K-2 are the maximum values from each alternative in Table K-1. reported in this summary are based on SNF management-related activities only site appendices. Doses from accidents are described by alternative in Sectio Savannah River Site did not quantify the worker dose for the maximum risk acc safety analysis reports from which accident information was extracted were pr issuance of DOE Order 5480.23 (DOE 1992). Before 1992, applicable DOE orders the inclusion of worker doses in safety analysis reports. Appendix C to Volu provides a co-located worker dose rather than a worker dose for the maximum r

11. Transportation-For incident-free transportation, the values in Table K-2 repr average fatalities from shipments of SNF for each alternative. Total fatalit radiation-related latent cancer fatalities for transportation workers and the nonradiological fatalities from vehicular emissions. These data are an aggre presented in Appendices A, B, C, D, and I. For transportation accident risks presented in Table K-2 for each alternative. The estimated risks of cancer f radiological risk from transportation accidents. The estimated risk of traff nonradiological risk from traffic accidents. Both quantities are on an annua

data are an aggregate of the data presented in Appendices D and I.

The data in Table K-1 have been rounded to two significant figures, the great significant figures that can be justified with this analysis. Zero values indicate In the summary table by alternatives, however, missing site data are treated as zer given alternatives can be understated. Missing data are indicated by blanks. Miss impacts are expected to be very small or trivial, so the magnitude of underestimati

Table K-1 shows the magnitude of differences between alternatives is very low observed differences between alternatives, Chapter 5 of this EIS should be consulte sites within an alternative require examination of the site-specific appendices for

Key to Alternatives and Sites

No Action: Very limited SNF shipments, limited upgrades to facilities, limited sta

Decentralization: Non-DOE sites (except Navy) transport to DOE sites, some upgrade

Option A: No examination of naval SNF
Option B: Limited examination of naval SNF at Puget Sound Naval Shipyard
Option C: Full examination of naval SNF at Idaho National Engineering Laborato for storage

1992/1993 Planning Basis: New SNF transported to Idaho National Engineering Laborat facility upgrades and expansion, stabilization.

Regionalization: SNF transported to regional sites, facility upgrades and expansio

4A: SNF to Idaho National Engineering Laboratory or Savannah River Site depen
4B: SNF to Western or Eastern Regional Site depending on geography

Option	Western Regional Site	Eastern Regional Site	Expended Core Faci
1E	Hanford Site	Savannah River Site	Savannah River Sit
1W	Hanford Site	Savannah River Site	Hanford Site
2W	Idaho National Engineering Laboratory	Savannah River Site	Idaho National Eng Laboratory
3E	Nevada Test Site	Savannah River Site	Savannah River Sit
3W	Nevada Test Site	Savannah River Site	Nevada Test Site
4E	Hanford Site	Oak Ridge Reservation	Oak Ridge Reservat
4W	Hanford Site	Oak Ridge Reservation	Hanford Site
5W	Idaho National Engineering Laboratory	Oak Ridge Reservation	Idaho National Eng Laboratory
6E	Nevada Test Site	Oak Ridge Reservation	Oak Ridge Reservat
6W	Nevada Test Site	Oak Ridge Reservation	Nevada Test Site

Centralization: SNF transported to central site, facility upgrades and expansion,

Option A: Hanford Site is the central site
Option B: Idaho National Engineering Laboratory is the central site
Option C: Savannah River Site is the central site
Option D: Oak Ridge Reservation is the central site
Option E: Nevada Test Site is the central site

Hanford	Hanford Site
INEL	Idaho National Engineering Laboratory
SRS	Savannah River Site
ORR	Oak Ridge Reservation
NTS	Nevada Test Site
Navy	Navy shipyards and prototype locations
Other	Small DOE, other government, and university research reactor sites

Table K-1. Summary of impacts by alternatives and by site.
Table K-1. (continued).
Table K-1. (continued).
Table K-1. (continued).
Table K-1. (continued).
Table K-1. (continued).
Table K-1. (continued).
Table K-1. (continued).
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Table K-1. (continued).
Table K-1. (continued).

K. REFERENCES

DOE (U.S. Department of Energy), 1992, Order 5480.23, "Nuclear Safety Analysis Repo Department of Energy, Washington, D.C., April 30.

APPENDIX L Environmental Justice

CONTENTS

FIGURES

TABLES

Appendix L

Environmental Justice

L-1 INTRODUCTION

in Minority Populations and Low-Income Populations (FR 1994), was released to Feder

order directs Federal agencies to incorporate environmental justice as part of thei agencies are specifically directed to identify and address as appropriate dispropor human health or environmental effects of their programs, policies, and activities o low-income populations. In addition to describing environmental justice goals, Exe directs the Administrator of the Environmental Protection Agency to convene an inte Group on Environmental Justice (referred to below as the Working Group). The Worki to provide guidance to Federal agencies on criteria for identifying disproportionat health or environmental effects on minority populations and low-income populations. also directed to coordinate with each Federal agency to develop an environmental ju is required by the proposed activities. At the time of this analysis, the Working guidance on the approach to be used in analyzing environmental justice, as directed The Working Group has issued draft definitions of terms in the Draft Guidance for F Terms in Executive Order 12898, dated November 28, 1994. These definitions, with s were used in the following analysis. Further, in coordination with the Working Gro internal guidance for the implementation of the Executive Order, which has not yet both DOE and the Working Group are still in the process of developing guidance, the analysis might depart somewhat from whatever guidance is eventually issued.

This section provides an assessment of the areas surrounding the 10 sites under management of SNF under all programmatic alternatives considered in this volume. sections: (a) the five sites considered for the management of DOE naval SNF only (Decentralization alternatives, and (b) the five DOE sites being considered for the DOE SNF under all alternatives. The five sites considered for the management of na Norfolk Naval Shipyard, Portsmouth, Virginia; Portsmouth Naval Shipyard, Kittery, Naval Shipyard, Honolulu, Hawaii; Puget Sound Naval Shipyard, Bremerton, Washingto Site, West Milton, New York. The five DOE sites considered for the management of s DOE SNF are the Savannah River Site, Aiken, South Carolina; Oak Ridge Reservation, Tennessee; Idaho National Engineering Laboratory, Idaho Falls, Idaho; Hanford Site, and Nevada Test Site, Mercury, Nevada.

This assessment includes potential adverse impacts resulting from both onsite a associated transportation of materials. Based on this assessment, it is concluded analyzed results in disproportionately high and adverse effects on minority populat communities surrounding any of the sites under consideration for the management of offsite transportation routes.

L-2 PUBLIC COMMENT RECEIVED ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

Public comment received on the Draft EIS is addressed in Volume 3, "Response to Comment," of this Final EIS. Overall comment indicated a widespread concern about activities on human health and the environment. A small number of comments were rec environmental justice; these indicated the need for an expanded analysis in the Fin previously committed to in the Draft EIS. The most specific comments were received Environmental Protection Agency's Office of Enforcement and Compliance Assurance an Bannock Tribes on the Fort Hall Indian Reservation. Environmental justice comments 1 of this EIS were in essence:

> Although the Draft EIS includes discussions on socioeconomic impacts, it do whether the alternatives would affect minority communities and low-income (Sanderson 1994).

> The DOE should pay particular attention to any environmental impacts that m Cattaraugus Reservation of the Seneca Nation of Indians, located downstrea Cattaraugus Creek from the DOE's West Valley Site in New York State. Trib engage in subsistence fishing on the river and should be given a full oppo participate in the National Environmental Protection Agency process (Sande

> The DOE must meet the requirements of Executive Order 12898 on environment and fully consider the comments of the Shoshone-Bannock Tribes on the Draf

consider the impacts of its proposed actions on the Tribes, the Fort Hall and on other disadvantaged populations living in proximity to the Idaho Na Engineering Laboratory. It was stated that the Indian Tribes are not just population," but are governments that have a special relationship to the F and its agencies and have certain authorities to regulate others including Government (Tinno 1994, Wolfley 1994).

Pertinent public comments on the topic of environmental justice have been considere which has been expanded over the discussions in the Draft EIS. Consultations have Shoshone-Bannock Tribes on the Fort Hall Indian Reservation and the Seneca Nation o Cattaraugus Reservation. As a result of consultations with the Seneca Nation of In have received a request by this tribe for notification of impending SNF shipments a Reservation. Consultations with the Shoshone-Bannock Tribes on the Fort Hall India specifically addressed in Section 5.20, Volume 2 of this EIS.

L-3 COMMUNITY CHARACTERISTICS

Demographic information obtained from the U.S. Bureau of Census was used to i populations and low-income communities in the zone of potential impact surrounding consideration. This zone is within a circle that has an 80-kilometer (50-mile) rad mile) radius was selected because it was judged to encompass all of the impacts tha also is based on air impact modeling and socioeconomic impact analysis used through Transportation impacts are assessed within 800 meters (0.5 miles) of transportation transportation because impacts beyond this distance are negligible. For transporta kilometer (50-mile) radius was used.

L-3.1 Methodology

Demographic maps were prepared using 1990 census data available from the U.S. B Census. Figures L-1 through L-10 and Figures L-11 through L-20 illustrate census t both minority populations and low-income populations for areas surrounding the five five DOE sites being considered for the management of all or some portion of all DO These maps are based on an analysis of 1990 United States Bureau of the Census Tige contain political boundaries and geographical features, and Summary Tape Files 3A (Environmental Protection Agency), which contain demographic information (USBC 1992) resolved to the census tract (see definition in Section 3.2) group level.

An 80-kilometer (50-mile) radius circle appears on each map, defining a zone o As discussed above, this zone of potential impact for low-income and minority commu that used for analysis performed in the EIS. The circle has been indexed to the ce or existing major SNF management facilities at each site or a conservative location number of minority populations and low-income populations.

L-3.2 Definitions

Definitions used to develop community characteristics are as follows:

Census tract: An area defined for the purpose of monitoring census data that i of between 2,500 and 8,000 persons, with 4000 persons being ideal. When first delin designed to be homogenous with respect to population characteristics, economic sta

conditions. Census tracts do not cross county boundaries. The spatial size of censu depending on the density of settlement. Census tract boundaries are delineated wit maintained over a long period of time so that statistical comparisons can be made f

Minority population: A group of people and/or community experiencing common co exposure or impact that consists of persons of the United States classified by Census as Negro/Black/African-American, Hispanic, Asian and Pacific Islander, A Eskimo, Aleut, and other nonwhite persons, based on self-classification by the the race with which they most closely identify. For the purposes of analysis, defined as those census tracts within the zone of impact for which the percent exceeds the average of all census tracts within the zone of impact or where the population exceeds 50 percent of the spacial area for any given census tract. I dispersed populations, a minority population consists of a group that is greate minority.

Low-income population: A group of people and/or community experiencing common exposure or impact in which 25 percent or more of the population is characteriz poverty (FR 1993) The U.S. Bureau of Census characterizes persons in poverty a income is less than a "statistical poverty threshold." Table L-1 presents the thresholds (USBC 1992) used in this analysis. This threshold is a weighted ave size and the age of the persons in the family. For instance, the 1990 census th four was a 1989 income of $12,674 .

Population Base: For the purpose of this analysis, census tracts were included 50 percent of the tract fell within the 80-kilometer (50-mile) radius.

Table L-1. Poverty thresholds in 1989 by size of family and number of related chil

Size of family unit	Weighted average threshold ($)	Related children under 18					
		None ($)	One ($)	Two ($)	Three ($)	Four ($)	Five ($)
One person (unrelated individual)	6,310						
Under 65 years	6,451	6,451					
65 years and over	5,947	5,947					
Two persons	8,076						
Household under 65 years	8,343	8,303	8,547				
Household 65 years	7,501	7,495	8,515				
Three persons	9,885	9,699	9,981	9,990			
Four persons	12,674	12,790	12,999	12,575	12,619		
Five persons	14,990	15,424	15,648	15,169	14,796	14,572	
Six persons	16,921	17,740	17,811	17,444	17,092	16,569	16,259
Seven persons	19,162	20,412	20,540	20,101	19,794	19,224	18,558
Eight persons	21,328	22,830	23,031	22,617	22,253	21,738	21,084
Nine or more persons	25,480	27,463	27,596	27,229	26,921	26,415	25,719

L-3.3 Distribution of Minority Populations Near Candidate Sites

The minority population characteristics within the 80-kilometer (50-mile) radiu for the SNF and INEL EIS are presented in Tables L-2 and L-3. Table L-2 lists the individuals residing near the candidate sites for the management of DOE naval SNF. number of minority individuals residing near the candidate sites for the management DOE SNF.

The racial and ethnic composition of the minority population residing near the is predominantly African-American, with the exception of Pearl Harbor where the mai Asian and Native Hawaiian.

The racial and ethnic composition of the minority population residing near the management of all or some portion of DOE SNF is predominantly African-American at t Reservation and Savannah River Site; Hispanic, American Indian, and Asian at the Id Engineering Laboratory; Hispanic and American Indian at the Hanford Site; and Hispa American at the Nevada Test Site.

Table L-2. Minority individuals residing near the candidate sites for the manageme nuclear fuel only per the 1990 census.

Candidate Site	Number of census tracts considered	Number of individuals residing within 80 km of site	Number o individu 80 km of
Kesselring Site	304	1,148,924	65,590
Norfolk Naval Shipyard	386	1,631,671	534,585
Puget Sound Naval Shipyard	643	2,960,229	379,461
Portsmouth Naval Shipyard	522	2,412,691	121,516
Pearl Harbor Naval Shipyard	200	836,465	571,482

Table L-3. Minority individuals residing near the candidate sites for the manageme of DOE spent nuclear fuel per the 1990 census.

Candidate Site	Number of census tracts considered	Number of individuals residing within 80 km of site	Number o individu 80 km of
Savannah River Site	147	619,959	233,955
Oak Ridge Reservation	211	867,231	49,742
Idaho National Engineering Laboratory	37	172,366	11,722
Hanford Site	79	370,807	75,381
Nevada Test Site	4	11,918	759

The spatial distribution by census tract of the minority population within each candidate site is shown in Figures L-1 through L-10. As indicated in the lege tracts have been shaded according to the percentage of minority individuals within noted that Bureau of Census tracts often extend into oceans, bays, and lakes to all individuals who reside on boats or offshore houses. This is especially noticeable i for the management of DOE naval SNF, with the exception of the inland Kesselring Si have been removed from Puget Sound proper in Figures L-3 and L-13 to improve clarit

L-3.4 Distribution of Low-Income Individuals

Near the Candidate Sites

The low-income population characteristics within the 80-kilometer (50-mile) ra sites for the SNF and Idaho National Engineering Laboratory EIS are presented in Ta L-4 lists the number of low-income individuals residing near the candidate sites

Table L-4. Low-income individuals residing near the candidate sites for the manage nuclear fuel only per the 1990 census.

Candidate site	Number of census tracts considered	Number of individuals within 80 km of site	Number o income i within 8
Kesselring Site	304	1,148,924	101,424
Norfolk Naval Shipyard	386	1,631,671	179,336
Puget Sound Naval Shipyard	643	2,960,229	250,452

Portsmouth Naval Shipyard	522	2,412,691	175,830
Pearl Harbor Naval Shipyard	200	836,465	60,093

Table L-5. Low-income individuals residing near the candidate sites for the manage portion of DOE spent nuclear fuel per the 1990 census.

Candidate site	Number of census tracts considered	Number of individuals within 80 km of site	Number o income i within 8
Savannah River Site	147	619,959	107,764
Oak Ridge Reservation	211	867,231	134,661
Idaho National Engineering Laboratory	37	172,366	23,416
Hanford Site	79	370,807	65,584
Nevada Test Site	4	11,918	1,474

Figure L-1. Minority population distribution within 80 kilometers (50 miles) of
Figure L-5. Minority population distribution within 80 kilometers (50 miles) of
Figure L-6. Minority population distribution within 80 kilometers (50 miles) of
Figure L-9. Minority population distribution within 80 kilometers (50 miles) of
candidate sites for the management of all or some portion of DOE SNF.

The spatial distribution by census tract of low-income individuals residi miles) of each candidate site are shown in Figures L-11 to L-20. As indicated in th census tracts have been shaded according to the percentage of low-income populatio

L-3.5 Limitations of Demographic Data

As discussed in Section 5.8 of Volume 1 of this EIS, characterization of minori populations residing within a geographical area is sensitive to the basic definitio conducting the analysis to identify them. Both the Interagency Working Group and D preparing final guidelines for use in the evaluation of environmental justice. In the definitions and approaches being used by and within Federal agencies could vary and the Draft Environmental Impact Statement on a Proposed Nuclear Weapons Nonproli Concerning Foreign Research Reactor SNF (Draft FRR SNF EIS) present demographic cha obtained from the same U.S. Census Bureau database, but use different definitions a

The differences in the definitions and assumptions between this EIS and the Dra as follows:

1. Although both these EISs use the same 1990 U.S. Census Bureau database, th data aggregated at the census tract level (2,500 to 8,000 persons), while EIS uses data aggregated at the block group level (250 to 550 housing unit

2. In some cases, census blocks or tracts lie partly within the area being an within the 80-kilometer (50-mile) radius around a potential SNF management the exact distribution of the populations within such blocks or tracts is are insufficient to allow a precise count. To address this situation, thi income or minority population in its analyses if 50 percent or more of the an 80 kilometer (50 mile) radius around the site being considered. In sim Draft FRR SNF EIS assumes that the general population and the minority pop distributed uniformly throughout a block group, and includes the fraction or minority population that corresponds to the fraction of the census bloc falls within the 80-kilometer (50-mile) radius.

Figure L-11. Low-income population distribution within 80 kilometers (50 miles)
Figure L-13. Low-income population distribution within 80 kilometers (50 miles)
Figure L-14. Low-income population distribution within 80 kilometers (50 miles)
Figure L-15. Low-income population distribution within 80 kilometers (50 miles)
Figure L-16. Low-income population distribution within 80 kilometers (50 miles)
Figure L-17. Low-income population distribution within 80 kilometers (50 miles)

Figure L-18. Low-income population distribution within 80 kilometers (50 miles)

Figure L-19. Low-income population distribution within 80 kilometers (50 miles) of

by the U.S. Census Bureau, based on the Consumer Price Index, and aggregat thresholds set forth by the U.S. Census Bureau (that is, a group of people community experiencing common conditions of exposure or impact, in which 2 more of the population is characterized as living in poverty), a method us Environmental Protection Agency. The Draft FRR SNF EIS uses the definitio income community, established by the U. S. Department of Housing and Urban Development, as an area for which the median household income is 80 percen median household income for the metropolitan statistical area (urban) or c Both definitions are permitted under the draft guidance developed by the I Working Group.

These different definitions and assumptions have resulted in differences in the low-income and minority populations. The two sets of data are summarized in Tables L-7, and the most significant differences are discussed below.

The minority populations identified are reasonably consistent between this EIS SNF EIS, except for results obtained at the Nevada Test Site (the largest proportio Hanford Site (the largest difference in numbers of individuals), as shown in Table for both locations is due to the different aggregations of the demographic data use and the differences in the methods used to account for the populations of tracts or within the area being analyzed, as discussed above. For example, both sites are lo populated regions so that census tracts surrounding the sites are relatively large addition, the outskirts of Las Vegas, Nevada, begin approximately 80 kilometers (50 Test Site, making the analysis particularly sensitive to differences in treatment o groups that lie partly within a circle of 80-kilometer (50-mile) radius centered a the zone of impact of the Nevada Test Site are restricted access and unpopulated la

As a result of the different definitions used for the identification of low-inc results of these analyses are markedly different, as shown in Table L-7. Both sets reflect the fact that different definitions and assumptions can result in different income populations.

Table L-6. Comparison of the DOE Programmatic Spent Nuclear Fuel Management and Id Engineering Laboratory Environmental Restoration and Waste Management Programs Envi Statement (SNF & INEL EIS) and the Draft Environmental Impact Statement on a Propos Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear F EIS) minority characterization results.

Candidate interim storage site	Total individuals residing within with 80 kilometers (50 miles)		Minority individuals residi with 80 kilometers (50 mile	
	SNF & INEL EIS	Draft FRR SNF EIS	SNF & INEL EIS	Draft FRR SNF EIS
Hanford Site	370,807	383,934	75,381	95,042
Idaho National Engineering Laboratory	172,366	176,311	11,722	15,449
Savannah River Site	619,959	566,823	233,955	214,016
Nevada Test Site	11,918	12,421	759	2,005
Oak Ridge Reservation	867,231	863,758	49,742	53,185

Table L-7. Comparison of the DOE Programmatic Spent Nuclear Fuel Management and Id Engineering Laboratory Environmental Restoration and Waste Management Programs Envi Statement (SNF & INEL EIS) and the Draft Environmental Impact Statement on a Propos Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear F

EIS) low-income characterization results.

Candidate site	Total individuals residing within with 80 kilometers (50 miles)		Minority individuals residi with 80 kilometers (50 mile	
	INEL EIS (individuals)	SNF EIS (households)	EIS (individuals)	SNF EIS (households)
Hanford Site	370,807	136,496	65,584	57,667
Idaho National Engineering Laboratory	172,366	55,109	23,416	22,452
Savannah River Site	619,959	197,937	107,764	82,930
Nevada Test Site	11,918	4,194	1,474	2,024
Oak Ridge Reservation	867,231	335,589	134,661	147,537

L-4 ENVIRONMENTAL JUSTICE ASSESSMENT

This assessment of potential environmental justice impacts addresses activities programmatic management of DOE SNF discussed in this EIS.

L-4.1 Methodology and Definitions

Analysis of environmental justice concerns was based on a qualitative assessmen reported in Section 5 of Volume 1 of the EIS regarding the proposed action and its was performed to identify any disproportionately high and adverse human health or e minority populations or low-income populations surrounding each of the 10 candidate

For this assessment, the following definitions were used:

Disproportionately high and adverse human health effects: Adverse health effec in risks and rates that could result in latent cancer fatalities, as well as ot impacts to human health. Disproportionately high and adverse human health effe risk or rate for a minority population or low-income population from exposure t hazard significantly exceeds the risk or rate to the general population and, wh appropriate comparison group.

Disproportionately high and adverse environmental impacts: An adverse environm is a deleterious environmental impact determined to be unacceptable or above ge norms. A disproportionately high impact refers to an impact (or risk of an imp or minority community that significantly exceeds that on the larger community. and aesthetic environmental impacts, account shall be taken of impacts that uni geographically dislocated or dispersed low-income or minority populations.

In this assessment, DOE reviewed the human health effects and environmental imp with the siting of the alternatives analyzed in Volume 1 of this EIS. This review arising under each of the major disciplines evaluated for the alternatives, includi water resources, air resources, ecology, health and safety, facility operations, cu transportation, which are the sciences pertinent to the identification of environme Regarding health effects, both normal facility operations and accident conditions w accident scenarios evaluated in terms of the risk to the public. Likewise, the exa included both normal and potential accident conditions for both truck and rail tran Special exposure pathways were evaluated with respect to subsistence consumption of

plants.

L-4.2 Results

Potential radiological impacts because of both facility operations and reasonab conditions are small for all management alternatives and potential sites considered number of potential fatalities due to both radiological and nonradiological exposur transportation are small. There is also little probability of adverse impacts beca consumption of fish, game, or native plants.

L-4.2.1 Results of Environmental Justice Assessment Near the Alternative Sites

Considered for the Management of Naval Spent Nuclear Fuel Only
The five sites evaluated for the management of naval SNF only are specifically Appendix D to Volume 1 of the EIS. Additional environmental justice matters pertai are included in Appendix D. It should be noted that, with one exception, these fiv considered for storage of naval SNF under the No Action and Decentralization altern exception is the partial examination of naval SNF at the Puget Sound Naval Shipyard alternative 2B. Under all other alternatives, these five sites would transport nav the larger five DOE sites analyzed in this EIS, and evaluated from an environmental Section L-4.2.2.

L-4.2.1.1 Incident-Free Human Health Effects and Environmental Impacts. As

discussed in Appendix D to Volume 1 of this EIS, the impacts on human health or the from operations associated with the management of naval SNF at any of the five loc storage of naval SNF would be small under any of the alternatives considered. This incident-free transportation. For example, it is unlikely that a single fatal canc naval SNF management activities under any alternative at any one of the five sites. single fatal cancer would occur as a result of activities associated with naval SNF alternative considered in the EIS. In fact, naval SNF could be managed at any of t 7,100 and 43,500 years (depending on the site) before a single fatal cancer would b impacts as a result of incident-free operations present no significant risk and do foreseeable adverse impact to the surrounding population, no disproportionately hig would be expected for any particular segment of the population, minority population populations included (see Tables L-2 and L-4).

L-4.2.1.2 Human Health Effects and Environmental Impacts Because of Accidents.

As discussed in Appendix D, the impacts on human health and the environment resulti facility or transportation accidents at any of the five locations limited to the st small under any of the alternatives considered. As explained in the EIS, the risk potential consequence of an accident multiplied by its probability of occurrence. represents the expected impact to members of the public. Based on this risk calcul single fatal cancer would occur from reasonably foreseeable facility or transportat naval SNF management activities under any of the alternatives. Because the potenti an accident for any of the alternatives considered would present no significant ris reasonably foreseeable adverse impact to the surrounding population, no disproporti effects would be expected for any particular segment of the population, minority po populations included (see Tables L-2 and L-4).

L-4.2.1.3 Effects of Natural Motive Forces. Impact analysis indicates that there would not be

disproportionately high and adverse impacts on human health and the environment res prevailing winds or the direction of surface or subsurface water flow. This is tru the effects of routine operations on air and water quality are so small. It is als because the consequences of any accident, however unlikely its chance of occurrence random conditions at the time it occurred. The wind conditions at the Pearl Harbor variable, but the predominant wind direction is toward the southwest, away from lan The wind directions at the other four sites are highly variable with no strongly do

L-4.2.1.4 Effects on Subsistence Consumption of Fish and Wildlife. Available data do

not show potential for disproportionately high and adverse impacts to minority and related to subsistence consumption of fish and wildlife in the vicinity of these fi Environmental monitoring in the vicinity of these relatively small and restricted s difference in the amounts of radionuclides present in the environment from levels i respective regions.

L-4.2.2 Results of Environmental Justice Assessment Near the Alternative Sites

Considered for the Management of All or Some Portion of DOE Spent Nuclear Fuel

The five sites evaluated for the management of all or some portion of DOE SNF a addressed in Appendices A (Hanford Site), B (Idaho National Engineering Laboratory) Site), and F (Nevada Test Site and the Oak Ridge Reservation) to Volume 1 of the EI that these five alternative sites are considered for the management of DOE SNF unde analyzed in this EIS. The one exception is the Nevada Test Site, which is not cons Decentralization, and 1992/1993 Planning Basis alternatives because no SNF is curre site.

L-4.2.2.1 Facility Operations. This EIS considers the impacts from the operations of both

existing and new facilities on a site-by-site basis as appropriate for programmatic specific implementation of the programmatic strategy for the management of SNF for period between 1995 and 2035 will be subject to additional National Environmental P appropriate on a case-by-case basis. Both incident-free operations and reasonably analyzed in terms of risk to both workers and the public. The potential impacts ca free operations and the risk of reasonably foreseeable accidents present no signifi constitute a reasonably foreseeable adverse impact to the surrounding population as Therefore, no disproportionately high and adverse effects would be expected for any population, minority populations and low-income populations included.

L-4.2.2.1.1 Incident-Free Operations-In Table K-2 of Volume 1 of this EIS, it is

shown that under all the alternatives, the estimated number of latent cancer fatali operation of DOE SNF management facilities would range from approximately zero to a cancer fatalities over the 40 year period, or about 0.05 latent cancer fatalities p disproportionately high and adverse effects would be expected for any particular se minority populations and low-income populations included (see Tables L-3 and L-5).

L-4.2.2.1.2 Reasonably Foreseeable Accidents-As explained in Section 5.1.1.4 of

this EIS, the risk to the public is defined as the potential consequence multiplied occurrence. This risk calculation represents the expected impact to members of the risk of latent cancer fatalities associated with reasonably foreseeable facility ac alternatives. The evaluated facility accident with the highest risk (breach of a f Centralization alternative at the Savannah River Site) would result in an estimated

fatality per year, which equates to one fatal cancer in 140 years of operation. Im consequence, low-probability accident scenarios would be adverse should they occur; specific population locations would be subject to meteorological conditions on the Whether or not such impacts would have disproportionately high and adverse effects particular segment of the population, minority and low-income populations included, natural motive forces, including random meteorological factors (see Tables L-3 and

L-4.2.2.1.3 Natural Motive Forces-Offsite health effect impacts from operations and

reasonably foreseeable accidents are propagated by natural motive forces such as me and water pathways, both surface and subsurface. Impacts because of incident-free by prevailing patterns in these natural motive forces, whereas the impacts of an ac would be random based on the meteorological conditions at the time of and following following conditions are prevalent at each of the five large DOE sites under consid

Prevailing winds for the Idaho National Engineering Laboratory are primaril southwest, although winds at the Test Area North are frequently from the n northeast. Local rivers and streams drain mountain watersheds to the nort Idaho National Engineering Laboratory, but most surface water is diverted before it reaches the site boundaries. Groundwater in the underlying Snake Aquifer generally flows to the south and southwest (see Figures L-8 and L-

Prevailing wind conditions at the Savannah River Site are from the northeas southwest. Both onsite surface streams and groundwater aquifers generally southwesterly direction, toward the Savannah River, which flows southeast Georgia (see Figures L-6 and L-16).

The prevailing wind direction at the Oak Ridge Reservation is from the sout secondary pattern from the northeast during the winter, spring, and summer situation is reversed in the fall. Surface and shallow subsurface water i to the potential siting of SNF management facilities would flow south into then to the Clinch River. The Clinch River flows southwest and west aroun and subsequently to the Tennessee River. Deeper groundwater tends to rema stationary because of high retention times (see Figures L-7 and L-17).

Prevailing winds at the Nevada Test Site are from the south during the summ during the winter. Surface topography usually results in a wind reversal the day to the north during the night. Almost all surface water is transi nature. In an area susceptible to the siting of SNF management facilities would flow east towards Frenchman Lake, where it would be lost by evaporat to the local groundwater system which discharges to the southwest. Water beneath the site would likely either evaporate or remain indefinitely beca depth of the groundwater at the site (see Figures L-10 and L-20).

Prevailing winds at the area of interest on the Hanford Site are from the n months of the year, with the second predominant pattern occurring from the primarily during the spring and fall. Roughly two-thirds of any surface w drain to the Columbia River, with the rest draining to the Yakima River an Colombia River below the Hanford Site. Groundwater systems underlying the tend to flow toward the Columbia River in a southeast and northeast direct L-9 and L-19).

As indicated in Appendix K of this EIS, the risk of impacts from incident-free from reasonably foreseeable accidents is so small that the propagation by motive fo consequence.

L-4.2.2.2 Transportation. Transportation corridors associated with shipment of SNF

management by either truck or rail can be classified as roughly 80 percent rural, 1 percent urban. Specific details of mileage and percentages by route are contained to Volume 1 of the EIS.

L-4.2.2.2.1 Incident-Free Transportation-For incident-free transportation, the total

number of potential fatalities would be the sum of the health effects because of ex vehicular emissions. The total number of shipments over the 40-year period would va during the transition period for naval SNF under the No Action alternative to about DOE's SNF were managed at the Nevada Test Site under the Centralization alternative alternative would result in a total of approximately 3,700 shipments among the site latent cancer fatalities resulting from incident-free transportation is less than t shipment (Centralization) alternative, while the preferred alternative results in l

L-4.2.2.2.2 Transportation Accidents-It is worth noting that the risk of fatalities

associated with vehicular accidents during the transport of SNF is higher than the radiation exposure because of such accidents, although both are very small. Also, radiation because of transportation accidents is even less than the small risk ass accidents. The reasonably foreseeable transportation accident scenario with the la rail shipment accident occurring in an suburban area) would lead to 55 latent cance probability of this scenario occurring is about 1 in 10 million. The overall risk consequence) of all accidents analyzed, including the above scenario, over the tota analyzed is much less than one fatality. Over this 40-year timeframe, up to two fa vehicular traffic accidents themselves without any radiological releases. When and occurred, if one in fact occurred, would be completely random with respect to the i population, as well as the motive forces that could propagate the impacts during th Although adverse impacts could occur in the unlikely event of a high-consequence ac disproportionality with respect to any population, minority and low-income populati the randomness of the combination of factors that can produce such impacts.

L-4.2.2.3 Subsistence Consumption of Fish, Wildlife, or Native Plants. The

calculations in this EIS estimate dose and risk from ingestion of radioactive mater agricultural data and assume a typical dietary pattern. Subsistence consumption of plant species is not explicitly addressed in these analyses. However, the calculati several conservative assumptions that bound the potential for ingestion of radioact exposure pathways. In particular, these calculations assume that a very high propo on locally grown produce and locally grazed livestock, both of which are produced a the highest calculated concentrations of radioactivity. Nevertheless, there may be the uptakes of grazed livestock and free-ranging game. No human populations in the the any of the five DOE sites are known to subsist entirely on locally harvested fi usually allowed on DOE sites, but some hunting is allowed under controlled conditio

Game species, locally grazed livestock, fish, locally grown foodstuffs, and nat sites are routinely sampled for radionuclides. Concentrations of radionuclides in small, and are seldom elevated above those observed at locations distant from these source of non-natural radionuclides is very small amounts of residual global fallou weapons tests. Data from monitoring programs are reported annually in site-specifi

If SNF management activities were to increase wildlife losses because of vehicl game, there might be a disproportionate impact to minority or low-income communitie hunted game. However, the maximum potential increases in shipments of SNF would be current rail and highway traffic, so the overall impact to wildlife would be small. measures for any resulting adverse impact to low-income or minority populations inc deceased animals to hunters in the vicinity known to partially subsist on game, con or relocating game if necessary.

L-4.2.2.4 Other Considerations. In addition to the above, reviews of other technical disciplines

pursuant to the methodology in Section 4.1 did not indicate any significant adverse use, socioeconomics, water and air resources, ecology, cultural resources, or cumul no disproportionately high and adverse impacts were identified for any segment of t

particular interest are the following:

L-4.2.2.4.1 Socioeconomics-Depending upon the various alternative evaluated, the

total labor force involved in SNF management could decrease by up to 180 jobs or in 2,100 jobs averaged over the 10-year implementation period between 1995 and 2005. programs would distribute such effects proportionately among workers, whereas coord activities with local communities would be intended to avoid placing undue burdens resources. DOE may also provide support to local agencies if necessary to mitigate

L-4.2.2.4.2 Land Use, Ecology, and Cultural Resources-None of the alternatives

would have a significant adverse impact on land use, ecology, and cultural resource amount of previously undisturbed land which would be needed for use onsite (no offs and mitigative programs already in place. These programs include working closely u State Historical Preservation Officers and Tribal governments regarding preservatio resources. Consultations with Tribal governments have expanded the DOE's awareness and values with respect to nature, religion, and the land, and are designed to avoi as possible. If avoidance were not possible, data recovery (such as archiving arti measures may be developed in consultation with affected Tribes and the respective Preservation Officer, as appropriate. Similarly, the DOE is aware of sensitive eco avoids wetlands and endangered plant or animal specie habitats. Disturbance of cer (which are not federally listed as threatened or endangered) is possible, but not l foreseen environmental impacts, if any, to land use, ecological resources, or cultu be small under any of the alternatives.

L-4.2.2.4.3 Cumulative Impacts-Based on the analysis of the impacts for each of the

disciplines analyzed in this EIS, along with the impact of other past, present, and future activities at each of the alternative sites, no reasonably foreseeable cumul expected to the surrounding populations, minority populations and low-income popula Tables L-2 through L-5).

L-4.2.2.5 Impacts Because of Perception. Potential adverse impacts may result from the

public's perception of risk associated with nuclear industry activities in general particular. For example, a SNF management facility has the potential to increase a industry, leading to concerns of potential adverse effects to the conduct of local tourism, agriculture, or the like. From both a National Environmental Policy Act a justice perspective, both the character and substance of these potential impacts is it is not possible to identify any quantifiably adverse or disproportionately high such perceived risk.

In order to better understand and help mitigate unfounded perceptions, the DOE enhance the general population's understanding of the potential impacts of DOE prog proposed action in particular, with emphasis on minority populations, low-income gr governments.

L-4.2.3 Perspective

To place the impacts in perspective with respect to risks encountered in everyd were approximately 510,000 cancer deaths in the United States population, of which among the nonwhite population. This equates to an average of roughly 1,132 cancer would affect minority populations) in an area comparable to that included in the 80

around any of the sites considered in this EIS. Additionally, in 1992, there were fatalities in the United States, of which about 7,400 were among the non-white popu an average of roughly 89 traffic fatalities (of which 16 would affect minority popu comparable to that included in the 80-kilometer (50-mile) radius around any of thes of additional fatalities provided in Sections L-4.2.1, L-4.2.2.1.2, and L-4.2.2.2. population because of DOE SNF management activities would not appreciably increase impacts were associated with minority or low-income populations.

L-5 CONCLUSIONS

The overall review indicated that the potential impacts calculated for each dis the alternative sites considered for the management of all or some portion of DOE S present no significant risk and do not constitute a reasonably foreseeable adverse population. Therefore, the impacts of the programmatic management of DOE SNF under evaluated in this EIS do not constitute a disproportionately high and adverse impac segment of the population, minorities or low-income communities included, and thus environmental justice concern.

The approach to evaluating environmental justice used in this EIS may differ fr issued by the Interagency Working Group or the DOE. Nevertheless, as demonstrated approaches discussed in Section L-3.5, the conclusions are not expected to change b resulting from the proposed action under all alternatives present no significant ri populations. As a result, no disproportionately high and adverse effects would be segment of the populations, including minority populations and low-income populatio

L-6 REFERENCES

FR (Federal Register), 1994, 59 FR 32, Executive Order 12898, "Federal Actio Justice in Minority Populations and Low-Income Populations", White House Office 7629.

FR (Federal Register), 1993, 58 FR 231, "Office of Environmental Equity Grant Notice for Fiscal Year 1994, Environmental Justice Grants to Community Groups," Environmental Protection Agency, December 3, p. 63955.

Sanderson, R .E., 1994, Director of the Office of Federal Activities, U.S. Env Washington, D.C. letter to T. L. Wichmann, U.S. Department of Energy, Idaho Op Idaho Falls, Idaho, regarding the U.S. Environmental Protection Agency's ratin October 4.

Tinno, K., 1994, Acting Chairman, Shoshone-Bannock Tribes, letter to T. L. Wi Energy, Idaho Operations Office, Idaho Falls, Idaho, regarding "Comments on th Energy (DOE) Programmatic Spent Nuclear Fuel Management and Idaho National Engi Laboratory (INEL) Environmental Restoration and Waste Management Environmental Statement (EIS), September 29.

USBC (U.S. Bureau of Census), 1992, 1990 Census of Population and Housing, Su CD-ROM, U.S. Department of Commerce, Bureau of Census, Washington, D.C., May.

Wolfley, J., 1994, Shoshone-Bannock Tribes, letter to T. L. Wichmann, U.S. De Operations Office, Idaho Falls, Idaho, regarding "Attachments A-E to Shoshone-B Comments," October 3.

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DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs Final Environmental Impact Statement VOLUME II

VOLUME II Part A

COVER SHEET
RESPONSIBLE AGENCIES: Lead Federal Agency: U.S. Department of Energy
Cooperating Federal Agency: U.S. Department of the Navy
TITLE: Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho N Engineering Laboratory Environmental Restoration and Waste Management Programs Fina Impact Statement.
CONTACT: For further information on this Environmental Impact Statement call or co

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ABSTRACT: This document analyzes at a programmatic level the potential environment over the next 40 years of alternatives related to the transportation, receipt, proc nuclear fuel under the responsibility of the U.S. Department of Energy. It also an consequences of the Idaho National Engineering Laboratory sitewide actions anticipa years for waste and spent nuclear fuel management and environmental restoration. F nuclear fuel management, this document analyzes alternatives of no action, decentra centralization and the use of the plans that existed in 1992/1993 for the managemen the Idaho National Engineering Laboratory, this document analyzes alternatives of n and minimum and maximum treatment, storage, and disposal of U.S. Department of Ener

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Volume 2 Summary

Reader's Guide

The U.S. Department of Energy's (DOE's) Environmental Impact Statement (EIS) for Pr Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Res Management Programs [DOE/EIS- 0203-F] is divided into three volumes:

- Volume 1, DOE Programmatic Spent Nuclear Fuel Management
- Volume 2, Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs (including site-specific spent nuclear fuel management)
- Volume 3, Comment Response Document.

Volume 1 comprises five primary sections and ten key appendices. The five primary s introduction and overview to DOE's spent nuclear fuel management program throughout purpose and need for action to manage spent nuclear fuel, (c) management alternativ consideration, (d) the affected environment, and (e) potential environmental conseq be caused by the implementation of each alternative. The information contained in t part, upon more detailed information and analyses in the ten key appendices. These the site-specific spent nuclear fuel management programs at three primary DOE facil sites, the naval spent nuclear fuel management program, offsite transportation of s environmental consequences data, and environmental justice considerations. Two addi glossary and a list of acronyms and abbreviations. Volume 2 is similarly constructe primary sections are presented that provide (a) the purpose and need for an integra restoration, waste management, and spent nuclear fuel management program at the Ida Engineering Laboratory, (b) background, (c) management alternatives under considera (d) the affected environment, and (e) potential environmental consequences that may with the implementation of each alternative. The information presented in these sec part, upon four key appendices, which include a basic description of radioactivity (chemical effects), agency consultation letters, detailed project summaries, and te methodologies and key data. Two additional appendices include a glossary and a list abbreviations. Volumes 1 and 2 provide an index as well as a list of references to enable the reader to further review and research selected topics. DOE has establish rooms and information locations across the United States where these references ma reviewed or obtained for review through interlibrary loan, The addresses, phone num hours of operation for these reading rooms and information locations are provided a Summary. A line in the margin in Volumes 1 and 2 indicates a change since the Draft EIS. Volume 3 comprises a primary section, called Comment Summaries and Responses, and three appendices. In the primary section individual public comme summarized, grouped with others that are similar and organized into topical section appendices are designed to aid the reader in locating specific comment summaries an is an alphabetical list of cornmentors, showing for each the assodated comment docu response section number(s). Appendix B is a numerically ordered list of comment doc associated commentors and response section numbers, and Appendix C provides a corre section numbers to comment document numbers.To find a response to comment(s), the r

1. Turn to Appendix A in Volume 3 and find the name (or organization or agency). and note the comment document number(s) assigned to hislher comments.
2. In the same entry, find the response section number(s) where the responses to the comments are located.
3. Turn to the Table of Contents in Volume 3 under the heading Comment Summaries and Responses, where response section numbers are listed in numerical order, to find the page on which the response section number(s) that apply to the comment(s) appear.
4. Turn to the appropriate page(s) to find a response to a summary of the comment

A copy of the actual comments (rather than the comment summaries found in

Volume 3 of the EIS) can be tound along with the EIS in the public reading rooms listed at the end of this summary

1. The first alphabetical entrant, Dinah Abbott, has been assigned comment document number 615.
2. Ms. Abbott`s first entry is for response number 01.01.01.01(005); four other response numbers are applicable to her comments.
3. The first entry is in Section 1.1.1.1, entitled "Action alternatives" under Specific Preferences for SNF Management Alternatives.
4. Section 1.1.1.1 begins on page 1-1. The selected entry for Ms. Abbott is Respnse 005 in that section and is located on page 1-2.

Contents

#Relationship Between Volumes 1 and 2

DOE is currently in the process of making two important sets of decisions. The f programmatic (DOE-wide) decisions regarding DOE's future spent nuclear fuel managem 1 of the EIS). The second involves site- specific decisions regarding the future di and waste management programs, which include spent nuclear fuel, at the Idaho Natio (addressed in Volume 2 of this EIS). DOE's programmatic decisions regarding spent n Idaho National Engineering Laboratory- specific decisions about spent nuclear fuel. components of the Idaho National Engineering Laboratory-specific alternatives have bear a relationship to those of Volume 1.

Volume 1-Programmatic Spent
Nuclear Fuel Management
Alternatives - Summary

No Action

Take minimum actions required for safe and secure management of spent nuclear fu current storage location. Decentralization Store most spent nuclear fuel at or cl

to the generation site or current storage location, with limited shipments to DOE
1992/1993 Planning Basis Transport and store newly generated spent nuclear fuel a
Engineering Laboratory or Savannah River Site. Consolidate some existing fuels a
Laboratory or the Savannah River Site. Regionalizatlon Distribute existing and pr
nuclear fuel among DOE sites based primarily on fuel type (Preferred Alternativ
Centralization Manage all existing and projected spent nuclear fuel inventories f
the Navy at one site until ultimate disposition.
Volume 2-Idaho National Engineering Laboratory Spent Nuclear Fuel Manag
Alternatives - Summary No Action Phase out inspection of naval spent
nuclear fuel. Close Expended Core Facility. Receive no non-naval spent nuclear
fuel. Phase out Idaho Chemical Processing Plant-603 storage pools.
Ten-Year Plan and Preferred Alternative (for spent nuclear fuel) Examine and store
nuclear fuel. Receive additional offsite spent nuclear fuel.
Transfer aluminum-clad spent nuclear fuel to Savannah River Site. Phase out Ida
Processing Plant-603 storage pools. Expand storage capacity in existing Idaho
pools. . Phase in dry storage. Demonstrate electrometallurgical
process. Minimum Treatment, Storage, and Disposal
Phase out inspection of naval spent nuclear fuel. Close Expended Core Facility
Transport all spent nuclear tue to another DOE site. Phase out spent nuclear f
facilities. Demonstrate electrometallurgical process.
Maximum Treatment, Storage, and Disposal Examine and store naval spent
nuclear fuel. Receive DOE-wide spent nuclear fuel Phase out idaho Chemical
Processing Plant-SOS storage pools. Expand storage capacity in existing Idaho
pools. Phase in expanded dry storage. Demonstrate electrometallurgical
process. Phase in spent nuclear fuel stabilization.
Comments and Responses During the public comment
period for the Draft EIS, more than 1,430 individuals, agencies, and organizations
comments. Comments were received from all affected DOE and shipyard communities. Mo
organizations expressed broad opinions, especially on siting and transportation opt
recommended new or enhanced alternatives or additional sites, or commented on the N
Environmental Policy Act process. Many commentors used this opportunity to comment
legislation, policies, or federal programs not specifically related to the EIS. Som
commented on the laws and regulations applicable to DOE's mission, DOE interim spen
fuel management, or environmental restoration and waste management at the Idaho Nat
Laboratory. Many commentors expressed strongly held opinions about the EIS, DOE, an
the Navy and/or the alternatives. Some commentors expressed the opinion that DOE do
public comments and that some comments will be given more weight than others. Other
driven commentors should be ignored, and decisions should be based on good science.
Recurring and controversial issues raised during the public comment period included
and Navy credibility; the apparent lack of a clear path forward with respect to ult
spent nuclear fuel and nuclear waste; continued generation of spent nuclear fuel; c
and risk to, the public; transportation of spent nuclear fuel and waste; impacts of
risk on local economies and the quality of life; other issues of local interest: an
energy, and foreign policies. Public comments were considered by the DOE and Navy a
changes to the Draft EIS and in the preparation of the Comment Response Document, V
In general, public comments, coupled with consultations with commenting agencies an
governments, resulted in additional analyses, clarifying or correcting facts, or ex
technical areas. where appropriate, Volume 3 provides an explanation of why certain
warrant further change to the EIS. Both volumes of the Final EIS identify DOE's pre
Regionalization by fuel type (Alternative 4A) for managing spent nuclear fuel, and
that is the Ten-Year Plan (Alternative B) enhanced to include elements of other alt
National Engineering Laboratory. The DOE's preferred alternatives are consistent wi
alternative identified in the draft EIS to continue to conduct refueling and defuel
and prototypes, and to transport spent nuclear fuel to the Idaho National Engineeri
examination and interim storage, using the same practices as in the past. Identific
alternatives was based on consideration of environmental impacts, public issues and
regulatory compliance, the DOE's and Navy's spent nuclear fuel missions, national s
and DOE policy. As committed to in the Draft EIS, the evaluation and discussion of
environmental justice has been expanded to both Volumes 1 and 2 of the Final EIS. M
is consistent with draft interagency definitions at the time of its preparation and
comments received regarding environmental justice. Consultation with commenting Nat
Tribes is reflected in the environmental justice analysis, as well as in various se
appropriate. In response to concerns raised by public comments regarding the
technical analysis, seismic and water resource discussions and analyses were review

enhanced for all alternative sites, and current data and analyses were added to Vol
In Volume 1, a discussion of potential accidents caused by a common initiator was a
stabilizing some of DOE's Spent nuclear fuel (specifically Hanford site production
it at available facilities located overseas was added, thus expanding processing op
EIS. An analysis of barge transportation was added to the EIS, addressing the optio
production-reactor fuel to a shipping point for overseas processing and supporting
Brookhaven National Laboratory Spent nuclear fuel to another site, as appropriate.
of shipboard fires was added, primarily in response to comments related to receivin
of U.S. origin from foreign research reactors. In response to public comments, the
results of a separate evaluation of the various alternatives' costs were summarized
evaluation was performed independently of the EIS for purposes broader than those a
EIS. The discussion of the option of leaving Fort St. Vrain spent nuclear fuel in
Colorado has been expanded, specifically with respect to contractual commitments ve
benefits. Other enhancements include clarification that potential shipment of
spent nuclear fuel of U.S. origin from foreign research reactors consists of approx
metal. As a result of public comments, Volume 1 was enhanced to include a descripti
relationship between other DOE NEPA reviews related to spent nuclear fuel and this
explains the interrelationship of these actions in response to comments about segrn
regard, the relationship between the EIS and Spent Fuel Vulnerability Action Plans
With regard to naval spent nuclear fuel, enhancements to Appendix D (Naval Spent Nu
Management) include providing additional information in the following areas: import
spent nuclear fuel examination, impacts of not refueling or defueling nuclear-power
why storage and processing of naval spent nuclear fuel in foreign facilities were n
environmental justice considerations, the transition period required to implement n
alternatives, potential accident scenarios at naval shipyards, and uncertainties in
environmental impacts. In Volume 2, the air quality analysis was revised to upgrade
information on existing baseline conditions. The analysis compared impacts of each
Prevention of Significant Deterioration increment limits. The Waste Experimental Re
Facility project summary was enhanced with respect to related operation and combust
The EIS was also revised to reflect employment projections resulting from the Idaho
Laboratory contractor consolidation. Volume 2- INEL Environmental Restoration and
Overview
The Idaho National Engineering Laboratory's mission is to develop, demonstrate, and
engineering technologies and systems to improve national competitiveness and securi
use of energy more efficient, and to improve the quality of life and the enviro
The environmental restoration program includes activities to assess and clean up
mactive Idaho National Engineering Laboratory operations, including waste sites whe
suspected releases of harmful substances into the environment, and to safely manage
surplus nuclear facilities. Waste management program activities are designed to pro
Engineering Laboratory employees, the public, and the environment in the design, co
and operation of treatment, storage, and disposal facilities in a cost effective,
regulatory compliant, and publicly acceptable manner.

Figure. The Idaho National Engineering Laboratory is located in southeastern Idaho.
Environmental Restoration: The cleanup and restoration of sites and
decontamination and decommissioning of facilities contaminated with radioactive and
or hazardous substances during past production, accidental releases, or disposal
activities.
Waste Management: The planning, coordination, and direction of those functions
related to generation, minimization, handling, treatment, storage, transportation,
disposal of waste, as well as associated surveillance and maintenance activities.
Spent nuclear fuel management at the Idaho National Engineering Laboratory
includes (a) accepting and examining shipments from generators or from other
storage sites, (b) setting standards and approving methods for storing spent nuclea
fuel and preparing (stabilizing) it for such storage, (c) constructing and operatin
facilities for stabilization, plus interim storage, (d) consolidating storage and r
outdated storage facilities, and (e) developing criteria and technologies for ultim
disposition of spent nuclear fuel (or its components). DOE is developing spent
nuclear fuel management plans for a 40-year timeframe that are anticipated to be
sufficient to cover the period during which ultimate disposition will be establishe
implemented for DOE's spent nuclear fuel.

Figure. Calcination is one form of waste management. Waste Management, Environmenta and Technology Development at the INEL

Waste Management
Waste management includes minimization, characterization, treatment, storage, and d waste generated from ongoing Idaho National Engineering Laboratory activities and f Restoration Program at nine ma)or facility areas. The Waste Management Program ensu that current and future waste management practices minimize any additional adverse impacts accomplished through such practices as waste reduction and recycling and su reduction and waste separation techniques. Table 1 summarizes theprimary functions

Environmental Restoration The Idaho National Engineering Laboratory Environmental R Program addresses contamination resulting from the past 50 years of operations. The Environmental Restoration Program are to clean up past environmental contamination and decommission facilities that are no longer needed (surplus). The cleanup progra Facility Agreement and Consent Order, entered into by the DOE, the U.S. Environment the State of Idaho, in accordance with the Comprehensive Environmental Response, Co Liability Act of 1980, as amended. Since 1986, about 500 suspected release sites ha identified for investigation. Potential release sites were grouped together for eff 10 areas called Waste Area Groups. Nine of the groups are roughly equivalent to the Engineering Laboratory. Waste Area Group 10 includes a site-wide area associated River Plain Aquifer and surface and subsurface areas that are not addressed by the Area Groups. Of the approximately 500 sites, over 270 have been proposed or designa no further action. Sources of contamination include spills, abandoned tanks, septic systems, percolation ponds, landfills, and injection wells. Contaminated sites rang facilities such as the pits and trenches at the Radioactive Waste Management Comple where minor spills have occurred. Environmental restoration also involves safely ma contaminated surplus nuclear facilities until they are decontaminated for reuse or decommissioned.

Table 1. Function of major facility areas at the Idaho National Engineering Laborat
Since the 1950s, spent nuclear fuel removed from nuclear-powered naval vessels and has been transported to the Naval Reactors Facility located at the Idaho National Spent nuclear fuel has also been recieved from university, commercial, industrial, Government and foreign reactors. Spent nuclear fuel continues to be generated at t Engineering Laboratory by reactor operations. Naval spent nuclear fuel, currently e Reactors Facility, is transferred to the Idaho Chemical Processing Plant for stor heavy metal per year. Spent nuclear fuel is stored at a number of site areas in var facilities awaiting ultimate disposition.

Figure. Major facility areas located at the Idaho National Engineering Laboratory.

Technology Development Technology development supports the Environmental Restorati Management, and Spent Nuclear Fuel Programs by designing and testing potential tech specific problems. Broad program areas include research, development, demonstratio evaluation; technology integration; development of safe and efficient packaging sy response management; education; and Laboratory analysis. Types of current technolo activities include minimizing waste; testing cleanup technologies; evaluationg and treat calcined, sodium-bearing, and high-level wastes; and designing sensors and o monitoring equipment and systems. An example of research activity includes investi technologies to prepare fuel for ultimate disposition.

Figure Dry storage of spent nuclear fuel.
Waste at the Idaho National Engineering Laboratory
Alpha Low-Level Waste: Waste that was previously classified as transuranic waste bu transuranic concentration lower than the currently established limit for transurani Alpha low-level waste requires additional controls and special handling (relative t This waste stream cannot be accepted for onsite disposal under the current waste ac critieria; therefore, it is special-case waste.
Greater-Than-Class-C Waste: Low-level radioactive waste that is generated by the co and that exceeds U.S. Nuclear Regulatory Commission concentration limits for Class as specified in Title 10 Code of Federal Regulations Part 61. DOE is responsible fo of Greater-Than-Class-C wastes from DOE non-defense programs.
Hazardous Waste: Under the Resource Conservation and Recovery Act, a solid waste, o of solid wastes, which because of its quantity, concentration, or physical, chemica or infectious characteristics may (a) cause, or significantly contribute to, an inc

irreversible, or incapacitating reversible, illness; or (b) pose a substantial pres
hazard to human health or the environment when improperly treated, stored, transpor
or otherwise managed. Source, special nuclear material, and byproduct material, as
Atomic Energy Act, are specifically excluded from the definition of solid waste.
High-Level Waste: The highly radioactive waste material that results from the repro
nuclear fuel, including liquid waste produced directly from reprocessing and any so
from the liquid that contains a combination of transuranic and fission product nucl
that require permanent isolation. High-level waste may include other highly radioac
the U.S. Nuclear Regulatory Commission, consistent with existing law, determines by
permanent isolation.
Low-Level Waste: Waste that contains radioactivity and is not classified as high-le
waste, or spent nuclear fuel. Test specimens of fissionable material irradiated for
development only, and not for the production of power or plutonium, may be classifi
provided the concentration of transuranic elements is less than 100 nanocuries per
Mixed Waste: Waste that contains both hazardous waste under the Resource Conservati
source, special nuclear, or byproduct material subject to the Atomic Energy Act.
Special-Case Waste: Waste that is owned or generated by DOE that does not fit into
plans developed for the major radioactive waste types.
Transuranic Waste: Waste containing more than 100 nanocuries of alpha-emitting tran
per gram of waste, with half-lives greater than 20 years, except for (a) high-level
(b) waste that the DOE has determined, with the concurrence of the Administrator of
Environmental Protection Agency, does not need the degree of isolation required by
Federal Regulations Part 191, and (c) waste that the U.S. Nuclear Regulatory Commis
for disposal on a case-by-case basis in accordance with Title 10 Code of Federal Re

Purpose and Need for Future Environmental Restoration and Waste Management

DOE is responsible by law for spent nuclear fuel management, waste management,
restoration at the Idaho National Engineering Laboratory in southeastern Idaho. U
1954, DOE is responsible for managing certain spent nuclear fuels. DOE also is res
wastes ans controlling hazardous substances in a manner that protects human health
under the Comprehensive Environmental Response, Compensation, and Liability Act of
1980, as amended; the Resource Conservation and Recovery Act of 1976; the Federal
1992; and other laws. DOE is committed to comply with these and all other applicab
and regulations, DOE orders, and interagency agreements governing spent nuclear fu
restoration, and waste management. Over the past 50 years, DOE activities have res
spent nuclear fuel; waste requiring cleanup. To better fulfill its responsibiliti
develop and implement a program for spent nuclear fuel management, environmental re
waste management at the Idaho National Engineering Laboratory. To establish an effe
the foreseeable future (focused on the next 10 years), DOE needs to make site-spec
would accomplish three major goals: (a) support research and development missions a
National Engineering Laboratory; (b)comply with legal requirements governing Spent
management, environmental restoration, and waste management, and (c) manage Spent n
treat, store, and dispose of waste; and conduct environmental restoration activitie
National Engineering Laboratory in an environmentally sound manner. To achieve thes
to develop appropriate facilities and technologies for managing waste and spent nuc
during the next 10 years; to more fully integrate all environmental restoration and
activities at the Idaho National Engineering Laboratory to achieve cost and operati
induding pollution prevention and waste minimization; and to responsibly manage env
impacts from environmental restoration and waste management activities.

What Are the INEL Decisions to Be Made Based on This EIS?

Spent Nuclear Fuel: What is the appropriate strategy of the Idaho National Engineer
Laboratory to implement DOE's national spent nuclear fuel decisions regarding
transportation. receipt, processing, and storage of spent nuclear fuel? What is the
appropriate storage capacity for spent nuclear fuel?
Environmental Restoration and Waste Management: What is the appropriate strategy of
the Idaho National Engineering Laboratory to implement DOE'S national environmental
restoration and waste management decisions?
What are the appropriate cleanup activities under the Comprehensive Environmental
Response, Compensation, and Liability Act of 1980, as amended, and the Federal Faci
Agreement and Consent Order of 1991?
What are the necessary capabilities, facilities, research and development, and tech
for treating, storing, and disposing of each waste type?
What treatment technologies should be used for sodium-bearing and high-level wastes
other radioactive and mixed waste?

Alternatives

DOE has chosen alternatives that represent a range of possible actions: No Action (B); Minimum Treatment, Storage, and Disposal (C); and Maximum Treatment, Storage, Alternative is an enhanced Alternative B (see adjacent text box). Alternatives C an extremes of minimum and maximum impacts at the Idaho National Engineering Laborator to 2005 time period. The impacts of Alternatives C and D would bound any reasonably would be selected as a result of this EIS. Each alternative includes components for decommisioning, waste management, and spent nuclear fuel management. Infrastructure and transportation were also considered. The alternatives, which reflect the public the following factors into account:

. The sources of waste and spent nuclear fuel that (a) exist at the Idaho National Engineering Laboratory as of June 1995, (b) would be generated between 1995 and 2005, and (c) might be transported to the Idaho National Engineering Laboratory from other sites.

The practical waste and spent nuclear fuel management options, including characterization, storage, and disposal, or stabilization (spent nuclear fuel) and treatment (waste).

The locations at which the waste and spent nuclear fuel management could reasonably b undertaken, either on or off the Idaho National Engineering Laboratory site.

Given this, DOE determined the projects and actions needed to manage the waste and associated with each alternative. This EIS provides the analysis required under the Policy Act for certain projects that DOE proposes as part of the spent nuclear fuel restoration, and waste management program at the Idaho National Engineering Laborat

Alternatives

A (No Action) Complete all near-term actions identified and continue operatin most existing facilities. Serves as benchmark for comparing potential effe three alternatives.

B (Ten-Year plan)
Complete identified projects and initate new projects to enhance cleanup, National Engineering Laboratory waste streams and spent- nuclear fuel, pre disposal, and develop technologies for spent nuclear fuel ultimate disposit

C (Minimum Treatment, Storage, and Disposal) Minimize treatment, storage, and disposal activities at the National Engineering Laboratory to the extent possible (including receipt Conduct minimum cleanup and decontamination and decommissioning prescribed regulation. Transfer spent nuclear tue and waste from environmental restora activities to another site.

D (Maximum Treatment, storage, and Disposal) Maximize treatment, storage, and disposal functions at the Idaho National Engineering Laboratory to accommo spent nuclear fuel from DOE facilities. Conduct maximum cleanup and deconta and decommissioning.

Preferred Alternative
Complete activities as in Alternative B (ren-year Plan), plus aocept offsi and mixed low-level waste for treatment and return treated waste to the so to approved disposal facilities. Plan for a high-level waste treatment fac resulting high-activity waste. Transfer aluminum-clad spent nuclear fuel t Site.

Alternative A (No Action)
Under Alternative A (No Action), existing environmental restoration and waste manag and projects would continue. Research and development and infrastructure facilities that support the environmental restoration and waste management program at the Idah Engineering Laboratory would also continue. There would be no shipments of spent nu fuel to the Idaho National Engineering Laboratory, with the exception of shipment approximately three year transition period. Existing inventories of spent nuclear f Activities and projects would include those that may be initiated after June 1995 b under the National Environmental Policy Act by that date. New activities would be safe operation. Implementation of Alternative A (No Action) would not fully meet a agreements and commitments under the Federal Facility Agreement and Consent Order a obligations to receive spent nuclear fuel from universities and Fort St. Vrain.
Alternative A (No Action) represents a baseline against which the potential environ alternatives can be compared.
Projects Related to Alternatives
In addition to current operations and activities at the Idaho National Engineering there are 49 projects that form the basis for analysis of reasonably forseeable fut in Volume 2. These 49 projects fall under the various Alternatives A, B, C, D, and Alternative. The 49 projects include 12 projects whose National Environmental Polic is already completed or was proposed to be completed before the Record of Decision. of Volume 2 and its appendices is to provide sufficient analysis for another 12 pro to allow timely deployment if needed for the project. DOE would evaluate the remain case-by-case basis to determine if any additional National Environmental Policy Act before implementing the project.

	ALTERNATIVE
- Expended Core Facility Dry Cell Project	B,D,P
- Increased Rack Capacity for Building 666 at the Idaho Chemical Processing Plant	B,D,P
- Dry Fuel Storage Facility; Fuel Receiving, Canning/Characterization, and Shipping	B,C,D(b),P
- Fort St.Vrain Spent Nuclear Fuel Shipment and Storage	B,D,P
- Tank Farm Heel Removal Project	B,C,P,D
- High-Level Tank Farm New Tanks	C,D
- Shipping/Transfer Station	C
- Waste Experimental Reduction Facility Incineration	B,D,P
- Nonincinerable Mixed Waste Treatment	B,D(b),P
- Sodium Processing Project	B,D,P
- Gravel Pit Expansions	B,D(b),P
- Calcine Transfer Project	B,D,P

a. Alternative A= No Action, Alternative B=Ten-Year Plan, Alternative C=Minimum Tre Storage, and Disposal, Alternative D=Maximum Treatment, Storage, and Disposal, Alte Preferred Alternative.
b. These projects would be expanded for Alternative D (Maximum Treatment, Storage, and Disposal).

Alternative B (Ten-Year Plan)
Under Alternative B (Ten-Year Plan), existing environmental restoration and waste management facilities and projects would continue to be managed. In addition to current facilities and projects, those proposed for 1995 through 2005 would be implemented to meet the current Idaho National Engineering Laboratory mission and to comply with negotiated agreements and commitments.
Under this alternative, spent nuclear fuel, environmental restoration, and waste management activities would be continued and enhanced to meet expanded spent nuclear fuel and waste handling needs. These enhanced activities would be needed to comply with regulations and agreements and

would result from acceptance of additional offsite materials and waste. Waste generation from onsite sources would increase because of increased decontamination and decommissioning and environmental restoration activities. Spent nuclear fuel and selected waste would be received from other DOE sites and aluminum-clad spent nuclear spent fuel would be transferred to the Savannah River Site. Onsite management would emphasize greater treatment and disposal capabilities, compared with Alternative A (No Action). Additional cleanup and decommissioning and decontamination projects would be conducted under this alternative.

Alternative C (Minimum Treatment, Storage, and Disposal)
Under Alternative C (Minimum Treatment, Storage, and Disposal), ongoing Idaho National Engineering Laboratory Spent nuclear fuel and waste management activities, along with materials and waste, would be transferred to other locations to the extent possible. Possible locations include DOE facilities, other Government sites, or private sector locations. Minimal treatment, storage, and disposal activities would be located at the Idaho National Engineering Laboratory. Waste and spent nuclear fuel would not be received from offsite sources for management by the Idaho National Engineering Laboratory. Whenever feasible, wastes generated from onsite environmental restoration activities would be minimized by emphasizing institutional controls over treatment options. Only current cleanup and decommissioning and decontamination projects would be conducted under this alternative. Existing onsite spent nuclear fuel and waste management capability would be expanded to the extent needed to comply with regulations and agreements.

Alternative A (No Action)

Spent Nuclear Fuel: Phase out examination of naval spent nuclear fuel after an approximate three-year transition period; no other fuels would be received; phase out storage pools at Building 603 of the Idaho Chemical Processing Plant.
Environmental Restoration: Conduct no activities other than already approved projects; decontaminate and decommission Auxiliary Reactor Area (ARA)-II and Boiling Water Reactor Experiment (BORAX)-V; clean up groundwater and vadose zone contamination; retrieve and treat Pit 9 waste.
High-Level Waste: Convert liquid to solid calcine.
Transuranic Waste: Retrieve/move transuranic and alpha low-level waste to new storage; transport transuranic waste offsite for disposal; accept offsite waste for storage on case-by-case basis.

Low-Level Waste: Treat onsite and offsite; dispose of onsite in existing facility.
Mixed Low-Level Waste: Treat onsite (nonincineration).
Greater-than-Class-C Waste: Continue management programs.
Hazardous Waste: Transport ofisite for treatment, storage, and disposal.

Alternative B (Ten-Year Plan)

Spent Nuclear Fuel: Receive additional offsite spent nuclear fuel; transfer aluminu clad spent nuclear fuel to Savannah River Site; examine and store naval spent nucle fuel; complete Expended Core Facility Dry Cell Project and expand storage capacity pools at Building 666 of the Idaho Chemical Processing Plant; phase out pools at Building 603 of the Idaho Chemical Processing Plant; phase in new dry storage; demonstrate electrometallurgical process at Argonne National Laboratory-West.
Environmental Restoration: Conduct all planned projects in all Waste Area Groups; decontaminate and decommission Auxiliary Reactor Area (ARA)-II, Boiling Water Reactor Experiment (BORAX)-V, Engineering Test Reactor, Materials Test Reactor, Fue Processing Complex, Fuel Reciept/Storage Facility, Headened Processing Plant, Waste Calcine Facility, and Central Liquid Waste Processing Facility; cleanup groundwater contamination and vadose zone: retrieve and treat Pit 9 wastes.
High-Level Waste: Convert liquid to calcine (solid); construct a facility to immobi both liquid and solid calcine.
Transuranic Waste: Retrieve/move transuranic and alpha low-level waste to new stora treat offsite and onsite transuranic and alpha low-level waste; transport transuranic waste offsite for disposal; accept transuranic waste offsite for treatm
Low-Level Waste: Treat onsite and offsite; construct and operate additional treatme and disposal facilities onsite.
Mixed Low-Level Waste: Treat onsite by incineration and nonincineration; construct and operate facilities to treat waste by incineration and nonincineration; construc operate disposal facility; transport waste offsite for treatment and disposal.
Greater-than-Class-C Waste: Receive sealed sources for recycle or storage; construct dedicated storage facility.
Hazardous Waste: Transport offsite for treatment, storage, and disposal.

Alternative C (Minimum Treatment, Storage, and Disposal)

Spent Nuclear Fuel: Transport Idaho Natioanl Engineering Laboratory spent nuclear f to another DOE site; continue to examine and store naval spent nuclear fuel during three-year transition period; phase out spent nuclear fuel handling facilities; dem electrometallurgical process at Argonne National Laboratory-West.
Environmental Restoration: Conduct all planned projects for all Waste Area Groups: and decommission Auxillary Reactor Area (ARA)-II, and Boiling Water Reactor Experim focus on institutional controls to the extent possible for cleanup projects; clean and vadose zone; and treat Pit 9 wastes.
High-Level Waste: Select technology and plan immobilization facility; develop treat minimize volume of high-activity waste; construct replacement liquid storage tanks.
Transuranic Waste: Retrieve/move transuranic and alpha low-level waste to new stora transuranic waste offsite for disposal; transport waste to offsite DOE facility for
Low-Level Waste: Transport to otehr DOE facilities for treatment, storage, and disp
Mixed Low-Level Waste: Transport offsite for treatment, storage, and disposal.
Greater-than-Class-C Waste: Discontinue management programs.
Hazardous Waste: Transport offsite for treatment, storage, and disposal.

Alternative D (Maximum Treatment, storage, and Disposal)

Spent Nuclear Fuel: Examine and store naval spent nuclear fuel; receive DOE spent n storage capacity in pools at Building 666 of the Idaho Chemical Plant; phase in exp out storage pools at Building 603 of the Idaho Chemical Processing Plant; phase in stabilization; demonstrate electrometallurglcal process.
Environmental Restoration: Conduct planned projects for all Waste Area Groups; deco decommission Auxiliary React rea (ARA)-ll, Boiling Water Reactor Experiment (BORA Test Reactor, Materials Test Reactor, Fuel Processing Complex, Fuel Receipt/Storage Processing Plant, Waste Calcine Facility, and Central Liquid Waste Processing Facil future land use to the extent possible for cleanup projects; clean up groundwater a and treat Pit 9 wastes.
High-Level Waste: Convert liquid calcine; select technology and plan immobolization treatment to minimize high-activity waste; construct replacement liquid storage tan
Transuranic Waste: Retrieve/move transuranic and alpha low-level waste to new stora transuranic waste offsite for disposal; accept offsite transuranic waste; treat off transuranic waste and alpha low-level waste; dispose of alpha low-level waste at ne

Low-Level Waste: Recieve offsite waste; treat waste onsite; constuct and operate ad treatment and disposal facilities onsite.
Mixed Low-Level Waste: Recieve offsite waste; treat waste onsite by incineration an construct facilities for onsite incineration and nonincineration treatment; constru disposal facility; transport waste offsite for treatment and disposal.
Greater-than-Class-C Waste: Recieve sealed sources for recycle or storage; construc facility.
Hazardous Waste: Transport waste offsite for treatment, storage, and disposal; poss onsite treatment, storage, and disposal facility.
restoration activities would be minimized by emphasizing institutional controls ove current cleanup and decommissioning and decontamination projects would be conducted Existing onsite spent nuclear fuel and waste management capability would be expande comply with regulations and agreements. Alternative D (Maximum
Treatment, Storage, and Disposal) Under Alternative D (Maximum
Treatment, Storage, and Disposal), spent nuclear fuel and waste would be transferre the Idaho National Engineering Laboratory for management to the extent possible. En restoration activities would emphasize residential use as the preferred end land us potentially would result in maximum waste generation. Implementation of this altern would require additional projects not yet defined or the expansion of identified pr Alternative B (Ten-Year Plan)]. Acceptance of waste and spent nuclear fuel from oth be maximized. Wastes generated from environmental restoration and waste management would be increased over that of the other alternatives. Spent nuclear fue and envir waste management activities at the Idaho National Engineering Laboratory would be c enhanced to meet current and expanded Spent nuclear fuel and waste handling needs. enhancements would be needed to comply with regulations and agreements and to allow acceptance of additional offsite generated materials and waste. Onsite management w greater treatment and disposal capabilities compared with Alternative B (Ten-Year P decontamination and decommissioning projects, complete dismantlement and restoratio be emphasized where possible and, therefore, the volume of wastes generated would b greater than under Alternative B (Ten- Year Plan).

Figure. Pictures Preferred Alternative
Under the Preferred Alternative, similar to the adivitiCs described under Alternati environmental restoration and waste management facilities and projects would contin addition to existing facilities and projects, projects proposed under Alternative B would be implemented to meet the current Idaho National Engineering Laboratory miss negotiated agreements and commitments (see Projects Related to Alternatives on page Ongoing spent nuclear fuel management, environmental restoration, and waste managem activities would be continued and enhanced to meet current and expanded spent nucle needs. These enhanced activities would be needed to comply with regulations and agr acceptance of additional offsite- generated materials and waste. Waste generation f increase (reflecting regulatory requirements and increased environmental restoratio Spent nuclear fuel, transuranic, and mixed low level waste would be received from o receive waste depending on decisions based on Site Treatment Plans negotiated under Compliance Act and the Waste Management Programmatic Environmental Impact Statement transuranic waste and mixed low-level waste received from other DOE sites would be returned to the original DOE site (generator) or transported to an approved offsite negotiated under the Federal Facility Compliance Act with the State of Idaho and th

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Preferred Alternative

Spent Nuclear Fuel: Receive additional non-aluminum-clad offsite spent nuclear fuel; transfer aluminum-clad spent nuclear fuel to Savannah River Site; examine and store naval spent nuclear fuel; complete Expended Core Facility Dry Cell Project and expand storage capacity in pools at Building 666 of the Idaho Chemical Processing Plant; phase out pools at Building 803 of the Idaho Chemical Processing Plant; phase in new dry storage; demonstrate electrometallurgical process at Argonne National Laboratory-West.
Evironnmental Restoration: Conduct all planned projects in all Waste Area Groups; decontaminate and decommission Auxiliary Reactor Area (ARA)-11. Boiling Water Reactor Experiment (BORAX)-V. Engineering Test Reactor, Materials Test Reactor. Fuel Processing Complex, Fuel Receipt!

Storage Facility, Headend Processing Plant, Waste Calcine Facility. and Central Uquid Waste Processing Facility; clean up groundwater contamination and vadose zone; retrieve and treat Pit 9 wastes.
High-Level Waste: Convert liquid to calcine; develop treatment that minimizes high-activity waste; plan a facility to immobilize both liquid and solid calcine.
Transuranlc Waste: Retrieve/move onsite transuranic and alpha low-level waste to new storage; treat offsite and onsite transuranic and alpha low-level waste; transport transuranic waste offsite for disposal; accept transuranic waste from ofisite for treatment; return treated offsite waste to the generator or an approved ofisite disposal site.
Low-Level Waste: Treat onsite and offsite; construct and operate additional treatment and disposal facilities onsite.
Mixed Low-Level Waste: Treat onsite by incineration and nonincineration; construct and operate facilities to treat waste by incineration and nonincineration; construct and operate disposal facility; transport waste offsite for treatment and disposal; accept offsite mixed low-level waste for treatment; return treated ofisite waste to the generator or an approved otfsite disposal site.
Greater-than-Class-C Waste: Receive sealed sources for recycle or storage; construct dedicated storage facility (may or may not be located at Idaho National Engineering Laboratory).
Hazardous Waste: Transport offsite for treatment, storage, and disposal.

Agency, and with other affected States. Ongoing rernediation and decommissioning and decontarnination projects would be continued and additional projects would be conducted.

Affected Environment at the INEL

The Idaho National Engineering Laboratory is located on 890 square miles (230,000 hectares) west of the City of Idaho Falls in southeast Idaho. The site sits on the Eastern Snake River Plain and is bordered by the Bitterroot, Lemhi, and Lost River mountain ranges. Local rivers and streams drain the mountain watersheds, but most surface water is diverted for irrigation before it reaches the site boundaries. Site activities do not directly affect surface water quality outside the site because current discharges from facilities go to seepage and evaporation basins or storm water injection wells.

The Idaho National Engineering Laboratory overlies the Snake River Plain Aquifer, the largest aquifer in Idaho. Subsurface water quality near the site is affected by natural water chemistry and contaminants originating at the site. Previous waste discharges to unlined ponds and deep wells have introduced radionuclides, nonradioactive metals, inorganic salts,

and organic compounds into the subsurface. Because of improved waste management practices, these discharges no longer occur and groundwater quality continues to improve. Only extremely low concentrations of radioactive iodine (iodine-i 29) and tritium have ever migrated beyond the site boundary; tritium no longer migrates offsite and iodine-129 concentrations are well below maximum contaminant levels (upper allowable limit in drinking water) established by the U.S. Environmental Protection Agency.

Idaho National Engineering Laboratory activities result in radiological air emissions; however, these are very low (less than background radiation) and well within standards. Nonetheless, Idaho National Engineering Laboratory workers may be exposed to radiation through their work. Those who may receive more than 0.1 rem per year (DOE's administrative limit is 2.0rem) are monitored. About 32 percent of workers monitored between 1987 and 1991 received measurable radiation doses.

The Idaho National Engineering Laboratory primarily consists of open, undeveloped land covered predominantly by sagebrush and grasslands with animal communities typical of these vegetation types. Two Federal endangered and nine candidate animal species have the potential for occurring, and nine animal species of special concern (State listing) occur at the Idaho National Engineering Laboratory. Eight plant species identified as sensitive, rare, or unique by other Federal agencies and the Idaho Native Plant Society also occur at the Idaho National Engineering Laboratory. Radionuclides have been found above background levels in individual plants and animals adjacent to facilities, but have not been observed at the population, community, or ecosystem levels.

Many land areas and plants on the Idaho National Engineering Laboratory are important to the Shoshone-Bannock Tribes. Certain plants are used as medicines, food, tools, fuel and in traditional practices. Land areas of importance to the Shoshone-Bannock Tribes

Figure. View of the Snake River include the buttes, wetlands, sinks, grasslands, juniper woodlands, Birch Creek, and the Big Lost River.

The Idaho National Engineering Laboratory site has a varied inventory of cultural resources. These include fossil localities, prehistoric archaeological sites, historic sites, and facilities assodated with the development of nuclear science in the United States. Similarly, because Native American people hold the land saaed, in their terms the entire Idaho National Engineering Laboratory is culturally important.
Most land within the site boundaries is used for grazing or is general open space Only about 2 percent of the 890 square miles (230,000 hectares) is used for facilities and operations, with another 6 percent devoted to public roads and utility rights-of-way. Over 97 percent of Idaho National Engineering Laboratory employees live in the seven counties surrounding the site. The regional economy relies on farming, ranching, and mining. The Idaho National Engineering Laboratory accounts for approximately 10 percent of the total regional employment.

Environmental Consequences

The environmental consequences of the site-specific alternatives have been assessed for the Idaho National Engineering Laboratory and the surrounding region. The environmental impact analyses are based on conservative assumptions (that is, with a tendency to overestimate). Analytical approaches were designed to provide a reasonable projection of the maximum reasonably foreseeable consequences.
The potential effects of each alternative were estimated by evaluating each individual project proposed for the alternative, summing the projects' collective effects under each alternative, and including interactions among the individual projects that compose each alternative. Cumulative impacts were determined by evaluating past, present, and reasonably foreseeable future actions of DOE and non-DOE projects or activities, in combination with the alternatives.
Although the impact to each environmental discipline (for example, land use or employment) is assessed in greater detail in Volume 2, this Summary focuses on potential adverse impacts that DOE has found to be of greater interest to the public, as demonstrated through the scoping process, comments on the Draft EIS, and other public involvement programs at

the Idaho National Engineering Laboratory.
In addition, the impacts presented in this Summary reflect the Preferred Alternative, which is essentially the Ten-Year Plan (Alternative B) modified to include elements of other alternatives. Impacts under the Preferred Alternative would be similar to those of the Ten-Year Plan and less than those of Alternative D (Maximum Treatment, Storage, and Disposal).

Air Quality
The operation of specific projects associated with the alternatives would result in airborne emissions ot radionuclides, criteria pollutants (e.g., sulfur dioxide, particulate matter), and toxic air pollutants (e.g., benzene, mercury). The effects of these emissions have been analyzed and compared with standards and criteria which are appropriate for comparison. The results indicate that, although some degradation of air quality could occur, all impacts would be below applicable standards established for public health and welfare. Measures such as administrative controls and best available control technology would be used as needed to minimize these impacts.
Atmospheric visibility has been specifically designated as an air-quality-related value under the 1977 Prevention of Significant Deterioration Amendments to the Clean Air Act. Conservative, screening-level analyses have been applied to estimate potential impacts related to visibility degradation at Craters of the Moon Wilderness Area [about 12 miles (20 kilometers) southwest of the Idaho National Engineering Laboratory]. The results indicate that for all alternatives, including the Preferred Alternative, there would be no perceptible changes in contrast, but potential impacts related to color shift could result. If the application of refined modeling confirms the findings of the screening-level analyses, measures such as the use of emissions controls or relocation of projects would be required to prevent these impacts.
The visual setting, particularly in the Middle Butte area of the Idaho National Engineering Laboratory, is considered by the Shoshone-Bannock Tribes to be an important

Native American resource. The Shoshone-Bannock Tribes would be consulted before any projects were developed that could have impacts to resources of importance to the tribes.
For all alternatives, including the Preferred Alternative, radiation doses to offsite individuals and site workers would be below applicable limits. Similarly, projected ambient air levels of toxic air pollutants would be below applicable standards for all alternatives.
Concentrations of criteria pollutants from operation of existing and proposed projects at the Idaho National Engineering Laboratory were also found to be below State and National Ambient Air Quality Standards and Prevention of Significant Deterioration limits for all alternatives. Criteria pollutant levels associated with the alternatives represent only minor increases over existing baseline levels. As a result, the cumulative (alternatives plus baseline) levels would not differ much between alternatives.
Construction and remediation activities would result in short-term, elevated levels of particulate matter in localized areas. Under all alternatives, including the Preferred Alternative, construction activities would result in maximum 24-hour concentrations of particulate matter at locations along public roads that exceed the State and Federal standards. Particulate levels at the site boundary would not exceed these standards. Standard construction practices such as watering would be used to minimize dust generation during the activities.
The air quality was evaluated in light of past, present, and reasonably foreseeable future actions, including DOE projects not associated with the spent nuclear fuel, environmental restoration, and waste management programs, plus offsite projects conducted by Government agencies, businesses, or individuals. This impact analysis found that the contribution to cumulative impacts from operation of projects associated with the alternatives would be low relative to other projects, and within limits prescribed by applicable standards.

Cultural Resources
Methods to identify, evaluate, and

mitigate impacts to cultural resources have been established through the National Historic Preservation Act, as amended; the Archaeological Resource Protection Act; the Native American Graves Protection and Repatriation Act; and the American Indian Religious Freedom Act. Potential impacts to cultural resources were assessed by identifying project activities that could affect known or expected significant resources and determining whether a project activity would have an effect on significant resources. A project would affect a significant resource if it would alter the resource's characteristics.
Geographically, the Idaho National Engineering Laboratory site is included within a large territory once inhabited by and still of importance to the Shoshone-Bannock Tribes.
However, the site lies outside the land boundaries established by the Fort Bridger Treaty and is occupied by the DOE.
Because some projects are not yet fully defined, the impacts to cultural resources cannot be completely identified. The impacts to cultural resources would depend on the (a) amount of surface disturbance [ranges from about 40 acres (16 hectares) under Alternative A (No Action) to about 1,340 acres (542 hectares) under Alternative D (Maximum Treatment, Storage, and Disposal)]; (b) degree to which these areas have been surveyed for resources and the number of potentially affected structures [6 for Alternative A (No Action) and 11 for Alternative C (Minimum Treatment, Storage, and Disposal), 66 for the Preferred Alternative and 70 for Alternatives B (Thn-Year Plan) and D (Maximum Treatment, Storage, and Disposal)]; and (c) number of known cultural resource sites (22 for Alternatives B and D and the Preferred Alternative). For any alternative, DOE would conduct detailed preconstruction surveys and would consult with the State Historic Preservation Office and Native American Groups, before any undertaking, to determine the appropriate measures to mirurruze impacts to significant resources,
In general, Alternatives A and C would have a lesser effect on cultural resources than the Preferred Alternative, and Alternatives B and D.

Ecology

The Idaho National Engineering Laboratory primarily consists of open, undeveloped land covered predominantly by sagebrush and grasslands with animal communities typical of these vegetation types. Radionuclides have been found above background levels in individual plants and animals adjacent to facilities, but effects have not been observed at the population, community, or ecosystem levels.

Under Alternatives A (No Action) and C (Minimum Treatment, Storage, and Disposal), limited environmental restoration activities would be undertaken, resulting in the long-term presence of radioactive and hazardous wastes in the environment. Plants and animals would continue to be exposed to these wastes. The Preferred Alternative and Alternatives B (Ten-Year Plan) and D (Maximum Treatment, Storage, and Disposal) would result in a decrease in radioactive uptake over the long-term as environmental restoration activities proceed.

Implementation of any alternative would result in the loss of habitat from facility modification and construction. Alternative D would have the greatest estimated consequences, followed by Alternative B, the Preferred Alternative, Alternative C and Alternative A. implementation of Alternative D (Maximum Treatment, Storage, and Disposal) would claim about 1,340 acres (542 hectares), of which 232 acres (94 hectares) would be revegetated, resulting in a net loss of about 1,108 acres (448 hectares). Alternative B and the Preferred Alternative would have similar impacts, with the latter claiming about 783 acres (317 hectares), of which 232 acres (94 hectares) would be revegetated, resulting in a long-term net loss of 551 acres (223 hectares). Alternative C would disturb about 355 acres (144 hectares) including 232 acres (94 hectares) that would be revegetated. Alternative A (No Action) would have the least relative impact, disturbing only about 40 acres (16 hectares) of habitat.

Estimated habitat loss from each alternative was assessed in light of other DOE and non-DOE projects When these projects were considewd together, it was estimated that Alternative A (No Action) would disturb 260 acres (105 hectares),

followed by Alternatives C (Minimum Treatment, Storage, and Disposal) [576 acres (233 hectares)], B (Ten-Year Plan) [823 acres (333 hectares)], and D (Maximum Treatment, Storage, and Disposal) [1,560 aaes (631 hectares)]. For the Preferred Alternative this cumulative habitat loss would be similar to Alternative B and less than Alternative D. To minimize habitat loss, DOE conducts surveys and consults with appropriate Federal and State agencies before facility construction or modification. If necessary, current project planning would be modified to minimize surface disturbances.

Groundwater Quality
Previous operations have introduced radionuclides, nonradioactive metals, inorganic salts, and organic compounds into the subsurface. Radionuclide concentrations in the Snake River Plain Aquifer beneath the site have generally decreased since the mid 1980s because of changes in disposal practices, radioactive decay, adsorption of radionuclides to rocks and minerals, and dilution by natural surface water and groundwater entering the aquifer. Extremely low concentrations of iodine-I 29 and tritium (both below maximum contaminant levels) have migrated outside of site boundaries. Although nonradioactive metals, inorganic salts, and organic compounds have been detected in the aquifer, none have migrated beyond site boundaries. Modeling to estimate radionuclide (and other constituent) migration was performed. Tritium, iodine-I 29, and strontium-90 are discussed because they appear to have had the most impact on groundwater quality.
Drinking water at the Idaho National Engineering Laboratory site may contain small concentrations of tritium, strontium-90, and iodine-I 29. Over a 50-year working period, this

Figure. Relationship of Snake River Plain to the INEL

radioactivity could result in a maximum of about a 22-millirem dose to an individual worker. This radiation dose is well within regulatory limits and is small compared to other sources of occupational radiation exposure.

Normal Operations Impacts
Potential impacts from any alternative would occur to workers and the public from exposures to radiation during routine operations of facilities and during routine transportation of spent nuclear fuel and radioactive waste.

Facilities
Idaho National Engineering Laboratory facilities release small amounts of radionuclides to the air in levels that are within regulatory standards. Estimates of latent cancer fatalities are based on exposures to 10 years of Idaho National Engineering Laboratory operations under each alternative. The likelihood of the maximally exposed worker contracting a fatal cancer ranges from 1 in about 500,000 [Alternatives B (Ten-Year Plan) and D (Maximum Treatment, Storage, and Disposal) and Preferred Alternative] to 1 in about 770,000 [Alternatives A (No Action) and C (Minimum Treatment, Storage, and Disposal)]. For the maximally exposed member of the public living offsite, the likelihood ranges from 1 in about 240,000 [Alternative D (Maximum Treatment, Storage, and Disposal)] and from 1 in about 320,000 (Alternatives B and Preferred) to 1 in about 1,000,000 (Alternatives A and C). In the nearby population, it is estimated that less than one latent cancer fatality would occur in the 10-year period for all alternatives.

Workers
Impacts to workers at the Idaho National Engineering Laboratory from routine occupational hazards were also assessed. It is estimated that routine exposure to radiation would result in less than one latent cancer fatality for any alternative over 10 years of Idaho National Engineering Laboratory operations in the worker population. Based on historical data, these same populations of workers would also report between 2,500 and 3,000 occupationally-related injuries and illnesses over 10 years of Idaho National Engineering Laboratory operations. Work place hazards would be reduced by the worker and safety programs and regulatory standards currently in place.

Transportation
During the incident-free transportation of waste and spent nuclear fuel, the general population living and traveling along the transport route would be

exposed to radiation from the passing shipments. Transportation workers would also be exposed. The total number of fatalities for the shipments would be the sum of the estimated number of radiation-related latent cancer fatalities for transportation workers and the general population anc the estimated number of nonradiological fatalities from vehicular emissions.

Over the 10-year period 1995 through 2005, for all alteratives, if waste shipments were made by truck, the estimated number of total fatalities would range from 0.10 to 1.4. If waste shipments were made by rail, the estimated number of total fatalities would range from 0.02 to 0.3.

Over the 40-year period 1995 through 2035, if spent nuclear fuel shipments were made by truck, the estimated number of total fatalities would range from 0.1 to 1.7. If spent nuclear fuel shipments were made by rail, the estimated number of total fatalities would range from 0.1 to 0.26.

Accidents

A potential exists for accidents at facilities associated with the treatment, storage, and disposal of radioactive and hazardous materials. Accidents can be categorized into events that are abnormal (for example, minor spills), events that a facility was designed to withstand, and events that a facility was not designed to withstand (but whose impacts may be offset or mitigated). A range of accidents was considered for all alternatives and consequences were estimated for a member of the public at the nearest site boundary, for the population within 50 miles (80 kilometers), and for the workers. In addition, accident analyses were performed for the transport of Spent nuclear fuel and radioactive waste

Facilities

The maximum reasonably foreseeable accident for facility operations is the same among all alternatives and involves spent nuclear fuel. A severe earthquake damages the Hot Fuel Examination Facility and causes spent nuclear fuel to melt, resulting in a radiological release. Although such an event is unlikely (once every 100,000 years), the maximally exposed individual at the site boundary would incur an estimated

risk of increased latent cancer fatalities of one in about 40 million. In the surrounding population, this postulated accident could result in, at most, seven additional latent cancer fatalities.

Workers
The maximum reasonably foreseeable radiological accident for workers results from an earthquake causing the main stack at the Idaho Chemical Processing Plant to collapse. This event has a likelihood of occuring once in 3,300 years. As many as 50 workers could be subjected to potentially fatal prompt exposures. Workers that survive the initial event could see increased risk of developing a latent fatal cancer of 1 in 90. The maximum reasonably foreseeable hazardous material accident results from an accidental release of the entire inventory of chlorine gas (a hazardous material) from a facility. The event may occur once in 100,000 years and could cause fatalities to as many as 100 workers. Such a release also would be the maximum reasonably foreseeable hazardous material accident for public consequences, but no fatalities would be expected.

Transportation
During the transport of waste and spent nuclear fuel, radiological accidents and traffic accidents could occur. To determine the accident risk from transporting waste and spent nuclear fuel, a complete spectrum of accidents was evaluated.
The estimated cumulative risk of a latent cancer fatality from radiological accidents would range among all alternatives from 1 in 1,300 to 1 in 340 for the period 1995 through 2005 if waste shipments were made by truck. The estimated cumulative accident risk from traffic accidents would range from 0.30 to 3.4 fatalities for the period 1995 through 2005. The risk of latent cancer fatality as a result of radiological accidents, although small, is considered to be an involuntary risk incurred by the public.
The estimated cumulative risk of a latent cancer fatality from radiological accidents would range from one in 17,000 to one in 2,900 for the period 1995 through 2005 if waste shipments were made by train. The

estimated cumulative accident risk from traffic accidents would range from 0.003 to 0.04 fatalities for the period 1995 through 2005.
The estimated cumulative risk of a latent cancer fatality from radiological accidents would range from 1 in 240,000 to 1 in 200 for the period 1995 through 2035 if spent nuclear fuel shipments were made by truck. The estimated cumulative accident risk due to traffic accidents would range from 0.05 to 1.4 fatalities for the period 1995 through 2035.
The estimated cumulative risk of a latent cancer fatality from radiological accidents would range from 1 in 240,000 to 1 in 700 for the period 1995 through 2035 if spent nuclear fuel shipments were made by train. The estimated cumulative accident risk from traffic accidents would range from 0.05 to 1.2 fatalities for the period 1995 through 2035.
The consequences for various maximum reasonably foreseeable accidents also were evaluated for spent nuclear fuel and waste. The maximum reasonably foreseeable accident for spent nuclear fuel or waste shipments was for a rail shipping cask, containing special-case commercial spent nuclear fuel, to undergo any number of combinations of fire and impact to cause a release. This hypothetical accident, which was estimated to have a probability of occurring about once in 10 miffion years, was estimated to result in 55 radiation-related latent cancer fatalities.

Environmental Justice
In February 1994, Executive Order 12898 entitled, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" was released to Federal agencies. In accordance with the Executive Order, an interagency Federal Working Group on Environmental Justive has been convened to provide guidance to agencies on implementation of environmental justice.
For this final EIS, proposed projects, facilities, and transportation associated with the proposed alternatives were reviewed. This review included potential impads that might occur for each of the environmental disciplines, under normal operating conditions and under potential accident conditions, to minority and low-income communities

within 50 miles (80 kilometers) of an existing major facility area at the Idaho National Engineering Laboratory. In addition, exposure pathways were evaluated with respect to subsistence consumption of fish, game, and native plants The analysis found that the impacts from proposed environmental restoration and waste management programs and managing spent nuclear fuel, under all alternatives, would not constitute a disproportionately high and adverse impact on minority or low-income communities and, thus, do not present an environmental justice concern.

a. The location of the facility was selected to include the maximum minority and lo income populations within the 80-kllometer radius. Of the 172,400 people residing i area (based on the 1990 census), about 7 percent are classified by the U.S. Bureau Census as minority and about 14 percent as low-income.

Consultations and Environmental Requirements

DOE is committed applicable environmental laws, regulations, executive orders, DOE orders, and permits and compliance agreements with regulatory agencies. To ensure compliance with permits and other applicable legal requirements, regulatory agencies conduct inspections at the Idaho National Engineering Laboratory. In addition, DOE has a comprehensive program for conducting internal audits or inspections and self-assessments, including periodic reviews conducted by interdisciplinary teams of experts. DOE has prepared and issued a site-specific environmental compliance planning manual. This manual contains step-by-step methods to maintain compliance with the various requirements of Federal and State agencies that regulate operations at the Idaho National Engineering Laboratory. The DOE regulations that implement the National Environmental Policy Act require consultation with other agencies, when appropriate, to incorporate any relevant requirements as early as possible in the process. During preparation of the EIS, DOE initiated consultation with Federal and State agencies. The U.S. Fish and Wildlife Service and the State Historic Preservation Office have responded to DOE's request for consultation. The information provided has been considered in the analyses of the EIS.

The DOE and the Navy have reviewed all comments received on the draft EIS. To more fully understand, evaluate, and consider

certain agency comments,
consultations have taken place
among agency, Idaho National
Engineering Laboratory, and Navy
officials.

Attachment-Reading Rooms and Information Locations

U.S. Department ot Energy
Reading Rooms
Public Reading Acorn for U.S. Department
of Energy Headquarters
Room 1E-190, Forrestal Building
Freedom at Intormation Reading Room
1000 Independence Avenue, SW
Washington, DC 10585
(202) 586-6020
Monday-Friday 9:00 a.m. to 4:00 p.m.
Public Reading Room for U.S.
Department of Energy
Oakland Operations Office
Environmental Information Center
1301 Clay Street, Room 700 N
Oakland, CA 94612
(510)637-1762
Monday-Friday 8:30 a.m. to 5:00 p.m.
Public Reading Room for U.S.
Department of Energy
Rocky Flats Operations Office
Front Range Community College Library
3645 W. 112th Ave.
Level B, Center or the Building
Westminister. CO 80030
(303) 469-4435
Monday and Tuesday 10:30 a.m. to 6:30 p.m.,
Wednesday 10:30 a.m. to 4:00 p.m.,
Thursday 8:00 a.m. to 4:00 p.m.
Public Reading Room for U.S.
Department of Energy
Idaho Operations Office
Public Reading Room
1776 Science Center Drive
Idaho Falls, ID 83402
(208) 526-9162
Monday-Friday 8:00 a.m. to 5:00 p.m.
Public Reading Room for U.S.
Department of Energy
University of Illinois at Chicago Library
Government Documents Section
801 South Morgan Street
Chicago. IL 60607
(312) 998-2738
Monday-Thursday 8:00 a.m. to 10:00 p.m..
Friday 8:00 a.m. to 7:00 p.m.. Saturday 10:00 a.m. to
5:00p.m., Sunday 1:00 p.m. to 9:00 p.m.
Public Reading Room for U.S.
Department of Energy
National Atomic Museum
20358 Wyoming Boulevard, SE
Albuquerque, NM 87185
(505) 845-4378
Monday-Friday 9:00 a.m. to 5:00 p.m.
Public Reading Room fer U.S.
Department of Energy
Nevada Operations Office

Coordination and Information Center
3084 South Highland Drive
P.O. Box 98521
Las Vegas, NV 89106
(702) 295-0731
Monday-Friday 7:00 a.m. to 4:30 p.m.
Public Information Room for U.S.
Department of Energy
Fernald Operations Office
Public Environmental Canter
JANTER Building 10845
Hamilton-Cleves Highway
Harrison, OH 445030
(513)738-0164
Monday and Thursday 9:00 a.m. to 7:00 p.m..
Tuesday, Wednesday, and Friday 9:00a.m. to 4:30 p.m.,
Saturday 9 a.m. to 1 pm.
Public Reading Room for U.S.
Department of Energy
Savannah River Operations Office
Public Reading Room
Road lA, Building 703A, 0232
Aiken, SC 29802
(803)641-3320
Monday-Thursday 8:00 a.m. to 11:00 p.m.,
Friday 8:00 a.m. to 5:00 p.m.,
Saturday 10:00 a.m. to 5:00 p.m.,
Sunday 2:00 p.m. to 11:00 p.m.
Public Reading Room for U.S.
Department of Energy
Oak Ridge Operations Office
Pubic Reading Room
55 Jefferson Avenue
Oak Ridge, TN 37831
(615) 576-1216
Monday-Friday 8:00 a.m. to 11:30 a.m. and
12:30 p.m. to 5:00 p.m.
Public Reading Room for U.S.
Department of Energy
Richland Operations Office
Washington State University Tri-Cities
100 Sprout Road. Room 130 West
Richland. WA 99352
(509) 376-8583
Monday-Friday 8:00 a.m. to 12:00 noon and
1:00 p.m. to 4:30 p.m.
Navy Information Locations
Norfolk Naval Shipyard
Chesapeake Central Library
298 Cedar Rd.
Chesapeake. VA 23320-5512
(804) 438-8300
Monday-Thursday 9:00 a.m to 9:00 p.m..
Friday and Saturday 9:00 a.m to 5:00 p.m.
Sunday 1:00 p.m. to 5:00p.m.
Newport News Public Library
Grissom Branch
386 Deshazor Dr.
Newport News, VA 23602
(804) 886-7896
Monday-Thursday 9:00 a.m. to 9:00 p.m.,
Friday and Saturday 9:00 a.m. to 6:00 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
Kiln Library

301 East City Hall Ave.
Norfolk, VA 23510
(804) 441-2429
Monday-Thursday 9:00 a.m. to 9:00 p.m..
Friday 9:00 a.m. to 5:30 p.m..
Saturday 9:00a.m. to 5:00p.m.
Hampton Public Library
4207 Victoria Boulevard
Hampton, VA 23689
(804)727-1154
Monday-Thursday 9:00 a.m. to 9:00 p.m..
Friday and Saturday 9:00 a.m. to 5:00 p.m..
Sunday 1:00 p.m. to 5:00 p.m.
Portsmouth Public Library
Main Branch
601 Court St.
Portsmouth, VA 23704
(804) 393-8501
Monday-Thursday 9:00 a.m to 9:00 p.m.
Friday and Saturday 9:00 a.m to 5:00 p.m.
Virginia Beach Central Library
4100 Virginia Beach Blvd.
Virginia Beach. VA 23452
(804)431-3001
Monday-Thursday 10:00 a.m. to 9:00 p.m..
Friday and Saturday 10:00 a.m. to 5:00 p.m..
Sunday 1:00 p.m. to 5:00 p.m.
Puget Sound Naval Shipyard
Kitsap Regional Library
1301 Sylvan Way
Bremerton. WA 98310
(206) 377-7601
Monday-Thursday 9:30 a.m. to 9:00 p.m..
Friday and Saturday 9:30 a.m. to 5:30 p.m..
Sunday 12:30 p.m. to 5:30 p.m.
Kltsap Regional Library
Downtown Branch
6125th Ave.
Bremarton. WA 98310
(206) 377-3955
Monday-Friday 10:00 a.m. to 5:30 p.m.

Suzallo Library SM25
University of Washington Libraries
University of Washington
Seattle, WA 98185
(206)543-9158
Monday-Thursday 7:30a.m. to 12:00 midnight.
Friday 7:30a.m. to 6:00p.m..
Saturday 9:00 a.m. to 5:00 p.m..
Sunday 12:00 noon to 12:00 midnight
Portsmouth Naval Shipyard
Rice Public Library
8 Wentworth Street
Kittery, ME 03904
(207)439-1553
Monday-Wednesday, Friday 10:00 a.m. to 5:00 p.m.,
Thursday 10:00 a.m. to 8:00 p.m..
Saturday 10:00a.m. to 4:00p.m.
Portsmouth Public Library
8 Islington Street
Portsmouth. NH 03801
(603)427-1540
Monday-Thursday 9:00 a.m. to 9:00 p.m.,

Friday 9:00 a.m. to 5:30 p.m.,
Saturday 9:00 a.m. to 5:00 p.m.
Pearl Harbor Naval Shipyard
Aiea Public Library
99-143 Monalua Rd.
Ajea, HI 95701
808) 48S-25S4
Monday and Thursday 10:00a.m. to 8:00p.m..
Tuesday. Wednesday. Friday. and Saturday
10:00 a.m. to 5:00p.m.
Hawaii State Library
478 South King Street
Honolulu, HI 96813
(808) 586-3535
Monday, Wednesday, and Friday,
9:00 a.m. to 5:00 p.m..
Tuesday and Thursday 9:00 a.m. to 8:00 p.m.
Saturday 10:00 a.m. to 5:00 p.m.
Pearl City Public Library
1138 Waimano Home Rd.
Pearl City, HI 96782
(808)4554134
Monday-Wednesday 10:00 a.m. to 8:00 p.m.
Thursday and Saturday 10:00a.m. to 5:00p.m..
Friday and Sunday 1:00 p.m. to 5:00 p.m.
Pearl Harbor Naval Base Library
Code 90L
1614 Makalapa Dr.
Pearl Harbor, HI 98860-5350
(808)471-8238
Tuesday-Thursday 10:00 a.m. to 7:00 p.m.
Friday and Saturday 9:00 a.m. to 5:00 p.m..
Sunday 1:00 p.m. to 5:00 p.m.
Kesselring Site
Albany Public Library
Reference and Adult Services
161 Washington Ave.
Albany, NY 12210
(518)449-3380
Monday-Thursday 9:00 a.m. to 9:00 p.m.
Friday 9:00 a.m to 6:00 p.m..
Saturday 9:00 a.m. to 5:00 p.m..
Sunday 1:00 p.m. to 5:00 p.m.
Saratoga Springs Public Library
320 Broadway
Saratoga Springs, NY 12886
(518) 584-7860
Monday-Thursday 9:00 a.m. to 9:00 p.m.,
Friday 9:00 a.m. to 6:00 p.m.,
Saturday 9:00 a.m. to 5:00 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
Schenectady County Library
99 Clinton Street
Schenectady, NY 12305
(518)389-4511
Monday-Thursday, 9:00a.m. to 9:00 p.m.
Friday and Saturday, 9:00a.m. to 5:00p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
Other Locations
Main Library
University of Arizona
Tucson, AZ 85721
(602)621-6421
Monday-Thursday 7:30 a.m. to 1:00 a.m.,

Friday 7:30 a.m. to 8:00 p.m.,
Saturday 10:00 a.m. to 6:00 p.m..
Sunday 11:00 a.m. to 1:00 a.m.
Main Library
University of California at Irvine
Government Publications Receiving Dock
Irvine, CA 92717
(714)824-6936
School Hours:
Monday-Thursday 8:00 a.m. to 1:00 a.m.
Friday 8:00 a.m. to 9:00 p.m.,
Saturday 9:00 a.m. to 6:00 p.m.,
Sunday 12:00 noon to 1:00 a.m.
Summer Hours:
Monday-Friday 8:00 a.m. to 5:00 p.m.,
Saturday and Sunday 1:00 p.m. to 5:00 p.m.
Pleasanton Public Library - Reference Desk
400 Old Bernal Avenue
Pleasanton, CA 94566
(510) 462-3535
Monday and Tuesday 1:00 p.m. to 8:00 p.m.,
Wednesday 10:00 a.m. to 8:00 p.m.,
Thursday 10:00 a.m. to 6:00 p.m.,
Closed Friday
Saturday and Sunday 1:00 p.m. to 5:00 p.m.
San Diego Public Library
820 "E" Street
San Diego, CA 92101
(619)236-5867
Monday-Thursday 10:00 a.m. to 9:00 p.m.,
Friday and Saturday 9:30 a.m. to 5:30 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
Denver Public Library
1357 Broadway
Denver, CO 80203
(303) 840-8845
Monday-Wednesday 10:00 a.m. to 9:00 p.m.,
Thursday-Saturday 10:00 a.m. to 5:30 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
George A. Smathera Libraries, Library West
University of Florida Library, Room 241
P.O. Box 117001
Gainesville, FL 32611-7001
(904) 392-0367
Monday-Thursday 8:00 a.m. to 9:30 p.m.,
Friday 6:00 a.m. to 5:00 p.m.,
Sunday 2:30 p.m. to 9:30 p.m.
Atlanta Public Library
1 Margaret Mitchell Square
Atlanta, GA 30303
(404)730-1700
Monday-Thursday 9:00 a.m. to 9:00 p.m.,
Friday and Saturday 9:00 a.m. to 6:00 p.m.,
Sunday 2:00 p.m. to 6:00 p.m.
Reese Library
Augusta College
2500 Walton Way
Augusta, GA 30904-2200
(708) 737-1744
School Hours:
Monday-Thursday 7:45 a.m. to 10:30p.m.,
Friday 7:45 a.m. to 5:00 p.m.,
Saturday 9:00 a.m. to 5:00 p.m.,
Sunday 1:30 p.m. to 9:30 p.m.

Summer Hours:
Monday-Friday 8:00 a.m. to 5:00 p.m.
Chatham-Effingham-Liberty
Regional Library
2002 Bull Street
Savannah, GA 31401
(912)652-3600
Monday-Thursday 9:00 a.m. to 9:00 p.m.,
Friday 9:00 a.m. to 6:00 p.m.,
Saturday 10:00 a.m. to 6:00 p.m.,
Sunday 2:00 p.m. to 6:00 p.m.
Parks Library
Iowa State University
Government Publications Department
Ames, IA 50011-2140
(515)294-3642
School Hours:
Monday-Thursday 7:30 a.m. to 12:00 midnight.
FrIday 7:30 a.m. to 10:00 p.m.,
Saturday 10:00 a.m. to 10:00 p.m.,
Sunday 12:30 p.m. to 12:00 midnight,
Summer Hours:
Monday-Thursday 7:30 a.m. to 10:00 p.m.,
Friday 7:30 a.m. to 5:00 p.m.,
Saturday 12:30 p.m. to 5:00 p.m.,
Sunday 12:30 p.m. to 5:00 p.m.,
Boise Public Library
715 South Capitol Boulevard
Boise, ID 83702
(208) 364-4023
Monday and Friday 10:00 a.m. to 6:00 p.m.,
Tuesday-Thursday 10:00 a.m. to 9:00 p.m..
Saturday and Sunday 12:00 noon to 5:00 p.m.
Idaho State Library
325 West State Street
Boise, ID 83702
(208) 334-2152
Monday-Friday 9:00 a.m. to 5:00 p.m.
Shoshone-Bannock Library
Bannock and Pima Streets, HRDC Building
Fort Hall, ID 83203
(208) 238-3882
Monday-Friday 8:00 a.m. to 5:00 p.m.
Idaho Falls Public Library
457 Broadway
Idaho Falls, ID 83402
(208) 529-1462
Monday-Thursday 9:00 a.m. to 9:00 p.m,
Friday and Saturday 9:00 a.m. to 5:30 p.m.,
Sunday 1:30 p.m. to 5:30 p.m.
University of Idaho Library
Rayburn Street
Moscow, ID 83844-2353
(208) 885-8344
Monday-Friday 8:00 a.m. to 12:00 midnight,
Saturday 9:00 a.m. to 12:00 midnight,
Sunday 10:00 a.m. to 12:00 midnight
Pocatello Public Library
812 East Clark Street
Pocatello, ID 83201
(208) 232-1263
Monday-Thursday 9:30 a.m. to 8:00 p.m.
Friday and Saturday 9:30 a.m. to 5:30 p.m.
Twin Falls Public Library

434 Second Street East
Twin Falls, ID 83301
(208) 733-2964
Monday, Friday, and Saturday 10:00 a.m. to 6:00 p.m.,
Tuesday-Thursday 10:00 a.m. to 9:00 p.m.
Main Library, Third Floor
University of Illinois
801 South Morgan, Mail Code 234
Chicago, IL 60607
(312)413-2594
Monday-Thursday 7:30 a.m. to 10:00 p.m.,
Friday 7:30 a.m. to 5:00 p.m.,
Saturday 10:00 a.m. to 8:00 p.m.,
Sunday 1:00 p.m. to 9:00 p.m.
Documents Library, 200-D
University of Illinois
1408 W. Gregory Drive
Urbana, IL 61801
(217) 244-2060
School Hours:
Monday-Thursday 8:00 a.m. to 12:00 midnight,
Friday 8:00 a.m. to 6:00 p.m.,
Saturday 9:00 a.m. to 6:00 p.m..
Sunday 1:00 pm. to 12:00 midnight
Summer Hours:
Monday-Thursday 8:00 a.m. to 9:00 p.m.,
Friday 8:00 a.m. to 6:00 p.m.,
Saturday 9:00 a.m. to 5:00 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
Engineering Library
Purdue University
West Lafayette, IN 47907
(317) 494-2871
School Hours:
Monday-Thursday 8:00 a.m. to 12:00 midnight,
Friday 8:00 a.m. to 10:00 p.m.,
Saturday 8:00 a.m. to 5:00 p.m..
Sunday 1:00 p.m. to 12:00 midnight,
Summer Hours:
Monday-Friday 8:00 a.m. to 5:00 p.m.
Manhattan Public Library
Julliette and Poyntz
Manhattan, KS 66502
(913) 776-4741
Monday-Friday 9:00 a.m. to 9:00 p.m.,
Saturday 9:00 a.m. to 6:00 p.m.,
Sunday 2:00 p.m. to 6:00 p.m.
Massachusetts Institute of
Technology Science Library
160 Memorial Drive Building 14
Cambridge, MA 02139
(617) 253-5885
Monday-Thursday 8:00 a.m. to 12:00 midnight,
Friday and Saturday 8:00 a.m. to 8:00 p.m.,
Sunday 12:00 noon to 12:00 midnight
O'Leary Library
University of Massachusetts
1 University Ave
Lowell, MA 01854
(508) 934-3205
School Hours:
Monday-Thursday 7:30 a.m. to 12:00 midnight,
Friday 7:30 a.m. to 5:00 p.m.,
Saturday 10:00 a.m. to 6:00 p.m.,

Sunday 1:00p.m. to 12:00 midnight
Summer Hours:
Monday-Friday 8:30 a.m. to 9:00 p.m.,
Sunday 2:00 p.m. to 7:00 p.m.
Worcester Public Library
3 Salem Square
Worchester, MA 01608
(508) 799-1655
Monday-Thursday 9:00 a.m. to 9:00 p.m.
Friday and Saturday 9:00 a.m. to 5:30 p.m.
Bethesda Public Library
7400 Ariington Road
Bethesda, MD 20814
(301)986-4300
Monday-Thursday 10:00 a.m. to 8:30 p.m.,
Friday 10:00 a.m. to 5:00 p.m.,
Saturday 9:00 a.m. to 5:00 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
Gaithersburg Regional Library
18330 Montgomery Village Avenue
Gaithersburg, MD 20879
(301)940-2515
Monday-Thursday 10:00 a.m. to 8:30 p.m.,
Friday 10:00a.m. to 5:00p.m.,
Saturday 9:00 a.m. to 5:00 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
Hyattsville Public Library
6530 Adelphi Road
Hyattsville, MD 20782
(301) 779-9330
Monday-Thursday 10:00 a.m. to 9:00 p.m.,
Friday 10:00 a.m. to 6:00 p.m.,
Saturday 10:00 a.m. to 5:00 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
Ann Arbor Public Library
343 South 5th Avenue
Ann Arbor, MI 48104
(313) 994-2335
Monday 10:00 a.m. to 9:00 p.m.,
Tuesday-Friday 9:00 a.m. to 9:00 p.m.,
Saturday 9:00 a.m. to 6:00 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
Zanhow Library
Saginaw Valley State University
7400 Bay Road
University Center, MI 48710
(517)790-4240
School Hours:
Monday-Thursday 8:00 a.m. to 11:00 p.m..
Friday 6:00 a.m. to 4:30 p.m.,
Saturday 9:00 a.m. to 5:00 p.m..
Sunday 1:00 p.m. to 9:00 p.m.
Summer Hours:
Monday-Thursday 8:00 a.m. to 10:30 p.m.,
Friday 8:00 a.m. to 4:30 p.m..
Saturday 10:00 a.m. to 2:00 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
Ellis Library
University of Missouri
Columbia, MO 65201
(314) 852-0748
School Hours:
Monday-Thursday 7:30 a.m. to 12:00 midnight,
Friday 7:30 a.m. to 11:00 p.m.,

Saturday 9:00 a.m. to 9:00 p.m.,
Sunday 12:00 noon to 1:00 a.m.
Summer Hours:
Monday and Thursday 8:00 a.m. to 8:00 p.m..
Tuesday, Wednesday, and Friday 8:00 a.m. to 5:00 p.m.
Saturday 12:00 noon to 5:00 p.m.
Curtis Laws Wilson Library
University of Missouri Library
Rolla, MO 65401-0249
(314)3414227
School Hours:
Monday-Thursday 8:00 a.m. to 12:00 midnight.
Friday 8:00 a.m. to 10:30 p.m.,
Saturday 8:00 a.m. to 5:00 p.m.,
Sunday 2:00 p.m. to 12:00 midnight,
Summer Hours:
Monday-Friday 8:00 a.m. to 5:00 p.m.
D.H.Hill Library
North Carolina State University
RO. Box 7111
Raleigh, NC 27695-7111
(919)515-3364
School Hours:
Monday-Thursday 7:00 a.m. to 1:00 a.m.,
Friday 7:00 a.m. to 9:30 p.m.,
Saturday 9:30 a.m. to 6:00 p.m.,
Sunday 1:00 p.m. to 1:00 a.m.
Summer Hours:
Monday-Thursday 7:00 a.m. to 11:00 p.m.,
Friday 7:00 am. to 6:00 p.m.
Saturday 9:30 a.m. to 5:30 p.m.,
Sunday 1:00p.m. to 11:00p.m.
Omaha Public Library
215 5. 15th Street
Omaha, NE 68102
(402) 444-4800
Monday-Thursday 9:00 a.m. to 9:00 p.m.,
Friday and Saturday 9:00 a.m. to 5:30 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
General Library
University of New Mexico
Albuquerque, NM 87131-1456
(505) 277-5441
School Hours:
Monday-Thursday 8:00 a.m. to 9:00 p.m.,
Friday 8:00 a.m. to 5:00 p.m..
Saturday and Sunday 12:00 noon to 4:00 p.m.,
Summer Hours:
Monday-Friday 8:00 a.m. to 6:00 p.m.,
Saturday 10:00 a.m. to 5:00 p.m.
U.S. DOE Community Reading Room
1450 Central Avenue, Suite 101
MS C314
Los Alamos, NM 87544
(505)665-2127
Monday-Friday 9:00 a.m. to 5:00 p.m.
Lockwood Library
State University ot New York-Buffalo
Buffalo. NY 14260-2200
(716)645-2816
School Hours:
Monday-Thursday 8:00a.m. to 10:45p.m.,
Friday 8:00a.m. to 9:00p.m.,
Saturday 9:00 a.m. to 5:00 p.m..

Sunday 1:00 p.m. to 9:00 p.m.,
Summer Hours:
Monday, Wednesday, Thursday and
Friday 9:00 a.m. to 6:00 p.m..
Tuesday 9:00 a.m. to 10:00 p.m.
Sunday 1:00 p.m. to 9:00 p.m.
Engineering Library
Cornell University
Carpenter Hall, Main Floor
Ithaca, NY 14853
(607) 255-5762
School Hours:
Monday-Thursday 8:00 a.m. to 11:00 p.m.,
Friday 8:00a.m. to 8:00 p.m.,
Saturday 10:00 a.m. to 6:00 p.m.,
Sunday 12:00 noon to 11:00 p.m.,
Summer Hours:
Monday-Friday 8:00 a.m. to 6:00 p.m.,
Saturday 12:00 noon to 6:00 p.m.
Cardinal Hayes Library
Manhattan College
4531 Manhattan College Parkway
Riverdale, NY 10471
(718)920-0100
School Hours:
Monday-Thursday 8:00 a.m. to 11:00 p.m.,
Friday 8:00 a.m. to 6:30 p.m.,
Saturday 10:00 a.m. to 5:00 p.m.,
Sunday 1:00 p.m. to 11:00 p.m.,
Summer Hours:
Monday-Thursday 8:30 a.m. to 6:30 p.m.,
Friday 8:00 a.m. to 4:00 p.m.
Brookhaven National Laboratory
25 Brookhaven Avenue. Building 477 A
P.O. Box 5000
Upton, NY 11973-5000
(516)282-3489
Monday-FrIday 8:30 a.m. to 9:00 p.m.,
Saturday and Sunday 9:00 a.m. to 5:00 p.m.
Columbus Metropolitan Library
96 South Grant Avenue
Columbus, OH 43215
(614)645-2710
Monday-Thursday 9:00 a.m. to 9:00 p.m.,
Friday and Saturday 9:00 a.m. to 6:00 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
Kerr Library
Oregon State University
Corvallis, OR 97331-4905
(503) 737-0123
Monday-Friday 7:45 a.m. to 12:00 midnight,
Saturday and Sunday 10:00 a.m. to 12:00 midnight,
Summer Hours:
Monday- Friday 7:45 a.m. to 9:00 p.m.,
Saturday 10:00 a.m. to 5:00 p.m.,
Sunday 10:00 to 9:00 p.m.
Branttord Price Millar Library
Portland State University
934 S.W. Hanison
Portand,OR 97201
(503)725-4617
Monday-Thursday 8:00 a.m. to 12:00 midnight
Friday 8:00 a.m. tO 10:00 p.m.,
Saturday 10:00 a.m. to 10:00 p.m.,

Sunday 11:00 a.m. to 12:00 midnight
Pattee Library
Pennsylvania State University
University Park, PA 16601
(814)865-2112
School Hours:
Monday-Thursday 8:00 a.m. to 12:00 midnight.
Friday 8:00 a.m. to 10:00 p.m.,
Saturday 8:00 a.m. to 9:00 p.m.,
Sunday 1:00 p.m. to 12:00 midnight.
Summer Hours:
Monday-Thursday 7:45 a.m. to 10:00 p.m.,
Friday 7:45 a.m. to 9:00 p.m.,
Saturday 6:00 a.m. to 9:00 p.m.,
Sunday 1:00 p.m. to 10:00 p.m.
Narragansett Public Library
35 Kingston Road
Nanagansett, RI 02882
(401) 789-9507
Monday 10:00 a.m. to 9:00 p.m.,
Tuesday-Friday 10:00 a.m. to 6:00 p.m.,
Saturday 10:00 a.m. to 5:00 p.m.
(Saturday hours September to May only)
Charleston County Main Library
404 King Street
Charleston. SC 29403
(803)723-1645
Monday-Thursday 9:30 a.m. to 9:00 p.m.,
Friday-Saturday 9:30 a.m. to 6:00 p.m.,
Sunday 2:00 p.m. to 5:00 p.m.
South Carolina State Library
1500 Senate Street
Columbia, SC 29201
(803) 734-8666
Monday-Friday 8:15 a.m. to 5:30 p.m.,
Saturday 9:00 a.m. to 1:00 p.m.
Clinton Public Library
116 South Hicks Street
Clinton, TN 37716
(615)457-0519
Monday and Thursday 10:00 a.m. to 8:00 p.m.,
Tuesday, Wednesday, Friday, and
Saturday 10:00 a.m. to 5:00 p.m.
Harriman Public Library
601 Walden Street
Harriman. TN 37748
(615)882-3195
Monday-Thursday 9:00 a.m. to 5:00 p.m.,
Friday and Saturday 9:00 a.m. to 1:00 p.m.
Kingston Public Library
1000 Bradford Way Building #3
Kingston, TN 37763
(615)376-9905
Monday and Thursday 10:00 a.m. to 7:30 p.m.,
Tuesday Wednesday, and Friday 10:00 a.m. to 5:30 p.m.,
Saturday 10:00 a.m. to 2:00 p.m.
Lawson McGhee Public Libmry
500 West Church Avenue
Knoxville, TN 37902
(615)544-5750
Monday-Thursday 9:00 a.m. to 8:30 p.m.,
Friday 9:00 a.m. to 5:30 p.m.,
Saturday and Sunday 1:00 p.m. to 5:00 p.m.
Oak Ridge Public Library

Civic Center
Oak Ridge, TN 37830
(615)482-8455
Monday-Thursday 10:00 a.m. to 9:00 p.m.,
Friday 10:00 a.m. to 6:00 p.m.,
Saturday 9:00 a.m. to 6:00 p.m.,
Sunday 2:00 p.m. to 6:00 p.m.
Oliver Springs Public Library
607 Easterbrook Avenue
Oliver Springs. TN 37840
(615)435-2509
Tuesday-Thursday 2:00 p.m. to 4:00 p.m.,
Saturday 9:00 a.m. to 12:00 midnight
Rockwood Public Library
117 North Front Avenue
Rockwood, TN 37854
(615)354-1281
Monday, Wednesday. Friday, and
Saturday 10:00 a.m. to 5:00 p.m.,
Tuesday and Thursday 10:00 a.m. to 8:00 p.m.
General Library
University ot Texas
PCL 2.402X
Austin, TX 78713
(512)495-4262
School Hours:
Monday-Friday 8:00 a.m. to 12:00 midnight,
Saturday 9:00 a.m. to 12:00 midnight,
Sunday 12:00 noon to 12:00 midnight,
Summer Hours:
Monday-Friday 8:00 a.m. to 10:00 p.m.,
Saturday 9:00 a.m. to 10:00 p.m.,
Sunday 12:00 noon to 10:00 p.m.
Evans Library
Texas A&M University, MS 5000
College Station, TX 77843-5000
(409) 845-8850
School Hours:
Monday-Thursday 7:00 a.m. to 12:00 midnight.
Friday 7:00 a.m. to 7:00 p.m.,
Saturday 9:00 a.m. to 5:00 p.m.,
Sunday 1:00 p.m. to 11:00 p.m.,
Summer Hours:
Monday-Thursday 7:00 a.m. to 11:00 p.m.,
Friday 7:00 a.m. to 7:00 p.m.,
Saturday 9:00 a.m. to 5:00 p.m.,
Sunday 1:00 p.m. to 11:00 p.m.
Marriot Library
University of Utah
Salt Lake City, UT 84112
(801) 581-8394
School Hours:
Monday-Thursday 7:00 a.m. to 11:00 p.m.,
Friday 7:00 a.m. to 8:00 p.m.,
Saturday 9:00 a.m. to 8:00 p.m.,
Sunday 11:00 a.m. to 11:00 p.m.
Summers Hours:
Monday-Thursday 7:00 a.m. to 10:00 p.m.,
Friday 7:00 a.m. to 5:00 p.m.,
Saturday 9:00 a.m. to 5:00 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.
Alderman Library
University of Virginia
Charlottesville, VA 22903-2496

(804) 924-3133
School Hours:
Monday-Thursday 8:00 a.m. to 12:00 midnight,
Friday 8:00 a.m. 10 9:00 p.m.,
Saturday 9:00 a.m. to 6:00 p.m.,
Sunday 12:00 noon to 12:00 midnight,
Summer Hours:
Monday-Thursday 8:00 a.m. to 10:00 p.m.,
Friday 8:00 a.m. to 6:00 p.m.,
Saturday 9:00 a.m. to 6:00 p.m.,
Sunday 2:00 p.m. to 10:00 p.m.
Owen Science & Engineering Library
Washington State University
Pullman, WA 99164-3200
(509)335-4181
School Hours:
Monday-Thursday 8:00 a.m. to 11:00 p.m.,
Friday 8:00 a.m. to 9:00 p.m.,
Saturday 12:00 noon to 9:00 p.m.,
Sunday 12:00 noon to 11:00 p.m.,
Summer Hours:
Monday and Thursday 7:30 a.m. to 11:00 p.m.,
Tuesday, Wednesday, and Friday 7:30 a.m. to 6:00 p.m.,
Saturday and Sunday 12:00 noon to 6:00p.m.
Foley Center
Gonzaga University
East 502 BOone Avenue
Spokane, WA 99258
(509) 3284220, extension 3125
School Hours:
Monday-Thursday 8:00 a.m. to 12:00 midnight,
Friday and Saturday 8:00 a.m. to 9:00 p.m.,
Sunday 11:00 a.m. to 12:00 midnight,
Summer Hours:
Monday-Friday 8:00 a.m. to 5:00 p.m.,
Saturday 10:00 a.m. to 5:00 p.m.,
Sunday 1:00 p.m. to 7:00 p.m.
Madison Public Library
201 W. Mifflin Street
Madison, WI 53703
(608) 266-6350
Monday-Wednesday 8:30 a.m. to 9:00 p.m.,
Thursday and Friday 8:30 a.m. to 5:30 p.m.,
Saturday 9:00 a.m. to 5:30 p.m.
Teton County Public Library
320 South King Street
Jackson, WY 83001
(307) 733-2184
Monday, Wednesday and Friday 10:00 a.m. to 5:30 p.m.,
Tuesday and Thursday 10:00 a.m. to 9:00 p.m.,
Saturday 10:00 a.m. to 5:00 p.m.,
Sunday 1:00 p.m. to 5:00 p.m.

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1. PURPOSE AND NEED FOR AGENCY ACTION

This section identifies the proposed action and the purpose and need for that

1.1 Proposed Action

To fullfill near-term goals, the U.S. Department of Energy (DOE) proposes the

- to develop appropriate facilities and technologies to manage waste and expected at the Idaho National Engineering Laboratory (INEL) in southea the next ten years
- to more fully integrate all environmental restoration and waste managem INEL to achieve cost and operational efficiencies, including pollution minimization
- to responsibly manage environmental impacts from environmental restorat management activities.

1.2 Purpose and Need

DOE is responsible by law for spent nuclear fuel management, waste management environmental restoration at the INEL. Under the Atomic Energy Act of 1954, as ame responsible for managing certain spent nuclear fuels. Under the Comprehensive Envi Compensation, and Liability Act of 1980, as amended; the Resource Conservation and 1976; the Federal Facility Compliance Act of 1992; and other laws, DOE is responsib and controlling hazardous substances in a manner that protects human health and the committed to comply with these and all other applicable Federal and State laws and and interagency agreements governing spent nuclear fuel and environmental restorati management.

Over the past 50 years, DOE activities have resulted in the accumulation of s requiring treatment, storage, and disposal; and sites requiring remediation. To be responsibilities, DOE needs to develop and implement a program for spent nuclear fu environmental restoration and waste management activities at the INEL. To establis program [for the foreseeable future, focused on the near term (the next ten years)] specific decisions that would accomplish three major goals: (a) support research an the INEL; (b) comply with legal requirements governing spent nuclear fuel, environm waste management; and (c) treat, store, and dispose of waste, manage spent nuclear environmental restoration activities at the INEL in an environmentally sound manner

As part of the proposed action, DOE needs to decide upon the appropriate

- Strategy for implementing at the INEL, DOE's national spent nuclear fue regarding transportation, receipt, processing, and storage of spent nuc
- Strategy for implementing at the INEL, DOE's environmental restoration management decisions.
- Cleanup strategy for actions required by the Comprehensive Environmenta Compensation, and Liability Act of 1980, as amended, and the Federal Fa and Consent Order of 1991.
- Capabilities, facilities, research and development, and technologies fo disposing of each waste type at the INEL.
- Actions regarding certain projects at the INEL, such as treatment techn bearing and high-level wastes, storage capacity for spent nuclear fuels technologies for other radioactive and mixed wastes.

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2. BACKGROUND

2.1 Environmental Impact Statement Scope and Overview

DOE is currently in the process of making major decisions regarding its futur national level and specifically at the Idaho National Engineering Laboratory (INEL) Environmental Impact Statement (EIS) has been prepared to evaluate environmental im implementing DOE's national decisions at the INEL. This is done by evaluating the components of the programs (for example, waste stream management, remediation, deco decommissioning; see Appendix E, Glossary, for a definition of these terms), and va DOE intends to decide whether or not to proceed with proposed site-specific project the alternatives for management of waste streams and spent nuclear fuel. The propo discussed in Chapter 3, Alternatives, and Appendix C, Information Supporting the Al of analyses are in Chapter 5, Environmental Consequences.

At the national level, two Programmatic EISs are being prepared to address de overall direction of DOE's Spent Nuclear Fuel (SNF) and Waste Management (WM) Progr "Programmatic EIS" is a term for an EIS that covers matters of broad scope, such as agency program that includes a variety of interrelated activities. A Programmatic subsequent analyses of narrower scope that incorporate by reference the general dis Programmatic EIS. Volume 1 of this EIS discusses the environmental consequences of nuclear fuel decisions; the Waste Management Programmatic EIS (draft scheduled to b and agency review by mid-1995) will address the environmental consequences of DOE's management decisions. These national decisions will have potential environmental c because they will require developing a site-specific strategy to implement the nati

Volume 3 summarizes the comments that DOE received on the EIS during the publ period and provides responses to those comments. Volume 3 also includes discussion public comments resulted in changes to the EIS and describes how to find specific c responses.

The foreseeable strategy for environmental restoration and waste management (INEL will include waste avoidance and minimization. Environmental restoration at t into the future, but expected future land use will influence methods of remediation generated. Also, administering spent nuclear fuel and ER&WM activities at the INEL is expected to require new storage, characterization, retrieval, treatment, and dis minimization and avoidance projects. Technology development to support these proje improvements, and a continuing active environmental monitoring program will also be

2.1.1 Environmental Impact Statement Content

The SNF and INEL ER&WM EIS has been prepared in accordance with the National Policy Act of 1969. The content of this document follows recommendations for the c the Council on Environmental Quality and DOE regulations implementing the National Act. (Chapter 7, Consultations and Environmental Requirements, gives more details environmental statutes and regulations.)

This volume examines potential environmental impacts associated with four alt managing waste, spent nuclear fuel, and related materials at the INEL (see Chapter Alternative A (No Action) entails continued operation and maintenance of current fa with only minor changes to some facilities. Alternative B (Ten-Year Plan) entails INEL of the existing ten-year plan to comply with regulatory requirements, protect support the INEL mission. Alternative C (Minimum Treatment, Storage, and Disposal) activities by transporting spent nuclear fuel and wastes to other sites for treatme characterization, storage, or disposal (or disposition). Alternative D (Maximum Tr Disposal) would involve receiving and managing the maximum potential amount of spen waste at the INEL from other sites.

2.1.2 Environmental Impact Statement Scope

This section discusses the scope of the EIS as it relates to INEL's ER&WM and activities and the timeframe for decisions supported by this EIS. Activities addre include those that have produced and continue to produce radioactive (high-level,

---

DEFINITIONS

Alpha Low-Level Waste: Waste that was previously classified as transuranic waste bu concentration lowere than the currently established limit for transuranic waste. Al requires additional controls and special handling. This waste stream cannot be acce disposal under the current waste acceptance criteria; therefore, it is special-case

Environmental Restoration: Cleanup and restoration of sites and decontamination and facilities contaminated with radioactive and/or hazardous substances during past pr releases, or disposal activities.

Greater-Than-Class-C Waste: Low-level radioactive waste that is generated by the co and that exceeds U.S. Nuclear Regulatory Commission concentration limits for Class- waste as specified in 10 CFR 61. DOE is responsible for the disposal of greater-tha from DOE nondefense programs.

Hazardous Waste: Under the Resource Conservation and Recovery Act, a solid waste, o of solid wastes, which because of its quantity, concentration, or physical, chemica characteristics may (a) cause or significantly contribute to an increase in mortali in serious irreversible, or incapacitating reversible, illness or (b) pose a substa or potential hazard to human health or the environment when improperly treated, sto disposed of, or otherwise managed. Source, special nuclear material, and by-product as defined by the Atomic Energy Act, are specifically excluded from the definition

High-Level Waste: The highly radioactive waste material that results from the repro fuel, including liquid waste produced directly from the liquid that contains a comb and fission product nuclides in quantities that require permanent isolation. High-l include other highly radioactive material that the U.S. Nuclear Regulatory Commissi with existing law, determines by rule requires permanent isolation.

INEL Industrial Waste: Material that is not subject to Resource Conservation and Re C or Atomic Energy Act regulation. It is generated by manufacturing or industrial p waste is also known as solid waste and is regulated by the Resource Conservation an D.

Low-Level Waste: Waste that contains radioactivity and is not classified as high-le waste, and spent nuclear fuel. Test specimens of fissionable material irradiated fo development only, and not for the production of power or plutonium, may be classifi provided the concentration of transuranics is less than 100 nanocuries per gram of

Mixed Waste: Waste that contains both hazardous waste under the Resource Conservati and source, special nuclear , or by-product material subject to the Atomic Energy A (42 USC 2011, et seq.).

Radioactive Waste: Waste that is managed for its radioactive content.

Special-Case Waste: Waste that is owned or generated by DOE that does not fit into plans developed for the major radioactive waste types.

Spent Nuclear Fuel: Fuel that has been withdrawn from a nuclear reactor following i constituent elements of which have not been separated. For the purposes of this EIS fuel also includes uranium/neptunium target materials, blanket subassemblies, piece of fuel, and debris.

Transuranic Waste: Waste containing more than 100 nanocuries of alpha-emitting tran with half-lives greater than 20 years, per gram of waste, except for (a) high-level (b) waste that DOE has determined, with the concurrence of the Administrator of the Protection Agency, does not need the degree fo isolation required by 40 CFR 191, or the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case accordance with 10 CFR 61.

Waste Management: The planning, coordination, and direction of those functions rela generation, handling, treatment, storage, transportation, and disposal of waste, as as associated surveillance and maintenance activities.

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transuranic, low-level, and mixed) wastes, hazardous waste, and INEL industrial was fall outside the scope of the EIS are also identified. This EIS provides the analy Environmental Policy Act for certain projects required to implement the Spent Nucle Programs at the INEL.

2.1.2.1 Environmental Restoration and Waste Management Activities.

Waste
management activities discussed in this EIS are evaluated at both the site-wide (by management) and project-specific levels. For example, the evaluation of the INEL's program addresses site-wide impacts associated with the treatment, storage, and dis by ongoing remediation, nuclear energy, energy research, and defense programs. Exa specific evaluation related to waste management activities at the INEL include eval construct replacement capacity for high-level waste tanks and evaluating the potent consequences of incineration (for example, the Waste Experimental Reduction Facilit

For environmental restoration, potential impacts at the INEL are addressed on level. For example, the EIS evaluates the potential site-wide impacts associated decommissioning and decontamination or dismantling of facilities scheduled for clos specific impacts of activities cannot be specifically quantified at this time, so t evaluated in this EIS. Project-specific impacts of these activities at the INEL wi in the future, as appropriate, as part of Comprehensive Environmental Response, Com Liability Act actions, in accordance with the Federal Facility Agreement and Consen

Environmental restoration and waste management activities cannot be separated environmental restoration is a major waste generator. Waste from environmental res dictate waste management activities.

2.1.2.2 Spent Nuclear Fuel Activities.

This EIS also addresses all INEL activities related to
spent nuclear fuel, except for reactor operations. Specific activities covered by transportation, processing, characterization, storage, and technology for ultimate this EIS addresses spent nuclear fuel decisions for the entire DOE-wide system, whi spent nuclear fuel activities at the INEL.

2.1.2.3 Timeframe.

The Record of Decision supported by Volume 2 of this EIS will determine
how DOE manages its ER&WM and spent nuclear fuel activities at the INEL for the ten 1995 to 2005. Volume 1 of this EIS uses a 40-year (1995-to-2035) timeframe for eva impacts associated with DOE's programmatic spent nuclear fuel decision. The ten-ye Volume 2 for the evaluation of impacts because too much uncertainty exists to estim specific impacts at the INEL beyond the year 2005. However, some projects to be im ten-year timeframe are evaluated in this EIS (for example, the Waste Immobilization because actions taken in the ten-year timeframe may determine whether these other p In addition, it is assumed that any facility constructed or used during the ten-yea decontamination and decommissioning in the future (but outside the ten-year timefra

2.1.2.4 Activities Outside the Environmental Impact Statement Scope.

Various
activities at the INEL fall outside the scope of the EIS and are not addressed in t Volume 2 does not evaluate impacts of operations not associated with the ER&WM and Programs at the INEL. However, some non-ER&WM and nonspent-nuclear-fuel activities appropriate sections when they are relevant to understanding either the affected en are expected to occur at the INEL during the next ten years. Such activities inclu generation of waste to be handled by the ER&WM Program and those activities related utilities, fire protection, emergency preparedness, and security. Potential effect and nonspent-nuclear-fuel activities are included, when appropriate, in the analysi (see Section 5.15, Cumulative Impacts and Impacts from Connected or Similar Actions

2.1.3 Other Related National Environmental Policy Act Documents

DOE currently has a range of National Environmental Policy Act reviews under interrelated with this SNF and INEL ER&WM EIS. Because the scope of spent nuclear includes a wide variety of proposals, multiple National Environmental Policy Act re necessary. Volume 1 of the EIS provides the overall programmatic National Environm review of the management of DOE spent nuclear fuel policies and programs. This vol

provides the site-specific documentation for the INEL. The National Environmental related to ER&WM programs at the INEL are listed in Table 2.1-1. The National Envi documentation specifically related to the management of spent nuclear fuel is discu Volume 1 of this EIS. Discussion in

Table 2.1-1. and National Environmental Policy Act reviews related to the site-spe environmental assessments.

Description of Action
Waste management operations at the Idaho National Engineering Laboratory
Special Isotope Separation Project
Siting, construction, and operation of New Production Reactor capacity
Transportation, receipt, and storage of spent nuclear fuel from the Fort St. Vrain Reactor to the INEL
INEL Federal Aviation Administration Explosive Detection System
Independent Validationa and Verification Program
Test Reactor Area evaporation pond
Expansion of the INEL Research Center
High-Level Waste Tank Farm Replacement Project
Decontamination and selective demolition of Auxiliary Reactor Areas I and II
Low-level and mixed waste processing at the Waste Experimental Reduction Facility
Retrieval and re-storage of Transuranic Storage Area waste at the INEL
INEL Sewer System Upgrade Project
INEL Consolidated Transportation Facility
Waste Characterization Facility
Test Area North Pool Stabilization Project
Replacement of the Radiological and Environmental Sciences Laboratory
Interim action for the cleanup of Pit 9 at the Radioactive Waste Management Complex
Interim action to reduce contamination near the injection well and in the surrounding groundwater at Test Area North at the INEL
Replacement of the Health Physics Instrumentation Laboratory
Continuing operation of the Specific Manufacturing Capability
Process Equipment Waste and Process Waste Liquid Collection Systems at the Idaho Chemical Processing Plant
Argonne National Laboratory-West Waste Handling Facility
Argonne National Laboratory-West Fuel Cycle Facility
INEL new borrow source site
Plasma Hearth Process Project

a. EIS = environmental impact statement.
EA = environmental assessment.
ROD = record of decision.
FONSI = finding of no significant impact.

b. The Environmental Assessment was ruled inadequate by the United States District

c. FONSI issued for line upgrades, but not tank replacement.

the following subsections centers on major reviews with the greatest interrelations EIS.

2.1.3.1 Waste Management Operations, Idaho National Engineering Laboratory Environmental Impact Statement.

In 1977, DOE prepared a Final Environmental Impact Statement (DOE-ID 1977) that evaluated ongoing activities and operations at INEL waste management facilitie SNF and INEL ER&WM EIS supersedes this previous document by providing an updated ba tions and associated environmental impacts for INEL activities since 1977.

2.1.3.2 Waste Management Programmatic Environmental Impact Statement.

Currently in preparation, the Waste Management Programmatic EIS (previously known a Programmatic EIS) is analyzing alternative strategies and policies to maximize effi Waste Management Programs. The SNF and INEL ER&WM EIS (Volume 2) is being coordina Programmatic EIS. The Draft Programmatic EIS is scheduled to be available for publ mid-1995. The analysis in the Programmatic EIS will support DOE complex-wide decis

- Type, size, and number of waste storage, treatment, and disposal facilities n them, including the transportation network
- Proposed action formulating and implementing an integrated Waste Management P
- Alternative configurations for each waste type to provide a framework for sit specific locations.

The alternatives are structured to ensure analysis of the impacts of the mixed wast defined in the Site Treatment Plans developed pursuant to the Federal Facility Comp

2.1.3.3 Tritium Supply and Recycling Environmental Impact Statement.

The Nuclear Weapons Complex Reconfiguration Program has evolved considerably since its original prepare a programmatic EIS was issued in February 1991. DOE has now separated the Complex Reconfiguration EIS into two programmatic EISs: (a) a Tritium Supply and Programmatic EIS (expected completion in November 1995) and (b) a Stockpile Stewar Management Programmatic EIS. In the original Notice of Intent, DOE proposed to rec nuclear weapons complex to be smaller, less diverse, and less expensive to operate. evolved since then for many reasons, but primarily the end of the Cold War. The ta significant reduction in the size of the Nation's stockpile of nuclear weapons and production programs.

The Tritium Supply and Recycling Programmatic EIS will address alternatives a tritium production and the recycling of tritium recovered from weapons retired from is a candidate site for new tritium supply and recycling facilities. The scope of Stewardship and Management Programmatic EIS has yet to be determined, but proposed potentially affect the INEL.

2.1.3.4 Waste Isolation Pilot Plant Environmental Impact Statement.

The Final Supplemental EIS for the Waste Isolation Pilot Plant, the proposed Federal reposito transuranic waste located in Carlsbad, New Mexico, was issued in 1990 to support a a test phase. During the test phase, a limited quantity of waste would have been p Waste Isolation Pilot Plant (WIPP). However, following enactment of the WIPP Land 1992, DOE decided in 1993 not to proceed with the underground test phase but to per with waste, along with numerous other in situ and offsite studies, to demonstrate c Environmental Protection Agency disposal standards (40 CFR 191 Subparts B and C) an Disposal Act. DOE will prepare and issue an additional supplemental EIS at the end support a decision on whether or not to proceed with the disposal phase.

2.1.3.5 Environmental Impact Statement for a Potential Repository at Yucca Mountain for Disposal of High-Level Radioactive (Planned).

The Nuclear Waste Policy Act, as amended, mandated that DOE determine the suitability of the Yucca Mountain, Nevada, first licensed geologic repository for spent nuclear fuel and high-level radioactiv scheduled the Notice of Intent for 1995, and the Record of Decision for the year 20 potential repository site for spent nuclear fuel addressed in this programmatic env statement.

2.1.3.6 Draft Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel.

DOE
proposes to adopt and implement a policy concerning the management of spent nuclear enriched uranium that originated in the U. S. but that would come from foreign rese implementation of this policy would result in foreign research reactor spent nuclea S. marine points of entry and transported overland to DOE sites for storage pending The Foreign Research Reactors Draft EIS is scheduled to be completed in 1995. Alte in this EIS include nonrenewal of the policy; storage sites (Hanford Site, INEL, Sa Ridge Reservation, and Nevada Test Site); transportation from various points of ent technologies.

2.1.3.7 Federal Facility Compliance Act (1992).

For each facility at which DOE generates
or stores mixed waste, the Federal Facility Compliance Act requires DOE to prepare treatment capacities and technologies to treat mixed wastes to the standards promul Environmental Protection Agency. Upon submission of a plan to the appropriate regu requires the recipient to solicit and consider public comments and to approve, appr disapprove the plan within six months.

The Draft Site Treatment Plan reflects the site-specific preferred treatment the State's input and based on existing available information. To the extent possi Treatment Plan identifies specific treatment facilities for treating the mixed wast set forth in the Act. When finalized, the Site Treatment Plan will satisfy DOE's o develop and submit a treatment plan for the INEL.

2.1.4 Scoping Process

According to the National Environmental Policy Act, the purpose of the scopin determine, in general, the issues to be addressed in an EIS and to identify those s depth analysis.

For the SNF and INEL ER&WM EIS, the scoping process began on October 22, 1990 published in the Federal Register its Notice of Intent to prepare a Programmatic EI ER&WM activities (including spent nuclear fuel) at all DOE facilities (FR 1990). P solicited, and DOE released a Draft Implementation Plan to develop the EIS. Follow Draft Plan, a second comment period was conducted via six regional workshops. In t public was invited to express opinions and ask questions about the Plan. On Octobe lished a Notice of Intent to prepare a site-specific EIS on its ER&WM Programs (inc fuel) at the INEL (FR 1992). Scoping meetings were conducted in five different loc Idaho. DOE made numerous announcements in local newspapers and other media to aler these meetings. The meetings provided both formal and informal ways for the public and obtain information about the intended scope of analysis. DOE also conducted nu briefings with representatives of State and local governments, elected officials, a Indian Tribes. This was an effort to provide early notice and information about th briefings, participants provided input on their concerns and issues.

After public comments were taken and a plan was developed for preparing the E issued that expanded the scope of the EIS. On June 28, 1993, as an outgrowth of ci DOE, the State of Idaho, and other parties, the U.S District Court for the District prepare a comprehensive EIS for spent nuclear fuel management. This court order ad pare an EIS for the INEL that examines alternatives to the transport, receipt, proc nuclear fuel at the INEL site. Because of the quantities and types of fuel current evaluation of these activities required assessing similar activities throughout the decided to expand its site-specific EIS for the INEL to incorporate the programmat management of spent nuclear fuel within the DOE complex, previously part of DOE's W Programmatic EIS (previously known as the ER&WM Programmatic EIS). This expanded d SNF and INEL ER&WM EIS.

To allow the public an opportunity to comment on the scope of the SNF and INE DOE published a Notice of Opportunity on September 3, 1993. DOE used the public an ments received during the scoping comment period to identify major issues and to de natives that are evaluated in Volume 2. DOE's responses to comments and issues rai ment period are given in the Implementation Plan and its amendments for this EIS (D

During the scoping comment periods, DOE received a total of 970 comments addr

issues. The issues can be grouped into three types: technical issues, programmati and other issues. Figure 2.1-1 summarizes the 3,128 issues applying to the site-sp this volume.

The greatest number of issues raised during scoping were statements in opposi fuel and waste being managed in Idaho. Commentors were concerned about several asp fuel and about DOE siting criteria. The most frequently raised technical issue for materials and waste management. Other frequent comments focused on the National En Act process, DOE credibility, the range of alternatives, water quality, and the exp EIS. In response to these comments, DOE decided to expand the number of alternativ 2 from two to four (see Chapter 3).

Reflecting continuing DOE and public concern, the EIS process emphasized data analyses of potential impacts to water use and water quality. Other areas emphasiz future waste streams, hazardous material inventories, impacts to air quality, accid transportation analyses.

2.1.5 Response to Public Comments

Volume 3, Response to Public Comments, was added to this EIS to fully address public comments. In addition, DOE considered public comments, along with other fac programmatic need, technical feasibility, and cost, in arriving at DOE's preferred public comment period for the Draft EIS, more than 1,430 individuals, agencies, and DOE with comments. A broad spectrum of private citizens; businesses; local, State, Native American tribes; and public interest groups are represented within this volu Comments were received from all affected DOE and shipyard communities.

Volume 3 summarizes the comments on the EIS received by DOE during the public and provides responses to those comments. In addition, Volume 3 explains how publi the selection of the preferred alternatives, discusses the extent to which public

<u>**Figure 2.1-1. Comments and issues raised during the comment periods.**</u> comments resu responses in this volume.

Responses to comments consist of two parts. The first part summarizes the co second part responds to the comment(s). Identical or similar comment(s) were frequ than one commentor and, in such cases, DOE grouped the comments and prepared a sing group. This summarization was also appropriate due to the large volume of comments

In compliance with National Environmental Policy Act and Council on Environme regulations, public comments on the Draft EIS were assessed and considered both ind collectively by DOE and the Navy. Some comments resulted in modifications in the E why comments did not warrant further response. Most comments not requiring a chang in a response to correct factual misinterpretations, to explain or communicate gove the scope of the EIS, to explain the relationship of the EIS to other related polic EIS, to explain the relationship of the EIS to other related National Environmental to refer commentors to information in the EIS, to answer technical questions, or to issues. The Record of Decision will include the decision made by the Secretary of consider public comments on the Draft EIS.

2.1.5.1 How the Department of Energy Considered Public Comments in the National Environmental Policy Act Process.

As required in the Council on Environmental Quality regulations [40 CFR 1502.14(e)], DOE's preferred alternatives are identified in the Final EIS. for Volumes 1 and 2 were identified based on the consideration of environmental imp compliance, DOE and spent nuclear fuel programmatic missions, public issues and con security and defense, cost, and DOE policy. Public input considered in the decisio alternatives selection process included concerns, desires, and opinions regarding t the EIS and expectations of DOE in making the management decisions on complex-wide nuclear fuel management and environmental restoration and waste management programs Public input contributed to the development of performance factors, defined as desi characteristics that measure the relative acceptability of alternatives, which were preferred alternatives. The candidate preferred alternatives were then evaluated a and nontechnical sensitivities, including public perception of environmental impact preferences, implementation flexibility, regulatory risk, spent nuclear fuel proces justice, potential resistance to implementation, and fairness. DOE's preferred alt

consensus that spent nuclear fuel should be actively managed in preparation for ult addition, DOE's preferred alternative supports the implementation of a path forward disposition of spent nuclear fuel, a significant issue raised by the public. The E alternatives, will be considered by the Secretary of Energy, along with other facto to be documented in a formal Record of Decision.

2.1.5.2 Changes to the Environmental Impact Statement Resulting from Public Comment.

A major purpose of the National Environmental Policy Act is to promote efforts that prevent or eliminate damage to the environment by ensuring informed decisionmaking actions significantly affecting the quality of the human environment. Consideratio the Draft EIS helps to ensure that the EIS is an adequate decisionmaking tool; acco enhanced, as appropriate, in response to public comments. While a number of specif were raised by commentors, none of the issues or concerns identified new reasonable assessment or resulted in significant change in the results of the analysis of the consequences.

Based on review of public comments, coupled with the consultations held with as well as State and tribal governments, the main EIS enhancements include the foll

- Seismic and water resources discussions were reviewed, clarified, and e alternative sites, and current data and analyses were added to Volumes appropriate. A discussion of potential accidents caused by a common in The option of stabilizing some of DOE's spent nuclear fuel (specificall by processing it at available facilities located overseas was added, th processing options discussed in the EIS. An analysis of barge transpor the EIS, with respect to the option of shipping N-Reactor fuel to a shi overseas processing, as well as to support the potential transport of B Laboratory spent nuclear fuel to another site, as appropriate. In addi shipboard fires was added, primarily in response to comments related to nuclear fuel containing uranium of U. S. origin from foreign research r

- In Volume 2 of the EIS, the air quality analysis was revised to upgrade conditions and impacts of alternatives in terms of the amount of Preven Deterioration increment consumed, thus updating the baseline conditions INEL. Additionally, the Waste Experimental Reduction Facility project enhanced and clarified. The EIS was also revised to reflect current pr employment, including the projected downsizing of the INEL due to contr consolidation.

- In response to public comments, a brief summary of the results of a sep the costs of the various alternatives was added to the EIS, although th performed independently of the EIS for additional purposes. The discus regarding the management of Fort St. Vrain spent nuclear fuel currently has been expanded. As committed to in the Draft EIS, the evaluation an environmental justice has been expanded in both Volumes 1 and 2 of the was based on interim DOE guidance in the absence of interagency policy reflects limited public comments received regarding environmental justi with the commenting Native American tribes is reflected in the environm analysis, as well as in the various sections of the EIS, as appropriate

- Other enhancements include a clarification that potential shipment of s containing uranium of U. S. origin from foreign research reactors consis estimate of 22 metric tons (24 tons) of heavy metal. In addition, as a comments, Volume 1 of the EIS was enhanced to clarify the relationship DOE National Environmental Policy Act actions and this EIS. Likewise, between the EIS and the Spent Fuel Vulnerability Action Plans was clari With respect to the naval spent nuclear fuel, Appendix D of Volume 1 wa fully explain the import of naval spent nuclear fuel and to discuss pot terrorist attacks at naval shipyards.

2.2 Idaho National Engineering Laboratory Overview

2.2.1 General Site Description

The INEL site occupies about 230,000 hectares (890 square miles) of dry, cool Idaho. It is located in the Eastern Snake River Plain (Figure 2.2-1), southwest of [211 kilometers (132 miles)]; north of Salt Lake City, Utah [374 kilometers (234 mi Idaho [317 kilometers (198 miles)]. The INEL site lies west of the Snake River and forests and recreational areas. Population centers near the site are Idaho Falls t southeast, Pocatello to the south-southeast, and Arco to the west.

2.2.2 Organization and Administration

The INEL is a government-owned site managed by DOE and administered by three offices: (a) the Idaho Operations Office (DOE-ID); (b) the Idaho Branch Office of (IBO); and (c) the Chicago Operations Office (DOE-CH). Lockheed Idaho Technologies DOE-ID's activities at the INEL. Westinghouse Electric Corporation (WEC) supports Office of the Pittsburgh Naval Reactors, and Argonne National Laboratory (ANL) supp INEL.

As INEL Site Manager, DOE-ID is responsible for site services, environmental management, and overall safety and emergency planning functions. Thus, DOE-ID is r ER&WM activities. The INEL ER&WM Program is under the DOE Headquarters Office of E Management (EM) established in November 1989. These ER&WM activities are defined a within the regulatory environment described in Section 2.2.11, Regulatory Framework Restoration and Waste Management, and Chapter 7, Consultations and Environmental Re

Figure 2.2-1 Location of the Idaho National Engineering Laboratory (INEL) in south

2.2.3 Historic and Current Mission

The INEL has long provided research and engineering support to the military, government segments of the U. S. economy. Specific activities on the INEL have shi changing national needs. These shifts included changing from the application of nu commercial and naval uses, to spent nuclear fuel reprocessing and waste storage, to science and technology related to advancing and improving remediation and waste man and applying the knowledge gained from the INEL experience to other national needs.

Despite the long history and different operations carried out at the INEL, mo been affected by direct land disturbances. One result of the activities conducted of the INEL is the creation of nine major facility areas. These areas and their tr encompass the majority of industrial development and disturbances on the INEL site, percent of the total land area of the site. Public roads and utility rights of way additional 6 percent of the total land area of the site.

2.2.3.1 History of the Implementation of the INEL Mission.

During World War II, the U. S. Navy and the U. S. Army Air Corps used a portion of the present site as a gunnery range. In 1949, the site established as the National Reactor Testing Station. Over time, 52 different reacto of-a-kind facilities, were built here. Most of these reactors were phased out or d research missions were completed, but several are currently operating or operable (Major Facility Areas). Highlights of this program include the Experimental Breeder National Historic Landmark, which produced the first usable electrical power from n and the Boiling Water Reactor Experiment-III, which, in 1955, was the first reactor

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SITE HISTORY
1949: Formally Established
1950a: Test of first nuclear submarine reactor
1951: Site reactor first to generate electricity from nuclear fission
1952: Radioactive Waste Management Complex opened
1953: Idaho Chemical Processing Plant began operation
1955: Site reactor powered CIty of Arco
1970: Transuranic waste no longer buried
1974: Site became Idaho National Engineering Laboratory

(INEL)
1975: INEL designated National Environmental Research Park
1987: Consent Order and Compliance Agreement signed
1989: INEL on U.S. Environmental Protection Agency's National Priorities List
1991: Federal Facility Agreement and Consent Order signed
1992: Decision to phase out reprocessing at the Idaho Chemical Processing Plant

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Beginning in the 1950s, the Naval Reactors Facility tested and operated proto reactors for submarines and surface ships. In addition, this facility was a traini ships. The Navy discontinued training on the Large Ship Reactor (A1W) facility at Facility in 1994 and has announced the 1995 closure of the Submarine Reactor (S5G)

Another effort supporting U. S. nuclear programs was reprocessing spent nucle uranium at the Idaho Chemical Processing Plant. Reprocessing was begun in 1953 and in April 1992.

Between 1954 and 1989, defense-related nuclear waste was transported to the I from the Rocky Flats Plant in Colorado. Until 1970, this mostly transuranic waste and trenches at the Radioactive Waste Management Complex. After 1970, transuranic above ground in specially designed interim storage facilities.

Since the mid-1970s, one of the specific purposes of the INEL has been to adv technology related to environmental characterization and restoration of sites conta operations. In 1974, the National Reactor Testing Station was renamed the Idaho Na Laboratory to reflect its broader mission, which now includes research and engineer well as nuclear, energy programs. One year later, the INEL was designated as a Nat Research Park, one of seven in the nation. These parks were established by DOE to areas for research and education in the environmental sciences and to demonstrate t technology development and use with environmental quality. The INEL site provides where scientists can study changes in the natural environment caused by human activ continued to further emphasize the mission of developing restoration and waste mana to implement the requirements from the signing of the Consent Order and Compliance and, since the listing of the INEL on the National Priorities List, the Federal Fac Order in 1991, which superseded the Consent Order and Compliance Agreement.

2.2.3.2 Current Mission.

The current INEL mission is to develop, demonstrate, and deploy advanced engineering technology and systems to improve national competitiveness and production and use of energy more efficient, and to improve the quality of life and primary emphasis at the INEL include waste management and minimization, environment restoration, energy efficiency, renewable energy, national security and defense, nu advanced technology and methods. The ER&WM Program has DOE's top priority at the I

Specific aspects of the Environmental Restoration Program mission are to (a) sites where there are known or suspected releases of harmful substances into the en manage contaminated surplus nuclear facilities as they are decommissioned. Aspects Management Program mission are to (a) protect the safety of INEL employees, the pub environment in the design, construction, maintenance, and operation of INEL treatme facilities, and (b) operate these facilities in a manner that is cost-effective, is with regulations, and is publicly acceptable. While fulfilling these missions, DOE all INEL facilities into compliance with local, State, and Federal regulations.

2.2.4 Major Facility Areas

Mission activities including those associated with ER&WM occur primarily in n areas that were developed since the INEL site was established. This section descri at the INEL site (see Figure 2.2-2) and the Idaho Falls operations facilities. As facility areas are located in the southwestern portion of the site. These faciliti implementing both historic and current missions.

The specific facilities described in this section include both those where sp ER&WM activities occur (proposed actions evaluated in this EIS) and where nonspent- ER&WM activities occur (actions generally not evaluated in this EIS with the except would generate). Information on Spent Nuclear Fuel and ER&WM Program activities is Sections 2.2.5 (Spent Nuclear Fuel), 2.2.6 (Environmental Restoration), 2.2.7 (Wast

2.2.10 (Activities Not Directly Related to Spent Nuclear Fuel or Environmental Rest Management).

Figure 2.2-2. Major facility areas located at the Idaho National Engineering Labor Chemical Processing Plant, Central Facilities Area, Power Burst Facility, Experimen I/Boiling Water Reactor Experiment, Radioactive Waste Management Complex, Naval Rea Argonne National Laboratory-West. In addition to the major facility areas located support facilities are located in the City of Idaho Falls. The facilities at the s facilities in Idaho Falls make up the INEL.

2.2.4.1 Test Area North.

The Test Area North is located in the northern portion of the INEL site on State Highway 33 about 24 kilometers (15 miles) east of the town of Howe and 19 west of the town of Mud Lake. This facility area covers a total area of about 80 h

Test Area North's original purpose was to house the Aircraft Nuclear Propulsi discontinued project to develop nuclear-powered aircraft. Later, this facility are Test Facility, which was used in light-water-reactor accident testing. Structures operations still exist at Test Area North. Test Area North's current purpose inclu irradiated material, supporting energy research and defense programs (including pro demonstrating dry cask storage of spent nuclear fuel, performing flow tests to supp and storing spent nuclear fuel.

Test Area North's four key facilities related to spent nuclear fuel and ER&WM Test Facility, which was used for the Aircraft Nuclear Propulsion Project, has been consists of seven vacant buildings; the Technical Support Facility, which is used f radioactive materials, contains the Process Experimental Pilot Plant, and consists administrative, service, and maintenance functions; the Water Reactor Research Test for reactor flow experiments, includes the Thermal-Hydraulic Experimental Facility Building, and contains eight structures; and the Containment Test Facility, formerl Facility, which houses the Specific Manufacturing Capability project that produces Army and consists of 34 structures.

2.2.4.2 Test Reactor Area.

The Test Reactor Area covers about 40 hectares (100 acres) and is located in the southwestern portion of the INEL site. This facility area contains which were built as early as 1952. The Test Reactor Area's current purpose is to s on materials, fuels, and equipment and to perform chemistry and physics experiments Area's major facilities include three reactors, four low-power reactors, and a hot highly radioactive materials. The three reactors are the Materials Test Reactor, t and the Advanced Test Reactor. The Materials Test Reactor and Engineering Test Rea deactivated and are planned for decontamination and decommissioning. The Advanced operating. It is used for materials testing under reactor conditions and for produ medicine, research, and industry.

The four low-power reactors used for criticality measurements are the Enginee Critical Facility (in decommissioning and decontamination), the Advanced Test React line), the Advanced Reactivity Measurement Facility (shutdown status), and the Coup Measurement Facility (shutdown status).

2.2.4.3 Idaho Chemical Processing Plant.

The Idaho Chemical Processing Plant covers approximately 100 hectares (250 acres) and contains over 150 buildings. Twenty-one are planned for construction. The Idaho Chemical Processing Plant is located near the southwestern part of the INEL site.

The Idaho Chemical Processing Plant's original purpose was to function as a o reprocessing facility for government-owned nuclear fuels from research and defense recovered uranium from spent nuclear fuel so that it could be reused.

The Idaho Chemical Processing Plant's current purpose is to

- Receive and store DOE-assigned spent nuclear fuels

- Prepare high-level liquid and solid waste for disposition in a reposito

- Develop technologies for the disposition of spent nuclear fuel, sodium-high-level waste
- Develop and apply technologies to minimize waste generation and manage hazardous wastes.

Major operating facilities at the Idaho Chemical Processing Plant include bot facilities. Storage facilities provide spent nuclear fuel storage (pools and dry s waste) storage (in bins), and liquid high-level waste storage (in underground tanks include a waste solidification facility for treatment of liquid high-level waste an Waste Calcining Facility) and an evaporator used to concentrate low-level waste and Another treatment facility prevents radioactive waste from being discharged to the recovers nitric acid for reuse. Mixed and low-level waste is handled and stored in Radioactive Mixed Waste Staging Area and the Hazardous Chemical/Radioactive Waste F operating facilities include process development and robotics laboratories.

2.2.4.4 Central Facilities Area.

The Central Facilities Area encompasses about 220 hectares (550 acres) in the southwestern portion of the INEL site and contains over 80 build Facilities Area's purpose is to provide technical and support services for the INEL include environmental monitoring and calibration laboratories, communication system protection, medical services, warehouses, a cafeteria, vehicle and equipment pools, bus operations.

Major Central Facilities Area facilities include two waste operations facilit Storage Facility and the INEL Landfill Complex. The Hazardous Waste Storage Facili hazardous wastes pending transport to a commercial, offsite, U. S. Environmental Pr permitted treatment and disposal site. The Landfill Complex is a facility used to waste.

2.2.4.5 Power Burst Facility.

The Power Burst Facility is located in a 280-hectare (700-acre) area in the southernmost portion of the INEL site off U. S. Highway 20. The origin Burst Facility was for Special Power Excursion Reactor Tests (I-IV), which were sev nuclear fuels and materials used in reactors. This facility is planned for use in program. The reactor support facilities are being used for waste management-relate development of radioactive waste volume-reduction techniques and waste immobilizati

The Power Burst Facility has four major facilities: the Waste Experimental R which was designed to treat low-level and mixed low-level waste for volume reductio Resource Conservation and Recovery Act hazardous waste; the Mixed Waste Storage Fac provides temporary storage for mixed low-level waste; the Waste Experimental Reduct Storage Building, which stores waste awaiting treatment in the Waste Experimental R augments the capacity of the Mixed Waste Storage Facility; and the Waste Engineerin Facility, which is used for treatment, decontamination, and technology development

Near the Power Burst Facility area is the Auxiliary Reactor Area, which encom

The Auxiliary Reactor Area's original purpose was to test portable power reac Army. The program has been phased out, and all reactors have been removed or disma buildings at the Auxiliary Reactor Area have been identified for decontamination an buildings in the area are vacant except for intermittent small-scale testing progra

2.2.4.6 Experimental Breeder Reactor-I/Boiling Water Reactor Experiment.

This facility area is located in the southwestern portion of the INEL site and encompass acres). This facility area originally housed the Experimental Breeder Reactor-I, w reactor to generate usable amounts of electricity. This facility is a National His Heat Transfer Reactor Experiment Test engine assemblies, which were operated as par Nuclear Propulsion Program. Also nearby is the Boiling Water Reactor Experiment ar originally included five separate experimental reactors, which are not being used a

decontaminated and decommissioned.

2.2.4.7 Radioactive Waste Management Complex.

This facility area is the most
southwestern of all areas at the INEL site. It contains over 35 buildings and cove
acres).
The original purpose of the Radioactive Waste Management Complex was to dispo
radioactive wastes generated at the INEL site and defense wastes (mostly transurani
The current purpose of the facility is to provide waste management for interi
waste and disposal of low-level waste. It also supports research and development p
treatment and interim storage of transuranic waste, low-level waste disposal, burie
technologies, and environmental remediation.
At the Radioactive Waste Management Complex, two main areas, including severa
are operating: the Transuranic Storage Area and the Subsurface Disposal Area. The
Area is dedicated to the management of transuranic waste, including interim storage
technology development, and future transport to the Waste Isolation Pilot Plant. T
Examination Pilot Plant, located in the Transuranic Storage Area, is currently on o
Transuranic Storage Area also includes the following: three asphalt transuranic st
an area that stores wastes from buried waste retrieval studies, TSA-R; and an Inter
Storage Facility, which handles waste with radiation levels that require remote han
engineered storage modules meeting Resource Conservation and Recovery Act requireme
constructed by June 1995 for the waste stored on two of the asphalt pads currently
structures.
The Subsurface Disposal Area is dedicated to the permanent disposal of low-le
the INEL site. Related projects support studies of buried waste, remediation techn
migration. The Subsurface Disposal Area includes pits, trenches, and concrete-line
for low-level disposal. One disposal pit (Pit 9) is the subject of a comprehensive
buried waste remediation.

2.2.4.8 Naval Reactors Facility.

The Naval Reactors Facility area, which covers about 28
hectares (70 acres), is located in the south-central portion of the INEL site. It
The Naval Reactors Facility is under the jurisdiction of the Naval Nuclear Propulsi
Navy program. Its current purposes are as a research and development facility, for
plant operators, and for inspection of naval spent fuel. However, all reactor oper
facility will cease by May 1995.
The major facility at the Naval Reactors Facility is the Expended Core Facili
fuel from the facility itself are received and examined to support fuel development
The Expended Core Facility also removes structural material from the fuel assemblie
the fuel to the Idaho Chemical Processing Plant for storage.

2.2.4.9 Argonne National Laboratory-West.

This facility area is the most southeastern
facility area on the site and the closest to Idaho Falls [about 43 kilometers (27 m
major complexes and numerous buildings.
The original purpose of the Argonne National Laboratory-West was as a testing
reactor technology. The Experimental Breeder Reactor-II, the first pool-type liqui
electricity for the INEL site prior to it being shut down in 1994.
The facility area consists of several major complexes, including the Experime
the Transient Reactor Test Facility, the Zero Power Physics Reactor, the Hot Fuel E
Fuel Cycle Facility, and the Fuel Manufacturing Facility. The Experimental Breeder
used to demonstrate the Integral Fast Reactor concept. The Transient Reactor Test
Power Physics Reactor are used to conduct reactor analysis and safety experiments.
Examination Facility provides a large inert-atmosphere containment for handling and
reactor fuel. The Fuel Cycle Facility has been modified for the Integral Fast Reac
remote reprocessing and refabrication in the fuel cycle. The Fuel Manufacturing Fa
manufacture metallic fuel elements for the fuel cycle.
Supporting facilities at Argonne National Laboratory-West include the Radioa
Treatment Facility, the Radioactive Scrap and Waste Facility, the Radioactive Sodiu

the Sodium Process Facility. The Radioactive Liquid Waste Treatment Facility proce
(aqueous) liquid waste. Transuranic waste from Argonne National Laboratory-West is
Radioactive Scrap and Waste Facility. Contact-handled mixed waste is stored in the
Storage Facility (sodium-contaminated), and remote-handled mixed waste is stored at
and Waste Facility. The Sodium Process Facility was built to process reactor sodiu

2.2.4.10 Idaho Falls Operations.

About 30 percent of the INEL's employees work in Idaho
Falls and provide administrative and scientific support and nonnuclear laboratory s
associated with ER&WM is the INEL Research Center, which is the location for a wide
and features a prominent plasma research center, biotechnical center, materials res
measurement sciences laboratory. Other major facilities include DOE-ID office buil
Building, the INEL Supercomputing Center, the Engineering Research Office Building,
support buildings.

2.2.5 Spent Nuclear Fuel

Spent nuclear fuel is fuel that has been withdrawn from a nuclear reactor fol
constituent elements of which have not been separated by reprocessing. Spent nucle
unused part of the fuel, fission products, transuranics, and the metal cladding or
fuel. Spent nuclear fuel still contains material that can potentially be reclaimed

2.2.5.1 Current Spent Nuclear Fuel Management.

Two basic sources of fuel are handled at
the INEL: naval vessel and prototype spent nuclear fuel; and university, commercia
(including DOE), and foreign reactor spent nuclear fuel. Figure 2.2-3 shows the cu
activities and their locations at the INEL site.

Spent nuclear fuel removed from nuclear-powered naval vessels and prototypes
to the Naval Reactors Facility at the INEL site. Shipments have been restricted si
SNF and INEL ER&WM EIS is completed and the Record of Decision has been published.

Figure 2.2-3. Current spent nuclear fuel management program at the Idaho National

Spent fuel is unloaded from shipping containers into water pools at the Expen
examination. The examined naval spent nuclear fuel is transferred to the Idaho Che
a rate of 1 metric ton of heavy metal per year.

Spent nuclear fuel has also been received at the INEL site from university, c
DOE and other U. S. government, and foreign reactors. Some spent nuclear fuel,
such as fuel from university reactors and from the Fort St. Vrain reactor in Colora
to the Idaho Chemical Processing Plant for storage. Damaged Three Mile Island fuel
transported directly to Test Area North for examination and storage.

Spent nuclear fuel continues to be generated and transported on the INEL site
Reactor operations continue to generate about 0.1 metric ton of heavy metal per yea
that is transported to the Idaho Chemical Processing Plant for storage. The Experi
operations at Argonne National Laboratory-West continued to generate, through 1994,
of heavy metal per year of spent nuclear fuel. This fuel is stored at Argonne Nati
Naval reactor spent nuclear fuel currently examined at the Naval Reactors Facility
Chemical Processing Plant for storage.

At the INEL site, spent nuclear fuel is stored at five facility areas in vari
facilities awaiting final disposition. The areas are Test Area North, Test Reactor
Processing Plant, Power Burst Facility, and Argonne National Laboratory-West. Beca
reprocessed and disposition options have not yet been selected for spent nuclear fu
fuel generation increases the amount stored at the site.

Several specific spent nuclear fuel management activities occur at the Idaho
Plant. As described in Chapter 3, Alternatives, spent nuclear fuel stored underwat
basins of Building 603 is to be removed by December 31, 1996, and the entire Underw
Facility at Building 603 is to be emptied by December 31, 2000. Fuel is being tran
facilities at the Idaho Chemical Processing Plant. Equipment is scheduled to be op
would stabilize the fuel for consolidated storage.

DOE is developing spent nuclear fuel management plans for a timeframe (that i
anticipated to be sufficient to cover the period during which ultimate disposition

fuel will be established and implemented.

2.2.5.2 Vulnerability Assessment.

In August 1993, the Secretary of Energy commissioned a comprehensive baseline assessment of the environmental, safety, and health vulnerab the storage of spent nuclear fuel in the DOE complex. A multidisciplinary working employees and contractors assessed 66 facilities at eight sites to evaluate the inv DOE's reactor-irradiated nuclear material, which includes spent nuclear fuel and re material. The working group also evaluated the condition of facilities that store vulnerabilities and problems that are currently associated with these facilities. report to the Secretary (DOE 1993a) available to the public in December 1993. The ultimately identified 106 vulnerabilities associated with spent nuclear fuel storag site. DOE (1993a) identified eight DOE facilities with major vulnerabilities, incl INEL, the CPP-603 Fuel Storage Facility.

DOE issued a Phase I Plan of Action to address spent fuel storage vulnerabili (DOE 1994a), a Phase II Plan of Action in April 1994 (DOE 1994b), and a Phase III P October 1994 (DOE 1994c). A summary of specific corrective actions to address the vulnerabilities identified at the INEL site are listed in Table 2.2-1. This is not corrective actions but does include those with potential adverse environmental cons corrective actions are currently underway or have been completed. These activities activities for which the National Environmental Policy Act review is complete befor for this EIS is issued were analyzed under Alternative A (No Action). Activities u underway as of June 1995) to address the major vulnerabilities identified at the CP Facility would (a) reduce the potential environmental impacts associated with corro minimize the release of fissile material to the fuel storage basin. These activiti

- Replacing the failed System for Nuclear Auxiliary Power fuel containers overpacks
- Installing redundant stainless steel rigging on corroded spent nuclear
- Transferring spent nuclear fuel out of the north and middle basins of C

Many of the specific INEL spent nuclear fuel Plan of Action projects could re worker exposure, or other potential environmental impacts. The potential environme result from each project or corrective action item were not analyzed individually b enveloped by the spent nuclear fuel management activities reported and analyzed for Volume 2. Successful completion of the corrective actions would reduce the near-te and health risks associated with spent fuel storage at the INEL site.

Table 2.2-1. Corrective actions addressing spent nuclear fuel storage vulnerabilit

Facility and concern	Identification numbera	Corrective actio
Hot Fuels Examination Facility at Argonne National Laboratory-West		
Lack of an approved safety analysis report for ID.	.1.1lity	- Safety ana mission is
Radioactive Scrap/Waste Facility		
Corrosion of in-ground carbon steel fuel storagID. Argonne National Laboratory-West	.2.1ners -	- Complete r new liners - Complete in (1994-99)
Zero Power Physics Reactor		
Potential localized radioactive releases from cID. separation from fuels stored in storage vault	.5.1	- Reencapsul - Periodicall for degrada
Test Area North		
Inadequate corrosion monitoring at Test Area NoID.E.1.1		- Remove non- stored in a

		- Remove non-stored in s - Transfer al Storage Poo

Table 2.2-1. (continued).

Facility and concern	Identification numbera	Corrective actio
Test Area North Pool		
Lack of leak detection and leak trending of TesID.E.1.2orth Storage Pool water inventory		- Evaluate le order
Long-term ownership of Test Area North Pool andID.E.1.3tion of residual reactor-irradiated nuclear materials inventory		- Remove non-stored in a - Remove non-stored in s
Test Area North-607 Basin		
Potential deficiency in seismic design of basinID.E.1.4		- Complete co
Materials Test Reactor Canal		
Inadequate corrosion monitoring	ID.E.3.1	- Remove and materials f - Complete tr dry storage
Lack of leak detection and leak trending of MatID.E.3.2est Reactor Canal water inventory		- Evaluate le make decisi
Canal has no clear DOE ownership (is an orphan ID.E.3.3)		- Office of N identified

Table 2.2-1. (continued).

Facility and concern	Identification numbera	Corrective actio
Advanced Reactivity Measurement Facility		
Inadequate corrosion monitoring at Advanced ReaID.E.4.1 Measurement Facility/Coupled Fast Reactivity Measurement Facility Canal		- Remove and materials f - Complete tr dry storage
Advanced Reactivity Measurement Facility/Coupled Fast Reactivity Measurement Facility Canal		
Has no programmatic ownership (is an orphan facID.E.4.2		- Office of N identified
Power Burst Facility		
Inadequate corrosion monitoring	ID.E.5.1	- Remove and materials f - Complete tr dry storage
CPP-603 Basins		
Corrosion of aluminum associated with fuel and ID.W.1.1of fissile material and radionuclides into the basin environment		- Overpack fa Power fuel - Complete up removal/sup - Complete ca units

Table 2.2-1. (continued).

Facility and concern	Identification numbera	Corrective actio
CPP-603 Basins (continued)		
Uncharacterized water content of fuel now storeID.W.1.2be encapsulated in containers		- Establish t examination

		contents
		- Complete fu measurement
Institutional criticality control of stored reaID.W.1.3adiated nuclear materials		- Complete de Operation f
		- Complete pr implement B
No repacking capability at CPP-603 (required toID.W.1.4 minimize the effects of corrosion on the fuel assemblies and ensure safe storage of the fuel)		- Complete Op activities
		- Complete ca units
Excessive corrosion of fuel handling units at CID.W.1.6		- Transfer 19 CPP-666
		- Transfer 17 CPP-666
		- Transfer re to CPP-666

Table 2.2-1. (continued).

Facility and concern	Identification numbera	Corrective actio
CPP-603 Basins (continued)		
Lack of leak detection and leak trending of relID.W.1.7fission products into the environment from the spent fuel storage basins at CPP-603		- Complete in monitoring
		- Continue pe monitoring
Worker exposures and releases to the environmenID.W.1.10 encapsulation of fuel in CPP-603 basins		- Complete re
		- Complete up removal/ support sys
		- Implement o recovery/ encapsulati
Basin wall failure and superstructure collapse ID.W.1.11rge seismic event		- Complete Ba Plan
		- Complete tr storage
		- Complete re
Excessively corroded and cracked carbon steel yID.W.1.12 baskets could fail, potentially resulting in a criticality		- Overpack fa Power fuel
		- Complete ca units

Table 2.2-1. (continued).

Facility and concern	Identification numbera	Corrective actio
CPP-666 Basins		
Corrosion of aluminum clad fuel and release of ID.W.2.1material and radionuclides into the CPP-666 basin environment		- Implement i of CPP-666
		- Design and baskets
Susceptibility to damage and downgrading of engID.W.2.2 safety features at CPP-666 basins		- Review crit controls
		- Evaluate en monitoring/ preventive
CPP-603/Irradiated Fuel Storage Facility		
Ignition of brittle cardboard fuel containers aID.W.3.2cility		- Complete el
		- Complete tr

		containers
Roof collapse and control room equipment failur large seismic event	ID.W.3.3	- Complete se rack inside - Complete se structure a

Table 2.2-1. (continued).

Facility and concern	Identification numbera	Corrective actio
CPP-603 Fuel Element Cutting Facility		
Possible degraded Peach Bottom fuel	ID.W.4.2	- Inspect con support ret
CPP-749 Drywells		
Potentially degrading aluminum fuel cans and baskets	ID.W.5.2	- Complete 8 generation - Complete 25 generation

a. Tracking and identification number from DOE (1994c).

The working group report identified a vulnerability associated with a lack of disposition of spent nuclear fuel stored at INEL facilities. The Plan of Action id this EIS as a corrective action to address this vulnerability. In fact, this EIS i needed to safely manage spent nuclear fuel until future decisions regarding its ult and implemented.

In addition to the Spent Fuel Working Group report on vulnerabilities and the action to resolve the identified vulnerabilities, the Defense Nuclear Facilities Sa Recommendation 94-1 calling for DOE to develop an expedited schedule for resolving vulnerabilities across the DOE complex. Recommendation 94-1 was critical of DOE's correcting known spent nuclear fuel management deficiencies. Further, Recommendati DOE's lack of prioritization of corrective actions and lack of an integrated system previously identified spent nuclear fuel management issues. DOE has developed a pl Recommendation 94-1 across the DOE complex. The implementation plan was submitted Nuclear Facilities Safety Board on February 28, 1995 (DOE 1995). The plan includes corrective actions to remedy known deficiencies utilizing a DOE complex-wide system consideration of limited budgets. The plan focuses on fulfilling outstanding commi (for example, court-ordered milestones) and fully recognizes the urgency required t spent nuclear fuel management issues.

2.2.6 Environmental Restoration

Since the 1970s, the INEL Environmental Restoration Program has addressed con resulting from the past 45 years of operations at the site. Environmental restorat program elements: (a) remediation and (b) decontamination and decommissioning.

2.2.6.1 Remediation.

Remediation is the process of assessing and cleaning up releases and threatened releases of hazardous substances, including radioactive substances at th program at the INEL is conducted under the Federal Facility Agreement and Consent O DOE, the U. S. Environmental Protection Agency, and the State of Idaho pursuant to Environmental Response, Compensation, and Liability Act (CERCLA).

The INEL follows the remedial action process (Figure 2.2-4) established under implementing regulation, the National Contingency Plan. Under CERCLA, the INEL ent Facility Agreement and Consent Order, which provides site-specific direction for th This process directs both the assessment and cleanup of release sites and is design risk management decision regarding which remedy is most appropriate for a given sit flexible enough to be tailored to the specific circumstances of individual potentia

Flexibility in the process is allowed by following different assessment track sites that will not likely require any cleanup action and can be assessed with exis Track 2 studies are for sites or operable units that require field data collection

the potential risk. Both Track 1 and 2 studies are considered preliminary scoping Investigation/Feasibility Study is a more rigorous study for sites where more exten contamination, assessment of risk, and evaluation of cleanup alternatives are requi decision.

If at any time it is determined that a threat exists and there is greater urg phase, an interim action may be implemented. Removal actions may also be implement relatively simple cleanups that will achieve progress toward the long-term remedial

Once a study is complete and an interim or final action is identified, a prop public comment. The proposed plan summarizes the investigation and risk assessment preferred cleanup alternative. When all comments have been considered, a CERCLA Re issued that selects the cleanup alternative. This Record of Decision also establis and criteria that will be met to adequately protect human health and the environmen Design/Remedial Action phase occurs after the cleanup is authorized by this Record action is successfully completed when DOE-ID and the regulatory agencies agree that established in the Record of Decision have been met.

DOE has identified and currently is implementing the remediation process on a where hazardous substances have been or are suspected of having been released to th

Figure 2.2-4. Flow chart of remedial action process at the Idaho National Engineer

investigation. As of June 1994, over 270 of the suspected release sites had been p requiring no further action.

Release sites with similar contamination problems are grouped together into o promote management and cleanup efficiency. Operable units are, in turn, grouped in called Waste Area Groups (WAGs), for efficiency in managing the assessment and clea these Waste Area Groups are roughly equivalent to the major facility areas identifi Facility Areas (see Figure 2.2-2). Waste Area Group 10 includes a site-wide area a River Plain Aquifer and surface and subsurface areas that are not addressed by the Groups.

Sources of contamination at the INEL include spills, abandoned tanks, septic ponds, landfills, and injection wells. Contaminated sites range from large facilit Disposal Area (pits and trenches) at the Radioactive Waste Management Complex (WAG in various locations where minor spills may have occurred. Table 2.2-2 summarizes wastes and contaminants for each Waste Area Group.

Numerous proven technologies are suitable for cleanup of the potential releas INEL. These technologies include containment (capping, vertical barriers, and subs barriers), immobilization (solidification and stabilization), physical processes (s vacuum extraction, air stripping, filtration, ion exchange, and membrane separation (incineration, pyrolysis, wet oxidation, or in situ vitrification), chemical proces neutralization, precipitation, and dechlorination), and biological processes (aerob and biodegradation).

2.2.6.2 Decontamination and Decommissioning.

Decontamination and decommissioning
activities are concerned with safely managing contaminated surplus nuclear faciliti decontaminated for reuse or decommissioned. A long-term goal for DOE is to deconta decommission all contaminated surplus facilities as funds become available to ensur the environment are protected.

Table 2.2-2. Waste types and contaminants located at Waste Area Groups at the Idah

Waste Area Group	Location	Waste site
1	Test Area North	Underground storage tanks, pits, ponds, ra turntable
2	Test Reactor Area	Leaching pond, underground storage tank, r piles, cooling towers, injection well, fre spills
3	Idaho Chemical Processing Plant	Septic tanks, cesspools, seepage pits, spi injection well, sewage treatment plant, gr french drains
4	Central Facilities Area	Spills, underground tanks, landfill, leach
5	Power Burst Facility/	Evaporation ponds, sanitary sewer, waste s

	Auxiliary Reactor Area	storage pads
6	Experimental Breeder Reactor-I/ Boiling Water Reactor Experiment	Reactor burial site, trash dump, fuel oil tanks, leach pond, spills
7	Radioactive Waste Management Complex	Soil vaults, acid pit, waste pits and tren tank
8	Naval Reactors Facility	Landfills, spill sites, wastewater disposa storage areas
9	Argonne National Laboratory-West	Tanks, wastewater handling/disposal system ditches, ponds, drains
10	Miscellaneous (including Snake River Plain Aquifer)	Organic Moderated Reactor Experiment, ordn areas, liquid corrosive chemical disposal pond

After a facility ceases operations, but prior to its being accepted into the Decommissioning Program, it enters the Facility Transition Program. The purpose of provide a consistent approach to determine whether a facility is available for reus decontamination and decommissioning. This phase consists of (a) termination of fac placement of the facility on the Surplus Facilities List, if no other mission is id surveillance and maintenance program to monitor the remaining known hazards and to a safe condition; (d) achievement of safe shutdown/deactivation; and (e) transfer o Office of Environmental Restoration.

The Surplus Facilities List can be found in the INEL D&D Long-Range Plan (Buc Some of the larger surplus facilities on this list are Auxiliary Reactor Area-II, B Experiment-V, Engineering Test Reactor facilities, Materials Test Reactor facilitie Complex, Fuel Receipt/Storage Facility, Headend Processing Plant, and the Waste Cal

After a facility has been accepted into the Decontamination and Decommissioni term surveillance and maintenance program is established and shutdown and deactivat activities for safe shutdown include

- Removing special nuclear material, hazardous chemicals, combustible mat of radioactivity

- Ensuring that the minimum necessary confinement systems (both structure ventilating) are working

- Controlling access of personnel.

Surveillance and maintenance activities are performed, which include monitoring rem and maintaining the facility in a safe condition until it is ready for decontaminat

Next, a project plan is written. The project plan identifies the preferred d decommissioning options, DOE's proposed strategy for compliance with the National E Act, and the relationship to the Comprehensive Environmental Response, Compensation The options that can be considered under the decontamination and decommissioning pr on the condition of the facilities, but generally fall under one of four categories stabilization (such as entombment), decontamination for reuse, and dismantlement. radioactive waste (for example, low-level, mixed low-level, high-level, transuranic potentially result from decontamination and decommissioning activities, depending o particular facility.

The next step is to complete an environmental review with the preparation of risk assessment and then reach a documented decision defining the proposed scope an project.

Next, a decommissioning plan is prepared, the surveillance and maintenance pr a contractor is selected, and the plan is executed. After the completion of the de closeout documentation is prepared and an independent verification is conducted to met.

Postoperations activities, where appropriate, consist of long-term surveillan other controls to carry out the final disposition of the project. These activities protection of human health and the environment.

2.2.7 Waste Management

Waste management activities under the ER&WM Program include minimization, ch treatment, storage, and disposal of wastes generated from ongoing INEL activities a sources, such as environmental restoration and decontamination and decommissioning

Management Program ensures that current and future waste management practices minim
adverse environmental impacts. During the past four decades, hazardous and radioac
produced, stored, treated, and/or disposed of at the INEL site. In addition, every
waste that must be managed. Several general types of wastes are managed at the INE
are defined in Appendix E, Glossary, and discussed in the following sections. Beca
represents the great majority of mixed waste, it is discussed separately in Section
waste and mixed transuranic waste are discussed under the high-level waste and tran
2.2.7.1.1 and 2.2.7.1.2, respectively.

2.2.7.1 Radioactive Waste.

Radioactive waste is grouped into several categories, depending on
the amount and types of radioactivity it contains (for example, low-level waste) or
example, high-level waste). The definitions for radioactive waste come from limit
the Atomic Energy Act and DOE orders. (More information on radioactivity is given i
on Radioactivity and Toxicology.) Presently, there are four radioactive waste stre
high-level, transuranic, low-level, and mixed low-level.

2.2.7.1.1

High-Level Waste-The term high-level radioactive waste means (a) the
highly radioactive material resulting from reprocessing of spent nuclear fuel, incl
directly in reprocessing and any solid material derived from such liquid waste that
sufficient concentrations, and (b) other highly radioactive material that the U. S.
Commission, consistent with existing law, determines by rule requires permanent iso
sodium-bearing liquid (produced by decontamination activities) is also managed as h
(see Appendix E, Glossary, for a definition of sodium-bearing waste). The current
management program, as depicted in Figure 2.2-5, is conducted at the Idaho Chemical

From 1953 to 1992, high-level liquid waste at the INEL resulted from reproces
fuel; however, reprocessing was phased out in 1992. Certain other processes genera
level liquid waste. For example, the process equipment waste evaporator, which con
waste, and the Liquid Effluent Treatment and Disposal Facility, which processes eva
generate such waste. Also, the calcined bed from the New Waste Calcining Facility
periodically dissolved and stored as high-level waste. These sources generated abo
cubic yards) of liquid high-level waste in 1993.

Figure 2.2-5. Current high-level waste management program at the Idaho National En
contained in concrete vaults at the Idaho Chemical Processing Plant. Only one tank
from previous reprocessing. Most of the remaining liquid waste is sodium-bearing,
in some of the 11 tanks. A project to upgrade the piping associated with all the t

These tanks are required to be taken out of service in the next two decades (
2015). They were built to the standards existing at the time of construction (195
all current standards. A project was in progress to replace these aging tanks; how
was phased out in 1992 at the Idaho Chemical Processing Plant, it was not clear tha
required. DOE commissioned a study to evaluate all feasible options for emptying t
to determine the need for replacement tanks (Palmer et al. 1994). Options from tha
the alternatives described in Chapter 3 of Volume 2 of this EIS.

High-level liquid waste has been blended routinely with sodium-bearing liquid
(calcined) at the New Waste Calcining Facility. Calcining transforms the waste int
granules. For calcination, sodium-bearing wastes have also been blended with purch
(aluminum nitrate) because the sodium-bearing waste cannot be directly calcined. T
not scheduled to resume until 1996. Equipment to concentrate the sodium-bearing wa
being installed during the current shutdown of the New Waste Calcining Facility.

The calcined waste is stored at the Idaho Chemical Processing Plant in stainl
inside near-surface concrete vaults. Seven sets of bins have been built: five sets
partially full.

Because the calcined waste remains a Resource Conservation and Recovery Act (
waste, it is regulated under RCRA and is subject to land disposal restrictions. Ul
that the calcined waste would be converted to an immobilized form and disposed of a

2.2.7.1.2 Transuranic Waste-Transuranic waste is defined as radioactive waste

having concentrations greater than 100 nanocuries per gram of transuranic elements atomic number greater than 92) with half-lives greater than 20 years. The radioact waste emit alpha radiation, which requires minimal shielding when outside the body lung tissue if inhaled. Transuranic wastes require long-term isolation from the en

Transuranic waste disposed or stored at the INEL has been generated primarily activities located offsite. Small volumes of transuranic waste have been generated from fuel examination activities. Additional waste may be generated by spent nucle transuranic waste [about 0.15 percent of INEL stored waste (DOE 1992)] contains hig radioactivity and may require more than minimal shielding and remote handling. Fig current INEL transuranic waste management program.

In the early 1980s, the definition of transuranic waste was revised from grea than 100 nanocuries per gram. As a result, nearly half of the waste now in storage Area of the Radioactive Waste Management Complex is expected to fall below the limi waste falling between the 10-and-100-nanocuries-per-gram limit is now called alpha Although this waste is technically considered low-level waste rather than transuran disposed of at the INEL because it does not meet all INEL low-level waste acceptanc 1994). Alpha low-level waste and transuranic waste are

<u>Figure 2.2-6. Current transuranic waste management program at the Idaho National E</u>

managed together at the INEL site. Both of these waste types are managed as a part stream.

Since 1954, the INEL site has received transuranic waste from both offsite an generators for disposal or interim storage. When transuranic waste was first accep Waste Management Complex, it was disposed of in pits and trenches. This waste was low-level waste. After 1964, transuranic waste was placed into pits and trenches s waste. In 1970, national policy mandated that newly generated transuranic waste be storage pending permanent disposition at some other facility. The Transuranic Stor at the Radioactive Waste Management Complex to provide this interim storage. The t at the Radioactive Waste Management Complex represents over half the retrievable tr entire DOE complex.

Although there is still no facility for disposal of transuranic waste, it is be retrieved from storage, repackaged, certified to meet disposition facility requi the Waste Isolation Pilot Plant for final disposition. A strategy for disposing of mixed low-level waste has yet to be established. Challenges to overcome include

- Storage space for transuranic waste at the INEL site is limited.
- Disposal facilities are not currently available at INEL site for alpha
- Certification or licensed transportation systems do not exist for remot waste.
- Some stored transuranic waste at the INEL site is incompatible with the Regulatory Commission-licensed shipping container (TRUPACT II).
- Waste Isolation Pilot Plant uncertainties:
  - Final waste acceptance criteria unknown
    - -- Need to treat waste for compliance to Resource Conservation Act and/or 40 CFR 191
    - -- Extent of needed waste characterization
    - -- Schedule for initiating disposal operations (currently sched
    - -- Whether to accept pre-1970 transuranic waste for disposal.

A small amount of transuranic waste is being generated onsite (Pole 1993). T generated at the Test Reactor Area is stored at the Radioactive Waste Management Co agreement with the State of Idaho, Argonne National Laboratory-East transports to t amount of transuranic waste generated as a result of INEL-related activities. Tran generated from environmental remediation and decontamination and decommissioning pr of transuranic waste may also be accepted on a case-by-case basis from other DOE si

Approximately 65,000 cubic meters (85,000 cubic yards) of transuranic and alp are retrievably stored on above ground asphalt pads covered with plywood, plastic, buildings at the Transuranic Storage Area of the Radioactive Waste Management Compl facilities, which meet State and U. S. Environmental Protection Agency Resource Con Act requirements for hazardous waste storage, are being constructed to replace thes being removed from the older storage facilities and placed into new storage as thes Waste received from offsite is placed into storage pending characterization. Small waste generated by current operations are also being placed into storage. Some tra stored at the Radioactive Scrap and Waste Facility at Argonne National Laboratory-W

Another 62,000 cubic meters (81,000 cubic yards) of transuranic and alpha low and Hendrickson 1995) have been disposed of by burial in pits, trenches, and soil v Disposal Area at the Radioactive Waste Management Complex prior to 1970.

DOE expects that much of the transuranic waste stored at the INEL site will h and/or treated to meet the waste acceptance criteria for the Waste Isolation Pilot underway at the INEL to prepare to transport stored certified transuranic waste to Plant for disposition. The Stored Waste Examination Pilot Plant, which would suppo certification of transuranic waste for transport to the Waste Isolation Pilot Plant new waste characterization facility is planned to provide required analyses of a re wastes before transport.

DOE is investigating the feasibility of constructing a facility (the Idaho Wa that could be used to treat alpha mixed low-level waste. The facility would first low-level waste and later to repackage or treat transuranic waste that could be cer transportation criteria and the Waste Isolation Pilot Plant waste acceptance criter investigating the possibility of offsite commercial treatment of transuranic and al

2.2.7.1.3 Low-Level Waste-Low-level waste is best defined in terms of what it is not.

Low-level waste is radioactive waste that is not high-level, transuranic, or by-pro uranium or thorium from processed ore. Most low-level waste contains short-lived r generally can be handled without additional shielding or remote handling equipment. level waste management program is depicted in Figure 2.2-7.

Low-level waste is generated at the Test Reactor Area, Idaho Chemical Process Facilities Area, Power Burst Facility, Radioactive Waste Management Complex, Naval Test Area North, and Argonne National Laboratory-West. About 60 percent of the was to reduce volume and stabilize it before disposal. The waste has been treated thro onsite at the Waste Experimental Reduction Facility located at the Power Burst Faci commercial facility. Currently, the waste is treated through compaction or size re Experimental Reduction Facility. Operation of the Waste

__Figure 2.2-7. Current low-level waste management program at the Idaho National Eng__

the shutdown, an environment assessment (DOE 1994d) was prepared. Based on this en assessment and a Finding of No Significant Impact issued in June 1994, DOE is under volume reduction activities at the Waste Experimental Reduction Facility with offsi commercial facilities. This offsite incineration includes shipping the waste from the resulting ash at the INEL site for disposal at the Radioactive Waste Management

Waste incineration is a process by which combustible waste materials are burn combustion gases, noncombustible residue, and ash. Incineration also reduces the m waste. Reductions in volume of 200 to 1 if ash is not stabilized, or 70 to 1 if as typical.

Solid low-level waste is disposed of through shallow land burial at the Radio Management Complex in pits and concrete-lined soil vaults in the Subsurface Disposa Subsurface Disposal Area occupies approximately 35 hectares (88 acres). As of 1991 capacity for low-level waste disposal in the area was 37,000 cubic meters (48,000 c additional 67,000 cubic meters (88,000 cubic yards) of expansion capacity is potent percent of solid low-level waste generated onsite is sent directly to the Radioacti Complex without treatment.

Most liquid low-level waste is concentrated at the Idaho Chemical Processing vapor (condensate) from the Idaho Chemical Processing Plant process equipment waste processed by the Liquid Effluent Treatment and Disposal Facility and the gaseous ef high-efficiency particulate air filtered stack. The material remaining after evapo Idaho Chemical Processing Plant tank farm. Some small volumes of radioactive liqui the Waste Experimental Reduction Facility and disposed of at the Radioactive Waste All of Argonne National Laboratory-West's low-level (aqueous) liquid waste is proce

Radioactive Liquid Waste Treatment Facility. It is volume-reduced to a sludge and Radioactive Waste Management Complex. Small volumes are discharged to the double-l Test Reactor Area. Potential low-level waste from storm runoff at Test Area North exchange system.

2.2.7.1.4 Mixed Low-Level Waste-Mixed low-level waste contains Resource

Conservation and Recovery Act (RCRA)-controlled substances and is radioactive. It RCRA requirements because of its RCRA hazardous waste characteristics and according Energy Act because of its radioactive components. The current INEL mixed low-level program is depicted in Figure 2.2-8.

Mixed low-level waste is further divided into two categories for management p low-level waste and beta-gamma mixed low-level waste. The difference between the c quantity of transuranic radionuclides in the mixed waste. Most of the alpha mixed the INEL site is waste that has been reclassified from mixed transuranic waste. Mo

Figure 2.2-8. Current mixed low-level waste management program at the Idaho Nation

of the mixed low-level waste currently stored at the INEL site is alpha mixed low-l the INEL for storage and treatment from offsite generators. This alpha mixed low-l part of the transuranic waste stream and is described more fully in Section 2.2.7.1 remainder of this section relates only to beta-gamma mixed low-level waste.

Under U. S. Environmental Protection Agency regulations, mixed low-level wast before land disposal, and disposal facilities must meet RCRA minimum technology req RCRA hazardous waste portion of mixed low-level waste is subject to the land dispos Act. Land disposal restrictions prohibit the disposal of any RCRA-controlled waste specific prohibitions are in effect. Storage of restricted wastes is prohibited un stored for the purpose of accumulating sufficient quantities for treatment. As a g technologies are available for such wastes, storage is prohibited. As discussed in 7.2.5.9, Federal Facility Compliance Act, mixed waste treatment plans are currently potential activities and methods identified in the plans are reflected in the alter Alternatives, and analyzed in Chapter 5, Environmental Consequences.

Mixed low-level waste is generated at Test Area North, Test Reactor Area, Ida Processing Plant, Central Facilities Area, Power Burst Facility, Radioactive Waste Naval Reactors Facility, Argonne National Laboratory-West, and the Idaho Falls faci environmental restoration, decontamination and decommissioning, production operatio activities, construction, maintenance, and research and development activities.

Waste minimization is also being used at the INEL to eliminate potential sour waste before generation. These efforts include using improved operating practices, material changes, product changes, waste avoidance through recycling, and other act

Eleven hundred cubic meters (1,400 cubic yards) of mixed low-level waste are stored in permitted (or interim status) storage facilities onsite. Existing permit cubic meters (2,300 cubic yards).

Mixed low-level waste at the INEL is stored at the Mixed Waste Storage Facili Experimental Reduction Facility Waste Storage Building) and portable storage units Facility area. In addition, smaller quantities of mixed low-level waste are stored INEL including the Hazardous Chemical/Radioactive Waste Facility at the Idaho Chemi the Radioactive Sodium Storage Facility, Building 703, and the Radioactive Scrap an Argonne National Laboratory-West. The majority of mixed low-level waste at the INE and disposal; a small amount is being treated through ongoing treatability studies

As part of the site treatment plans required by the Federal Facility Complian treatment options have been identified to eliminate the hazardous waste component f low-level waste (DOE-ID 1993b). Existing treatment facilities include the Waste Ex Facility incinerator and stabilization system and the Waste Engineering Development system, all of which are currently on operational standby. Additional facilities i treatment unit, debris treatment at the Idaho Chemical Processing Plant, and the hi filter leach system at the Idaho Chemical Processing Plant. Commercial treatment o considered for mixed low-level waste.

In addition, some of the mixed low-level waste streams require new forms of t wastes include contaminated lead, one-of-a-kind wastes, and contaminated polychlori (Polychlorinated biphenyls are hazardous substances managed under the Toxic Substan DOE is conducting treatability studies and research onsite and at university and co to identify new forms of treatment for disposal at onsite and offsite DOE or commer

Ultimately, mixed wastes will be treated and disposed of in accordance with a

All RCRA-controlled wastes generated at the INEL are evaluated to certify that they contaminated. If this certification cannot be made, then the wastes are managed as analyses verify that treated characteristic mixed low-level waste no longer exhibit therefore is no longer hazardous, and if the treated waste meets Radioactive Waste radioactive waste acceptance criteria, it is reclassified as low-level waste and se Management Complex for disposal. Waste that does not meet the Radioactive Waste Ma waste acceptance criteria will be stored until a suitable facility is available. D DOE orders, require all DOE-generated radioactive waste to be disposed of on a DOE treated to meet Land Disposal Restrictions, must be disposed of at a DOE facility. be used on a case-by-case basis.

Liquid low-level mixed waste is concentrated at the Idaho Chemical Processing condensed vapor (condensate) from the Idaho Chemical Processing Plant process equip is then processed by the Liquid Effluent Treatment and Disposal Facility and the va efficiency particulate air filtered stack. The material remaining after evaporatio then pumped to the Idaho Chemical Processing Plant tank farm.

2.2.7.1.5 Greater-Than-Class-C Low-Level Waste-Greater-than-Class-C waste

exceeds U. S. Nuclear Regulatory Commission concentration limits for Class-C low-le 10 CFR 61 and thus exceeds limits for shallow land burial. The Low-Level Radioacti Amendments Act of 1985 (Public Law 99-240) requires DOE to ensure safe disposal of 1989, the U. S. Nuclear Regulatory Commission (NRC) promulgated a rule that require C waste to be disposed of in a deep geologic repository, unless the NRC approves di

Under the Low-Level Radioactive Waste Policy Amendments Act of 1985, the Fede responsible for the disposal of greater-than-Class-C low-level waste generated by l Agreement States. DOE was identified as the Federal agency responsible for this ef report to Congress from DOE (DOE 1989) stated that it plans to accept and manage li greater-than-Class-C low-level waste until a disposal facility is developed. DOE h responsibility for this effort to the INEL. The Radioactive Waste Management Compl total of about 25 cubic meters (33 cubic yards) of greater-than-Class-C waste. Thi 1987 and 1988 from two offsite commercial generators.

2.2.7.1.6 Special-Case Waste-Special-case waste is defined as a radioactive waste

owned or generated by DOE that does not fit into typical management plans developed radioactive waste types such as high-level waste, low-level waste, or transuranic w waste at the INEL has been classified by a categorization process described in Winb Special-case waste comprises five types of waste based on disposal requirements:

- Containers of waste with unknown contents

- Spent nuclear fuel and fuel debris (originally used in research and dev in configurations unlike normal commercial fuel elements, and therefore the anticipated high-level waste repository waste acceptance criteria

- DOE wastes that do not meet the disposal requirements of the Radioactiv Management Complex waste acceptance criteria

- DOE wastes that are generated by Energy Research Programs, Nuclear Ener U. S. Nuclear Regulatory Commission licensees and that have concentrati constituents exceeding the Class C limits specified in 10 CFR 61.55

- DOE wastes generated by Defense Programs that do not meet the waste acc for the Waste Isolation Pilot Plant.

Special-case waste at the INEL is stored in various major facility areas, inc Laboratory-West, the Advanced Test Reactor at the Test Reactor Area, the Naval Reac Power Burst Facility, Test Area North, and the Radioactive Waste Management Complex waste, such as activated metals from reactor cores, will be generated as long as re Because of this continuing generation, new storage facilities or additional disposa provided. In addition to alpha low-level waste, some of the existing special-case one of the major radioactive waste types. Until the waste is characterized, it is waste. Actions associated with this special-case waste are evaluated on a case-by- the EIS does not specifically assess impacts related to such actions.

Two hundred cubic meters (260 cubic yards) of special-case waste consists of performance-assessment-limited low-level waste and nondefense transuranic waste loc facilities. These data do not include the potential special-case waste that may be Environmental Restoration Program and other programs.

As with the transuranic waste, when characterization, treatment, or disposal are identified, they will be implemented.

2.2.7.2 Hazardous Waste.

A hazardous waste is any solid waste, not otherwise precluded from regulation under the Resource Conservation and Recovery Act (RCRA), that exhibits t ignitability, corrosivity, reactivity, or toxicity, as defined by RCRA, or which ha to pose a hazard and which has been designated by the RCRA as a listed hazardous wa hazardous wastes include paint thinner, lead, and chromium wastes. The U. S. Envir Agency has also established requirements for the management of these materials. Th program at the INEL also manages substances regulated by the Toxic Substances Cont polychlorinated biphenyls. The current INEL hazardous waste management program is 2.2-9.

Hazardous waste at the INEL is currently generated at the Radioactive Waste M Central Facilities Area, Power Burst Facility, Naval Reactors Facility, Test Area N Argonne National Laboratory-West, Idaho Chemical Processing Plant, and Idaho Falls Decontamination and decommissioning and remediation activities also generate hazard percent of the total waste generated at the INEL is hazardous waste.

To reduce the quantity of hazardous waste, waste generated at the INEL is rec reprocessed where possible. Also, some hazardous substances used at the INEL may b nonhazardous substances. Recyclable hazardous waste at the INEL includes metals (s mercury, chromium), solvents, fuel, and other waste materials. Recyclable material periodically as sufficient quantities are accumulated or as negotiated with recycli The total volume of recyclable hazardous waste from the INEL in 1992 was 760 cubic yards).

Under RCRA, hazardous waste generated at the INEL may remain for less than 90 designated accumulation points. The waste is then transported to a RCRA interim st storage facility. The Hazardous Waste Storage Facility at the Central Facilities A RCRA Part B-permitted storage facility. The facility is designed primarily to prep transported to an offsite RCRA-permitted treatment facility prior to offsite dispos hazardous waste generated annually at the INEL is transported offsite for treatment

Hazardous waste generated in a radioactively controlled area or suspected of be transported offsite until it is surveyed for radioactivity. If the waste is rad classified and managed as mixed waste (see Section 2.2.7.1.4, Mixed Low-Level

<u>**Figure 2.2-9. Current hazardous waste management program at the Idaho National Eng**</u>

basis and are either stored, burned, or detonated at the Reactive Storage and Treat Auxiliary Reactor Area. (More detailed information on toxic substances is given in Radioactivity and Toxicology.)

2.2.7.3 INEL Industrial Waste.

INEL industrial wastes are nonhazardous materials. The current INEL industrial waste management program is depicted in Figure 2.2-10.

<u>**Figure 2.2-10. Current INEL industrial waste management program at the Idaho Natio**</u>

Industrial waste is nonhazardous waste generated during manufacturing or indu the INEL, this is categorized as INEL industrial waste. Also at the INEL, sanitary category. (See Appendix E, Glossary, for a definition of sanitary waste.) Over 94 generated at the INEL is classified as INEL industrial waste (DOE-ID 1993c) and dis Facilities Area Landfill (site) and the Bonneville County Landfill (Idaho Falls fac

The portion of the INEL Landfill Complex targeted for landfill use is approxi (220 acres), which is estimated to be adequate capacity for 30 to 50 years. Landfi Landfill III comprises two separate areas: the INEL industrial waste disposal area currently used disposal area. The current disposal area is located in a 4.8-hectar Landfill II. Although nearly filled, part of the INEL industrial area of Landfill waste containing asbestos.

Waste types disposed of at the INEL Landfill Complex include asbestos, asphal

dirt and gravel, masonry and concrete, scrap metal, trash, sweepings, wood and scra and trees.

An active recycling program has been started to reduce the amount of INEL ind recycling program is coupled with a concerted effort to ensure that waste materials In addition, a materials exchange program has been initiated; this program arranges stored at one INEL facility to be reused at other facilities. Through 1991, 320,00 pounds) of office waste and 3,100 kilograms (6,800 pounds) of scrap metal were recy Efforts are underway to expand the recycling program to include asphalt and metals wood into mulch.

DOE's long-term goal is to greatly reduce the amount of industrial commercial INEL industrial waste) generated through an intensive program of waste avoidance, r segregation.

2.2.8 Infrastructure

DOE is responsible for ensuring the continued safe operation of INEL faciliti activity is infrastructure support. The current program of infrastructure support plant projects to maintain and upgrade the current facilities, buildings, roads, an operations. Other aspects of DOE's responsibility involves upgrading facilities, r maintaining facilities and equipment, providing environmental monitoring, and ensur and quality assurance programs are in place.

Present infrastructure upgrades include general plant projects for utility an maintenance, as well as larger line item projects. Near-term projects include the Radiological and Environmental Sciences Laboratory and a new Health Physics Instrum

A major support service for the ER&WM Program is the INEL environmental monit This monitoring program is designed to determine if waste management practices are environment and, if so, how these practices need to be changed to decrease or elimi 1992). The monitoring program includes air, surface water, drinking water, nonradi ambient (surrounding) radiation levels, and plants and animals. Various locations perimeter of all facilities and the INEL site as a whole are monitored. The State an independent program to monitor INEL operations. The U. S. Environmental Protect State of Idaho each have regulatory authority for different aspects of environmenta

The long-term goal is to provide the necessary support required for ER&WM pro continue to ensure that operations are conducted as safely as possible, including m and minimum risk to personnel, facilities, the public, and the environment.

2.2.9 Technology Development

Technology development supports ER&WM by designing and testing potential tech specific problems related to ER&WM. Broad program areas under technology developme development, demonstration, testing, and evaluation; technology integration; infras developing and improving safe and efficient packaging systems; emergency response m and laboratory analysis. Types of current technology development activities at the waste minimization; testing remediation technologies; evaluating and testing method level, sodium-bearing, and other waste types; and designing sensors and other envir equipment and systems.

In 1992, DOE had proposed to engage in research and development activities fo development and demonstration required to assure that spent nuclear fuel could be a disposition in a geologic repository. Any such repository is not expected to be av 2010. DOE has therefore adopted a systems approach to plan the development of tech resources to ensure safe and effective management of spent nuclear fuel in the inte Program Systems Engineering process is a formal structured methodology to ensure th necessary interfaces are identified and satisfied, and that technical requirements stakeholder values are accommodated in decisions related to the interim management addition to identifying and integrating fuel management requirements, the systems e implements a formal method for selecting best alternatives for stabilizing, conditi transporting, and storing the spent nuclear fuel.

2.2.10 Activities Not Directly Related to Spent Nuclear Fuel or Environmental Restoration

and Waste Management

Many activities at the INEL are identified in Section 2.2.4, Major Facility A activities, for example, the operation of nuclear reactors, fall outside the scope Environmental Consequences, of Volume 2 evaluates impacts if they are associated wi restoration, waste management, and spent nuclear fuel operations at the INEL. Howe evaluates cumulative impacts of activities at the INEL not directly related to spen Hazardous materials are included in this section due to their potential impact on h environment.

2.2.10.1 Hazardous Materials.

Hazardous materials are broadly defined as hazardous substances, hazardous chemicals, or toxic substances. The Emergency Planning and C Know Act, Section 312, requires an annual inventory of hazardous chemicals at the I chemicals are managed at the INEL to prevent harmful impacts to human health and sa environment.

The 1992 hazardous chemicals inventory lists 774 hazardous chemicals used at quantities of 0.5 kilogram (1 pound) or greater. Volumes range from 0.5 kilogram (chemicals to a maximum single volume of approximately 1,100,000 kilograms (2,400,00 (Priestly 1992, Slaughterbeck 1993).

The number of hazardous chemicals and the total weight of any chemicals routi changes from day to day and from facility to facility. Year-to-year inventories ar for through the annual Emergency Planning and Community Right-to-Know Act reports f The percentage of hazardous materials used onsite that become hazardous waste or pa cannot be determined.

2.2.10.2 Support Services.

DOE provides safety services, security and safeguards, utilities and plant services, environmental compliance, and emergency preparedness. A program of preparedness for site areas and facilities has been developed based on prevention, recovery (DOE-ID 1993d).

2.2.11 Regulatory Framework for Environmental Restoration and Waste Management

Various laws and regulations govern environmental restoration and waste manag These regulations affect choices in treatment, storage, and disposal; drive cleanup standards against which the impacts of the alternatives are measured. Agreements b regulatory agencies, and governmental agencies have been signed to provide guidance of these laws. In addition, DOE Headquarters and DOE-ID issue orders and supplemen implement laws, regulations, and requirements; give specific responsibilities; and processes and procedures. Additional information on environmental regulations, com compliance status can be found in Chapter 7, Consultations and Environmental Requir

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