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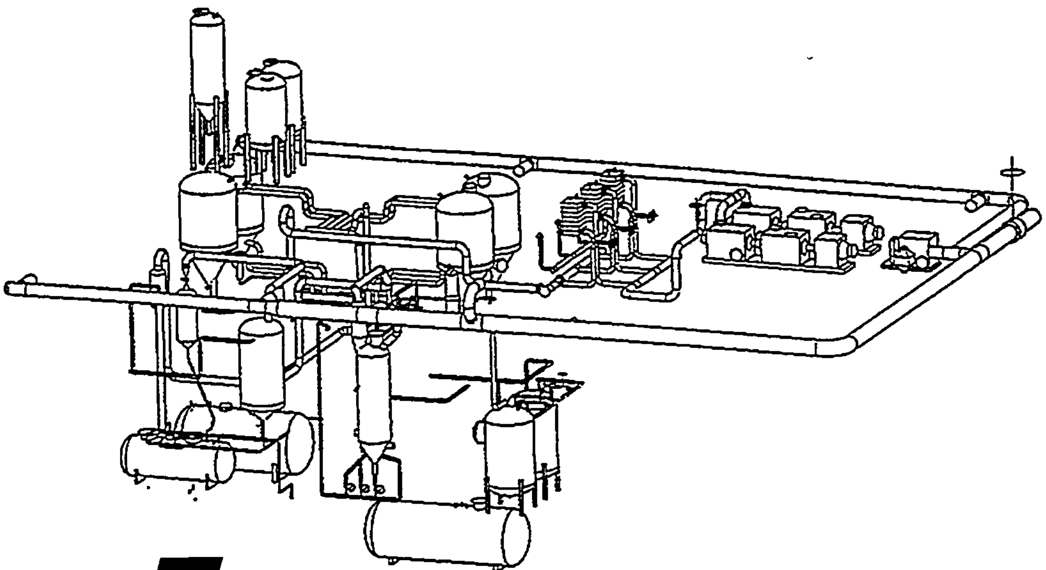
Draft Environmental Assessment

Closure of the Waste Calcining Facility (CPP-633), Idaho National Engineering Laboratory



Idaho National Engineering Laboratory

U.S. Department of Energy • Idaho Operations Office

U. S. DEPARTMENT OF ENERGY
DRAFT FINDING OF NO SIGNIFICANT IMPACT FOR THE CLOSURE OF THE WASTE CALCINING FACILITY AT THE IDAHO NATIONAL ENGINEERING LABORATORY

Agency: U. S. Department of Energy (DOE)

Action: Finding of No Significant Impact

SUMMARY: The DOE-Idaho Operations Office has prepared an environmental assessment (EA) to analyze the environmental impacts of closing the Waste Calcining Facility (WCF) at the Idaho National Engineering Laboratory (INEL). The purpose of the action is to reduce the risk of radioactive exposure and release of radioactive and hazardous constituents and eliminate the need for extensive long-term surveillance and maintenance. DOE has determined that the closure is needed to reduce these risks to human health and the environment and to comply with Resource Conservation and Recovery Act requirements.

The WCF closure project is described in the DOE Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (Programmatic EIS). DOE determined in the Programmatic EIS Record of Decision (ROD) that certain actions would be implemented and other actions deferred. The ROD states, for the WCF that "Implementation decisions will be made in the future pending further project definition, funding priorities and any further review under the Comprehensive Environmental Response Compensation and Liability Act, or the National Environmental Policy Act." In accordance with 40 CFR Section 1502.2, the WCF EA tiers from the Programmatic EIS. This EA was prepared to provide the further National Environmental Policy Act (NEPA) review identified in the ROD and to address the site specific environmental impacts of the WCF Closure Project.

The EA examined the potential environmental impacts of the proposed action and evaluated reasonable alternatives, including the no action alternative in accordance with the Council on Environmental Quality Regulations (40 CFR Parts 1500-1508). Based on the analysis in the EA, the action will not have a significant effect on the human environment within the meaning of NEPA and 40 CFR Sections 1508.18 and 1508.27.

Selected Action: The selected action includes filling the below-grade vessels and operating compartments of the WCF with grout to prevent future subsidence and maintain the integrity of the closure cap, disconnecting and/or blocking all lines in or out of the WCF to prevent moisture from entering the building, dismantling the superstructure and covering the encased process equipment and rubble with a concrete cap to minimize future infiltration of water. The action is described in detail in Section 2.1 of the EA.

Schedule: Closure activities would begin in Fiscal Year 1996 and continue for three years. The Comprehensive Facility and Land Use Plan states that the INEL boundaries are expected to remain unchanged for up to 100 years. Post-closure activities such as monitoring and inspections would continue for up to 30 years.

SUMMARY OF IMPACTS: The following is a summary of the impacts evaluated in the EA at the referenced pages and presented in relation to the significance criteria described in 40 CFR 1508.27.

1) Beneficial and adverse impacts [40 CFR 1508.27 (b)(1)]:

- Portions of the WCF are interim status hazardous waste units. Analysis indicates that it is impractical to remove all of the waste residues and contaminated equipment and associated structures from the WCF. Therefore, the WCF would be closed in accordance with the closure and post closure requirements that apply to hazardous waste landfills (40 CFR 265.197 and 265.310) (Section 2.1.1, *Closure Activities*, p. 5).

- There are no significant adverse impacts associated with:
  - Closure or post-closure activities (Section 4.1, *Alternative 1 (Proposed): Closure-In-Place*, p. 15);
  - Radioactive emissions and radiation exposure (Section 4.1.1, *Air Emissions*, p. 15);
  - Generation of radioactive and nonradioactive wastes (Section 4.1.9, *Waste Management*, p. 21).

2) Public health and safety [40 CFR 1508.27 (b)(2)]:

- Public exposure to radiation will be below levels known to cause adverse health effects (Section 4.1.8, *Health Effects*, p. 20).

- The highest risk of a cancer fatality in the public resulting from activities associated with the selected action is less than the National Oil and Hazardous Substance Pollution Contingency Plan target risk range of 10^{-4} to 10^{-6} (Section 4.1.8, *Health Effects*, p. 20).

- The annual dose to individual workers is not expected to exceed 1.5 rem/year, a Lockheed Idaho Technologies Company administrative limit (Section 4.1.8, *Health Effects*, p. 20).

3) Unique characteristics of the geographical area [40 CFR 1508.27 (b)(3)]:

- No unique characteristics of the geographical area will be impacted by the selected action (Section 4.1.2, *Geology*, p. 16; Section 4.1.3, *Surface Water*, p. 17; Section 4.1.4, *Groundwater*, p. 17; Section 4.1.5, *Biological Resources*, p. 18; Section 4.1.6, *Cultural Resources*, p. 19; and Section 4.1.7, *Land Use and Visual Resources*, p. 19).

4) Degree to which effects on the quality of the human environment are likely to become highly controversial [40 CFR 1508.27 (b)(4)]:

- The project will result in no significant adverse effects on the quality of the human environment based on accepted methods of evaluation.

5) Uncertain or unknown risks to the human environment [40 CFR 1508.27 (b)(5)]:

- No unique, uncertain, or unknown risks or effects to the human environment will result from the operational or cumulative impacts associated with the project.

6) Precedent for future actions [40 CFR 1508.27 (b)(6)]:

- The project does not set a precedent for future actions that may have significant effects.

7) Cumulatively significant impacts [40 CFR 1508.27 (b)(7)]:

- There are no significant cumulative impacts associated with the project (Section 4.1.10, *Cumulative Impacts*, p. 21).

8) Effect on cultural or historical resources [40 CFR 1508.27 (b)(8)]:

- No cultural resources are anticipated to be impacted (p. 19). The WCF is potentially eligible for listing on the National Register of Historic Places. However, DOE will complete consultation as required by Section 106 of the National Historic Preservation Act before commencement of any activities associated with the selected action (Section 4.1.6, *Cultural Resources*, p. 19 and Section 6, *Coordination and Consultation*, p. 33).

9) Effects on threatened or endangered species or critical habitat [40 CFR 1508.27 (b)(9)]:

- No threatened or endangered species or critical habitat will be affected by the action (Section 4.1.5, *Biological Resources*, p. 18 and Section 6, *Coordination and Consultation*, p. 33.

10) Violation of Federal, State, or Local law [40 CFR 1508.27 (b)(10)]:

- The project will not violate any federal, state, or local law (Section 5, *Permit and Regulatory Requirements*, p. 31).

DETERMINATION: Based on analysis presented in the attached EA, I have determined that this project does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, preparation of an environmental impact statement is not required and I am issuing this finding of no significan impact.

INFORMATION: Copies of the EA and Programmatic EIS are available from: Brad Bugger, Office of Communications, MS-1214, Idaho Operations Office, U. S. Department of Energy, 850 Energy Drive, Idaho Falls, Idaho, 83403-3189, or by calling (208) 526-0833 or the toll-free INEL citizen inquiry line (800) 708-2680.

For further information on DOE's NEPA process contact: Roger Twitchell, NEPA Compliance Officer, MS-1216, U. S. Department of Energy, 850 Energy Drive, Idaho Falls, Idaho, 83403-3189, (208) 526-0776.

Issued at Idaho Falls, Idaho on this _______ day of ____________________, 1996.

J. M. Wilcynski
Manager, Idaho Operations Office

DOE/EA-1149

Draft Environmental Assessment

Closure of the Waste Calcining Facility (CPP-633), Idaho National Engineering Laboratory

Published April 1996

Prepared for the
U. S. Department of Energy
DOE Idaho Operations Office

HELPFUL INFORMATION FOR THE GENERAL READER

Scientific Notation

Scientific notation is used to express numbers that are very small or very large. A very small number will be expressed with a negative exponent, such as 1.3×10^{-6}. To convert this number to the more commonly used form, the decimal point must be moved left by the number of places equal to the exponent, in this case 6. The number thus becomes 0.0000013. For large numbers, those with a positive exponent, the decimal point is moved to the right by the number of places equal to the exponent. The number 1,000,000 can be written as 1.0×10^{6}. English units are used in this document with conversion to Metric units provided below.

Units

cm	centimeter(s)
Ci	curie
ft	foot (feet)
ft^2	square foot (feet)
ft^3	cubic foot (feet)
in.	inch(es)
km	kilometer(s)
km^2	square kilometer(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mi.	mile(s)
$mi.^2$	square mile(s)
mo.	month(s)
mrem	millirem(s) (1/1000th of a rem)
pCi	picocuries (10^{-12})
rem	roentgen equivalent man (measure of radiation exposure)
R	Roentgen
yr.	year(s)

Conversions

Metric to English

To Convert	Multiply By	To Obtain
cubic meters	3.531×10^{1}	cubic feet
cubic meters	1.308	cubic yards
liters	2.64×10^{-1}	gallons
kilograms	2.205	pounds
kilometers	6.214×10^{-1}	miles
meters	3.28084	feet
meters	1.093613	yards
square km	3.861×10^{-1}	square mi.
square meters	1.196	square yards
kilograms	1.0×10^{-1}	tons

English to Metric

To Convert	Multiply By	To Obtain
cubic feet	2.8×10^{-2}	cubic meters
cubic yards	7.646×10^{-1}	cubic meters
gallons	3.785	liters
pounds	4.54×10^{-1}	kilograms
miles	1.609334	kilometers
feet	3.048×10^{-1}	meters
yards	9.144×10^{-1}	meters
square mi.	2.590	square km
square yards	8.361×10^{-1}	square meters
tons	9.07185×10^{2}	kilograms

Units of Radioactivity, Radiation Exposure and Dose

The basic unit of radioactivity used in this report is the curie (Ci). The curie is based on the radionuclide Radium-226, of which one gram decays at the rate of 37 billion disintegrations per second. For any other radionuclide, one curie is the amount of that radionuclide that decays at this rate.

Radiation exposure is expressed as Roentgen (R), the amount of ionization produced by gamma radiation in air. Dose is given in units of "Roentgen equivalent man" or rem, that takes into account the effect of radiation on tissues.

Source of Radiation

Every person living in the United States, or the world, is exposed to sources of ionizing radiation--radiant energy that produces ions as it passes through cells. Three general types of radiation sources are: those of natural origin unaffected by human activities, those of natural origin but enhanced by human activities and those produced by human activities.

The first group includes terrestrial radiation from natural radiation sources in the ground, cosmic radiation from outer space and radiation from radionuclides naturally present in the body. Exposures to natural sources may vary depending upon the geographical location and even the altitude at which a person resides. When such exposures are much higher than the average, they are considered elevated.

The second group includes a variety of natural sources from which the radiation has been increased by human actions. For example, radon exposures in a given home may be elevated because of natural radionuclides in the soil and rock on which the house is built; however, the radon exposures of occupants may be enhanced by characteristics of the home, such as extensive insulation. Another example is the increased exposure to cosmic radiation that airplane passengers receive when traveling at high altitudes.

The third group includes a variety of exposures from materials and devices such as medical x-rays, radiopharmaceuticals used to diagnose and treat disease and consumer products containing minute quantities of radioactive materials. Exposures may also result from radioactive fallout from nuclear weapons testing, accidents at nuclear power plants and other episodic events caused by human activity in the nuclear industry. Except for major nuclear accidents, such as the one that occurred at Chernobyl, exposure to workers and members of the public from activities at nuclear industries is very small compared with exposures from natural sources[a].

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[a] Paraphrased from National Council on Radiation Protection and Measurements, *Ionizing Radiation Exposure of the Populations of the United States*, NCRP Report No. 93, September 1, 1987, p. 1.

CONTENT

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

APS	atmospheric protection system
CEDE	committed effective dose equivalent
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	curie
COPC	contaminants of potential concern
DOE	U. S. Department of Energy
DOE-ID	U. S. Department of Energy, Idaho Operations Office
EA	environmental assessment
EDE	Effective Dose Equivalent
EPA	U. S. Environmental Protection Agency
FONSI	finding of no significant impact
FR	Federal Register
FWS	U. S. Fish and Wildlife Service
HEPA	high efficiency particulate air
HWMA	Hazardous Waste Management Act
ICPP	Idaho Chemical Processing Plant
IDAPA	Idaho Administrative Procedures Act
INEL	Idaho National Engineering Laboratory
LITCO	Lockheed Idaho Technologies Company
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NEPA	National Environmental Policy Act
RCRA	Resource Conservation and Recovery Act

RI/FS	Remedial Investigation / Feasibility Study
ROD	Record of Decision
R	Roentgen
RWMC	Radioactive Waste Management Complex
rem	Roentgen equivalent man
SHPO	State Historic Preservation Officer
SWPPP	Storm Water Pollution Prevention Plan
T&E	threatened and endangered
WCF	Waste Calcine Facility

Environmental Assessment
Closure of the Waste Calcining Facility (CPP-633), Idaho National Engineering Laboratory

1. INTRODUCTION

1.1 Purpose and Need

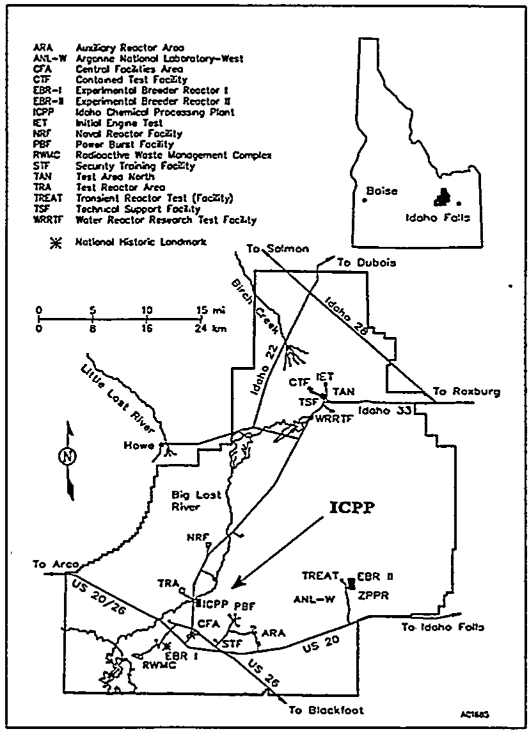

Figure 1. Location of the Idaho Chemical Processing Plant and other Facilities on the Idaho National Engineering Laboratory.

The U. S. Department of Energy (DOE) proposes to close the Waste Calcining Facility (WCF). The WCF is a surplus DOE facility located at the Idaho Chemical Processing Plant (ICPP) on the Idaho National Engineering Laboratory (INEL) (Figure 1). Six facility components in the WCF have been identified as **Resource Conservation and Recovery Act**[b] (RCRA)-units in the INEL RCRA Part A application. The WCF is an interim status facility. Consequently, the proposed WCF closure must comply with Idaho Rules and Standards for Hazardous Waste contained in the Idaho Administrative Procedures Act (IDAPA) Section 16.01.05. These state regulations, in addition to prescribing other requirements, incorporate by reference the federal regulations, found at 40 CFR Part 265, that prescribe the requirements for facilities granted interim status pursuant to the RCRA. The purpose of the proposed action is to reduce the risk of radioactive exposure and release of hazardous constituents and eliminate the need for extensive long-term surveillance and maintenance. DOE has determined that the closure is needed to reduce potential risks to human health and the environment, and to comply with the Idaho **Hazardous Waste Management Act** (HWMA) requirements (see Section 5.2).

[b] Words highlighted in boldface are defined in Appendix A, "Glossary," page 41.

1.2 Background

The WCF began operations in 1963 and solidified over four million gallons of **aqueous** wastes from reprocessing of spent nuclear fuels before it was shutdown in 1981. The calcining process involved evaporating and oxidizing liquid high-level radioactive waste in a high-temperature fluidized bed. Liquid waste from spent nuclear fuel reprocessing was transferred from the ICPP tank farm to the WCF through underground pipelines. The liquid waste, which consisted of dissolved metals, **radionuclides** and nitrates in an aqueous solution, was sprayed into a hot fluidized bed of granular solids in the calciner vessel. As the water evaporated, nitrates were converted to **nitrogen oxides** (NO_x) and the dissolved metals formed oxides and salts. The calcined solids were then pneumatically transferred through underground pipelines to binsets in the Calcine Solid Storage Facility. Process off-gases, NO_x, and water were cooled using a nitric acid solution. The cooled off-gas was passed through silica-gel **adsorbers** to capture radioactive **ruthenium** and passed through two banks of high efficiency particulate air (HEPA) filters before being discharged. Nine calcining campaigns at the WCF produced approximately 77,000 ft^3 of solids.

Successive **decontamination** cycles with corrosive cleaning solutions led to progressive deterioration of processing equipment. Therefore, the WCF was replaced by the New Waste Calcining Facility in 1981. The old WCF is a heavily reinforced concrete structure with about 20,000 ft^2 of floor space involving a ground level and two levels **below-grade**, within a 70 x 110 ft footprint (Figures 2 and 3). Nonradioactive service areas for the facility are located in the above-grade level and are of concrete block and steel construction. The below-grade process system was designed for hands-on maintenance of the process components during periodic routine shutdowns after decontamination.

Currently, moderate to high levels of radioactivity remain in those portions of the WCF that were used to process high-level waste. The WCF's vessels, piping systems, pumps, off-gas blowers and processing cells remain radiologically contaminated since shutdown in 1981. The process equipment condition and successive decontamination cycles with corrosive reagents have left vessel surfaces etched or pitted, providing numerous areas for radioactive contaminants to deposit and adhere. Equipment leaks allowed process materials to form dried deposits on exterior surfaces of vessels and on cell floors that, in many cases, constitute persistent radioactive contamination. After the final shutdown, the WCF calcine system vessels and piping were flushed with high velocity air and the process cells were washed down with water. However, some process residues, silica gel and other potential sources of hazardous materials such as **asbestos**, lead shielding, and radioactive contaminants remain in the facility. The evaporator system in the WCF continued operating after the calciner shutdown to concentrate liquid waste feed to the New Waste Calcining Facility. The evaporator was drained after its final use in 1987. The WCF process equipment and areas have been continuously ventilated by air drawn through the **atmospheric protection system** (APS). The Hot Sump Tank is currently used to collect building heat steam condensate that is transferred to the process equipment waste evaporator system.

The RCRA interim status (Part A) units in the WCF include the evaporator system containing five vessels with associated pumps and piping, and a waste pile containing five used HEPA filters. The units are located in various below-grade, high radiation areas of the WCF. The hazardous constituents cannot be safely removed to achieve clean closure without major modifications to WCF utility, ventilation and off-gas control systems and without decontaminating and shielding work areas to provide access. After identification and review of closure options, DOE proposes to close the units by filling empty spaces in the vessels and the below-grade portion of the building with cement-like **grout**. A **RCRA cap** would

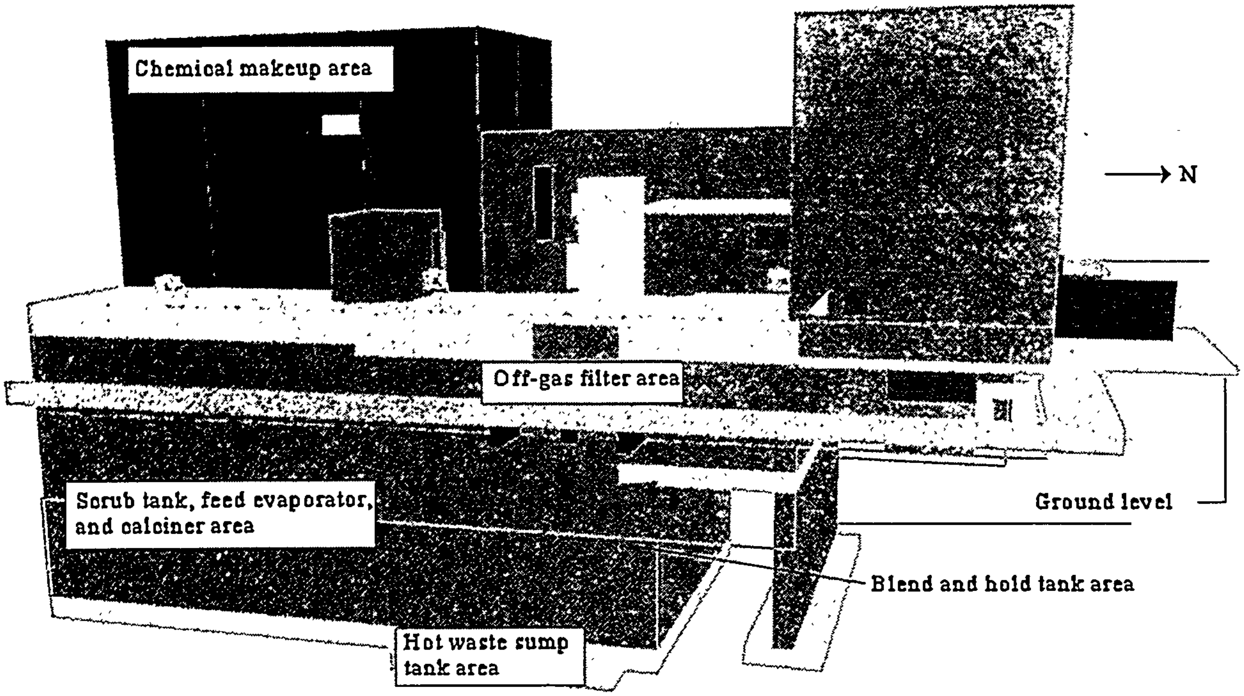

Figure 2. Three-dimensional Schematic of the Outside Structure Showing Different Areas of the WCF.

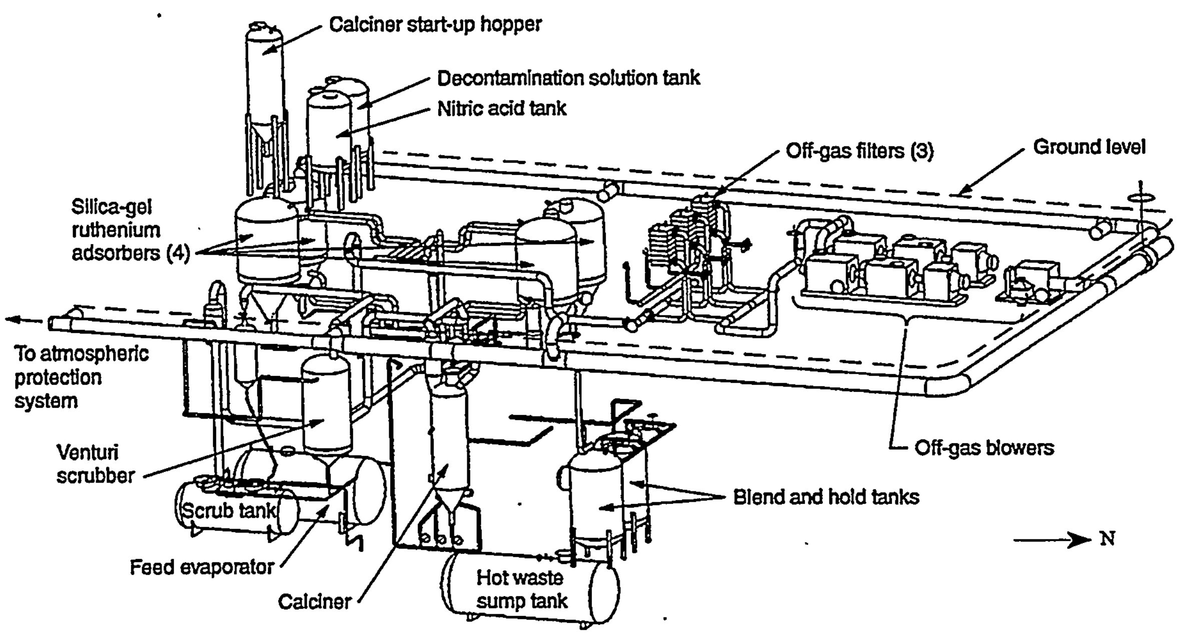

Figure 3. Three-dimensional Schematic of the the Components Inside the the WCF.

then be placed over the WCF. This in-place closure action would meet applicable RCRA requirements (40 CFR 265.111 and 40 CFR 265.310). Simply put, the proposed alternative would result in one large underground solid block of concrete encasing the WCF. The term "Closure" shall be used generically throughout this EA to include the combined building closure including the RCRA closure of interim status units, and closure of the areas not included in the INEL Part A permit application.

The proposed closure would be coordinated with other environmental remediation activities that are being conducted at the ICPP pursuant to the Federal Facility Agreement and Consent Order between DOE, Environmental Protection Agency (EPA) and the State of Idaho. The agreement establishes a procedural framework and schedule for developing and implementing appropriate environmental response actions at hazardous substance release or potential release sites as required by the **Comprehensive Environmental Response, Compensation, and Liability Act** (CERCLA). Actions are performed as necessary at each release site to abate health or environmental concerns in accordance with the **National Oil and Hazardous Substance Pollution Contingency Plan** (NCP).

There are four CERCLA release sites near the WCF that include contaminated soil under and near the WCF foundation, and a below-grade off-gas duct that surrounds three sides of the building. Implementation of the proposed closure may reduce accessibility to some of the release sites but it would not preclude further investigation or remediation, if required. The comprehensive **Remedial Investigation / Feasibility Study** (RI/FS) for the ICPP would consider any residual risks that may exist at release sites outside of the WCF.

The WCF closure project is described in the DOE Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs **Environmental Impact Statement** (Programmatic EIS), DOE/EIS-203-F, April 1995 (DOE 1995a). DOE determined that certain projects evaluated in the Programmatic EIS would be carried out, while other actions were deferred. The **Record of Decision** (ROD) states, for the WCF, "Implementation decisions will be made in the future pending further project definition, funding priorities and any further review under Comprehensive Environmental Response, Compensation, and Liability Act or the National Environmental Policy Act," 60 Federal Register (FR) 28680, June 1, 1995, p. 28685 (DOE 1995b). In accordance with 40 CFR Section 1502.2, the WCF **Environmental Assessment** (EA) tiers from the Programmatic EIS[c]. In its June 1, 1995 ROD, DOE selected the "Modified Ten-Year Plan Alternative" for implementation at the INEL.

This document was prepared in accordance with the requirements of the **National Environmental Policy Act** (NEPA) of 1969 (42 U.S.C.§§ 4321 et seq.), as amended, and implemented by the **Council on Environmental Quality** Regulations [40 CFR Parts 1500-1508], DOE NEPA Implementing Procedures (10 CFR Part 1021) and DOE Order 451.1. This EA will serve as the basis for issuance of a **finding of no significant impact** (FONSI) <u>or</u> lead to a determination that an EIS is required for the proposed action.

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[c] Whenever a broad environmental impact statement has been prepared and a subsequent statement or environmental assessment is then prepared on an action included within the entire program or policy, the subsequent statement or environmental assessment need only summarize the issues discussed in the broader statement by reference and shall concentrate on the issues specific to the subsequent action (see 40 CFR §§ 1502.20; 1508.28).

2. DESCRIPTION OF ALTERNATIVES

The following sections discuss three alternatives for the closure of the WCF at the ICPP. These include a) Closure-in-Place or the proposed action, Section 2.1, b) Closure-by-Removal, Section 2.2 and c) the no action alternative, Section 2.3. DOE believes that the two primary alternatives give an adequate range to describe potential impacts, and result in the intended purpose of the action, that is to bring the WCF to closure. The goals of either Closure-in-Place or Closure-by-Removal are to minimize the need for further maintenance and to control, minimize or eliminate post-closure escape of a hazardous or radioactive waste from the facility. The proposed action, Closure-in-Place, is DOE's perferred alternative.

The Closure-in-Place alternative presented in this EA is a refinement of the WCF Closure Project described in the Programmatic EIS and ROD. The EIS project included phaseout activities to remove some of the residual hazardous materials from the WCF and closure of the permitted tanks and waste pile under RCRA. The remaining facility components would be removed or decontaminated, the subsurface areas filled, and the superstructure demolished as a decontamination and decommissioning action. The EIS alternative would require about nine years and cost $24 million.

Other alternatives that have been considered for WCF closure include: phased removal of process equipment beginning with the silica gel adsorbers and ending with clean closure by removal; and various combinations of removal and grouting (e.g., remove RCRA-units and grout the remaining process equipment and cells). These alternatives offered no apparent advantages and were eliminated from detailed consideration due to estimated higher cost and **occupational radiation doses.**

Closure activities refer to the actual closure of the WCF, ranging from three years for Alternative 1 to nineteen years for Alternative 2. The INEL is controlled by DOE and public access is restricted to public highways and other authorized areas. The INEL Comprehensive Facility and Land Use Plan (INEL Land Use Plan) (DOE 1996a) indicates that the INEL boundaries are expected to remain at present locations and that most of the developed areas of the site will remain industrial areas for up to 100 years in the future. However, post-closure risks addressed in this EA conservatively assume that institutional control would end and residential establishment would occur 30 years following closure. Risks analyzed for post-closure activities were evaluated for 30-year and peak groundwater concentrations. At a minimum, the risk assessment addresses EPA's standard default scenarios of current occupational and future 30-year residential exposures (Rood and Rood 1995).

2.1 Alternative 1 (Proposed): Closure-In-Place

2.1.1 Closure Activities

Lockheed Idaho Technologies Company (LITCO), the U. S. Department of Energy, Idaho Operations Office (DOE-ID), and the Idaho Division of Environmental Quality have agreed that the concept of a risk-based, cost-effective, in-situ or in-place strategy is a reasonable approach to reduce environmental risks. With state agreement, LITCO and DOE-ID have proceeded to explore a RCRA Closure Plan and Risk Assessment for closure-in-place of the WCF. However, to fully comply with

NEPA, DOE-ID is also preparing this EA to evaluate the impact of reasonable closure alternatives and no action before committing significant resources or making an irreversible commitment of resources. In addition, this EA will be used to present the closure-in-place concept and other alternatives to the public.

The proposed action includes filling the below-grade vessels and operating corridors with grout to prevent future subsidence and maintain the integrity of the closure cap, disconnecting and/or blocking all lines in or out of the facility to prevent moisture from entering the WCF, dismantling the superstructure and covering the encased process equipment and rubble with an engineered protective barrier to minimize future **infiltration** of water. A team of engineers from LITCO and independent contractors has indicated that this approach is feasible (Borschel and Helm 1995). The grouting and demolition sequence option would include the following steps:

- disconnect and reroute utility and power
- cap and/or grout lines exiting the facility
- fill vessels and piping with grout
- fill below-grade cells or rooms with grout
- demolish the above-grade superstructure
- place rubble from the above-grade superstructure on top of grout-filled below-grade structure
- fill in the empty spaces in rubble with grout
- install a reinforced concrete cap
- perform post-closure monitoring and maintenance.

For a detailed description of the grouting and demolition sequence refer to Borschel and Helm (1995). Closure activities associated with the Closure-In-Place alternative such as dismantling and capping would take about three years to complete and cost an estimated $9 million.

The interim status waste management units in the WCF are subject to the requirements of Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities for tanks and waste piles in IDAPA 16.01.05.009 [40 CFR 265, Subparts J (Tank Systems) and L (Waste Piles)]. The tank systems in the WCF do not comply with all of the requirements for secondary containment in 40 CFR 265.193 and must be closed. It is not practical to remove the process residues, decontaminate the equipment, and remove the HEPA filters in the waste pile. Therefore, the WCF would be closed-in-place accordance with the closure and post closure requirements that apply to hazardous waste landfills (IDAPA 16.01.05.009 [40 CFR 265.197 and 265.310]).

The proposed sequence minimizes worker exposure to radiation and complicated and labor-intensive methods of debris removal and stabilization. Tanks would be grouted through existing lines accessed from uncontaminated areas. Contaminated cells would be grouted without personnel entry, and, entry of other, less contaminated areas such as stairwells and corridors would be minimized. All above-grade structures would be demolished and covered with a reinforced concrete cap. This concrete cap would extend about 5 ft beyond the footprint of the existing WCF to reduce the amount of contact between infiltrating water and the walls of the WCF solid concrete block.

The goals of the WCF grouting and capping action are to reduce the long-term migration of liquid through the areas that contain waste residue, function with minimum maintenance, and to reduce settling and subsidence that could affect the integrity of the cap. The cap and appropriate grading and asphalt paving around the WCF would divert stormwater **run-off** to the ICPP stormwater collection system.

The cap and drainage controls would reduce the potential for deterioration from **erosion** and abrasion, and would prevent future intruders from coming into contact with the hazardous and radioactive constituents encased in the WCF. In addition, the ICPP will be a controlled and restricted area for many years following closure due to ICPP's Spent Nuclear Fuel mission and on-going CERCLA activities.

The EPA (1991) recommends use of a three-layer design for RCRA covers, consisting of a top layer, a drainage layer and a low permeability layer. The standard three-layer cover was determined to be impractical for the WCF closure because the size required to achieve the appropriate slope and grade would have covered nearby roads, utility tunnels, waste storage facility berms and CERCLA sites. However, other designs may be used if they can be demonstrated to be equivalent to the recommended RCRA design. Keck (1995) evaluated three designs for the cover:

- a standard three-layer RCRA cover
- a vegetated soil layer
- a sloped reinforced concrete surface.

The study determined that a sloped concrete cap would meet all the RCRA performance objectives at a cost almost half that of the standard RCRA cap and slightly less than the soil cover (Keck 1995). Properly formulated and cured reinforced concrete would have strength, low permeability, durability, low maintenance, and freeze, thaw, cracking and abrasion resistance. The footprint of the sloped concrete cap would allow access to the CERCLA release sites outside the WCF, and equipment access to other nearby facilities.

2.1.2 Post-Closure Activities

In addition to the WCF, the ICPP contains several known hazardous material release sites that are undergoing review and corrective action under CERCLA. Some of the CERCLA sites are expected to be closed with waste in place and to require maintenance and monitoring for many years in the future. To eliminate duplication of effort and cost, post-closure cap maintenance, groundwater monitoring, notices, certifications, and security for the WCF would be assumed by the CERCLA program at the ICPP. The post-closure maintenance and monitoring period for the WCF would continue for at least 30 years. The concrete cap would be inspected at least annually for cracks and loss of degradation of the joint seals between the sections. Identified cracks and deteriorated seals would be repaired. Groundwater monitoring will be performed consistent with the Record of Decision for the comprehensive CERCLA RI/FS for the ICPP.

2.1.3 Waste Management

The Closure-in-Place alternative would minimize the generation of waste requiring treatment, storage or disposal at other facilities. The below-grade components such as tanks, ductwork, and sumps and areas such as rooms, cells, corridors, and stairwells would be filled with grout and left in place. Before final grouting of the below-grade areas, the process equipment located in relatively uncontaminated above-grade rooms would be surveyed for radioactive contamination and decontaminated as necessary, and removed for salvage or cut apart and placed on the floor or in various low-radiation below-grade areas to be grouted in place.

After the below-grade areas are filled with grout and the grout is cured, the roofing material would be removed and the walls broken down. The roofing is comprised of deep corrugated steel sheets covered with asbestos-containing roofing felts and sealants. The asbestos materials in the roof are intact and **nonfriable**. Some areas of the roof are slightly contaminated with radioactivity from deposition of airborne particulates. The WCF above-grade walls are constructed of 12-in. concrete blocks. Following radiation surveys and hot spot stabilization with paint or adhesive fixatives, the roof and walls would be dismantled using a backhoe with a crushing and shear jaw attachment or similar equipment. The walls and roof structure would then be further **sized** and placed on the floor over the grouted and cured below-grade structure. Suspension of radioactive or asbestos particles would be controlled by application of water or other dust suppressants during the dismantling and sizing processes. Track mounted equipment, such as bulldozers, would be used to level and compact the debris, and grout would be applied to fill empty spaces and encase the rubble. The entire structure would then be covered by a reinforced concrete cap.

2.2 Alternative 2: Closure-By-Removal

This alternative would provide RCRA closure of the WCF by removing the remaining hazardous and radioactive materials and waste, thereby eliminating the need for post-closure care at the WCF site. The closure process would involve removing radioactive and hazardous process residues using dry and wet decontamination techniques, followed by sequential area decontamination, dismantlement and removal of process equipment, decontamination or stabilization of contamination on structural components, demolition, and disposal in approved waste disposal sites. The below-grade concrete footings, foundations, and floors would be left in-place. In addition, the site would be restored to a grade and contour consistent with the surrounding area by backfilling with clean soil. The removal process would entail a similar series of activities that would be performed in each room, cell and corridor of the WCF. The general sequence of activities includes:

- Modify ventilation system to maintain a negative pressure in area vessels and work areas, and to ensure appropriate off-gas HEPA filtration for particulate control.
- Upgrade and/or reconnect utilities to provide light and power to work areas.
- Conduct radiological surveys and decontaminate or shield hot spots.
- Install and/or connect process equipment decontamination systems such as solution tanks, pumps, piping, and collection tanks.
- Install rigging equipment to remove large or heavy pieces of process equipment.
- Perform in-situ treatment or decontamination using appropriate wet remote, wet contact, dry remote, dry contact and removal actions. Transfer decontamination solutions to storage or treatment tanks, collect dry waste for appropriate storage, treatment and disposal.
- Dismantle and remove waste, debris, process equipment, instrumentation, shielding, and wall liners.
- Size and package materials, and transport packages to appropriate storage, treatment or disposal facilities.
- Decontaminate and remove access and rigging equipment.
- Perform final area cleaning and inspection.
- Isolate cleaned area from active work areas.
- Backfill cleaned areas with soil.

Preliminary waste characterizations of the WCF indicate that several different **waste streams** would be generated during the Closure-By-Removal process. A summary of the estimated waste stream volumes and treatment and disposal options is presented in Appendix C, Table 10.

A more detailed description of a Closure-By-Removal alternative is presented in the Raytheon (1994) study. This alternative is estimated to require about 19 years to complete and cost about $150 million.

2.3 Alternative 3: No Action

Under this alternative, closure of the WCF would not occur. The existing levels of surveillance, maintenance and essential support systems such as ventilation, filtration, inspection and radiation monitoring to protect workers in nearby facilities would continue. No funding would be requested to perform increasing building maintenance to offset deterioration as the building ages. Therefore, no action could eventually result in failure to maintain control of radioactive and mixed hazardous material resulting in an endangerment to health, safety and the environment or would require increased funding for building maintenance.

The No Action Alternative would consist of an indefinite period of continued monitoring and inspection costing about $400,000 annually and an additional amount for building maintenance. The INEL Land Use Plan (DOE 1996a) indicates that the ICPP would remain an industrial corridor with no public access for up to 100 years in the future. Beyond 100 years, it is assumed that public access to the ICPP would continue to be restricted.

3. AFFECTED ENVIRONMENT

The INEL is a 890 square mile DOE research facility located on the Eastern Snake River Plain in southeastern Idaho (Figure 1). The physical and biological environment of the region in general and the INEL in particular has been extensively described in the Programmatic EIS. All land within the INEL is controlled by DOE, and public access is restricted to public highways, DOE-sponsored tours, special use permits and the Experimental Breeder Reactor I National Historic Landmark. The INEL occupies portions of five Idaho counties. The area surrounding the INEL is classified under the Clean Air Act as a **Prevention of Significant Deterioration** Class II area, an area with reasonable or moderately good air quality that allows moderate industrial growth.

The area immediately surrounding the ICPP is dominated by crested wheatgrass (*Agropyron cristatum*), a European **perennial** grass seeded in disturbed areas to provide cover and hold soil. No known endangered or threatened species nests or inhabits the INEL. However, the bald eagle (*Haliaeetus leucocephalus*), a threatened species, has been observed wintering on or near the INEL (Martin 1995).

The ground surface of the ICPP is mostly flat. A 30 ft layer of mixed sediments covers a deeper layer of underlying **basalt**. A grayish-brown gravelly silt loam, derived from loess mixed with **alluvium** from the Big Lost River, makes up the topsoil. Gravels occupy 50 to 75 percent of the surface area, and the erosion hazard is slight. The soil is moderately permeable, well drained and generally non alkaline. However, alkalinity increases with depth and hardpan zones may occur at depths from 20 in. to 20 ft. Because groundwater supplies more than 50 percent of the drinking water consumed within the eastern Snake River Plain and an alternative drinking water source or combination of sources is not available, the EPA designated the Snake River Plain **Aquifer** a **sole-source aquifer** in 1991 (56 FR 50634, 1991).

Surface water flows on the INEL consist mainly of three streams draining intermountain valleys to the north and northwest of the site: the Big Lost River, the Little Lost River and Birch Creek. Flows from these surface waters seldom reach the INEL because of irrigation withdrawals upstream. However, the Big Lost River and Birch Creek sometimes flow onto the INEL following the irrigation season or during high water years. The WCF is about 0.5 mi. from the Big Lost River channel and about 11 ft above the riverbed elevation. The ICPP area is protected from flooding by a control system constructed on the Big Lost River in 1958 and enlarged in 1984. There is no history of flooding at the ICPP.

The Snake River Plain Aquifer underlies the ICPP at a depth of approximately 450 ft. Liquid low-level radioactive and dilute chemical wastes were discharged to the subsurface through **injection wells** at the ICPP and the nearby Test Reactor Area between 1952 and 1984. Liquid waste disposal by injection has since been replaced by waste reduction, treatment and disposal to surface evaporation and percolation ponds. Water withdrawn from the aquifer near the ICPP for facility processes and drinking water meets the State of Idaho drinking water standards for all constituents.

A 1986 field study identified three perched water bodies that occur at depth zones from about 30 ft to 322 ft beneath the ICPP, and extend laterally as far as 3,600 ft. Overall, the chemical concentrations, shape and size of these perched water bodies have fluctuated over time in response to the volumes of water discharged to the ICPP **percolation** ponds (Irving 1993).

The 1990 census indicated the following populations, in parentheses for cities in the region: Idaho Falls (43,929), Pocatello (46,080), Blackfoot (9,646), Arco (1,016) and Atomic City (25) (U. S. Department of Commerce, Bureau of Census 1990). Approximately 127,554 persons reside within a 50 mi. radius of the ICPP. However, no permanent residents reside on the INEL.

The WCF is located within the perimeter fence of the ICPP (Figure 4). The area within the fence is occupied by buildings, roads, and walkways. Currently, the WCF is structurally sound. Remote inspections of the cell walls and floors reveal no serious signs of physical deterioration. However, inspections are limited by the capabilities of the remote equipment. While cracks have not been observed on the cell floors, there are signs of in-leakage through small cracks in the cell upper walls. The integrity of the ventilation room floor was compromised by holes drilled to drain water from the building. The piping and instrumentation is in poor condition. Freezing conditions occurred in the facility when the steam supply system was interrupted in the late 1980's and resulted in burst piping and instrumentation failures. Only piping and instruments necessary to meet interim status compliance and safety documentation have been maintained.

The facility contains an estimated 14 ft^3 of process residues representing between 2,000 and 3,000 curies of radioactive contamination (Appendix B, Tables 7, 8, and 9). The residues are distributed in about 17,370 ft^3 of process equipment and structural materials that must be handled as radioactive or mixed hazardous waste if removed from the WCF (Appendix C, Table 10). Therefore, the building and vessels are maintained under a negative pressure to prevent the dry radioactive and mixed radioactive materials from escaping to the operating areas and to the environment. The ICPP main stack blower system and HEPA filters meet the ventilation and emission control needs of the shutdown facility.

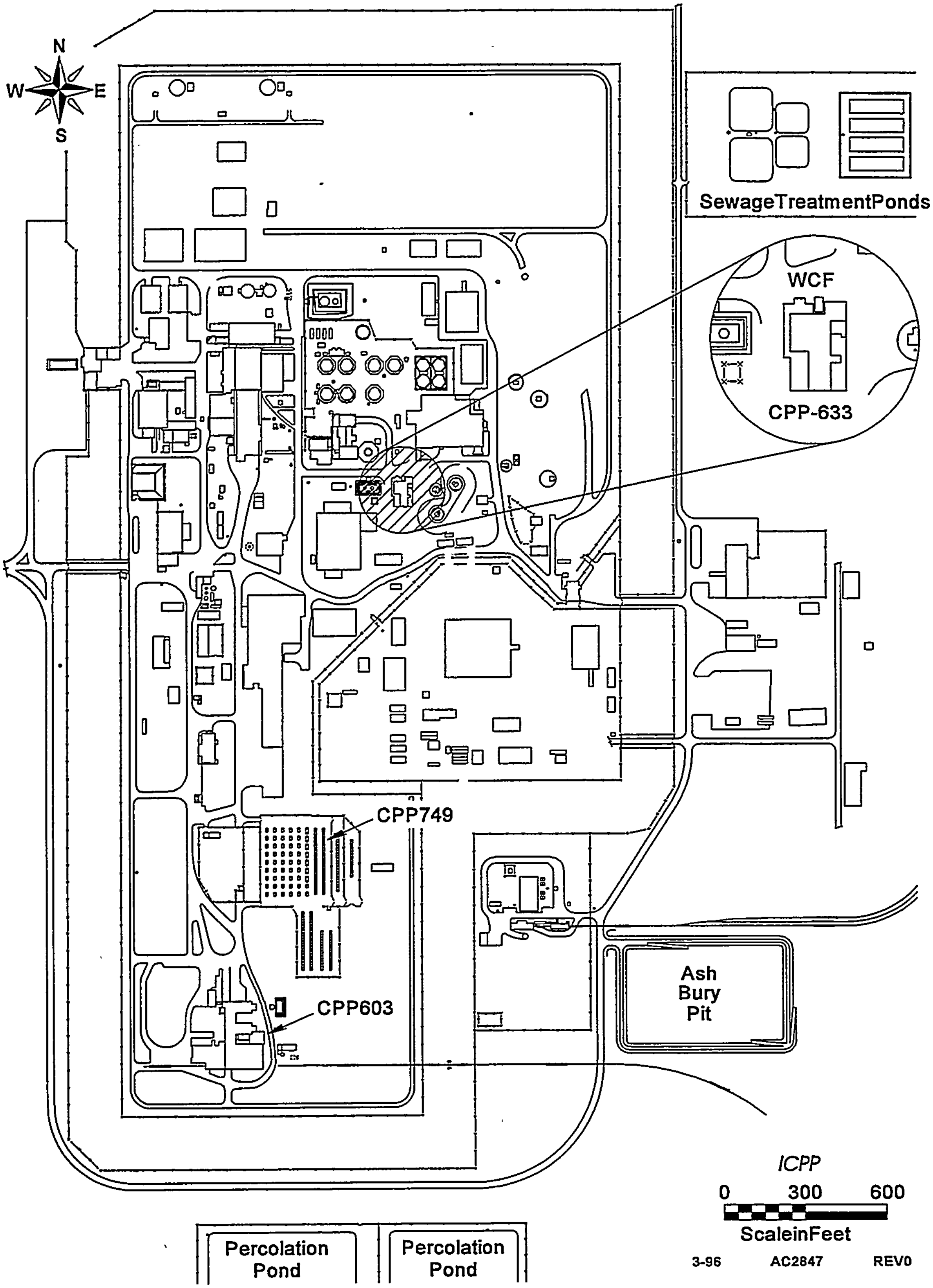

Figure 4. Location of the WCF within the Perimeter of the ICPP.

4. ENVIRONMENTAL CONSEQUENCES

This section describes the environmental consequences to the environment of the INEL and surrounding region that may result from the closure of the WCF. In addition, the section describes the potential consequences associated with each alternative. The environmental impacts associated with the Closure-in-Place are discussed in Section 4.1; Closure-by-Removal, Section 4.2; and No Action, Section 4.3. Section 4.4 compares the impacts of the alternatives.

Closure includes those activities such as filling vessels and below-grade cells with grout, demolishing above-grade structure, and installing the cap described in Section 2.1.1 that are necessary to complete the WCF closure. Post-closure activities include maintenance and environmental monitoring for up to 30 years. Institutional control would restrict access to 100 years and beyond.

4.1 Alternative 1 (Proposed): Closure-In-Place

4.1.1 Air Emissions

Closure Activities. Although the WCF has been idle since 1981, the ventilation system connection to the ICPP atmospheric protection system (APS) has remained operational for contamination control purposes. Approximately 10,800 ft^3/minute of off-gas is vented from the WCF through three streams. Two streams maintain the required vacuum on the calciner process vessels, waste vessels, hot sumps, sample stations and other primary confinement systems. These streams are filtered by a primary HEPA filter before being vented to the APS. The third stream, which ventilates buildings and cells, flows from formerly occupied operating areas, through the process cells and out to the APS. The ICPP APS controls particulate emissions with a fiberglass bed prefilter and a HEPA filter. The filtered off-gas is released to the 250 ft ICPP main stack.

The sequence of WCF closure events described in Section 2.1.1 would reduce radionuclide resuspension and control emissions during the closure process. Potential emission conduits would be sealed, and existing ductwork to the ICPP APS would be grouted in stages to provide for continued collection, filtration and monitoring of air that would be expelled during most of the closure sequence. Contaminated surfaces in the above-grade portions of the facility would be decontaminated or stabilized with fixatives before demolition. The nature of the closure process, such as slowly filling the piping and vessels with a wet grout mixture, is intended to fix and hold radioactive residues with minimal resuspension into the air.

Potential radionuclide emissions and associated doses resulting from the closure of the WCF were estimated by Staley (1996). The release scenario assumes that 0.002 percent of the radionuclide inventory estimated to remain in the WCF (Table 1) would be resuspended and transported to the WCF primary HEPA filter or the ICPP APS during a single year (DOE 1994). The grouting process would reduce resuspension, and any resuspended particulate must travel through a complex path of ducts and vessels before contacting the WCF or APS filters. Much of the resuspended material would likely settle in the ducts and vessels before reaching the control equipment.

Table 1. WCF Radionuclide Inventory and Releases During Closure-In-Place[a].

Nuclide	Curies Available[b] (Ci)	Curies Released to Atmospheric Protection System (Ci)	Curies Released to Main ICPP Stack (Ci)
Cs-137	1.38×10^3	2.77×10^{-2}	8.30×10^{-8}
Ba-137m[c]	1.38×10^3	2.77×10^{-2}	8.30×10^{-8}
Sr-90	1.21×10^3	2.43×10^{-2}	7.28×10^{-8}
Y-90	1.21×10^3	2.43×10^{-2}	7.28×10^{-8}
Pu-238	2.40×10^1	4.80×10^{-4}	1.44×10^{-9}

Source: Staley 1996.

a. Annual release during a single year.

b. Demmer and Archibald (1995), daughter products Ba-137m and Y-90 added.

c. m = metastable

The CAP-88 computer code (EPA 1990) was used to estimate the potential dose to the public from radionuclide emissions generated during closure activities. Meteorological data collected at the upper level of the INEL meteorological tower, about 2 mi. north of the ICPP (Grid 3), were used as input to the CAP-88 code. The potential receptor is located where the maximum **off-site** dose occurs. That location is an actual residence 27.2 mi. northeast of the ICPP (DOE 1995c).

The **Committed Effective Dose Equivalent** (CEDE) resulting from the airborne releases is estimated to be 1.5×10^{-9} mrem and 2.5×10^{-8} **person-rem** for the **maximally exposed individual** near the INEL and the public residing within 50 mi. of the ICPP, respectively (Staley 1996). The estimated dose to the maximally exposed individual is well below the EPA's approval to construct application threshold of 1.0×10^{-1} mrem found in 40 CFR 61, Subpart H. This dose to the maximally exposed individual can be compared to the CEDE from the combined ICPP main stack emissions of 1.1×10^{-5} mrem in 1994, or the total CEDE from all ICPP operations of 3.0×10^{-4} mrem in 1994 (DOE 1995c) (see Section 4.1.8 for a discussion of health effects associated with these doses).

The RSAC-5 computer code was used to estimate the potential dose to the maximally exposed individual on-site (worker) who is about 328 feet from the ICPP main stack. The **Effective Dose Equivalent** (EDE) to the worker is estimated to be 1.4×10^{-7}.

Post-Closure Activities. No post-closure air emissions or associated impacts are expected.

4.1.2 Geology

Closure Activities. The Closure-in-Place alternative would only have minor, localized impacts on the geology of the INEL site. Closure activities would be of short duration and soil loss would be reduced by keeping the areas of surface disturbance small and by utilizing engineering practices such as dust supression, storm water runoff control including sediment catchment basins, slope stability and soil stockpiling with wind erosion protection.

Post-Closure Activities. Subsidence of soil due to the increased weight from filling the structure with grout is calculated to be about 0.6 in. because the WCF is on basalt bedrock (Matzen 1995). Therefore, excessive settlement is not expected and failure of soils beneath the WCF by plastic deformation is unlikely (Matzen 1995).

The distribution of earthquakes at and near the INEL site from 1884 to 1989 clearly shows that the Eastern Snake River Plain has a remarkably low rate of **seismicity** (DOE 1995a). In the event of an earthquake the concrete block and cap could be expected to crack. However, this would be less severe than the conservative assumptions used to estimate bounding groundwater concentrations of contaminants from the closed WCF (see Section 4.1.4). Therefore no seisimic hazards are anticipated for the Closure-in-Place alternative.

4.1.3 Surface Water

Closure Activities. The Closure-in-Place alternative would not have any direct impacts to the Big or Little Lost Rivers or Birch Creek. The distance from the WCF to the Big Lost River channel, local topography between the WCF and the channel, infiltration rates of the surface alluvium and basalt and intermittent to non existent flows in the Big Lost River channel all suggest that, under normal flows, the Big Lost River would not have any effect on the WCF -- nor the WCF on the Big Lost River. During closure activities, water and wind erosion would be controlled by adhering to a Storm Water Pollution Protection Plan.

Post-Closure Activities. Normal flows in the Big Lost River would not have any impact on the WCF or solid concrete block. Koslow and Van Haaften (1986) evaluated the potential consequences of a maximum flood coupled with a MacKay Dam failure. The probability of a occurrence for this combined event is estimated at 10^{-6}. This event would result in flood water within the ICPP-controlled area up to about 4,916.6 ft above mean sea level (LITCO 1995). The elevation of the WCF is about 4,916 ft. However, low water velocities and shallow water depths resulting from this flood would not be sufficient to cause serious erosion damage to backfill around buildings. Therefore it is unlikely that any damage to the concrete-encased WCF or leakage of radionuclide or hazardous chemicals would occur. Also, the cap would not be overtopped. Hence, no discernible impacts on regional surface water quality would be expected from the Closure-in-Place alternative.

4.1.4 Groundwater

Closure Activities. Impacts from contaminants leaching to the soil surrounding the WCF are unlikely because the methods of filling the below-grade portion of the WCF would leave the above-grade superstructure, including the roof, intact until the below-grade portion is filled. In addition, an asphalt apron around the facility would reduce infiltration of water.

Post-Closure Activities. Post-closure impacts to groundwater would occur if contaminants escape from the solid concrete block and migrate to the aquifer. Rood et al, (1996) calculated the maximum concentration of the **contaminants of potential concern** (COPC) by estimating the rate of leaching from the WCF to the groundwater. Individual peak groundwater concentrations for the COPC and their transit time to groundwater are shown in Appendix D, Table 12. The cancer risk from exposure to these COPC is discussed in Section 4.1.8, "Health Effects."

Potential risks[d] to human health from exposure to the COPC at the WCF were evaluated using a two-phased approach (Rood 1994). The first phase used the groundwater screening model and computer code, GWSCREEN (Rood 1994) and conservative assumptions, (see box) to estimate groundwater concentrations of COPC. Screening model values of four COPCs exceeded the lower threshold of the NCP target risk range of 10^{-6} (Rood et al. 1996). These are: Np-237, Pu-239, Pu-240 and Tc-99 (Appendix D, Table 13). No metals or RCRA regulated constituents exceeded the threshold of the NCP target risk range, therefore they were not included in the refined risk assessment. The second phase included evaluation of exposure pathways for the radionuclides exceeding the NCP target risk range with more realistic assumptions (see box) and the refined risk model, PORFLOW.

<u>Screening Assessment Assumptions</u>

- No credit was taken for the cap that would prevent water infiltration.
- The entire waste inventory was assumed to be concentrated in a volume equal to the calciner vessel in the WCF rather than dispersed over a large volume and area.
- The calciner vessel would be oriented with the long side parallel to groundwater flow to facilitate maximum contaminant migration.
- No credit was taken for the containment of the calciner vessel.
- No credit was taken for the grout within or surrounding the calciner vessel.
- No credit was taken for the concrete floors or walls of the WCF.
- The contaminants of potential concern were assumed to be homogeneously mixed in a surface soil media that occupies a volume equal to the calciner vessel rather than in impermeable grout.
- Groundwater concentrations of the contaminants of potential concern were evaluated at the receptor's well located at the down gradient edge of the WCF.

<u>Refined Risk Assessment Assumptions</u>

- The cap and concrete block would remain intact for 100 years.
- Beyond 100 years, cracks would allow unimpeded water flow through the cap and concrete block.
- Specific hydraulic transport parameters such as conductivity, pore size, moisture content, sorption, diffusion, etc. for waste, concrete, sediments and basalt were used to model waste migration.

The maximum groundwater concentrations of the metals and radionuclides calculated by the screening and refined risk models are below the EPA primary or secondary drinking water standards and guidelines (see Appendix D, Table 14). The calculated gross **alpha particles** would not exceed 15 pCi/l, the EPA public drinking water standard (40 CFR 141). The summation of the estimated **beta particle** concentrations divided by the proposed drinking water standards would be less than one, indicating a calculated gross beta particle concentration below the 4.0 mrem/yr. limit (see Appendix D).

4.1.5 Biological Resources

Closure Activities. The Closure-in-Place alternative would not have any direct impacts on the flora, fauna, endangered species, or ecology of the INEL site. Closure activities would not affect the existing environment outside the ICPP fence. The area inside the ICPP fence has been disturbed by activities

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[d] A general discussion of the risk assessment methodology used in this EA is presented in Appendix D.

such as paving and building. The Environmental Science and Research Foundation has determined that a biological assessment would not be required for this alternative (Reynolds 1996).

Post-Closure Activities. Long-term impacts to biological resources from the Closure-in-Place alternative would consist of continued lost productivity from the lands covered by the cap, about 0.2 acres.

4.1.6 Cultural Resources

Closure Activities. The Closure-In-Place alternative would destroy a structure which is potentially eligible for listing in the National Register of Historic Places. The American Nuclear Society named the WCF a Historic Nuclear Landmark in 1993. This award acknowledges the contribution WCF made to the nuclear industry by successfully providing "an essential contribution to, or basis for, subsequent peaceful application of nuclear technology or nuclear energy, and has been a first-of-a-kind, or provided an important new departure" (INEL 1995).

The Closure-in-Place alternative would proceed only in accordance with all of the substantive requirements resulting from consultation between the DOE-ID, the Idaho State Historic Preservation Officer (SHPO) and other interested parties. This consultation is required by Section 106 of the National Historic Preservation Act and will be completed before initiation of any of the activities (see Section 6). In the event that bones, chips/flakes, "arrowheads", charcoal stained soil, or other unusual materials are discovered during excavating activities, the INEL Stop Work Authority would be invoked and all work temporarily halted until the INEL Cultural Resource Office gives a clearance or develops a mitigative action plan.

Post-Closure Activities. No long-term impacts are expected to cultural resources.

4.1.7 Land Use and Visual Resources

Closure Activities. The WCF is located within the ICPP fence, an area that has been highly disturbed by paving and building. Closure activities such as grouting and capping would not affect the current land use or visual resources near the ICPP.

Post-Closure Activities. Most of the INEL is open space that DOE has not designated for specific uses. The INEL Land Use Plan (DOE 1996a) indicates that the ICPP would remain an industrial area with no public access for 100 years in the future. Facilities and operations use about 2 percent of the total INEL site, primarily for nuclear energy research and support operations. Public access to the ICPP and most other facility areas is restricted. Land use plans and policies for the ICPP and other INEL facilities identify continued energy research, waste management and environmental restoration as the major INEL business activities through the foreseeable future (DOE 1996a). The Closure-in-Place alternative is included in the waste management and environmental restoration missions of the INEL. In addition, it is consistent with current and forseeable land use plans.

Long distance views are of the INEL's rolling hills, buttes and volcanic outcrops; and of the Lemhi, Lost River and Bitterroot mountain ranges that border the INEL on the north and west. The ICPP is located on a relatively flat area and is surrounded by undeveloped land that supports a shrub-grassland vegetation. Other INEL industrial facilities visible from the ICPP include the Central Facilities Area, Test Reactor Area, Naval Reactors Facility and Power Burst Facility. The closure of the WCF would not affect scenic views or aesthetic values because only the cap would be above-grade level and inside the ICPP complex. If the ICPP complex is removed in the future, the WCF cap would become an inconspicuous landmark.

4.1.8 Health Effects

Closure Activities. The purpose of this section is to present the potential health effects to both workers and the public that would result from exposure to hazardous and radioactive material.[e] Potential risks and hazards associated with the COPC at the WCF were assessed for occupational or worker exposure and residential or public receptors. Only the airborne and external exposure pathways were evaluated for closure activities.

For airborne releases from the WCF, health effects were assessed for the maximally exposed individual located at an actual residence near the INEL site boundary and for the population within 50 miles of the ICPP. It was assumed that airborne exposure would result from particulate matter suspended in escaping air as the WCF vessels and below-grade portions were filled with grout. Therefore, the airborne pathway would be short-term, lasting only as long as the grouting operation.

It is postulated that the air doses from emissions identified in Section 4.1.4 would result in a very small increase in fatal cancer risk to the maximally exposed individual of 7.5×10^{-16}. In the affected population of 127,554 persons residing within a 50 mi. radius of the ICPP, the increased risk of a cancer fatality is also very small or 1.3×10^{-11}. This is equal to an additional fatal cancer risk of 1.0×10^{-16} per person. The increased risk of an individual in the general population developing cancer from this closure activity is about 1 in 10 quadrillion.

In this population, an average of 37.9 cancer deaths (about 1 in 3,369) from all other sources occurs each year, based on 1987 through 1991 National Cancer Institute data from Idaho (National Cancer Institute 1994). The cancer risks of the Closure-in-Place alternative would be negligible, causing only a 3.4×10^{-11} percent statistical increase in cancer deaths in the surrounding population. The annual dose to individual workers would not be allowed to exceed the 1.5 rem/year DOE administrative limit (DOE-ID 1995). The estimated collective dose from external radiation to workers associated with proposed closure actions is estimated to be 20 person-rem.

Post-Closure Activities. The 100-year future occupational and residential exposures scenarios were evaluated using the refined risk assessment model for those radionuclides where the risks were greater than the lower NCP target risk range of 10^{-6}. Health effects associated with the external exposure and groundwater ingestion pathways are associated with post-closure activities. Risks associated with ingestion of groundwater contaminated with COPC remaining at the WCF were calculated by estimating the rate of leaching from the soil to groundwater. The external pathway was evaluated for exposure from radionuclides remaining in the WCF to a receptor standing over the WCF cap. This exposure pathway was evaluated both for a worker and a maximally exposed individual.

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[e] Radiation exposure and its consequences are topics of interest to the general public near nuclear facilities. For this reason, this EA places more emphasis on the consequences of exposure to radiation than on other topics, even though the effects of radiation exposure evaluated in this EA are small. Refer to "Helpful Information for the General Reader" for an explanation on the measurement of radiation and the different sources of radiation (p. iii).

Based on the screening analysis peak groundwater concentrations of contaminants discussed in Section 4.1.4, only groundwater ingestion from exposure to Pu-239, Pu-240, Tc-99 and Np-237 presented risks greater than the 10^{-6} lower limit of the NCP target for allowable risk range (Appendix D, Table 15). Risks from the other radionuclides were below the 10^{-6} lower NCP target and noncarcinogenic risks from metal ingestion were less than the **hazard index** of 1 (see Appendix D, Tables 15 and 16). Using the refined risk assessment, risks from Pu-239, Pu-240 and Np-232 would also be less than the 10^{-6} lower limit of the NCP target risk range and Tc-99 would be within the NCP target risk range of 10^{-4} to 10^{-6}. The total cancer risk due to groundwater ingestion from these four radionuclides would be 2×10^{-6} (Appendix D, Table 15). Therefore, the radionuclides and hazardous constituents remaining in the WCF would not pose an unacceptable risk to human health or the environment during the post-closure period.

4.1.9 Waste Management

The Closure-in-Place alternative would generate only a few cubic feet of waste material, mostly from anti-contamination clothing, grout hoses and connections, and grout truck clean-out residue. The anti-contamination clothing would be volume reduced by compaction or incineration at the Waste Experimental Reduction Facility and disposed of at the Radioactive Waste Management Complex (RWMC). Uncontaminated waste such as hoses, forms, and grout residue that cannot be reused or recycled would be disposed of in the INEL landfill at CFA or in designated grout truck clean out areas.

The Closure-in-Place alternative would encase essentially all of the contents of the WCF, including the radioactive and hazardous materials listed in Appendix B, Tables 8 and 9 in a solid concrete block. Following capping, the closed WCF would be managed in accordance with the post-closure care requirements that apply to RCRA landfills (40 CFR 265.310). The total estimated volume of the encased facility and its contents is 5,000 yd^3.

4.1.10 Cumulative Impacts

The radiological releases from current and future INEL operations (DOE 1995a) to the worker, maximally exposed individual, and the population within 50 miles of the INEL are identified in Table 2. The incremental and cumulative average annual dose includes emissions associated with the WCF Closure. Based on exposure for the cumulative annual dose, the risk to an INEL worker at the location of highest dose from airborne radionuclide emissions would cause an estimated increase lifetime chance of developing fatal cancer of less than 1 in 526,000. The annual occupational radiation dose received by the entire INEL workforce (about 10,000 workers) would result in less than 1 fatal cancer. For comparison, the natural lifetime incidence of fatal cancers in the same population from all other causes would be about 2,000 (DOE 1995a). Radiological dose impacts to the maximally exposed individual were conservatively summed to derive **cumulative impacts**, although the location of the maximally exposed individual may be different for each source. This conservatism serves to establish the upper-bounding dose. Despite this conservatism, the dose to the maximally exposed individual is low (Table 2) and would result in a fatal cancer risk for the maximally exposed individual of less than 1 occurrence in 312,000. A one-year cumulative dose from existing and planned INEL operations would produce about 0.002 additional fatal causes in the entire surrounding population. For perspective, about 37.9 cancer deaths occur from all other sources each year according to the National Cancer Institute (1994). Radiological releases resulting from the proposed action, present INEL operations, and other proposed

Table 2. Radiological Air Emission Baseline and Cumulative Dose.

	Annual Dose		
	INEL Baseline[a]	Incremental due to the WCF[b]	Cumulative Dose from Existing and Proposed INEL Activities[c]
On-Site MEI[d]	3.2×10^{-1} mrem	1.4×10^{-7} mrem	4.6×10^{-1} mrem
Off-Site MEI	5.0×10^{-2} mrem	1.5×10^{-9} mrem	6.3×10^{-1} mrem
Population within 50 miles[e]	3.0×10^{-1} person-rem	2.5×10^{-8} person-rem	2.9×10^{0} person-rem
Natural Background	3.5×10^{2} mrem		3.5×10^{2} mrem

a. Programmatic EIS, Volume 2, Table 5.12-1, p. 5.12-7 (DOE 1995a.).
b. See Section 4.1.1, "Air Emissions"
c. Programmatic EIS, Volume 2, Table 5.12-2, p. 5.12-8 (DOE 1995a.) and converted to an annual dose. Based on implementation of projects in the Programmatic EIS, including the WCF Closure..
d. The on-site maximally exposed individual (worker) is located 328 feet from the ICPP main stack.
e. Cumulative radiation dose (person-rem) to the populations within 50 miles of site facilities from INEL operations from 1995 to 2005.

future actions would not be expected to cause adverse health effects to workers, the maximally exposed individual, or the public.

The closure of the WCF would consume irretrievable amounts of electrical energy, fuel, and miscellaneous chemical, concrete, metals, plastics, lumber, sand, gravel, silt and clay, and water. The proposed action would occur within the boundaries of an existing industrial facility, the ICPP.

4.2 Alternative 2: Closure-By-Removal

4.2.1 Air Emissions

The Removal Alternative would require decontamination or stabilization of radioactive areas within the WCF, dismantlement of process equipment and waste packaging, removal, storage, transport, treatment and disposal activities. During the closure process, procedures and controls such as component decontamination, particle stabilization, gloveboxes, and tents with filters would be used to minimize emission of pollutants to the air. In addition, the WCF off-gas control system would be reactivated, and/or additional ventilation supply and off-gas control systems would be installed and operated to control particulate emissions.

Staley (1996) estimated radionuclide emissions and doses associated with process equipment removal and liquid waste treatment using known radioactive inventory volumes and process knowledge. Removal would require decontamination, disassembly, handling, and movement of the entire inventory of radioactive and hazardous material within the WCF. Wet decontamination techniques, as described in Section 2.2, would be used to reduce the amount of loose radioactive material present in the vessels and piping. Resuspension of radioactive material during the wet decontamination process was calculated using similar resuspension assumptions as described in Section 4.1.1. The wet decontamination process would result in about 40,000 gallons of decontamination fluid that would eventually be processed through the New Waste Calcine Facility. Potential emissions from calcining were estimated using information from the last calcining campaign, 1994. A release factor of 10^{-14} was used to calculate emissions from calcining the decontamination fluid (DOE 1996b). Dry decontamination techniques would be used wherever practical to remove contamination from the remaining structure and equipment. Emissions from dry decontamination and equipment removal was estimated using a 10^{-3} resuspension factor described National Emission Standard for Hazardous Air Pollutants, 40 CFR 61, Appendix D, "Methods for Estimating Radionuclide Emissions."

Most of the highly radioactive residue would be removed and treated during the decontamination and calcining processes; relatively small amounts of fixed radioactive material would remain on the walls, floors, and equipment in the WCF. The sum of emissions from wet and dry decontamination and the calcining operation would account for the majority of the emissions from the Removal Alternative. The CEDE resulting from the airborne release from the decontamination and removal processes is estimated at 8.5×10^{-9} mrem and 1.4×10^{-7} person-rem for the maximally exposed individual near the INEL and the public residing within 50 miles of the ICPP, respectively (Staley 1996). The dose from wet and dry decontamination and calcining would occur during the first year of the proposed project. Doses associated with the removal of the structure and equipment would be expected to be distributed over 19 years.

Additional emissions could be generated during treatment of the waste streams removed from the WCF. The physical parameters, chemical composition and radiological attributes of the waste materials and components in the WCF have not been fully characterized. Because of uncertainties regarding the materials that would be removed, specific waste treatment and disposal plans and estimated emissions from treatments have not been developed. A list of some possible treatment options, based on general waste stream descriptions, is presented in Appendix C, Table 10. Possible treatment and disposal processes that would generate air emissions are identified in Appendix C, Table 11. The potential air quality impacts of treating the types of waste streams that would be generated by removal is bounded by the analysis in the Programmatic EIS, Volume 2, Appendix F-3, Air Resources, p. F-3-1. (DOE 1995a).

4.2.2 Geology and Water Resources

The Removal Alternative would only have minor, localized impacts on the geology of the INEL site. Direct impacts to geologic resources at the INEL site would be associated with disturbing or extracting surface deposits to fill the hole left by removing the dismantled below-grade structures. A secondary impact to geology from decontaminating and dismantling and filling activities would be the potential for increased soil erosion. In the short-term, some soil loss would be expected. However, these activities would be of short duration and soil loss would be reduced by keeping the areas of surface disturbance small and by utilizing engineering practices such as storm water run-off control including sediment catchment basins, slope stability and soil stockpiling with wind erosion protection. This alternative would leave the decontaminated below-grade concrete footings, foundations and floors in place. The floors may be drilled or fractured to facilitate stormwater drainage and the below-grade areas backfilled with clean soil. No impacts to groundwater are expected to result from this alternative, but the potential for leakage or spills and subsequent contaminant transport to the groundwater is greater for this alternative because it would generate a relatively large volume of liquid waste from decontamination fluid.

4.2.3 Biological Resources

Potential impacts to flora and fauna from the Removal Alternative would be small, and there would be no adverse impacts to endangered species or the INEL ecology. A minor loss of small, less mobile animals and plants may occur at the silt and clay borrow sites that would furnish the material for filling the below-grade portion of the WCF. The DOE has determined that a biological assessment would not be required for this alternative (Reynolds 1996).

4.2.4 Cultural Resources

Direct impacts may occur to archaeological materials such as bones, chips/flakes, and "arrowheads" from soil disturbance when excavating fill material. If archaeological materials are encountered during soil disturbance activities work would stop in the immediate vicinity of the discovery and the Cultural Resource Office would be notified.

The removal alternative would proceed only in accordance with all of the substantive requirements resulting from consultation between the DOE-ID, the Idaho SHPO and other interested parties. See Section 4.1.6 for additional requirements.

4.2.5 Land Use and Visual Resources

The Removal Alternative is consistent with the waste management and environmental restoration missions of the INEL and would not result in any short-term changes in land use. Following removal, the below-grade areas would be backfilled to restore the WCF site to a grade, contour and visual characteristics consistent with its surroundings.

4.2.6 Health Effects

Doses associated with emissions identified in Section 4.2.1 would result in a very small increase in fatal cancer risk to the maximally exposed individual of 4.3×10^{-15}. In the affected population of 127,554 persons residing within a 50 mi. radius of the ICPP, the increased risk of a cancer fatality is also very small at 7.0×10^{-11}. This is equal to an additional fatal cancer risk of 5.5×10^{-16} per person. The increased risk of an individual in the general population developing cancer from this closure activity is about 1 in 2 quadrillion.

In this population, an average of 37.9 cancer deaths (about 1 in 3,369) from all other sources occurs each year, based on 1987 through 1991 National Cancer Institute data from Idaho (National Cancer Institute 1994). The cancer risks of the Closure-by- Removal alternative would be negligible, causing only a 1.9×10^{-10} percent statistical increase in cancer deaths in the surrounding population.

The Removal Alternative would require decontamination or stabilization of radioactive areas within the WCF, dismantlement of process equipment and waste packaging, removal, transport, treatment and disposal activities. The estimated dose to workers associated with removal actions under this alternative is 242 person-rem (Raytheon 1994). The dose to the worker and public from waste transportation, treatment, and disposal were not calculated, but are expected to be small.

4.2.7 Waste Management

The Removal Alternative would generate about 17,370 ft^3 of solid wastes, and 41,500 gallons of liquid waste (see Appendix C, Table 10) that would require handling, packaging, transport, storage, treatment and/or disposal at other facilities. Approximately 75 percent of the solid waste volume is estimated to be mixed waste or debris, 15 percent would be low-level radioactive waste, and the remainder would be industrial waste. The WCF processing components that were in direct contact with high-level waste produce radiation fields ranging from less than 0.1 mrem/hr. to 100,000 mrem/hr. Extensive in-cell decontamination, remote techniques, shielding and personal protective equipment would be required to reduce personnel exposures during decontamination and removal. Even with these precautions, the estimated dose to workers removing the waste is 242 person-rem (Raytheon 1994). Additional unquantified exposures and accident risks would occur during waste transportation, treatment and disposal.

The highest volume waste stream would be mixed waste or debris. This waste would require treatment to remove or mitigate chemical hazards in compliance with RCRA requirements before disposal. Because of uncertainties regarding the physical, chemical and radiological properties of mixed waste materials that would be removed under this alternative, specific handling, treatment and disposal plans have not been developed. There are no demonstrated treatment methods for some of the mixed waste materials, such as contaminated asbestos, and silica gel from the ruthenium adsorber beds, so these materials would require interim storage until accepted treatment and/or disposal become available. Before removing mixed waste from the WCF, a treatment plan specifying the strategies, such as methods, facilities, capabilities, technology development requirements, permitting for mixed waste treatment and disposal would be prepared (DOE 1995e). The INEL program for mixed waste management is described in the Site Treatment Plan (DOE 1995d). The plan identifies mixed waste or debris treatment facilities, capabilities and the volumes and types of wastes that are intended to be treated at the INEL. No mixed waste streams associated with the WCF closure are included in the plan. Before the Removal Alternative could be implemented, the strategies for mixed waste treatment and disposal must be added to the site treatment plan and approved by the State Department of Environmental Quality.

A list of some possible treatment and disposal options, based on general tyeps of waste streams that would be generated by the removal action, is presented in Appendix C, Table 10. The potential impacts of treating the types of waste streams that would be generated by the Removal Alternative are described and evaluated in the Programmatic EIS, Volume 2, Sections 2.2.7 and 3.4 (DOE 1995a). A qualitative summary of potential impacts associated with waste treatment and disposal under the Removal Alternative is presented in Appendix C, Table 10.

4.3 Alternative 3: No Action

Under the No Action Alternative air emissions would continue as present, resulting in a dose estimated to be less than 1.2×10^{-6} mrem to a maximally exposed receptor from the ICPP main stack emission. The estimate is based on ICPP main stack emissions measured during 1994 when the New Waste Calciner was not operating. Total 1994 radionuclide emissions from the ICPP stack contributed a dose of 1.2×10^{-5} mrem to a maximally exposed individual (DOE 1995c). The ventilation air from the WCF contributes approximately 10 percent of the average main stack exhaust volume. If the radionuclide concentration in the WCF stream were proportional to other main stack exhaust streams, the 1994 dose from WCF ventilation emissions would be about 1.2×10^{-6} mrem. The radionuclide loading in the WCF exhaust has not been measured. However, since there are no active processes within the WCF, the process equipment was flushed with high velocity air following the 1981 shutdown, and the ventilation system has continued operating since shutdown, facility engineers believe that the radionuclide concentration and dose from routine WCF exhaust would be much less than the volumetric ratio of 1.2×10^{-6}. For example, estimated emissions from resuspension during grouting under the Closure-In-Place alternative would only increase the emissions by only 1.5×10^{-9} mrem or 0.1 percent (see section 4.1.1).

Fugitive air emissions could occur as the WCF deteriorates. Deterioration of the building could also allow the movement of animals, such as mice, in and out of the buildings, thus creating a potential biological pathway for radiation exposure. Stormwater infiltration and drainage may occur as the roof and walls deteriorate resulting in potential soil and groundwater contamination. The WCF may also be susceptible to floodwater intrusion from a maximum flood event coupled with MacKay Dam failure, as described in Section 3. Flooding of the WCF could release radiological and hazardous contamination to the surface water and groundwater, increasing potential exposure.

During and beyond institutional control, the WCF site would be restricted from other uses. The lack of maintenance of the WCF would result in deterioration of a structure that is potentially eligible for listing on the National Register of Historic Places.

Failure to maintain control of mixed hazardous material could result in a violation of RCRA and an endangerment to health, safety and the environment.

4.4 Comparison of Mitigative Measures and Environmental Impacts

Several **mitigative measures** would be undertaken to reduce the impact to the environment, workers and the public. Table 3 summarizes these measures. The impacts of each alternative are described in Sections 4.1, 4.2 and 4.3. Tables 4, 5, and 6 summarize closure and post-closure impacts and project cost and duration. The biggest differences between alternatives are related to worker dose, waste disposal, project duration and cost.

The Closure-in-Place alternative would result in an estimated dose to workers of 20 person-rem. The Removal Alternative would result in an estimated dose of 242 person-rem for cleaning and dismantling of the WCF equipment. Under the Removal Alternative, additional exposure and accident risk would occur from routine waste handling, transportation and treatment and disposal. In the Closure-In-Place alternative, the 17,370 ft^3 of waste would be encased in 5,000 yd^3 of concrete, while under Alternative 2, the 17,370 ft^3 of waste would be disposed of or treated in approved facilities. The duration and cost of the Closure-in-Place alternative is three years and $9 million, while Alternative 2 would last about nineteen years and cost $150 million (Tables 4, 5, and 6).

The No Action alternative poses greater risks to all receptors over the long term. For instance, the radionuclide emissions to the air would continue and health risks associated with exposure and groundwater ingestion would be higher for the No Action alternative than for any of the other alternatives.

Table 3. Summary of Mitigative Measures Across Alternatives.

Alternative 1: RCRA Closure-In-Place	Alternative 2: RCRA Closure-By-Removal
• Sequence of closure events (e.g., sealing ductwork, slowly filling pipes and vessels with wet grout) would minimize radionuclide emissions due to resuspension (Sections 2.1.1 and 4.1.1). • Contaminated surfaces in the above ground portions of the facility would be stablized with fixatives before demolition (Section 4.1.1) • Soil disturbance and loss would be minimized by keeping the disturbed area small and using erosion controls (e.g., catchment basins, slope stability, spraying a soil fixative) (Section 4.1.2). • Surface waters would be protected by adhering to a Storm Water Pollution Prevention Plan (Sections 4.1.2, 4.1.3, and 4.2.1). • Water infiltration would be controlled and minimized by building an asphalt apron around the WCF, causing rain water to run off away from the building and construction area (Sections 2.1.1 and 4.1.4). • During the 30 year post-closure period the concrete cap would be inspected at least annually for cracks and loss or degradation of the joint seals between the sections. If cracks are observed they would be repaired as soon as possible. If a joint seal is lost or degraded, it would be replaced or repaired. The slope of the area around the capped WCF would be maintained to prevent run-on and run-off from eroding or otherwise damaging the cover. • DOE would complete consultation as required by Section Section 106 of the National Historic Preservation Act before commencement of any activities associated with the proposed alternative (Section 4.1.6). • Volume reduction by compaction or incineration and recycling of wastes would minimize the amount disposed or stored in hazardous or radioactive disposal and storage facilities (Section 4.1.9). • During the thirty year post-closure period the concrete cap would be inspected at least annually for cracks and loss or degradation of the joint seals between the sections. If cracks are observed they would be repaired as soon as possible. If a joint seal is lost or degraded, it would be replaced or repaired according to the manufacturer's recommendation as soon as possible. The slope of the area around the capped WCF would be maintained to prevent run-on and run-off from eroding or otherwise damaging the cover (Section 4.1.4)..	• During the closure process, procedures and controls would be employed to minimize resuspension of pollutants to the air (e.g., decontamination, stablization, gloveboxes, tents) (Section 4.2.1). • Soil disturbance and loss would be minimized by keeping the disturbed area small and using erosion controls (e.g., catchment basins, slope stability, spraying a soil fixative) (Section 4.2.2). • Pre-disposal treatments and packaging would reduce or delay the potential for contaminant migration (Section 4.2.2) • DOE would complete consultation as required by Section Section 106 of the National Historic Preservation Act before commencement of any activities associated with the Alternative 2 (Section 4.2.4). • Following removal, the below-grade cells would be backfilled to restore the WCF site to grade, contour and visual characteristics consistent with it's surroundings. (Sections 2.2 and 4.2.5). • WCF processing components that were in direct contact with high-level waste would require decontamination, remote techniques, shielding, and personal protective equipment to minimize personnel exposure during removal (Section 4.2.7).

Table 4. Summary of Closure Impacts Across Alternatives.

Impacts	Alternative 1 (Preferred): RCRA Closure-In-Place	Alternative 2: RCRA Closure-By-Removal	Alternative 3: No Action
Closure Impacts			
Air Emissions	Radionuclides released (Ci) from WCF: 8.30×10^{-8} of Cs-137 and Ba-137m; 7.28×10^{-8} of Sr-90 and Y-90; and 1.44×10^{-9} Pu-238	Higher resuspension and longer duration, thus greater than Alternative 1.	N/A[A]
Geology	Soil loss from disturbance and erosion	Same as Alternative 1 plus use of borrow source material to fill hole and cover waste debris. Also, 17,370 ft^3 disposed in approved radiological, mixed, or industrial landfills.	N/A
Surface Water	None	None	N/A
Groundwater	None	Potential to release decontamination solutions.	N/A
Biological Resources	None	Loss of some less mobile organisms from silt and clay pits.	N/A
Cultural Resources	Dismantle structure that is potentially eligible to the National Register of Historic Places	Same as Alternative 1	N/A
Visual Resources	None	None	N/A
Land Use	None	None	N/A
Health Effects			
WCF Worker Dose	20 person-rem	242 person-rem	N/A
ICPP Worker Dose	1.4×10^{-7} mrem	8.1×10^{-7} mrem	
Public Dose			
Airborne Pathway	1.5×10^{-9} mrem to the MEI or 7.5×10^{-16} cancer risk; 2.5×10^{-8} person-rem to the public or 1.3×10^{-11} cancer risk	8.5×10^{-9} mrem to the MEI or 4.3×10^{-15} cancer risk; 1.4×10^{-7} person-rem to the public or 7.0×10^{-11} cancer risk	N/A
Groundwater Pathway	None	Potential to release decontamination solutions.	N/A
External Exposure	None	Potential exposure from transportation on pubic highways	N/A
Waste Management	17,370 ft^3 of low-level waste, mixed low-level waste and industrial waste disposed of in 5,000 yd^3 of concrete	17,370 ft^3 of solid waste treated and disposed in approved facilities, plus treatment and disposal of 41,500 gallons of decontamination solution.	N/A

a. Not applicable because no action does not include a Closure Activity, see Table 4.

Table 5. Summary of Post-Closure Impacts Across Alternatives.

Impacts	Alternative 1 (Preferred): RCRA Closure-In-Place	Alternative 2: RCRA Closure-By-Removal	Alternative 3: No Action
Post-Closure Impacts			
Air Emissions	None	None	Continued as present, WCF emissions would be <1.2 x 10^{-6} mrem from the ICPP main stack. Fugitive radioactive and hazardous emissions may occur as a result of deteriorating conditions and controls
Geology	None	None	None
Surface Water	None	None	Potential for floodwater intrusion and radionuclide mobilization
Groundwater	Potential to transport small amounts of radionuclides to groundwater (see dose summary below)	None at the WCF site, unknown at other disposal sites.	Potential for stormwater and floodwater intrusion and radionuclide percolation to groundwater
Biological Resources	None	None	Organisms could become a contaminant pathway as building deteriorates and small animals gain access to the building
Cultural Resources	None	None	Historic structure would remain intact, but lack of maintenace or neglect of the WCF would result in deterioration.
Visual Resources	None	None	None
Land Use	WCF Site would be restricted from other uses	None	WCF site hazards and risks would restrict other uses through institutional control
Health Effects			
ICPP Worker Dose	3.0 x 10^{-18} mrem	None at WCF, potential increase at Treatment, Storage, and Disposal Facilities	Continued existing dose with potential increases as building deteriorates.
Public Dose			
Airborne Pathway	None	None	Same as above
Groundwater Pathway	2 x 10^{-6} cancer risk calculated from the refined risk assessment	Unknown because of disposal at other locations.	Potential for increased risk from stormwater and floodwater intrusion.
External Exposure	2 x 10^{-18} cancer risk	Same as above	Continued existing dose with potential increases as building deteriorates.
Waste Management	30 year monitoring requirement	Waste management and/or monitoring at other disposal locations.	HWMA Interim Status requirements for waste management, monitoring, and inspections

Table 6. Summary of Estimated Closure Costs and Durations Across Alternatives.

Impacts	Alternative 1 (Preferred): RCRA Closure-In-Place	Alternative 2: RCRA Closure-By-Removal	Alternative 3: No Action
Closure Costs	$9 million	$150 million	$400 thousand/yr. for minimal monitoring and maintenance.[a]
Closure Duration	3 years	19 years	Indefinite period of continued monitoring, maintenance, and inspection.

a. Maintenance costs are likely to increase over time.

5. PERMIT AND REGULATORY REQUIREMENTS

5.1 Federal

Section 106 of the National Historic Preservation Act of 1966, as amended, requires agencies to consider the impact of activities on properties listed or eligible for listing in the National Register of Historic Places. Section 110 directs federal agencies to establish programs to find, evaluate and nominate eligible properties to the National Register of Historic Places, including previously unidentified historic properties that may be discovered during the implementation of a project (36 CFR Part 800). In addition, the Archaeological Resource Protection Act of 1979, as amended, provides for the protection and management of archaeological resources on federal lands.

Subpart M of EPA's regulations for NESHAP (40 CFR 61.145 and 61.154) contains standards for demolishing buildings containing friable asbestos and for asbestos waste disposal. The regulations require specific notifications and reporting to the EPA. The regulatory standards specify procedures to control visible emissions and reduce safety risks during typical asbestos stripping, removal and landfill disposal activities. The WCF closure would encase asbestos materials in grout for disposal-in-place. The grouting process and emission controls would prevent visible asbestos emissions. However, the disposal-in-place action may create a site subject to portions of 40 CFR 61.151 and 154 such as warning signs, record keeping, and notation on land title.

Before closure of the WCF, a project Storm Water Pollution Prevention Plan (SWPPP) would be prepared and approved in accordance with the INEL Construction Activities SWPPP (DOE 1993). During closure and post-closure phases, erosion prevention and sediment controls would be implemented according to best management practices from EPA's Storm Water Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices (EPA 1992).

5.2 State

Air emissions from the ICPP main stack are permitted under the ICPP Nitrogen Sources Permit to Construct (PTC 023-0001) issued by the Idaho Division of Environmental Quality on February 13, 1995. The permitted limit for radionuclide emissions is 10 mrem/yr. in aggregate with all other INEL sources. The closure activity would not require modification to the air permit nor would it result in a violation of any permit limits or requirements.

The HWMA closure performance standards of IDAPA § 16.01.05.009, *"Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities"* require the design and construction of a low-permeability cover over the unit to reduce the migration of liquids into the grouted structure. The owner or operator of a hazardous waste management facility must close the facility in a manner that:

- Minimizes the need for further maintenance
- Controls, reduces, or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere
- Complies with the closure requirements of this subpart IDAPA 16.01.05.009 [40 CFR 265].

A WCF Closure Plan is being prepared to demonstrate how the Closure-in-Place alternative would comply with HWMA requirements. The Closure Plan must be approved by the Idaho Division of Environmental Quality before initiation of closure activities.

6. COORDINATION AND CONSULTATION

Lockheed Idaho Technologies Company, the U. S. Department of Energy, Idaho Operations Office (DOE-ID), and the Idaho Division of Environmental Quality have agreed that the concept of a risk-based, cost-effective, in-situ or in-place strategy is a reasonable approach to reduce environmental risks. With state agreement, LITCO and DOE-ID have proceeded to explore a RCRA Closure Plan and Risk Assessment for closure-in-place of the WCF. However, to fully comply with NEPA, DOE-ID is also preparing this EA to evaluate the impact of reasonable closure alternatives and no action before committing significant resources or making an irreversible commitment of resources. In addition, this EA will be used to present the closure-in-place concept and other alternatives to the public.

DOE is required to review as guidance the most current U. S. Fish and Wildlife Service (FWS) list for threatened and endangered (T&E) plant and animal species. If, after reviewing the list, DOE determines that the proposed action would not impact any T&E species, DOE may determine or document that formal consultation with the FWS is not required for this action. The Environmental Science and Research Foundation has determined that a biological assessment would not be required for the proposed action or alternative actions (see Section 4.1.5).

DOE must consult with the SHPO as required by Section 106 of the National Historic Preservation Act before commencement of any activities associated with the proposed action or alternative actions (Section 4.1.6).

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APPENDICES

APPENDIX A -- Glossary

Adsorbers. Solid or liquid materials that collect gases, liquids, or solutes on their surface. In this case silica gel. 2

Alluvium. Sediment deposited by flowing water, as in a riverbed, flood plain, or delta. 11

Alpha particles. Positively charged particles, indistinguishable from helium atom nuclei and consisting of two protons and two neutrons. Alpha particles have low penetrating power and can be stopped by paper. Gross alpha particles activity refers to the total activity due to emission of alpha particles. Used as screening measurement of radioactivity. These particles are low external, but high internal hazards and are found throughout the operating cells of the WCF. 18

Aqueous. Dissolved in water or watery. 2

Aquifer. A body of rock or sediment sufficiently permeable to conduct groundwater and to yield significant quantities of water to wells and springs. The Snake River Aquifer underlies the INEL. . . 11

Asbestos. A mineral fiber that can pollute air or water and cause cancer when inhaled. The EPA has banned or severely restricted its use in manufacturing and construction and was used in insulation and roof of the WCF. 2

Atmospheric Protection System (APS). Ventilation exhaust cleanup system for the ICPP main stack emissions consisting of a fiberglass bed prefilter and 104 HEPA filters arranged in 26 parallel banks. . 2

Basalt. A general term for dark-colored, fine-grained igneous rock. Found throughout the INEL both on the surface and below the surface. 11

Below-grade. The area of the Waste Calcine Facility below ground level. 2

Beta particles. High-speed electrons or positrons, especially those emitted in radioactive decay. Beta particles have medium penetrating power and can be stopped by wood and plastic material. Gross Beta Particle activity is the total activity due to emission of beta particles. Used as a screening measurement for radioactivity from man-made radionuclides. 18

Committed Effective Dose Equivalent (CEDE). The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues. The committed dose equivalent is the dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake. 16

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA or "Superfund," was enacted by Congress in 1980. In 1986, CERCLA was amended by the Superfund Amendments and Reauthorization Act. CERCLA's major provisions are designed to address the problems associated with inactive hazardous material disposal sites. CERCLA provides EPA the authority to clean up these sites or forces clean up by private business and federal agencies.. 4

Contaminants of Potential Concern (COPC). The types of contaminants that are likely to be site-related and of concern related to human health and the environment. The three types of contaminants expected to be present in the WCF are radionuclides, metals and anions. 17

Council on Environmental Quality (CEQ). A council established by the National Environmental Policy Act of 1969, as amended (Public Law 91-90, 42 U.S.C. 4321-4347, January 1970, as amended by Public Law 94-52, July 3, 1975, and Public Law 94-83, August 9, 1975). The Council's duties are described in Title II of the National Environmental Policy Act. 4

Cumulative impacts. Impacts on the environment which result from incremental impacts of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. 21

Decontamination. To make safe by removing poisonous or otherwise harmful substances, such as noxious chemicals or radioactive material. 2

Effective Dose Equivalent (EDE). The sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that is irradiated. It includes the dose from radiation sources internal and/or external to the body and is expressed in units of rem. The International Commission on Radiation Protection defines this as the effective dose. 16

Environmental Assessment (EA). A concise public document for which a Federal agency is responsible that serves to: (1) Briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact. 4

Environmental Impact Statement (EIS). A document that serves to ensure that the policies and goals defined in NEPA are incorporated into the programs and actions of the Federal government. An EIS gives a full and fair discussion of significant environmental impacts. The EIS informs decision makers and the public of reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the human environment. 4

Erosion. The wearing away of land surface by wind or water. Erosion occurs naturally from weather or run off but can be intensified by land-clearing practices. 7

Finding of No Significant Impact (FONSI). A document, based on an environmental assessment by a Federal agency briefly presenting the reasons why an action will not have a significant effect on the human environment and for which an environmental impact statement will therefore not be prepared. . 4

Grout. A thin mortar used to fill cracks and crevices in masonry. In this case, the mortar would be used to completely fill the structures and vessels of the WCF. 2

Hazard Index (HI). The sum of Hazard Quotients. If the Hazard Index is greater than one, there may be concern for the potential noncarcinogenic effects because the intake exceeds the reference dose. If the Hazard Index is less than one, the estimated soil concentration of the metal is presumably below the threshold of potential noncarcinogenic effects, and no adverse health effects are expected from exposure to the metal. The hazard quotient is the ratio of a single substance exposure level over a specified time period to a reference dose for that substance derived from a similar exposure period (see Appendix D). 21

Hazardous Waste Management Act (HWMA). Idaho Hazardous Waste Management Act, IDAPA 16.01.05, "Rules and Standards for Hazardous Waste" are the rules adopted pursuant to the authority vested in the Board of Health and Welfare by the Hazardous Waste Management Act of 1983, Sections 39-4401 et seq., Idaho Code. Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, IDAPA 16.01.005.009, incorporate by reference 40 CFR Part 265, and all Subparts (excluding Subpart R and 40 CFR Parts 265.149 and 265.150) revised as of July 1,1994. (4-26-95). 1

Infiltration. The penetration of water through the ground surface into sub-surface soil. 6

Injection wells. Wells into which fluids are injected for purposes such as waste disposal. 11

Maximally Exposed Individual (MEI). A hypothetical individual defined to allow dose or dosage comparison with numerical criteria for the public. This individual is located at the point on the DOE site boundary nearest to the facility in question. 16

Mitigative measures. Those actions that avoid impacts altogether, minimize impacts, rectify impacts, reduce or eliminate impacts, or compensate for the impact. In this case they are actions that are incorporated into the project design to minimize or eliminate potential impacts. 26

National Environmental Policy Act (NEPA). A Federal law, enacted in 1970, that requires the Federal government to consider the environmental impacts of, and alternatives to, major proposed actions in its decisionmaking processes. Commonly referred to by its acronym, NEPA. 4

National Oil and Hazardous Substance Pollution Contingency Plan (NCP). The federal regulation that guides determination of the sites to be corrected under the Superfund program and the program to prevent or control spills into surface waters or other portions of the environment. 4

Nitrogen oxides. Products of combustion from transporation and stationary sources and major contributors to the formation of ozone in the troposphere and acid deposition. 2

Nonfriable. Material cannot be crumbled in your hand. 8

Occupational radiation dose. Annual dose received by a worker from job-related ionizing radiation. 5

Off-site. An area outside the INEL boundaries. 16

Percolation. The movement of water downward and radially through the sub-surface soil layers, usually continuing downward to the groundwater. 11

Perennial. A plant that lives three or more years. 11

Person-rem. A unit of collective radiation dose applied to populations or groups of individuals. In this case, those members of the public residing within a 50 mi. radius of the WCF or ICPP. 16

Prevention of Significant Deterioration (PSD). Clean Air Act regulations designed to "protect public health and welfare from any actual or potential adverse effect . . .", U.S. Code, Title 42, The Public Health and Welfare, Chapter 85--Air Pollution Prevention and Control, Subchapter I--Programs and Activities, Part C--Prevention of Significant Deterioration of Air Quality. 11

Radionuclide. An unstable isotope, of an element, that decays or disintegrates spontaneously, emitting radiation. Approximately 5,000 natural and manmade radionuclides or radioisotopes have been identified. 2

RCRA cap. A cover, in this case, a concrete cover, designed to (a) provide long-term minimization of migration of liquids through the closed cell, (b) function with minimum maintenance, (c) promote drainage and minimize erosion or abrasion of the cover, (d) accommodate settling and subsidence so that the cover's integrity is maintained; and have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present. 2

Record of Decision (ROD). A concise public record of decision (40 CFR 1505.2) at the conclusion of the an environmental impact statement. The ROD, which must be published in the *Federal Register*, will (a) State what the decision is, (b) Identify all alternatives considered and specify the alternative or alternatives which were considered environmentally preferable, and (c) State whether all practicable means to avoid or minimize environmental harm from the alternative selected have been adopted and, if not, why they are not. 4

Remedial Investigation / Feasibility Study (RI/FS). The Comprehensive Environmental Response, Compensation, and Liability Act process of determining the extent of hazardous substance contamination and, as appropriate, conducting treatability investigations. The RI provides the site-specific information for the feasibility study. The feasibility study is a step in the environmental restoration process and should result in a decision (ROD) selecting a remedial action alternative. 4

Resource Conservation and Recovery Act (RCRA). A regulatory statute designed to provide "cradle-to-grave" control of hazardous waste by imposing management requirements on generators and transporters of hazardous wastes and upon owners and operators of treatment, storage, and disposal facilities. 1

Run-off. That part of precipitation or snow melt that runs off the land, and pavement into streams or other surface-water. It can carry pollutants from the air and land into the receiving waters. 6

Ruthenium. A radioactive isotope adsorbed on the silica gels in the WCF calcining process. 2

Seismicity. The phenomenon of earth movements; seismic activity. Seismicity is related to the location, size, and rate of occurrence of earthquakes. 17

sized. The result of compaction, melting, or mechanical reduction of wastes thereby minimizing the empty spaces in waste boxes. 8

Sole source aquifer. A designation granted by the EPA when groundwater from a specific aquifer supplies more than 50 percent of the drinking water for the area overlying the aquifer. Federal financial assistance to projects which are determined to be potential unhealthy for the aquifer may be limited or withheld. 11

Waste streams. Wastes or groups of wastes with similar physical form, radiological properties, EPA waste codes, or associated land disposal restriction treatment standards. 9

APPENDIX B -- Waste Calcining Facility Process Residue (Heel) and Hazardous Waste

Demmer and Archibald (1995) calculated the expected amount of process residue remaining in the shutdown process vessels or equipment of the WCF. The remaining solid residue is referred to as the heel volume. Refer to their report for a detailed description of assumptions, calculations and estimates.

The total estimated heel volume remaining in the WCF is presented in Table 7. Hazardous and radiological constituents present in the heel volume were estimated by studying the chemical analysis of similar types of waste processes. Based on these comparisons, Demmer and Archibald (1995) estimated the composite waste residue concentrations and quantities of elements and isotopes expected at the WCF. The total mass of residue was calculated to be about 1,400 pounds with an estimated volume of 14.02 ft^3 (Table 7). The estimated concentrations and quantities of elements and isotopes that comprise the heel volume are shown in Tables 8 and 9.

The WCF also contains some lead shielding, mercury and used oil and asbestos materials. About 15 tons of lead shielding material are distributed through the high radiation areas in walls, pipe corridors, sample collection areas, and doorways. An estimated 26 pounds of mercury are present in instruments located inside the high-radiation cells. About 270 gallons of lubricating oils are contained in in-cell equipment blowers, quench pumps and shielded windows. The friable asbestos has been removed from accessible operating corridors within the WCF. However, some residual friable asbestos may remain on piping within the high radiation cells. An estimated 500 ft^3 of nonfriable asbestos is present in the WCF roofing sealant. There is no estimate for total asbestos volumes at the WCF.

Table 7. Total Estimated Process (Heel) Volumes.

Process Area	Estimated Heel Volume (ft^3)
Solid Vessels	4.99
Liquid Vessels	0.18
Piping and Ducts	2.96
Miscellaneous	3.03
Cell Floors	2.86
Total	14.02

a) Source: Rood et al. 1996.

Table 8. Estimated Quantities of Metals in the WCF Heel Volume.

Element	Concentration in Residue (weight %)	Estimated Total quantity (kg)
Aluminum	1.16×10^{1}	7.357×10^{1}
Boron	1.20×10^{0}	7.61×10^{0}
Calcium	3.25×10^{1}	2.06×10^{2}
Cadmium	0	0
Carbonate	7.20×10^{0}	4.57×10^{1}
Chloride	1.00×10^{-1}	6.30×10^{-1}
Chromium	3.00×10^{-1}	1.90×10^{0}
Flouride	3.23×10^{1}	2.05×10^{-2}
Iron	2.80×10^{-1}	1.78×10^{0}
Potassium	7.00×10^{-1}	4.44×10^{0}
Magnesium	1.50×10^{0}	9.51×10^{0}
Sodium	1.90×10^{0}	1.205×10^{1}
Tin	4.30×10^{-1}	2.73×10^{0}
Zirconium	2.30×10^{1}	1.46×10^{2}
Nitrate	3.60×10^{0}	2.28×10^{1}
Total[a]		5.3474×10^{2}

Source: Demmer and Archibald 1995.
a. Total rounded.

Table 9. Estimated Quantities of Radionuclides in the WCF Heel Volume.

Isotopes	Concentration in Residue (μg/g)	Half-life Corrected (Ci)
Am-241	3.40×10^{-1}	7.20×10^{-1}
Cm-244	1.60×10^{-3}	5.00×10^{-2}
Cs-134	5.00×10^{-2}	2.90×10^{-1}
Cs-137	3.52×10^{1}	1.38×10^{3}
Co-60	1.30×10^{-3}	1.30×10^{-1}
Eu-154	1.50×10^{-1}	7.85×10^{0}
Eu-155	2.80×10^{-2}	1.06×10^{0}
Np-237	1.47×10^{1}	7.00×10^{-3}
Pu-238	2.48×10^{0}	2.40×10^{1}
Pu-239	3.25×10^{0}	1.30×10^{-1}
Pu-240	5.50×10^{-1}	8.00×10^{-2}
Pu-241	9.00×10^{-2}	2.90×10^{0}
Pu-242	0	0
Ru-106	4.30×10^{-3}	4.00×10^{-4}
Sb-125	1.60×10^{-2}	1.60×10^{-1}
Sr-90	1.99×10^{1}	1.21×10^{3}
Tc-99	3.26×10^{1}	3.50×10^{-1}
U-234	1.44×10^{0}	6.00×10^{-3}
U-235	1.77×10^{1}	2.43×10^{-7}
U-236	2.18×10^{0}	8.94×10^{-5}
U-238	1.13×10^{3}	2.42×10^{-5}
Total[a]		2.63×10^{3}

Source: Demmer and Archibald 1995.
a. Total rounded.

APPENDIX C -- Waste Management Summary

The potential waste streams and treatment and/or disposal options for the Removal Alternative are shown in Table 10. The potential impacts from removal on waste treatment and disposal facilities are shown in Table 11.

Table 10. Potential Waste Streams and Treatment/Disposal Options for Alternative 2, Closure-By-Removal.

Waste Stream	Estimated Volume	Treatment	Disposal
Mixed Waste and Debris			
Spent decontamination fluids	40,000 gal.	Neutralization and evaporation in ICPP PEW or High Level Waste evaporator	Evaporator bottoms transferred to ICPP high level waste tanks
Silica gel - contaminated with mercury and ruthenium-106[a]	552 ft^3	In-situ washing with decontamination solutions (e.g. nitric acid, detergent, water) to remove RCRA constituents	If the treated silica gel could be reclassified as low-level waste, it would be disposed of at RWMC, otherwise, at a RCRA mixed waste landfill.
Lead bricks, shot and blankets	100 ft^3	Surface decontamination or macro encapsulation at Waste Reduction Operations Complex	Recycle if decontaminated or disposed at a commercial RCRA mixed waste landfill
Process equipment debris[a]	5,071 ft^3	Treat at ICPP debris-rule treatment facility or Waste Reduction Operations Complex using high pressure washing, abrasive blasting, solvents, detergents, encapsulation, etc.	Following debris rule treatment, the reclassified low-level waste would be disposed of at the RWMC. Mixed treatment residue would go to a RCRA mixed waste landfill.
Mercury	26 lb	Treat by amalgamation at Waste Reduction Operations Complex	Commercial RCRA mixed waste landfill
Equipment oil	100 gal.	Incinerate at Waste Experimental Reduction Facility or commercial RCRA mixed waste facility	Dispose of ash at commercial RCRA mixed waste landfill
Decontamination residue (dirt, paint chips, scabbling residue, contaminated tools, etc.)	Unknown, but small	Treat by incineration at Waste Experimental Reduction Facility (if combustible) or by encapsulation at Waste Reduction Operations Complex	Commercial RCRA mixed waste landfill
HEPA filters[a]	Unknown, but small	HEPA leach system or incineratied at the Waste Experimental Reduction Facility	RWMC
Low-Level Waste			
Removed surface contamination, activated metals, or materials with fixed contamination, asbestos, combustible waste (anti-contamination clothing, wood, paper, cloth, rubber, and plastic)	3,161 ft^3	Compactible and combustible waste to Waste Experimental Reduction Facility for volume reduction and repackaging.	RWMC
Liquid low-level waste from wet decontamination processes	1500 gal.	Evaporation in ICPP PEW evaporator	Evaporator bottoms to ICPP high-level waste tank
Industrial Waste			
Rubble from demolition of the superstructure	8,486 ft^3	Survey to verify the absence of radioactive contaminants	INEL industrial waste landfill

Source: Stanley, 1996.

a. The RCRA Debris Rule allows treating these materials to remove the RCRA-regulated waste, thus enabling reclassification of the metal debris as low-level waste or declassifying, if cleaning and treatment reduced the radioactive component to a low measurement.

Table 11. Potential Impacts from Alternative 2, RCRA Closure-By-Removal, on Waste Treatmant and Disposal Facilities.

		Potential Impacts				
		Treatment			Disposal	
Facility	Function	Air Emissions	Worker Radiation Dose	Waste Transport	Release to Surface Water	Release to Ground Water
ICPP Process Equipment Waste Evaporator	Low-level and mixed waste volume reduction by evaporation	x	x			
ICPP Debris Treatment and Storage Facility	Mixed waste debris decontamination by water washing, high-pressure water and steam sprays, and ultrasonic cleaning	x	x	x		
Waste Experimental Reduction Facility	Low-level and mixed waste volume reduction by compaction, metal sizing, incineration, and stabilization	x	x	x		
Mixed Waste Storage Facility	Mixed waste storage, verification sampling and repackaging		x	x		
Waste Reduction Operations Complex	Mixed waste volume reduction sizing, micro- and macro-encapsulation, mercury retorting	x	x	x		
Portable Water Treatment Unit	Dilute aqueous solution treatment by filtration, neutralization, carbon adsorption, and ion exchange	x	x			
HEPA Filter Leach System	HEPA filter cleaning using chemical extraction	x	x	x		
Radioactive Waste Management Complex	transuranic and low-level alpha and mixed waste storage, low-level waste disposal		x	x		x
INEL Industrial Landfill	Nonradioactive, nonhazardous industrial waste disposal					x
Off-site treatment facilities	Existing or planned facilities at commercial sites and other DOE facilities may have technologies not available at the INEL to treat some of the mixed wastes	x[a]	x	x	x[a]	x[a]

Source: Stanley, 1996.

a. Impacts depend upon the process and controls.

APPENDIX D -- Risk Assessment

D.1 Risk Characterization Methodology

The methodology used to calculate the effects from exposure to the COPCs in the WCF is presented in the following sections.

D.1.1 Carcinogens

For the radioactive carcinogens, risks represent the incremental probability of an individual developing fatal cancer over a lifetime as a result of exposure to carcinogens. The general form of the risk equation for radioactive carcinogens is to multiply the intake by the COPC-specific toxicity value (EPA 1989):

$$\text{Risk} = I \times SF$$

where,

Risk = cancer risk, expressed as a unitless probability
I = intake (pCi or pCi-yr./gram)
SF = slope factor [$(\text{pCi})^{-1}$ or $(\text{gram/pCi-yr.})^{-1}$]

Quantitative risks for the external exposure pathway were determined using the RESRAD computer code and risks for the groundwater ingestion exposure pathway were calculated using the computer code GWSCREEN.

D.1.2 Noncarcinogens

For the noncarcinogens such as the nonradionuclides hazard quotients are the measure by which the potential for adverse effects are measured. A hazard quotient is the ratio of the estimated intake over the RfD as presented below (EPA 1989):

$$HQ = \frac{I}{RfD}$$

where,

HQ = hazard quotient
I = intake (mg/kg-d)
RfD = reference dose (mg/kg-d)

Hazard quotients for the groundwater ingestion exposure pathway were calculated using the computer code GWSCREEN. If the hazard index (the sum of more than one hazard quotient) is greater than one, there may be concern for the potential noncarcinogenic effects because the intake exceeds the reference dose. If the hazard index is less than one, the estimated soil concentration of the metal is presumably below the threshold of potential noncarcinogenic effects, and no adverse health effects are expected from exposure to the metal.

D.2 Hazardous and Radionuclide Concentrations and Risk

Table 12 shows the peak groundwater concentrations, time of maximum concentrations, maximum contaminant levels, and concentration at 10^{-6} cancer risks for fourteen metals and twenty radionuclides. Table 13 shows the predicted concentrations and time of maximum concentrations for four radionuclides where the risk exceed the lower limit of the NCP target risk range. These COPC include: Np-237, Pu-239, Pu-240, and Tc-99. For a complete discussion of methods and assumptions used to calculate these values refer to Rood et al. 1996.

The calculated radionuclide concentrations potentially available to the soil from the WCF (see Rood et al. 1996) are compared (Table 14) with the proposed Drinking Water Standards (see 40 CFR Parts 141 and 142).

Table 15 shows the cancer risk from external exposure and groundwater ingestion for the twenty radionuclides using GWSCREEN. Table 16 shows the hazard quotients for the eleven nonradionuclides or metals. In addition, Table 16 shows the cancer risk from groundwater ingestion for four radionuclides using PORFLOW in the refined risk assessment.

Table 12. Peak Average Groundwater Concentrations, MCLs (Metals), Transit Times to Groundwater, and Groundwater Concentrations at Cancer Risk Value (10^{-6}) (Radionuclides) for Contaminants of Potential Concern.

Metal	Peak Groundwater Concentration (mg/l)[a]	MCL[b]	Transit Time to Groundwater (yr.)[a]
Aluminum	2.16×10^{-4}	5.0×10^{-2}	1.30×10^{1}
Boron	2.23×10^{-5}	None	1.30×10^{1}
Chromium	7.89×10^{-7}	1.0×10^{-1}	1.32×10^{2}
Fluoride	6.02×10^{-4}	4.0×10^{0}	1.30×10^{1}
Magnesium	2.79×10^{-5}	None	1.30×10^{1}
Nitrate	7.40×10^{-5}	1.0×10^{1}	1.30×10^{1}
Potassium	1.70×10^{-7}	None	1.26×10^{3}
Selenium	3.73×10^{-9}	5.0×10^{-2}	3.46×10^{2}
Silver	3.94×10^{-9}	1.0×10^{-1}	7.50×10^{3}
Sodium	3.55×10^{-5}	None	1.30×10^{1}
Tin	8.02×10^{-6}	None	1.30×10^{1}
Uranium	6.96×10^{-6}	None	5.12×10^{2}
Vanadium	7.54×10^{-12}	None	1.30×10^{1}
Zicronium	1.41×10^{-7}	None	$>1.00 \times 10^{4}$
Total	9.94×10^{-4}		

Radionuclide[c]	Peak Groundwater Concentration (pCi/l)[a]	Transit Time to Groundwater (yr.)[a]	Peak Groundwater Concentrations at 10^{-6} Cancer Risk Value (pCi/l)
Am-241	2.91×10^{-20}	$>1.00 \times 10^{4}$	1.46×10^{-1}
Cm-244	$<1.00 \times 10^{-88}$	$>1.00 \times 10^{4}$	1.00×10^{-64}
Co-60	$<1.00 \times 10^{-88}$	4.60×10^{3}	1.00×10^{-64}
Cs-134	$<1.00 \times 10^{-88}$	$>1.00 \times 10^{4}$	1.00×10^{-64}
Cs-137	$<1.00 \times 10^{-88}$	$>1.00 \times 10^{4}$	1.00×10^{-64}
Eu-154	$<1.00 \times 10^{-88}$	$>1.00 \times 10^{4}$	1.00×10^{-64}
Eu-155	$<1.00 \times 10^{-88}$	$>1.00 \times 10^{4}$	1.00×10^{-64}
Np-237	1.61×10^{-1}	2.09×10^{3}	1.61×10^{-1}
Pu-238	3.02×10^{-4}	1.84×10^{3}	1.51×10^{-1}
Pu-239	3.22×10^{0}	1.84×10^{3}	1.61×10^{-1}
Pu-240	1.72×10^{0}	1.84×10^{3}	8.60×10^{-2}
Pu-241	4.40×10^{-37}	1.82×10^{3}	4.40×10^{-13}
Ru-106	$<1.00 \times 10^{-88}$	5.05×10^{2}	1.00×10^{-64}
Sb-125	$<1.00 \times 10^{-88}$	4.10×10^{3}	1.00×10^{-64}
Sr-90	2.62×10^{-17}	1.99×10^{3}	8.73×10^{-1}
Tc-99	6.82×10^{2}	2.13×10^{1}	6.82×10^{1}
U-234	5.61×10^{-1}	5.12×10^{2}	1.12×10^{0}
U-235	2.28×10^{-5}	5.12×10^{2}	1.14×10^{0}
U-236	8.37×10^{-3}	5.12×10^{2}	1.20 x 100
U-238	2.27×10^{-3}	5.12×10^{2}	7.57×10^{-1}
Total	6.95×10^{-10}		

Source: Rood et al. 1996
a. Values are from GWSCREEN analysis.
b. MCL = Maximum Contaminant Level
c. Daughter products of radionuclides are included in the total.

Table 13. Maximum Predicted Concentration and Travel Times Using the Refined Groundwater Model.

Radionulicde[a]	Peak Groundwater Concentration (pCi/l)	Peak Time of Highest Concentration (yr.)	Peak Groundwater Concentration at 10^{-6} Cancer Risk Value (pCi/l)
Np-237	1.2×10^{-3}	$>1.0 \times 10^{4}$	1.20×10^{-1}
Pu-239	6.9×10^{-4}	$>1.0 \times 10^{4}$	1.38×10^{-1}
Pu-240	5.3×10^{-5}	$>1.0 \times 10^{4}$	1.33×10^{-1}
Tc-99	8.2×10^{1}	7.9×10^{2}	4.10×10^{1}
Total	8.2×10^{1}		

Source: Rood, et al. 1996

a. Daughter products are included in the total.

Table 14. Comparison of Estimated Radionuclide Concentrations and Proposed Drinking Water Standards.

	Estimated Concentrations		Proposed Drinking Water Standard[c]	--Ratio--
Radionuclides[a]	Ci/l[b]	pCi/l	pCi/l	Estimate / Standard[d]
Photon and Beta Particles				
Co-60	<1.00 x 10^{-100}	1.00 x 10^{-88}	2.18 x 10^{2}	4.59 x 10^{-91}
Cs-134	<1.00 x 10^{-100}	1.00 x 10^{-88}	8.21 x 10^{2}	1.22 x 10^{-91}
Cs-137	<1.00 x 10^{-100}	1.00 x 10^{-88}	1.19 x 10^{2}	8.40 x 10^{-91}
Eu-154	<1.00 x 10^{-100}	1.00 x 10^{-88}	5.73 x 10^{2}	1.75 x 10^{-91}
Eu-155	<1.00 x 10^{-100}	1.00 x 10^{-88}	3.59 x 10^{3}	2.79 x 10^{-91}
Pu-241	4.40 x 10^{-49}	4.40 x 10^{-37}	6.26 x 10^{1}	7.03 x 10^{-39}
Ru-106	<1.00 x 10^{-100}	1.00 x 10^{-88}	2.03 x 10^{2}	4.93 x 10^{-91}
Sb-125	<1.00 x 10^{-100}	1.00 x 10^{-88}	1.94 x 10^{3}	5.15 x 10^{-92}
Sr-90	2.62 x 10^{-29}	2.62 x 10^{-17}	4.20 x 10^{1}	6.24 x 10^{-19}
Tc-99[a]	8.20 x 10^{-11}	8.20 x 10^{1}	3.79 x 10^{3}	2.16 x 10^{-2}
Gross	8.20 x 10^{-11}	8.20 x 10^{1}	Sum of Ratio→	2.16 x 10^{-2}
Alpha Particles				
Am-241	2.91 x 10^{-32}	2.91 x 10^{-20}	6.34 x 10^{0}	
Cm-244	<1.00 x 10^{-100}	1.00 x 10^{-88}	9.84 x 10^{0}	
Np-237[a]	2.74 x 10^{-15}	2.74 x 10^{-3}	7.06 x 10^{0}	
Pu-238	3.02 x 10^{-16}	3.02 x 10^{-4}	7.02 x 10^{0}	
Pu-239[a]	6.94 x 10^{-16}	6.94 x 10^{-4}	6.21 x 10^{1}	
Pu-240[a]	5.96 x 10^{-17}	5.96 x 10^{-5}	6.22 x 10^{1}	
U-234	5.61 x 10^{-13}	5.61 x 10^{-1}	1.39 x 10^{1}	
U-235	2.28 x 10^{-17}	2.38 x 10^{-5}	1.45 x 10^{1}	
U-236	8.37 x 10^{-15}	8.37 x 10^{-3}	3.22 x 10^{1}	
U-238	2.27 x 10^{-15}	2.27 x 10^{-3}	1.46 x 10^{1}	
Gross	5.75 x 10^{-13}	5.75 x 10^{-1}	1.50 x 10^{0}	

a. Tc-99, Np-237, Pu-239, and Pu-240 values are from the refined risk assessment (Table 4).
b. From Rood et al. 1996.
c. From EPA, 40 CFR Parts 141 and 142, "National Primary Drinking Water Regulations; Radionuclides; Proposed Rules."
d. A summation of the ratio -- Estimate/Standard: Values less than 1 indicate concentrations below the 4 mrem/year limit.

Table 15. Cancer Risks for Radionuclides in the 30-Year Future Residential External and Groundwater Ingestion Exposure Pathway for the Screening Analysis and the Groundwater Ingestion Exposure for the Refined Risk Analysis.

	Risk		
Radionuclide	External Exposure	Groundwater Ingestion	Total
Screening Analysis (using GWSCREEN)			
Am-241	$<1 \times 10^{-30}$	2×10^{-25}	2×10^{-25}
Cm-244	$<1 \times 10^{-30}$	$<1 \times 10^{-30}$	$<1 \times 10^{-30}$
Co-60	1×10^{-20}	$<1 \times 10^{-30}$	1×10^{-20}
Cs-134	9×10^{-26}	$<1 \times 10^{-30}$	9×10^{-26}
Cs-137	1×10^{-18}	$<1 \times 10^{-30}$	1×10^{-18}
Eu-154	1×10^{-18}	$<1 \times 10^{-30}$	1×10^{-18}
Eu-155	$<1 \times 10^{-30}$	$<1 \times 10^{-30}$	$<1 \times 10^{-30}$
Np-237	3×10^{-28}	1×10^{-06}	1×10^{-06}
Pu-238	$<1 \times 10^{-30}$	2×10^{-09}	2×10^{-09}
Pu-239	$<1 \times 10^{-30}$	2×10^{-05}	2×10^{-05}
Pu-240	$<1 \times 10^{-30}$	1×10^{-05}	1×10^{-05}
Pu-241	$<1 \times 10^{-30}$	$<1 \times 10^{-30}$	$<1 \times 10^{-30}$
Ru-106	$<1 \times 10^{-30}$	$<1 \times 10^{-30}$	$<1 \times 10^{-30}$
Sb-125	1×10^{-27}	$<1 \times 10^{-30}$	1×10^{-27}
Sr-90	$<1 \times 10^{-30}$	3×10^{-23}	3×10^{-23}
Tc-99	4×10^{-27}	1×10^{-05}	1×10^{-05}
U-234	$<1 \times 10^{-30}$	5×10^{-07}	5×10^{-07}
U-235	$<1 \times 10^{-30}$	2×10^{-11}	2×10^{-11}
U-236	$<1 \times 10^{-30}$	7×10^{-09}	7×10^{-09}
U-238	9×10^{-28}	3×10^{-09}	3×10^{-09}
Total[a]	3×10^{-18}	5×10^{-05}	5×10^{-05}
Refined Risk Assessment[b] **(using PORFLOW)**			
Np-237	--	1×10^{-08}	1×10^{-08}
Pu-239	--	5×10^{-09}	5×10^{-09}
Pu-240	--	4×10^{-10}	4×10^{-10}
Tc-99	--	2×10^{-06}	2×10^{-06}
Total[a]		2×10^{-06}	2×10^{-06}

Source: Rood et al. 1996.

a. Totals rounded.

b. The only COPC modelled for the Refined Risk Analysis were the four radionuclides that exceeded the lower limit of the NCP limit in the Screening Analysis.

Table 16. Hazard Quotients for Nonradionuclides (Toxic Elements) in the 30-year Future Residential Exposure Scenario.

Metal	Groundwater Ingestion
Boron	3×10^{-6}
Chronmium (trivalent)	2×10^{-8}
Chromium (hexavalent)	4×10^{-6}
Fluoride	1×10^{-4}
Nitrate	6×10^{-7}
Selenium	2×10^{-8}
Silver	2×10^{-8}
Tin	2×10^{-7}
Uranium	6×10^{-5}
Vanadium	7×10^{-8}
Zirconium	1×10^{-9}
Total[a]	2×10^{-4}

Source: Rood et al. 1996.
a. Totals rounded.