Department of Energy
Washington, DC 20585

July 14, 2000

Dear Interested Party:

The *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE/EIS-0306) is enclosed for your information. This document has been prepared in accordance with the National Environmental Policy Act (NEPA) and reflects comments received on a draft released in July 1999.

The Department of Energy (DOE) proposes to treat its inventory of sodium-bonded spent nuclear fuel and facilitate its eventual disposition in a future geologic repository. The environmental impact statement (EIS) evaluates the associated potential environmental impacts at one or more spent nuclear fuel management facilities. The EIS analyzes the melt and dilute, electrometallurgical, plutonium-uranium extraction treatment technologies, and packaging in high-integrity cans as treatment alternatives as well as a no-action alternative.

After careful consideration of public comments and programmatic, environmental, nonproliferation, and cost issues, DOE has selected electrometallurgical treatment as its preferred alternative for the treatment and management of all sodium-bonded spent nuclear fuel except for the Fermi-1 blanket fuel. The physical characteristics of the Fermi-1 blanket spent nuclear fuel are such that alternative treatment techniques that currently require additional development may be more appropriate to treat this particular spent fuel. DOE will investigate those alternative techniques and make a final decision regarding the Fermi-1 blanket fuel at a later date.

The final EIS is available on the Office of Nuclear Energy, Science and Technology Web site (www.ne.doe.gov), DOE's NEPA Web site (tis.eh.doe.gov/NEPA), at libraries at the University of South Carolina and University of New Mexico, and at DOE reading rooms in Idaho Falls, Idaho; Aiken, South Carolina; Oak Ridge, Tennessee; Richland, Washington; and Washington, D.C.

Additional copies of the final EIS and the National Research Council's *Electrometallurgical Techniques for DOE Spent Fuel Treatment, Final Report (April 2000)* are available upon request by calling 1-877-450-6904 or by sending an e-mail to sodium.fuel.eis@hq.doe.gov.

We appreciate your continued participation in this decision-making process.

Sincerely,

William D. Magwood, IV, Director
Office of Nuclear Energy, Science
and Technology

Enclosure

DOE/EIS - 0306
July 2000

Final Environmental Impact Statement

for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

Volume 2

U.S. Department of Energy
Office of Nuclear Energy,
Science and Technology
Washington, DC 20585

In response to comments on the SBSNF Draft EIS and as a result of information that was unavailable at the time of the issuance of the draft EIS, the final EIS contains revisions and new information. These revisions and new information are indicated by a double underline for minor word changes or by a sidebar in the margin for sentence or larger additions. Appendix A contains the comments received during the public review period of the SBSNF Draft EIS and DOE's responses to these comments.

AVAILABILITY OF THE DRAFT SBSNF EIS

General questions regarding this EIS or for a copy of this EIS, please contact:

Susan M. Lesica, Document Manager
Office of Nuclear Facilities Management (NE-40)
Office of Nuclear Energy, Science, and Technology
U.S. Department of Energy
19901 Germantown Road
Germantown, MD 20874
Attention: SBSNF EIS
Telephone: (301) 903-8755

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Contact: For copies of this environmental impact statement (EIS), call: 1 (877) 450-6904

For additional information on this Final EIS, contact:

Susan M. Lesica, Document Manager
Office of Nuclear Facilities Management (NE-40)
Office of Nuclear Energy, Science, and Technology
U.S. Department of Energy
19901 Germantown Road
Germantown, MD 20874
Attention: SBSNF EIS
Telephone: (301) 903-8755

For general information on the DOE National Environmental Policy Act (NEPA) process, contact:

Carol M. Borgstrom, Director
Office of NEPA Policy and Assistance (EH-42)
Office of Environment, Safety, and Health
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585
Telephone: (202) 586-4600, or leave a message at: 1 (800) 472-2756

***Abstract*:** DOE is responsible for the safe and efficient management of its sodium-bonded spent nuclear fuel. This fuel contains metallic sodium, a highly reactive material; metallic uranium, which is also reactive; and in some cases, highly enriched uranium. The presence of reactive materials could complicate the process of qualifying and licensing DOE's sodium-bonded spent nuclear fuel inventory for disposal in a geologic repository. Currently, more than 98 percent of this inventory is located at the Idaho National Engineering and Environmental Laboratory (INEEL), near Idaho Falls, Idaho. In addition, in a 1995 agreement with the State of Idaho, DOE committed to remove all spent nuclear fuel from Idaho by 2035. This EIS evaluates the potential environmental impacts associated with the treatment and management of sodium-bonded spent nuclear fuel in one or more facilities located at Argonne National Laboratory-West (ANL-W) at INEEL and either the F-Canyon or Building 105-L at the Savannah River Site (SRS) near Aiken, South Carolina. DOE has identified and assessed six proposed action alternatives in this EIS. These are: (1) electrometallurgical treatment of all fuel at ANL-W, (2) direct disposal of blanket fuel in high-integrity cans with the sodium removed at ANL-W, (3) plutonium-uranium extraction (PUREX) processing of blanket fuel at SRS, (4) melt and dilute processing of blanket fuel at ANL-W, (5) melt and dilute processing of blanket fuel at SRS, and (6) melt and dilute processing of all fuel at ANL-W. In addition, Alternatives 2 through 5 include the electrometallurgical treatment of driver fuel at ANL-W. Under the No Action Alternative, the EIS evaluates both the continued storage of sodium-bonded spent nuclear fuel until the development of a new treatment technology or direct disposal without treatment. Under all of the alternatives, the affected environment is primarily within 80 kilometers (50 miles) of spent nuclear fuel treatment facilities. Analyses indicate little difference in the environmental impacts among alternatives. DOE has identified electrometallurgical treatment as its Preferred Alternative for the treatment and management of all sodium-bonded spent nuclear fuel, except for the Fermi-1 blanket fuel. The No Action Alternative is preferred for the Fermi-1 blanket spent nuclear fuel.

***Public Comments*:** The draft EIS was issued for public review and comment on July 31, 1999. The comment period ended on September 28, 1999, although late comments were accepted. Public hearings to solicit comments on the draft EIS were held in North Augusta, South Carolina; Boise and Idaho Falls, Idaho; and Arlington, Virginia. All comments were considered during the preparation of the final EIS, which also incorporates additional and new information received since the issuance of the draft EIS. In response to comments on the SBSNF Draft EIS and as a result of information that was unavailable at the time of the issuance of the draft EIS, the final EIS contains revisions and new information. These revisions and new information are indicated by a double underline for minor word changes or by a sidebar in the margin for sentence or larger additions. Appendix A contains the comments received during the public review period of the SBSNF Draft EIS and DOE's responses to these comments. DOE will use the analyses presented in this final EIS as well as other information in preparing the Record of Decision for the treatment and management of its sodium-bonded spent nuclear fuel. DOE will issue this Record of Decision no sooner than 30 days after the U.S. Environmental Protection Agency publishes a notice of availability of this final EIS in the *Federal Register*.

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Appendix I

Table I–1 Scientific Names of Animal and Plant Species Referred to in the Text I-1

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ANL	Argonne National Laboratory
ANL-W	Argonne National Laboratory-West
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CPP	Chemical Processing Plant
DOE	U.S. Department of Energy
EBR-II	Experimental Breeder Reactor-II
EIS	Environmental Impact Statement
EMT	Electrometallurgical Treatment (of spent fuel)
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guideline
FR	*Federal Register*
GMODS	Glass Material Oxidation and Dissolution System
HFEF	Hot Fuel Examination Facility
IAEA	International Atomic Energy Agency
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
P.L.	Public Law
PUREX	Plutonium-Uranium Extraction
RCRA	Resource Conservation and Recovery Act
SBSNF	Sodium-Bonded Spent Nuclear Fuel
SRS	Savannah River Site
U.S.C.	United States Code

Metric Conversion Chart

To Convert Into Metric			*To Convert From Metric*		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092903	square meters	square meters	10.7639	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.40469	hectares	hectares	2.471	acres
square miles	2.58999	square kilometers	square kilometers	0.3861	square miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32, then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

Metric Prefixes

Prefix	*Symbol*	*Multiplication Factor*
exa-	E	1 000 000 000 000 000 000 = 10^{18}
peta-	P	1 000 000 000 000 000 = 10^{15}
tera-	T	1 000 000 000 000 = 10^{12}
giga-	G	1 000 000 000 = 10^{9}
mega-	M	1 000 000 = 10^{6}
kilo-	k	1 000 = 10^{3}
hecto-	h	100 = 10^{2}
deka-	da	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	µ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}
femto-	f	0.000 000 000 000 001 = 10^{-15}
atto-	a	0.000 000 000 000 000 001 = 10^{-18}

APPENDIX A
OVERVIEW OF THE PUBLIC PARTICIPATION PROCESS

This appendix describes the public comment process for the U.S. Department of Energy's *Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* and the procedures used to respond to those comments. Section A.1 provides an overview of the public scoping process for the draft environmental impact statement. Section A.2 discusses the process for obtaining public comments on the draft environmental impact statement, including the public hearing format and the major issues raised by the comments received. Section A.2.5 presents oral comments made by attendees at the four public hearings and the U.S. Department of Energy's responses. Section A.2.6 contains scanned copies of comment documents received during the public comment period and the Department's responses to each comment.

A.1 THE PUBLIC SCOPING PROCESS

A.1.1 Scoping Process Description

As a preliminary step in the development of an environmental impact statement (EIS), regulations established by the Council on Environmental Quality (40 CFR 1501.7) and the U.S. Department of Energy (DOE) require "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action." The purpose of this scoping process is: (1) to inform the public about a proposed action and the alternatives being considered and (2) to identify and/or clarify those issues considered most relevant by the public.

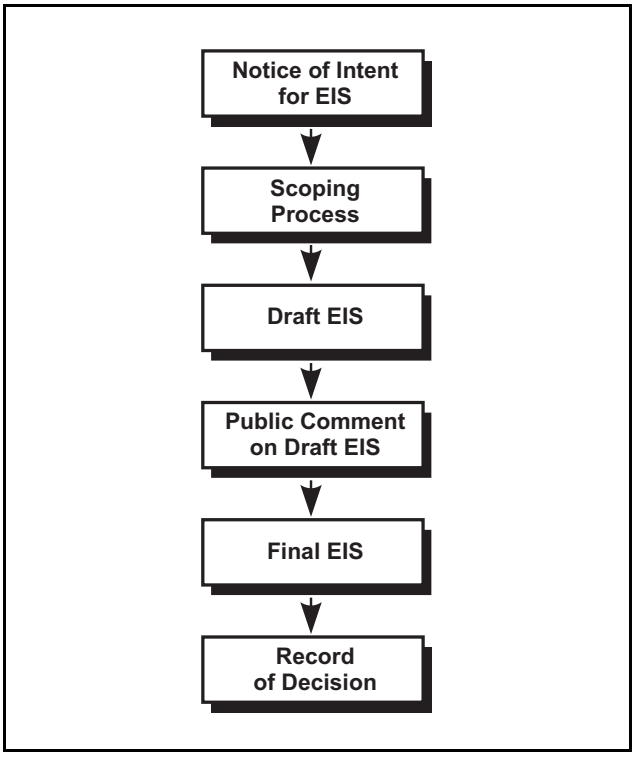

Figure A–1 NEPA Process

On February 22, 1999, DOE published in the *Federal Register* a Notice of Intent to prepare an EIS for the treatment of sodium-bonded spent nuclear fuel. As shown in **Figure A–1**, the scoping process is one of the opportunities for public involvement required as part of the National Environmental Policy Act (NEPA) process. The Notice of Intent listed the alternatives and issues initially identified by DOE for evaluation in the EIS. Members of the public, civic leaders, and other interested parties were invited to comment on these issues and to suggest additional issues that should be considered in the EIS. The Notice of Intent also informed the public that comments on the proposed action could be communicated via U.S. mail, a special DOE web site on the Internet, a toll-free phone line, a toll-free fax line, or in person at one of four public meetings.

Four public scoping meetings were held at locations in Idaho, South Carolina, and Virginia, near the Washington, DC, metropolitan area. The first public meeting was attended by about 60 members of the public and was held in Idaho Falls, Idaho, on March 9, 1999. The second meeting was held in Boise, Idaho,

on March 11, 1999, and was attended by about 7 members of the public. Approximately 10 members of the public attended the third meeting, which was held in North Augusta, South Carolina, on March 15, 1999. The fourth meeting was held in Arlington, Virginia, on March 18, 1999, and was attended by about 8 members of the public.

As a result of previous experience and positive responses from attendees of other DOE/NEPA public meetings and hearings, DOE chose an interactive format for the scoping meetings. Each meeting began with a presentation by a DOE representative who explained the proposed action. Afterwards, an impartial facilitator opened the floor to questions, comments, and concerns from the audience. DOE and national laboratory personnel were available to respond to the questions and comments as needed. A court reporter was provided at each of the meetings to record the oral comments, and personnel were available to receive any written statements or comments that were submitted at the meetings. In addition, the public was encouraged to submit written or verbal comments via letters, the DOE Internet web site, the toll-free phone line, or the toll-free fax line until the end of the scoping period on April 8, 1999 (45 days after publication of the Notice of Intent).

It should be noted that, for EIS public scoping purposes, a comment is defined as a single statement or opinion concerning a specific issue. Any statement may contain many separate comments. Most of the verbal and written public statements submitted during the EIS scoping period contained multiple comments on various individual issues.

A.1.2 Scoping Process Results

Two hundred twenty eight comments were received from citizens, interested groups, and other stakeholders during the public scoping comment period. Of these, 109 were verbal comments made during the public meetings. The remaining comments (119) either were submitted at the public meetings in written form or were received via mail, Internet, fax, or phone during the scoping comment period. In cases where a single commentor provided similar or identical comments both orally at the public meetings and in writing, each individual comment was counted once (i.e., repetitions were not counted).

Many members of the public who spoke at the public meetings asked specific, technical questions about the proposed action that were answered by the DOE and national laboratory representatives at each meeting. Primary areas of interest included:

- Waste volume reduction
- Nature of the spent nuclear fuel waste at Argonne National Laboratory-West (ANL-W)
- Waste forms characterization
- Waste disposition and qualification (repository acceptance criteria)
- Plutonium-uranium extraction (PUREX)
- Use of facilities
- Nonproliferation impacts
- Transportation
- Demonstration project

The comments obtained through the overall public scoping process addressed several key issues. A number of persons commented on the schedule for the EIS. Many said the draft EIS should not be issued for public comment before publication of other reports, such as the Waste Qualification Assessment from the National Research Council; the National Academy of Sciences' Independent Assessment Final Report on the demonstration project; a Nonproliferation Impacts Assessment by the DOE Office of Nonproliferation and National Security; and an independent study of the costs of the proposed action. Several commentors also said this EIS is premature because the demonstration project will not be completed until after the draft EIS is published.

Several commentors asked that the EIS include information about the costs of the proposed action and all of the technology alternatives under consideration. Other commentors stated the public should have an opportunity to comment on DOE's ongoing independent Nonproliferation Impacts Assessment within the same time frame as the draft EIS, or that this EIS should be delayed until the assessment is publicly available. Some suggested the assessment be included in the EIS. A few commentors expressed the opinion that electrometallurgical treatment of spent nuclear fuel is a proliferation-prone technology.

Waste was another issue that was frequently cited. Many waste-related comments included opinions about whether low-enriched uranium, plutonium, noble metals, and other components of the waste stream should be viewed as waste or potentially valuable resources. Several commentors asked that the EIS clarify which specific waste forms would be generated by the treatment processes. Others said the EIS should clarify whether the waste would remain at the Savannah River Site (SRS) after processing or be returned to Idaho if the PUREX process were used. Some commentors argued that the electrometallurgical treatment alternatives would not reduce the volume of waste to be stored in a repository. A few questioned how DOE can ensure the waste will meet the acceptance criteria for a repository when no one knows what those criteria will be—or if there will be any repository at all. A few others recommended that the EIS evaluate the PUREX process before it is shut down to ensure that the waste forms resulting from electrometallurgical treatment are as good as the borosilicate glass that is being prepared for the geologic repository.

Regarding the alternative technologies being evaluated as part of this EIS, the commentors generally agreed that DOE should evaluate in detail all of the alternative technologies that potentially could meet DOE's treatment and management needs—even those that DOE considers less technologically mature. Several commentors expressed the opinion that DOE already has made a technology decision in favor of electrometallurgical treatment, but that other alternative new technologies should not be dismissed because of a lack of knowledge about them. Some asked that the EIS: (1) explain how DOE can consider the PUREX process a reasonable alternative when, historically, it could not handle sodium-bonded spent nuclear fuel, and (2) evaluate whether changes in the PUREX process would be needed to accommodate sodium-bonded spent nuclear fuel. A few commentors suggested the EIS should analyze blanket and driver fuel separately, since they have different chemical and radiological characteristics and different treatments might be warranted.

Comments concerning environment, safety, and health issues were comparatively few, as were comments about transportation safety and security. A spokesman for the Shoshone-Bannock Tribe, which considers the Idaho National Engineering and Environmental Laboratory (INEEL) land to be part of their original territory, expressed confidence that the proposed electrometallurgical treatment process would not impact the land's cultural resources or native species. Other commentors wanted the EIS to explain whether there were any environmental threats associated with continued storage of the spent nuclear fuel in Idaho and the nature of the environmental impacts of all the alternative technologies listed in the Notice of Intent. Transportation-related comments were rare, but reflected some public concern about the safety and security of transporting spent nuclear fuel and other waste products over long distances.

Some commentors simply opposed the proposed action as a waste of money or an example of corporate welfare. Others stated that DOE already has determined its choice of alternatives and is merely engaging in a show process that meets the bare minimum legal requirements.

A.1.3 Comment Disposition and Issue Identification

Comments received during the scoping period were systematically reviewed and evaluated to determine whether the issues raised fell within or outside the scope of the EIS as contemplated in the Notice of Intent (64 FR 8553). Where possible, comments on similar or related topics were grouped under comment categories as a means of summarizing the comments. An attempt was made to avoid duplication in counting the number of comments received; however, comments submitted in both written and verbal form may have

been counted twice in some cases. The comment categories were used to identify specific issues of public concern. After the issues were identified, they were evaluated to determine whether they fell within or outside the scope of the EIS. Some issues were found to be already "in scope," i.e., they were among the EIS issues already identified by DOE for inclusion in the EIS. **Table A–1** lists these issues along with references to the specific EIS sections where each issue is discussed.

Additional issues were added to the scope of the EIS as a result of the public scoping process. These issues are listed in **Table A-2**.

DOE responded to all issues raised during the scoping period. Many of the public issues were not analyzed for a specific reason or were determined to be outside the scope of the EIS. These issues are listed in **Table A–3**. Corresponding responses from DOE also are provided in Table A–3 to explain why each issue was not analyzed.

Table A–1 Issues Already Included in the EIS (In Scope)

Issues	*No. of Comments*	*Draft EIS References*
The EIS should specify what the stable sodium compound technology alternative is and how it is derived	1	Section 2.3
The EIS should explain how the PUREX process, which could not handle sodium-bonded spent nuclear fuel before [in the aluminum-bonded Spent Nuclear Fuel EIS], now is considered an acceptable alternative for the proposed action.	1	Section 2.3.2
DOE says the Savannah River PUREX process will handle the sodium, but more research will be needed to improve the sodium-handling ability of the PUREX process. If research is needed to make the Savannah River PUREX process work for sodium, DOE might as well do research in Idaho in some different process. I'm in favor of Idaho; DOE should be cautious about talking PUREX and sodium-bonded stuff.	2	Section 2.3.2
The EIS should evaluate whether changes in the PUREX process would be needed to accommodate this material. After the plutonium is separated in the PUREX process, the high-level radioactive waste will be essentially no different from what is being handled now—no new ground broken, no new qualifications in materials. The uranium also will be unchanged after it goes through the PUREX process. The same with plutonium; if it goes through the PUREX, you haven't changed the existing process. So people should not get excited about this new stuff coming in—we've handled it for fifty years.	2	Sections 2.3.2 and 2.5.4
The EIS should analyze blanket and driver fuel separately since they have different chemical and radiological characteristics and different treatments might be warranted for each.	6	Sections 2.5, 4.3, 4.4, 4.5, 4.6, 4.7, and 4.8.
We're glad to see the melt and dilute alternative, a nonseparation technology, is being considered in this EIS.	1	Sections 2.5.5, 4.6, 4.7, and 4.8
The EIS should not assume that everything is known about the C-22 canister's performance in all conditions that could affect disposal; therefore, this canister should not be the only type of containment considered for encapsulation.	1	Section 4.13
The EIS should clarify whether, if the PUREX process were used, the waste would remain at the Savannah River Site after processing or be returned to Idaho.	4	Section 4.5.6
The EIS must clarify whether DOE considers low-enriched uranium to be a waste.	1	Section 4.3
The EIS must clarify which specific waste form will be used before any spent nuclear fuel is treated.	2	Sections 4.2.6, 4.3.6, 4.4.6, 4.5.6, 4.7.6, and 4.8.6
Will all of the technology alternatives shown on the poster handout be evaluated in this EIS? Has DOE made the ultimate decision concerning which alternatives will be evaluated in this EIS?	1	Section 2.5
Is there anything different about handling the materials involved in this EIS that would make the chloride volatility alternative more viable than was found for aluminum enriched uranium fuel? Hasn't this alternative already been evaluated in another EIS?	1	Section 2.7
The chemistry of the electrometallurgical process and the other alternatives should be provided.	1	Appendix C

Issues	*No. of Comments*	*Draft EIS References*
Blanket fuel can be mechanically declad and stripped of elemental sodium without the need for dissolution and separation of the solid fuel. While the minimal discussion in DOE documents stresses the difficulties of this approach, it is extremely hard to believe that the difficulties, costs, and risks of such minimal processing would be greater than those incurred by electrometallurgical treatment of the fuel. It is difficult to understand DOE's argument that this option is not as mature as electrometallurgical treatment, since it was employed for 15 times as many blanket rods as those that ultimately will be processed during the electrometallurgical treatment demonstration.	1	Section 2.5.3
Both DOE and the U.S. Nuclear Regulatory Commission underplay the significance of the mechanical decladding of 17 metric tons of heavy metal of blanket fuel. The U.S. Nuclear Regulatory Commission refers to this as a small amount even though it is 75 percent of the existing Experimental Breeder Reactor-II (EBR-II) blanket inventory. This is only one example of the loaded language in the Notice of Intent and its reference documents that strongly suggests the mechanical decladding alternative is not being fairly evaluated.	1	Section 2.5.3
All alternatives investigated and considered in this EIS should be viable and demonstrable. Unproven technologies preclude realistic bounding of environmental impacts and consequently do not appear to meet the intent of NEPA by providing implementable alternatives.	1	Section 2.5
Coordinate development of this EIS with others that are currently in preparation, including the Idaho High-Level Waste and Facilities Disposition, the Savannah River Spent Fuel, and the Yucca Mountain EISs.	3	Section 1.6
What are the plans for treatment of sodium-based fuel located at the other sites (about 2 percent of inventory)?	1	Section 2.2
Political decisions, such as the Idaho Settlement Agreement (which says that spent nuclear fuel must be out of Idaho by 2035), should not preclude any of the No Action Alternatives from being considered.	1	Sections 2.5.1, 4.2, and 4.13
I was pleased to hear you say you were looking at several options connected to the No Action [alternative].	1	Sections 2.5.1 and 4.2
The EIS should be specific about the stable compound of sodium and how that makes it like table salt (i.e., not a problem).	1	Appendix C and Section 2.3
How does this EIS relate to other EISs for treatment and disposal of other spent nuclear fuel types?	1	Section 1.6
What is the enrichment of the uranium?	1	Section 2.2.1
DOE should consider whether adequate information exists to allow estimation of bounding impacts for at least one treatment alternative in addition to the PUREX process at the Savannah River Site, the proposed electrometallurgical treatment at ANL-W, and the No Action Alternative. Instead of dismissing various treatment alternatives from further analysis, DOE should use existing information about those alternatives to support evaluation of as many treatment alternatives as possible. For example, the processing experience at Idaho Nuclear Technology and Engineering Center (INTEC) of the driver fuel using the PUREX-type process might be used in the analysis of the PUREX process at Savannah River.	1	Sections 2.5.3, 2.5.5, 4.4, 4.6, 4.7, and 4.8

Issues	*No. of Comments*	*Draft EIS References*
To support public review of the alternatives under consideration, the EIS should offer complete descriptions of how each alternative would be implemented.	1	Appendix C and Section 2.3
Each alternative should include full descriptions of all materials (including waste) resulting from treatment; proposed handling of all materials used in the treatment process; environmental impacts; measures to provide environmental protection; measures to ensure worker and public safety; facilities needed; full and complete discussion of waste handling facilities, magnitude and characteristics of the waste streams, type and amount of storage, and ultimate disposal method and location.	1	Sections 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, and 4.8
The EIS should provide bounding estimates of the size, frequency, and number of expected shipments of products leaving Idaho on an annual basis.	1	Section 4.11
The EIS should provide bounding estimates of the duration of time that INEEL would store any products before shipment elsewhere after treatment.	1	Sections 4.2.6, 4.3.6, 4.6, 5.6, 7.1, and 8.0
Preparation of the EIS and the related decision-making process should be coordinated with related environmental documentation being prepared to ensure they are based on common data and common planning assumptions.	1	Section 1.6
The EIS should deal with disposition of all the waste streams resulting from this proposed action.	2	Sections 2.8, 4.2.6, 4.3.6, 4.4.6, 4.5.6, 4.6.6, 4.7.6, and 4.8.6
To help the public understand DOE's rationale for moving forward with this decision, the EIS should describe how each treatment alternative would address the waste acceptance criteria for resulting waste products destined for disposal at current and planned disposal facilities.	1	Sections 2.8 and 4.13
The draft EIS should include a complete subject index and not just an alphabetically arranged list of headings.	1	Chapter 9
DOE should coordinate the related projects [e.g., the Idaho High-Level and Facilities EIS; the Management of Savannah River Spent Nuclear Fuel EIS; and the Geological Disposal Repository for Spent Nuclear Fuel and High-Level Waste at Yucca Mountain, Nevada, EIS] to support consistent, coordinated decision-making.	1	Section 1.6

Table A–2 Issues Added to the Scope of the EIS

Issues	*No. of Comments*	*Draft EIS References*
Analyses related to the No Action Alternative should include the environmental consequences of not doing anything...and [this alternative] should not be written off because somebody made a political decision that this stuff will be out of Idaho by 2035.	1	Section 4.2
The proposed structure of the EIS as described in the Notice of Intent is inconsistent with DOE's approach to spent nuclear fuel management at other sites and prematurely promotes a preferred option for managing sodium-bonded spent nuclear fuel. By presuming the proposed action is electrometallurgical treatment, the proposed structure of the EIS effectively establishes this treatment as the preferred alternative for stabilization of this material. While it is reasonable to rule out obviously impractical alternatives in the scoping process, several of the alternatives described in the Notice of Intent are technically viable and should not be prematurely dismissed.	3	Sections 1.2, 1.3, 1.4, and 2.5
DOE should consider the possibility of using different treatment processes for treatment of the driver fuel and the blanket fuel. Could the driver fuel be handled as part of the ongoing demonstration? Treatment alternatives for the blanket fuel could conceivably include direct disposal, as it is not yet clear that it will require treatment before disposal.	1	Sections 2.5.3, 2.5.4, 2.5.5, and 2.5.6
The three alternatives presented for treatment of the EBR-II fuel are the most reasonable ones politically available, namely (1) separate the highly enriched uranium and make the other materials into a ceramic using a hot isostatic press, or (2) separate both the uranium and plutonium using the PUREX process at the Savannah River Site and...vitrify the waste, or (3) direct burial.	1	Sections 2.5, 4.2, 4.3, and 4.4

Table A–3 Other Issues Considered

Issues	*No. of Comments*	*DOE Responses*
Costs		
The public needs information about the cost of the proposed action and the costs of the other technology alternatives before it can adequately comment on the EIS.	6	Information on cost will be made available to the public via the Cost Study, which will be issued during the draft EIS public comment period.
This program is not worth the money it will cost.	1	Information on cost can be found in the Cost Study which, along with the EIS, will factor into the Record of Decision.
The cost assessment has to be part of the EIS.	2	Although the cost assessment is not part of the EIS, it has been prepared concurrently with the EIS. The Cost Study, along with the EIS, will factor into the Record of Decision.

Issues	*No. of Comments*	*DOE Responses*
If you don't account for the low-enriched uranium stream, your cost estimates are going to be wrong or at least off. If you don't have a disposition scenario, you have to look at the long-term economic and environmental storage costs that will belong to DOE for a long time.	2	The environmental impacts and cost of storage of the low-enriched uranium stream have been analyzed in the EIS and Cost Study, respectively.
We think that combining the research and development efforts on these two different types of fuel [blanket and driver] might lead to considerable cost savings.	1	If an alternative technology is chosen that could treat both the driver and blanket fuel, research and development efforts would be combined, as they were for electrometallurgical treatment research and development.
As Savannah River has a huge vitrification facility and that technology already is available, DOE should compare the costs of vitrification with the costs of the PUREX process.	1	The vitrification facility at SRS treats the high-level radioactive waste that results from PUREX processing. The two are not independent. The cost of vitrification will be included in the cost of the PUREX alternative in the Cost Study. Direct vitrification of sodium-bonded spent nuclear fuel, however, is not technically feasible.
Cost analysis should include: (1) program costs so far in detail, including whether these costs were for pyroprocessing or for the EBR-II to shut down; (2) how much it would cost to close out the program at the end of the test, including decommissioning the machinery and dealing with all the waste streams (such as low enriched uranium); (3) what it would cost to scale-up the program, including commissioning and dealing with all waste streams at the end of the scale-up.	1	The Cost Study does not include EBR-II shutdown costs. The Cost Study includes the cost of any new machinery, if needed; treating the sodium-bonded spent nuclear fuel; deactivating machinery; and dealing with the waste streams. The low-enriched uranium product is not a waste. Its disposition will be the subject of a future NEPA review, however, the cost of storage of the low-enriched uranium is included in the Cost Study.
The EIS should include the cost of transportation if this stuff is moved across country from Idaho to South Carolina and then from South Carolina to wherever.	1	The cost of offsite and onsite transportation is included in the Cost Study.
Environment, Safety, and Health		
The Shoshone-Bannock Tribe considers the INEEL land to be part of their original territory and believes the electrometallurgical treatment process will not impact the land's cultural resources or native species and will make the best uses of these resources.	1	The commentor's support for the electrometallurgical technology is acknowledged.
DOE should explain the environmental considerations that are pushing this EIS to completion in such a short period of time, including the environmental threats of continuing to store the EBR-II spent nuclear fuel in Idaho, if any. Then, DOE should compare these environmental threats with the R&D schedule for all the alternative technologies being considered, especially the nonseparation technologies.	1	The purpose and need for agency action is discussed in Section 1.2. Under the No Action Alternative, the Department may decide to continue to store the sodium-bonded spent nuclear fuel indefinitely, or until research and development of an alternative treatment technology is successfully completed.

Issues	*No. of Comments*	*DOE Responses*
DOE should be able to provide the environmental impacts for all of the alternative technologies listed in the Notice of Intent; they should not be dismissed because DOE does not know enough about them.	1	Alternative technologies were not dismissed solely based on the lack of available information on the respective technologies. As discussed on Section 2.6, chloride volatility was dismissed due to the potentially significant (in comparison to other treatment technologies) occupational and public risks from the volatilization of fission products and chloride gas.
Nonproliferation		
Nonproliferation should not be addressed in a separate report; the nonproliferation assessment should be part of the EIS. Short-circuiting the nonproliferation analysis is particularly egregious in light of the pledge in the Notice of Intent to include this assessment in the draft EIS and the existence of such a DOE assessment from December 1998.	3	The Notice of Intent stated, "The combination of the information contained in the draft EIS, the public comment in response to the draft EIS, and the Nonproliferation Impacts Assessment report will enable the Department to make a sound decision..." Although the Nonproliferation Impacts Assessment is separate from the EIS, it will fully analyze the nonproliferation impacts of the alternatives in the EIS.
The public should have an opportunity to comment on the ongoing nonproliferation assessment, and the assessment should be publicly available before the comment period is closed on this EIS.	9	The Nonproliferation Impacts Assessment will be available to the public prior to the end of the public comment period for this draft EIS. However, the assessment will be issued as a final document.
The public needs information about the nonproliferation impacts of the proposed action before it can comment on the EIS.	1	The Nonproliferation Impacts Assessment will be available to the public prior to the end of the comment period for this draft EIS.
The EIS should not be released until nonproliferation concerns no longer are being debated; there is a potential for exporting this technology.	1	The Nonproliferation Impacts Assessment will be available to the public prior to the end of the comment period for this draft EIS.
Given that obtaining fuel material is the greatest hurdle to producing nuclear weapons, DOE should take nonproliferation concerns about small-scale reprocessing technologies like pyroprocessing more seriously and give them greater weight in its decision-making.	2	DOE is concerned with the nonproliferation impacts of all of its proposed actions. It is for this reason that a separate Nonproliferation Impacts Assessment report will be prepared specifically to address the alternatives under consideration.
Pyroprocessing is a proliferation-prone technology. For example, although plutonium no longer would be separated as a separate step in the EBR-II treatment, the original pyroprocessing technology was intended to remove plutonium and actinide components in a liquid cadmium cathode, and that option is always there.	4	DOE has conducted four independent nonproliferation assessments of electrometallurgical technology over the past 11 years. A new assessment that addresses the alternatives under consideration for treating sodium-bonded spent nuclear fuel is being conducted concurrently with the EIS and the report will be available for public review. Previous assessments have concluded that electrometallurgical technology was not capable of separating plutonium in a form that would be suitable for weapons. Development of the liquid cadmium cathode was canceled before significant engineering issues were resolved. No liquid-cadmium cathode was ever completed for the electrorefiners used in the Fuel Conditioning Facility, where spent nuclear fuel treatment would take place.

Issues	*No. of Comments*	*DOE Responses*
Pyroprocessing will continue to search for other missions before the issue of whether it can be shut down and decommissioned on a timely basis is decided. Use of pyroprocessing should be "nipped in the bud" because of nonproliferation concerns.	1	Electrometallurgical treatment technology is a promising technology for the management of spent nuclear fuel. DOE is considering applying this technology for the management of some or all of its sodium-bonded spent nuclear fuel at sometime in the near future. DOE is conducting a Nonproliferation Impacts Assessment that focuses on the application of electrometallurgical and alternative treatment technologies to sodium-bonded spent nuclear fuel. This new assessment will be made available to the public during the draft EIS public comment period. Previous nonproliferation assessments have found electrometallurgical technology to be in accordance with the U.S. nuclear nonproliferation policy for the specific applications considered.
The Savannah River nonproliferation assessment states that pyroprocessing can be modified to produce plutonium. This modification may not be easy, but it would be easier than building an entire PUREX facility or adding such a capability to any of the other nonseparation technology options—and it would certainly be of interest to rogue states who are interested in producing nuclear weapons.	3	The modification referred to in the Savannah River nonproliferation assessment involves adding a proven aqueous process such as PUREX onto the electrometallurgical process. Because the aqueous processes would be incompatible with the dry inert atmosphere required by the electrometallurgical process, a separate facility would be required. If a nation bent on weapons production had this capability, it could separate weapons-usable plutonium directly from spent nuclear fuel or plutonium production targets without the need for the electrometallurgical process equipment.
This program is inconsistent with the present U.S. position on reprocessing. The United States should not be funding new separation technologies.	2	The DOE Office of Arms Control and Nonproliferation will assess the nonproliferation impacts of the alternative treatment technologies under consideration in this EIS in a separate report to determine if the alternatives are consistent with U.S. nonproliferation policy and goals.
Pyroprocessing is reprocessing. MacArthur Prize Fellowship winner Frank Von Hippel and Professor James Warf, inventor of several reprocessing technologies, underscore this fact and express concern about the nuclear nonproliferation impacts of pyroprocessing: "...because pyroprocessing facilities are more compact than conventional facilities, they are easier to conceal. The world would become a more dangerous place."	2	In a nonproliferation assessment conducted for DOE in 1992, a panel of experts stated that there was no reason to conclude that electrometallurgical process facilities would be any easier to conceal than a conventional reprocessing plant. The electrometallurgical process requires a large heavily shielded hot cell with highly purified argon atmosphere and specialized process equipment.
While the Notice of Intent states that DOE has no plans to apply this technology (electrometallurgical treatment) to any other types of spent nuclear fuel, it clearly leaves the door open for other applications and raises the concern that ANL-W will continue to hunt for other materials that can be used to keep the electrometallurgical treatment apparatus operating after the sodium-bonded fuel campaigns are completed, or even to justify construction of new facilities. This open-ended approach...has severe implications for nonproliferation.	1	Electrometallurgical treatment technology is a promising technology for the management of spent nuclear fuel. DOE is considering applying this technology for the management of some or all of its sodium-bonded spent nuclear fuel at sometime in the near future. DOE is conducting a Nonproliferation Impacts Assessment that addresses the application of electrometallurgical technology, as well as the other alternatives under consideration, to sodium-bonded spent nuclear fuel. This new assessment will be made available to the public during the draft EIS comment period. Previous nonproliferation assessments have found electrometallurgical technology to be in accordance with U.S. nuclear nonproliferation policy for the specific applications considered.

Issues	*No. of Comments*	*DOE Responses*
The electrometallurgical treatment process can be modified to produce plutonium. Moreover, there are no plans to place ANL-W facilities under international safeguards. Therefore, from an arms control standpoint, the Fuel Conditioning Facility must be regarded as a dual-use facility capable of being operated as a reprocessing plant. In view of this, it is highly advisable to prepare for timely shutdown of the facility when any campaigns for which it is determined to be essential (if any) are completed.	1	DOE has conducted four independent nonproliferation assessments of electrometallurgical technology. A new assessment that focuses on the application of electrometallurgical technology to sodium-bonded spent nuclear fuel is being conducted concurrently with the EIS and will be available for public review. Previous assessments have concluded that electrometallurgical technology was not capable of separation plutonium in a form that would be suitable for weapons. Development of the liquid cadmium cathode was canceled before significant engineering issues were resolved. No liquid-cadmium cathode was ever completed for the electrorefiners used in the Fuel Conditioning Facility, where the spent nuclear fuel treatment would take place. The Fuel Conditioning Facility operates under DOE safeguards and security requirements.
DOE should make the nonproliferation assessment of the proposed electrometallurgical treatment action a part of the NEPA process. The assessment should cover not only the proposed action, but the broader proliferation implications of continued research and development of this reprocessing technology.	1	DOE is concerned with the nonproliferation impacts of all of its proposed actions. It is for this reason that a separate Nonproliferation Impacts Assessment will be prepared that will specifically address electrometallurgical treatment technology. DOE will consider this assessment in its decision-making process.
One issue that should be covered in the nonproliferation assessment is whether promotion of electrometallurgical treatment as a "proliferation-resistant" technology ultimately will prove harmful to U.S. nonproliferation goals. If this designation does not have a sound technical basis (as we believe it does not), the ultimate result will be an increased danger of proliferation.	1	DOE is concerned with the nonproliferation impacts of all of its proposed actions. It is for this reason that a separate Nonproliferation Impacts Assessment will be prepared that will specifically address electrometallurgical treatment technology.
For nations that reprocess spent nuclear fuel, switching to electrometallurgical treatment may enable them to argue that their current safeguards burden should be relaxed.	1	Prior to the export of any technology that may have nonproliferation impacts to a foreign nation, DOE assesses the impacts, if any, to ensure that U.S. nonproliferation goals are met.
The EIS should include a detailed, thorough analysis of the weapons proliferation implications of each treatment alternative.	1	DOE's Office of Arms Control and Nonproliferation is preparing a Nonproliferation Impacts Assessment of each treatment alternative. This new assessment will be made available to the public during the draft EIS public comment period.
One of the justifications for proceeding with the mixed oxide (MOX) proposal was to satisfy the international community's desire to forestall the ready availability of weapons-grade materials. This proposal creates the ready availability of those same materials. The EIS must account for this apparent contradiction of policy and address the measures intended to safeguard the by-product(s) of this process.	1	DOE recognizes the need to identify nonproliferation impacts of the treatment technologies. Therefore, the DOE Office of Arms Control and Nonproliferation will assess the nonproliferation impacts of the alternative treatment technologies in a report, separate from this EIS.
Alternative Technologies		
The EIS should re-evaluate and address plutonium separation; it would be less expensive to separate the plutonium because that would mean the repository would need to last only 300 years, instead of 10,000.	1	The EIS is evaluating plutonium separation as a part of the PUREX option for the blanket fuel. Plutonium separation would not guarantee a different performance requirement for the repository, since the long-term requirements are driven by other radioisotopes.

Issues	*No. of Comments*	*DOE Responses*
DOE has already made up its mind. Other methods than pyroprocessing haven't been given sufficient attention. These alternative methods continually are slated as "not developed enough." Yet in three years, there hasn't been much attention given to developing them to a point where they could be reviewed fairly. Alternative new technologies should not be dismissed due to lack of knowledge about them.	4	In response to public comments, DOE has reformulated the scope of the EIS to address more generally the treatment and management of DOE sodium-bonded spent nuclear fuel. Information developed in the course of preparing this EIS suggests that alternative technologies may have certain advantages (e.g., cost) for some or all of the fuel. Accordingly, DOE did not identify a preferred alternative in the Draft EIS. In the EIS, DOE also considers an option under the No Action Alternative in which the Department would actively conduct research and development of promising new technologies.
The Notice of Intent is biased toward electrometallurgical treatment because it disparages the other alternatives, which are tacked on just to satisfy a legal requirement. The program is taking the wrong approach toward electrometallurgical treatment because the alternatives are not really valid.	2	In response to public comments, DOE has reformulated the scope of the EIS to address more generally the treatment and management of DOE sodium-bonded spent nuclear fuel. Information developed in the course of preparing this EIS suggests that alternative technologies may have certain advantages (e.g., cost) for some or all of the fuel. Accordingly, DOE did not identify a preferred alternative in the Draft EIS. In the EIS, DOE also considers an option under the No Action Alternative in which the Department would actively conduct research and development of promising new technologies.
There is a danger that other technologies will be abandoned if, as it appears, DOE is rushing to produce waste or materials to go to a waste site somewhere or is pushing pyroprocessing ahead of other technologies.	1	In response to public comment, DOE has restructured the alternatives to be considered, including an option of deferring a treatment decision and developing alternative technologies.
The EIS should identify the alternative sites if Idaho is not selected and which sites will be needed for the alternative technologies.	1	The EIS has identified the SRS as an alternative site for the PUREX and melt and dilute alternatives.
The EIS should include a stabilization timeline on environmental grounds for EBR-II spent nuclear fuel. The time line should include the time needed to more fully develop other alternatives.	2	EBR-II spent nuclear fuel must be removed from the State of Idaho by the year 2035 in accordance with a DOE/State of Idaho Settlement Agreement and Consent Order, signed in October of 1995. DOE believes that treatment to remove sodium from EBR-II and other spent nuclear fuel will make acceptance of this fuel in a national geologic repository much more likely.
Will the EIS look at the vitrification facility at INTEC?	1	The proposed Vitrification Facility at INTEC is not compatible with any of the proposed waste forms or metal fuel such as the EBR-II or Fermi-1 fuel. It is for this reason that DOE has not analyzed this facility in the EIS.
The EIS should address the size of the electrometallurgical treatment facility and whether the plant capacity is greater than needed for the proposed mission (more than 62 metric tons of heavy metal).	1	The plant capacity for treating spent nuclear fuel using the electrometallurgical treatment equipment is approximately 5 metric tons of heavy metal per year. It would therefore require 12 years to treat the entire 60-metric ton DOE sodium-bonded spent nuclear fuel inventory.
The Notice of Intent indicates that DOE has no plans to apply electrometallurgical treatment to any other spent nuclear fuel types, suggesting the plant would be decommissioned after completing the electrometallurgical treatment mission for sodium-bonded spent nuclear fuel. The EIS, therefore, should address the impacts of decommissioning the plant.	2	At this time, DOE has no intent to apply electrometallurgical treatment to any other spent nuclear fuel types. The electrometallurgical treatment process equipment is housed within a large multipurpose hot cell facility which has programmatic value to DOE, even in the absence of a spent nuclear fuel treatment program. Any specific electrometallurgical treatment equipment would be deactivated at the end of any treatment program; however, there are no plans to discontinue use of the hot cell facility.

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Use a reactor or accelerator to fission the transuranic material.	1	This is not a reasonable alternative because the transuranic materials resulting from the electrometallurgical treatment process would require extensive additional processing before they would be suitable for fission in a reactor.
Adding another furnace and cathode to ANL-W's facility would both accelerate the processing and provide opportunities for new research.	1	The existing electrometallurgical treatment equipment would provide DOE an adequate processing rate for the sodium-bonded spent nuclear fuel inventory. New research would be accomplished with equipment in a nonradioactive laboratory environment.
Regarding the use of melt and dilute and Savannah River—the Savannah River process will not be sized or configured to handle INEEL fuel (which should be contrary to the Foreign Research Reactor Record of Decision). Melt and dilute at INEEL solely should be the alternative.	1	The sodium-bonded fuel would have its cladding and sodium removed before being placed in aluminum cans for shipment to the SRS, where the proposed melt and dilute process would take place. This pretreatment step would make the fuel compatible with the proposed SRS process.
Sodium is highly reactive with water/moisture, and this property could be taken advantage of by controlled reaction on a limited scale—exposing the sodium-bonded material to moisture. The sodium hydroxide formed could be neutralized with an appropriate acid, allowing the remaining spent nuclear fuel to loose its pyrophoric properties. Please address this in the EIS.	1	For fuel in which the sodium can be exposed, the EIS describes a process for safely removing it by vacuum distillation. The process described in the comment would accelerate corrosion of the uranium, resulting in an unsafe pyrophoric condition.
DOE may want to consider an alternative that examines the relationship between the EBR-II fuel at INEEL and the high-level radioactive waste at the stabilization facility.	1	The proposed INEEL high-level radioactive waste management EIS is considering methods to manage the calcine that was produced from the reprocessing of DOE spent nuclear fuel at INTEC. With the decision to shut down the reprocessing facilities, no processes are currently available that would make the sodium-bonded fuel compatible with the calcine.
The fall 1996 National Research Council report on pyroprocessing at ANL states that even more time and money than originally planned will be needed to "achieve the program's objectives" and raises troubling questions about several aspects of the research itself. Later reports, unfortunately, do not specifically follow up on these concerns.	1	DOE's Electrometallurgical Research and Demonstration Project has addressed concerns that have been raised by the National Research Council. Their 1998 report has recognized the progress in the Demonstration and has stated it should continue to completion.
The fall 1996 National Research Council report raises serious concerns about several aspects of the research including a lack of coordination between ANL East and West. This lack of coordination and differing goals have led to duplicate efforts in at least one case and equipment failures. The report notes the lack of a "well-coordinated implementation plan between ANL East and West...."	1	DOE's Electrometallurgical Research and Demonstration Project has addressed concerns that have been raised by the National Research Council. Their 1998 report has recognized the progress in the Demonstration and has stated it should continue to completion. DOE's Electrometallurgical Research and Demonstration Project, which is nearing completion at ANL-W, has successfully met National Research Council criteria to date. The success of this demonstration project has been possible only through close coordination between scientists and engineers at ANL-East and -West.

Issues	*No. of Comments*	*DOE Responses*
The [fall 1996 National Research Council] report found that equipment is not performing at expected levels and separation efficiencies are lower than expected. This means that, so far, the basic goal of the pyroprocessing program—to separate the uranium from the rest of the irradiated fuel—has not been met.	1	DOE's Electrometallurgical Research and Demonstration Project has addressed concerns that have been raised by the National Research Council. Their 1998 report has recognized the progress in the Demonstration and has stated it should continue to completion.
Research on selected alternatives should have been carried out to support a defensible analysis of their feasibility in the EIS.	1	The alternatives to be analyzed in detail are described in Chapter 2 of the EIS. An analysis of their feasibility is included in this chapter.
DOE has not demonstrated there is a safety-based need to process the driver fuel by experimentally assessing the impact of elemental sodium on radionuclide leach rates.	1	DOE has proposed treatment to remove the sodium from sodium-bonded spent nuclear fuel to allow acceptance of this fuel in a national geologic repository. This is because sodium reacts with water in the environment to form corrosive sodium hydroxide solutions and potentially explosive hydrogen gas.
DOE should initiate a process similar to the Processing Needs Assessment to determine at the earliest possible date the "small quantities of certain spent nuclear fuel types" that may be considered for electrometallurgical treatment in the future. Such an effort is essential for shutdown and decommissioning planning.	1	At this time DOE has no intent to apply electrometallurgical treatment to any other spent nuclear fuel types. If, during the sodium-bonded fuel treatment program, DOE finds another application for electrometallurgical treatment at ANL-W, the development of plans to deactivate the electrometallurgical treatment equipment at ANL-W would be delayed accordingly.
A study similar to the 1997-98 Processing Needs Assessment should be conducted to identify all materials in the DOE complex that might need reprocessing in the Savannah River Site canyons for stabilization purposes, thus limiting the universe of potential uses for the canyons and facilitating planning for their shutdown. A similar process should be conducted for the Fuel Conditioning Facility as part of this EIS process, with the opportunity for full public participation and comment.	1	The EIS is being coordinated with other DOE EIS documents and Records of Decision concerning complex-wide management of spent nuclear fuel. These EISs are described in Section 1.6 of this EIS.
It is unfortunate that the option of separating the plutonium along with the uranium by the electrometallurgical process could not have been considered. Although the resulting fissile material would only have been suitable for a fast-neutron reactor...at least we would not have the agony of worrying about putting this plutonium in a repository.	1	The electrometallurgical process cannot separate plutonium. Because of potential nonproliferation implications, the Department elected not to develop the capability for electrometallurgical processing to produce any plutonium-bearing product. Plutonium separation is an integral part of Alternative 3, PUREX Processing of the Blanket Fuel at SRS. However, removal of the plutonium would not significantly affect the long-term performance of the repository, which is driven by other radioisotopes.
Since the electrometallurgical method works, is ready to go, and is not expensive, it is in the public interest to get the fuel treatment job done rather than delay while developing some other method.	1	The commentor's support of the electrometallurgical treatment technology is acknowledged.

Issues	*No. of Comments*	*DOE Responses*
The addition of depleted uranium to the electrometallurgical treatment process is both a waste of depleted uranium and enriched uranium. Why add the depleted uranium?	1	Blending depleted uranium with the highly enriched uranium recovered from the spent EBR-II driver fuel results in low-enriched uranium. This step, which is consistent with U.S. nonproliferation policy, results in lower costs for storing and safeguarding the uranium. Because the uranium ingots still contain more enrichment than is required for commercial power reactor fuel, their potential economic value is not decreased. The Department currently stores more than 500,000 tons of depleted uranium for which no immediate use is planned. Using some 10 tons of this inventory for treating spent nuclear fuel would have no discernable impact.
Waste		
The EIS should address the disposal specifications for spent nuclear fuel, and DOE should make sure that, whatever technology is selected, the spent nuclear fuel will meet repository specifications. This determination should be made before the canyons are shut down to avoid precluding a way to get rid of the materials.	1	The ceramic and metallic high-level radioactive waste forms that would be produced from the proposed action are expected to be at least as durable as the borosilicate glass high-level radioactive waste form. The design criteria for the national spent nuclear fuel repository include receipt and disposal of the borosilicate glass high-level radioactive waste.
The EIS should explain why stainless steel and noble metals are considered waste and not potentially valuable resources.	1	The stainless steel and noble metals would be part of the metallic high-level radioactive waste forms. High-level radioactive waste is a material that the U.S. Nuclear Regulatory Commission has determined requires permanent isolation.
Waste characterization is a problem. Low enriched uranium is a problem-it's a waste not a product. The EIS should look at the long-term storage costs of uranium.	2	DOE does not consider low-enriched uranium to be a waste. No highly enriched uranium would result from any of the alternatives considered at INEEL.
Discussion of the low-enriched uranium stream must include a full analysis of what happens to this stream and when.	1	DOE has not made a decision concerning future uses for the low-enriched uranium other than that the low-enriched uranium would not be used for defense purposes.
Spent nuclear fuel is not a waste.	1	Spent nuclear fuel is a fuel that has been withdrawn from a nuclear reactor following irradiation; the constituent elements have not been separated for reprocessing.
The project is being sold as a way to reduce the volume of waste to Yucca Mountain. It won't reduce actual volume; it will only increase floor space by putting ceramic and metallic waste forms closer together while still avoiding criticality issues. That's where your 65 percent comes from. You don't have volume reduction; you just have split the waste into lots of different forms which you still have to find a home for. But the message that is getting out is that you will be sending a smaller by weight number of packages to Nevada.	3	Waste volumes, masses, and disposal paths for all types of waste are considered for the different alternatives in this EIS. The volume of high-level radioactive waste or spent nuclear fuel that would be sent to a geologic repository are some of the things considered in the waste management sections. The potential impact on different disposal sites is considered and discussed. However, the purpose and need for the proposed action is to treat and manage the spent fuel, not to reduce the volume of waste that eventually will be sent to a repository.
DOE does not know if electrometallurgical treatment waste will meet the repository waste acceptance criteria. DOE does not know what those criteria will be—or if there will be any repository at all. Will the waste be acceptable? We need honest assumptions on the waste stream.	4	The repository waste acceptance criteria are still being developed. However, the ceramic and metallic waste forms that would result from the electrometallurgical treatment process are expected to be accepted into the repository.

Issues	*No. of Comments*	*DOE Responses*
DOE should consider dealing with this high-level radioactive waste as part of the high-level radioactive waste being dealt with at INTEC.	1	The proposed INEEL High-Level Radioactive Waste Management EIS is considering methods to manage the calcine that was produced from the reprocessing DOE spent nuclear fuel at INTEC. With the decision to shut down the reprocessing facilities, no processes are currently available that would make the sodium-bonded fuel compatible with calcine. The restart of these facilities was considered and eliminated from the alternatives.
DOE admits to having no knowledge of the whereabouts of the documents pertaining to previous removal of the sodium bonding from 17 metric tons of EBR-II blanket fuel via mechanical decladding. Such mismanagement, if true, is of concern and should be investigated. We request that a greater effort be undertaken to find these documents and make them publicly available during the EIS period.	1	DOE has found the documents that describe the process, equipment, operating procedures, and waste disposal paths for the decladding and sodium removal of the 17 metric tons of EBR-II blankets. These documents were considered during the selection of the proposed decladding and sodium removal alternatives.
DOE's plans for disposing of the low-enriched uranium created from this process—will it be stored as a waste or sold as a resource?	2	DOE has not made a decision concerning future uses for the low-enriched uranium produced by the electrometallurgical treatment other than the decision that the low-enriched uranium would not be used for defense purposes.
This program [electrometallurgical treatment] has no place in a sound nuclear waste management policy. Proponents of this program are . . . making the problem worse not better. This program will increase the complexity and amount of nuclear waste generated at ANL. We do not support an expansion of this program and urge that it be terminated.	1	DOE believes that treating sodium-bonded spent nuclear fuel is in keeping with sound nuclear waste management. This is because the proposed action would reduce uncertainty regarding waste disposal. Also, the number of canisters that must be disposed of in a geologic repository would be reduced. Further, ceramic and metallic waste material is very durable and has been formulated to be unreactive in the environment.
If DOE creates high-level radioactive waste in a vitrified form, there will be three forms of high-level radioactive waste in one Idaho county (ceramic, metal, vitrified).	2	The statement is correct. Different waste streams often require different stabilization techniques. The ceramic, metallic and vitrified waste forms are being developed because they are best suited for specific waste streams.
If this material won't meet the disposal specifications for the repository, a specification should be incorporated into the Record of Decision to say that DOE will look at this material and its proposed specifications before the canyons are shut down to ensure it is as good as the PUREX borosilicated glass that is being prepared for the Yucca Mountain repository.	1	DOE will consider the programmatic impacts including schedule and technical uncertainties such as availability and waste acceptance when a Record of Decision is made.
Since the waste acceptance criteria at Yucca Mountain currently is not confirmed, how do you intend to meet and store [the waste] for "road-ready" conditions?	1	The present goal is to place the spent nuclear fuel and high-level radioactive waste at ANL-W in retrievable storage so that it can be shipped to the proposed packaging facility that will ship the INEEL-DOE spent nuclear fuel to the repository. For the SRS alternatives, the high-level radioactive waste glass or melt and dilute product would be coordinated with the streams that will be produced at SRS.

Issues	*No. of Comments*	*DOE Responses*
Will planned dry storage have to be retreated later to meet acceptance criteria at Yucca Mountain?	1	The No Action Alternative may require future treatment. The goal of the other alternatives is to put the waste in road-ready condition without further treatment. The uncertainty in the final repository waste acceptance criteria is part of the programmatic considerations.
Uranium metal also is reactive; will it be treated before placement in a geologic depository?	1	Uranium metal is currently managed as part of the Materials Disposition program and is out of the scope of the EIS.
The Environmental Assessment contained ridiculous estimates of waste streams, especially the low-level radioactive waste streams. Actual information about waste generated from the demonstration project should be released to the public for use in the EIS.	1	The actual waste generation rates for the demonstration project have been used to calculate estimates of waste streams in this EIS.
Previous National Research Council reports have concluded that several of the waste forms generated by this technology [pyroprocessing] would not be suitable for placement in a geologic repository. The fall 1996 National Research Council report raises serious concerns about the testing procedures used to determine whether one of the new waste forms will be suitable for placement in a geologic repository. Most troubling of all is the analysis of ANL's choice of test protocol. A key issue is the release of the radionuclides from the waste. The report notes that the test protocol focuses on a radionuclide release mechanism that is... "incorrect at best, and potentially misleading at worst."	1	In order to address the question on waste form qualification, DOE has asked the National Research Council to conduct a specific review on this subject. The report that discusses the results of this waste qualification review and the other National Research Council reports will be considered when a record of decision is formulated.
Since getting waste ready for a geologic repository is the justification for this project, it must not go forward until the waste produced by the demonstration project has been fully characterized, which will occur early in the next century.	1	The uncertainty and status of each waste or spent nuclear fuel characterization are part of the programmatic consideration when a record of decision is formulated.
Spent nuclear fuel must be removed by 2035 as a result of processing. One concern is that transuranic waste will go to the repository, but low-enriched uranium and highly enriched uranium will stay at INEEL.	1	No highly enriched uranium would result from any of the alternatives considered at INEEL. DOE has not made a decision concerning future uses for the low-enriched uranium other than the decision that the low-enriched uranium would not be used for defense purposes. DOE will compare all reasonable alternatives on the basis of cost, including the cost of long-term storage of materials.
Compare heat loading with the ceramic and metallic waste forms to heat loading of the highly enriched uranium rods—are they comparable with commercial spent nuclear fuel?	1	As packaged for disposal in a geological repository, the heat loading for the ceramic and metallic waste forms is higher than that for the highly enriched uranium fuel because of fissile material limits for disposal packages. These high-level radioactive waste packages in general have lower heat loads than commercial spent nuclear fuel. Heat load would not be a concern regarding potential disposal in a geologic repository.
Transportation		
These materials should not be transported throughout the United States.	1	It is DOE's intention to minimize transport of radioactive materials associated with its sodium-bonded spent nuclear fuel inventory wherever possible.

Issues	*No. of Comments*	*DOE Responses*
If the ultimate burial place for the high-level radioactive waste is 1,000 miles away instead of 2,000 miles away, is that fact insignificant to transportation?	1	Generally, the environmental impacts of transporting spent nuclear fuel and high-level radioactive waste are small and would not differ significantly under the example posed by the commentor. DOE recommends the commentor see the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* for additional information on this subject.
The EIS should evaluate the potential for terrorism, especially during transportation.	2	The potential for terrorist acts involving material transports does not fall within the scope of this EIS.
Is it not known that, if the waste is sent to South Carolina [SRS], it will have to go somewhere else eventually; it won't stay in South Carolina?	1	As described in Section 2.5 of the EIS, Alternatives 3 and 5 would result in the storage of waste or by-products at SRS in South Carolina. For Alternative 3, the products from processing blanket fuel in the PUREX facility would be plutonium metal, borosilicate glass logs, and depleted uranium. For Alternative 5, the metallic waste product from the blanket fuel melt and dilute process would be stored in the L Area at the SRS.
The EIS should provide bounding estimates of the size, frequency, and number of expected shipments of products coming into Idaho.	1	Chapter 4 and Appendix G of the EIS provide estimates of the size, frequency, and number of expected shipments of products coming into Idaho. The Record of Decision for the 1995 *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* also describes the size, frequency, and number of spent nuclear fuel shipments coming to Idaho.
DOE should develop an agreement with the Shoshone-Bannock Tribes to allow and appropriately manage the transport of any radioactive materials across the reservation.	1	Regardless of the alternative chosen, DOE will proceed in accordance with the DOE/Shoshone-Bannock Tribes Agreement-in-Principle, which covers notification and coordination of the transport of radioactive materials across the Fort Hall Reservation.
EIS Schedule		
This EIS may not be needed because the 1996 Environmental Assessment may be adequate.	1	DOE prepared an environmental assessment for the demonstration of electrometallurgical treatment on a limited amount(1.6 metric tons) of sodium-bonded spent nuclear fuel. In the May 15, 1996 Finding of No Significant Impact for the Environmental Assessment, DOE committed to prepare an EIS before applying the electrometallurgical treatment technology to the production-scale treatment of the sodium-bonded spent nuclear fuel inventory.
The Draft SBSNF EIS should not be issued for public comment before publication of relevant reports (e.g., waste qualification) from the National Research Council or the ongoing nonproliferation study. The schedule implies that DOE is not interested in incorporating the results from these studies into the EIS. Therefore, the time line for the EIS should delay its completion until at least three months after completion of these studies.	5	The Electrometallurgical Research and Demonstration Project is scheduled to conclude in August of 1999. At that time DOE will know if it has met the success criteria established by the National Research Council for the electrometallurgical treatment demonstration. Publication of the final report on the electrometallurgical treatment demonstration by the National Research Council may require a few months past the end of the demonstration project. DOE expects that the report will be available before it makes a decision on the management of the sodium-bonded spent nuclear fuel. DOE has prepared a Nonproliferation Impacts Assessment that addresses the treatment of sodium-bonded spent nuclear fuel.

Issues	*No. of Comments*	*DOE Responses*
This EIS is premature. The Draft SBSNF EIS should not be issued for public comment before publication of the National Academy of Science's Independent Assessment Final Report on the demonstration project, which probably won't be issued until October or November 1999. The National Academy of Sciences Final Report is answering the question, "Will it work," not, "Will it help?"	6	DOE believes that the results from the demonstration and the need to effectively utilize available resources justify the preparation of the EIS in parallel with the final demonstration reviews. The National Research Council has conducted ongoing reviews and issued status reports on the demonstration project. These reports are available for review and the final report will be considered when a record of decision is formulated.
DOE is premature in preparing this EIS because the demonstration project will not be completed until after the draft EIS is published.	11	The Electrometallurgical Treatment Research and Demonstration Project that began in June 1996 is scheduled to conclude in August 1999. At that time DOE will know if it has met the success criteria established by the National Research Council for the electrometallurgical treatment demonstration. DOE has obtained encouraging data from the demonstration to date, and is confident that the technology holds promise for the management of its sodium-bonded spent nuclear fuel inventory. Publication of the final report on the electrometallurgical treatment demonstration by the National Research Council may require a few months past the end of the demonstration project. DOE plans to make its decision in January 2000, based on the U.S. Nuclear Regulatory Commission final report and other factors such as cost, environmental consequences, and nonproliferation impacts.
DOE's willingness to proceed at this pace without even the completion of their demonstration project indicates the decision on pyroprocessing was made years ago.	2	DOE has made no decision on how the sodium-bonded spent nuclear fuel should be treated. The EIS addresses reasonable alternatives for treatment of this fuel.
More research and development should be completed before the Record of Decision on the alternatives.	1	DOE believes that enough is known about the alternatives to assess their environmental consequences in the EIS. DOE plans to make its decision on how to manage its sodium-bonded spent nuclear fuel in January 2000, based on such factors as technical feasibility, cost, environmental consequences, and nonproliferation impacts.
The EIS is premature in that there has not been enough time allowed to include the cost analysis.	1	A report comparing the costs of the alternatives will be made available to the public during the public comment period for the draft EIS.
We question the issuance of the Notice of Intent at this time and believe that it should be withdrawn pending compilation of all the technical documentation necessary to inform the scoping process.	1	DOE believes that adequate presentations, displays, and written materials on the proposed action and alternatives were provided to the public during the scoping process.
Although there is a regulatory driver for removal of this fuel from Idaho, that is not until 2035, and budget maintenance does not justify going ahead with this process until concerns about its technical feasibility, cost-effectiveness, and potential for proliferation have been adequately addressed. I recommend that DOE provide compelling evidence that it is prudent to proceed with preparing an EIS at this time.	2	DOE believes that enough is known about the alternatives to assess their environmental consequences in the EIS. DOE plans to make its decision on how to manage its sodium-bonded spent nuclear fuel in January 2000 based on factors such as technical feasibility, cost, environmental consequences, and nonproliferation impacts.

Issues	*No. of Comments*	*DOE Responses*
Miscellaneous		
This activity could be viewed as corporate welfare which, whether true or not, always is a concern.	2	DOE has identified the purpose and need for the proposed action, which is found in Section 1.2 of the draft EIS. Action is necessary for the responsible management of DOE's inventory of sodium-bonded spent nuclear fuel.
The intent of the agreement between the Governor of Idaho and DOE involves removing large amounts of radioactive materials, not just spent nuclear fuel.	1	The approximate 60 tons of sodium-bonded spent nuclear fuel currently stored in Idaho contains radioactive materials that cannot be reused, recycled, or disposed of in their current condition. Part of the intent of DOE's proposal is to prepare these materials for disposal or possible reuse for commercial purposes.
If a source is referenced in the EIS, it should be summarized in the EIS (e.g., EAR in the Depleted Uranium Hexafluoride Programmatic EIS).	1	Some reference documents are very large and difficult to summarize. Where practical, DOE has provided a brief summary of reference documents in the EIS.
DOE is not going to consider public comments; instead it is engaging in a show process that meets the bare minimum legal requirements.	1	DOE is considering and will continue to consider public comments in its sodium-bonded spent nuclear fuel management decision process. For example, DOE will provide a comparative Cost Study and a Nonproliferation Impacts Assessment to the public in response to comments received during the scoping process. Further, DOE has reformulated its proposed action in response to public comments.
It seems a bit of a waste of the public's time to continue to have these EISs in which we comment saying, "Slow down, we want more information," and DOE says, "Sure," and proceeds right along with its decision in the first place.	1	DOE is committed to providing the public the opportunity to review and comment on the proposed action to manage its inventory of sodium-bonded spent nuclear fuel.
This is not an EIS asking, "We've got a bunch of sodium-contaminated fuel. What should we do with it? We have the following five alternatives." We don't have an action that says, "We need to treat this fuel. We have EISs on it. We want to do pyroprocessing." It is lip service to the other alternatives that are available to deal with this spent nuclear fuel.	1	In response to public comments, DOE has revised the proposed action of the EIS from electrometallurgical treatment of sodium-bonded spent nuclear fuel in the Fuel Conditioning Facility at ANL-W to the treatment and management of sodium-bonded spent nuclear fuel.
We are gravely concerned with the project. We oppose it. We have opposed it all along.	1	DOE acknowledges the commentor's opposition to the proposed action.
That DOE is not waiting for the National Academy of Sciences' Final Report raises a question that Pit Nine also raises. DOE gets a lot of research and development money every year; do the data you collect mean anything?	1	The Electrometallurgical Treatment Research and Demonstration Project that began in June 1996 is scheduled to conclude in August 1999. At that time DOE will know if it has met the success criteria established by the National Research Council for the electrometallurgical treatment demonstration. DOE has obtained encouraging data from the demonstration to date, and is confident that the technology holds promise for the management of its sodium-bonded spent nuclear fuel inventory. Publication of the final report on the electrometallurgical treatment demonstration by the National Research Council may require a few months past the end of the demonstration project. DOE plans to make its decision in January 2000 based on the National Research Council's final report and other factors such as cost, environmental consequences, and nonproliferation impacts.

Issues	*No. of Comments*	*DOE Responses*
What is the endpoint for the National Research Council's waste characterization study? Is it a moving target or a dead horse?	1	The National Research Council is reviewing the waste qualification process and the acceptability of the waste forms.
I would like to see the products identified [cost analysis, nonproliferation analysis] in the briefing placed on a schedule that fits into the Secretary of Energy's decision on the Record of Decision. This schedule ought to be made available to the stakeholders.	1	DOE is preparing a Nonproliferation Impacts Assessment that addresses the treatment of sodium-bonded spent nuclear fuel. This assessment will be made available to the public during the draft EIS public comment period. DOE is also preparing a comparative Cost Study which will be made available to the public during the draft EIS public comment period.
In the past, DOE has had to redo work because of an inadequate initial assessment of a problem. The commentor hopes DOE will avoid such costly problems by proceeding only if it is clear that treatment is necessary. The commentor will be pleased to see DOE proceed with treating the spent nuclear fuel once adequate environmental documentation has been completed and once it has been established that treatment will be necessary before disposal.	1	This NEPA process will aid DOE in making an informed decision on how to proceed with the management of its sodium-bonded spent nuclear fuel. The alternatives analyzed in this EIS include no action and direct disposal with no treatment. DOE will make its decision in January 2000 based on the analytical results of this EIS combined with public comments on the draft EIS and the outcome of the demonstration project, as well as cost, schedule, and nonproliferation considerations.
Would it not be more realistic to base risk analysis on a Hormissis theory rather than the Linear Threshold theory?	1	The EIS acknowledges that there are other views on the effects of radiation at low dose rates. However, the linear dose response is the most accepted as well as the most conservative of current models, and is therefore appropriate for this analysis.
Press for the quickest, most scientifically proven solution to the preparation of this spent nuclear fuel for a repository.	1	DOE will make its decision in January 2000 based on the analytical results of this EIS combined with public comments on the draft EIS and the outcome of the demonstration project, as well as cost, schedule, and nonproliferation considerations.
Has integration/consolidation with other treatment/conditioning being performed at other DOE sites (Hanford, Savannah River) been considered?	1	DOE has considered the use of other DOE facilities as options for the management of sodium-bonded spent nuclear fuel. These issues were a major consideration of the DOE Programmatic Spent Nuclear Fuel EIS (April 1995). Alternatives 3 and 5 of the SBSNF EIS involve the use of two different facilities at SRS in South Carolina.
What happens in the No Action [Alternative] after 2035?	1	Under the No Action Alternative, the EIS evaluates the viability of direct disposal of sodium-bonded spent nuclear fuel in a geologic repository with no treatment, as well as storing the spent nuclear fuel and pursuing the research and development of a new or immature technology
Can the sodium be leached from the uranium?	1	The bond sodium could be melted and drained from the blanket fuel. The melt and drain process would not be effective on the sodium-bonded driver fuel because some of the bond sodium is inside or is encapsulated within the uranium material, and the uranium has become mechanically attached to the stainless-steel cladding.
Put the uranium into commercial fuel.	1	Although DOE has not made a decision regarding the disposition of low-enriched uranium, there is a possibility that the low-enriched uranium could be sold to the commercial reactor fuel industry as a feedstock material.

Issues	*No. of Comments*	*DOE Responses*
Few details about the [electrometallurgical treatment] process were provided [in the presentation].	1	The intent of the public scoping meeting presentation was to give the public a general overview of the NEPA process, electrometallurgical treatment, and other alternatives. The public meeting presentations during the draft EIS comment period will contain more detail about the electrometallurgical treatment process.
We believe that important questions about cost and waste characterization have been left out of most reviews of this program and urge the Energy Information Agency take an honest, comprehensive look at these issues.	1	As requested by members of the public during the scoping process, DOE is preparing a comparative Cost Report which will be made available to the public during the draft EIS comment period. DOE will make its decision in January 2000 based on the outcome of the demonstration project and other factors such as cost, environmental consequences, and nonproliferation impacts.
This program was featured on *NBC Nightly News* as a "Fleecing of America." According to DOE, this program is being created to cover the "redirection of valuable intellectual and physical resources at ANL.....as a result of the shutdown of the nuclear breeder reactor program known as the Advanced Liquid Metal Reactor). We are outraged that a key piece of a program that was supposedly terminated by Congress—the Advanced Liquid Metal Reactor—continues to squander taxpayer dollars on questionable "termination costs" and a wrong-minded "redirection" program known as pyroprocessing or electrometallurgical treatment at ANL. ...We are extremely concerned that this new "Nuclear Technology Research and Development" program represents nothing more than a continuation of the fuel reprocessing activities supported by the Advanced Liquid Metal Reactor program	1	The electrometallurgical treatment technology under consideration in the EIS for treating sodium-bonded spent nuclear fuel is a technology that was originally developed as part of DOE's Advanced Liquid Metal Reactor Program, which was discontinued in 1994. This technology was developed at significant expense to the taxpayer. DOE would be remiss in its responsibilities not to evaluate the potential application of this technology to the Department's sodium-bonded spent nuclear fuel. DOE believes that its proposal to apply electrometallurgical technology to the management of its sodium-bonded spent nuclear fuel inventory has the potential to solve a significant problem for the Nation.
DOE's record with other reprocessing technologies has been abysmal.	1	DOE has successfully used reprocessing technologies in the past to provide nuclear materials for research and defense purposes. The use of PUREX processing for the declad and cleaned blanket fuel [Alternative 3] is a viable option..
The [Snake River] Alliance encourages DOE to include ANL-W as part of INEEL in environmental analyses.	1	DOE has included the ANL-W facility as part of the INEEL in analyzing the environmental consequences of the alternatives in this EIS, as well as in the *DOE Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*.
The commentor would prefer to see the spent nuclear fuel treated only once if possible.	1	DOE also would prefer to treat its sodium-bonded spent nuclear fuel only once, if at all, before its final disposition.
To support informed public review of the draft EIS, the schedule for this EIS should allow for adequate public review of related documents before the close of the public comment period.	1	The schedule for this EIS allows 45 days for public comment, in accordance with NEPA requirements. Related reports such as those on costs and nonproliferation issues will be available to the public within the same time frame as this draft EIS.

A.2 THE PUBLIC COMMENT PROCESS

A.2.1 Overview

In July 1999, DOE published the *Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*. NEPA regulations mandate a minimum 45-day public comment period after publication of a draft EIS to provide an opportunity for the public and other stakeholders to comment on the EIS analysis and results. The 45-day public comment period on the Sodium-Bonded Spent Nuclear Fuel (SBSNF) Draft EIS began on July 31, 1999, and was scheduled to end on September 13, 1999. In response to commentor requests, the comment period was extended an additional 15 days through September 28, 1999. During this 60-day comment period, public hearings were held in North Augusta, South Carolina; Boise and Idaho Falls, Idaho; and Arlington, Virginia (see **Figure A–2)**. In addition, the public was encouraged to submit comments via the U.S. mail service, e-mail, a toll-free 800-number phone line, and a toll-free fax line. Section A.2.4 summarizes the major issues raised by comments received through the public comment process and DOE's position with respect to these comments.

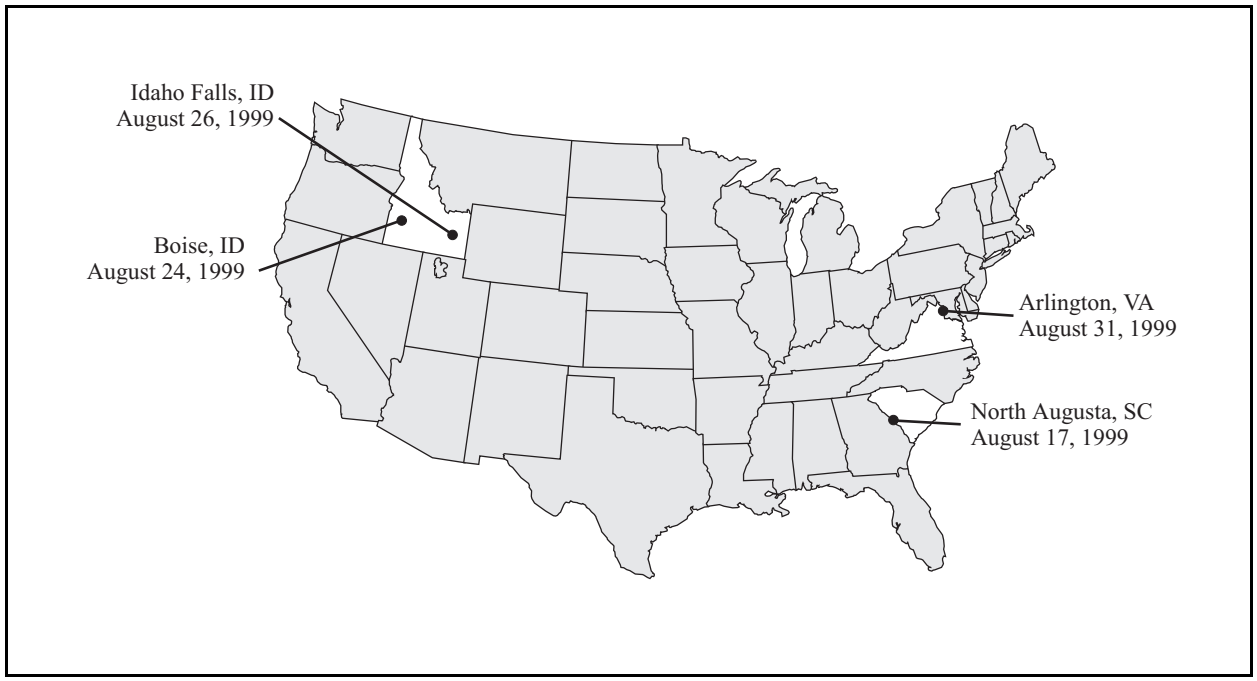

Figure A–2 Public Hearing Locations and Dates, 1999

The number of persons estimated in attendance at each hearing or meeting, together with the number of comments submitted and recorded, are presented in **Table A–4**. These attendance estimates are based on the number of registration forms completed and returned at each hearing or meeting, as well as a rough "head count" of the audience, and may not include all those present.

The public hearing comments were combined with comments received by other means (mail, e-mail, 800-number, fax) during the comment period. Written comments were date-stamped and assigned a sequential document number. **Table A–5** lists the number of comments received by method of submission.

Table A–4 Public Hearing/Meeting Locations, Attendance, and Comments Received

Location	*Date*	*Estimated Attendance*	*Comments*
North Augusta, South Carolina	August 17, 1999	20	18
Boise, Idaho	August 24, 1999	3	19
Idaho Falls, Idaho	August 26, 1999	45	21
Arlington, Virginia	August 31, 1999	20	25

Table A–5 Method of Comment Submission

Method	*Number of Comments*	*Number of Submittals*
Faxes	49	6
U.S. mail/hearing submittals	264	27
1-800 number	16	11
E-mail	82	12
Hearings (Number of Comment/Submittals)	83	16
Total Submittals	494	72

A.2.2 Public Hearing Format

The public hearings were organized to encourage public comments on the Sodium-Bonded Spent Nuclear Fuel (SBSNF) Draft EIS and to allow two-way interaction between public attendees and DOE representatives. A neutral facilitator was present at each hearing to direct and clarify discussions and comments. A court reporter also was present at each hearing to record the proceedings and provide a transcript of the public comments and the dialogue between the public and the DOE and contractor representatives on hand. These transcripts are available in DOE public reading rooms near each of the proposed sites and in Washington, D.C.

The format used for each hearing included a presentation, question and answer session, and a public comment period. The hearing opened with a welcome from the facilitator, followed by a presentation on the proposed action by a DOE representative. The facilitator next opened the question and answer session to give the audience a chance to ask questions about the material presented. This was followed by the public comment session, during which attendees were given an opportunity to read a prepared statement of no more than five minutes. Modifications to the format were made at each of the public hearings to fulfill the special requests of attendees. Following the public hearings, the comments were identified from the transcripts of each hearing and the comment documents submitted by the attendees.

A.2.3 Comment Disposition

Comments received at the public hearings and via fax, U.S. mail, e-mail, or the toll-free 800-number phone line were divided into ten issue categories to facilitate responses and provide an overview of the type of comments that DOE received. The categories appear in Table A–8 later on in this appendix.

All the comments received during the SBSNF Draft EIS comment period appear in either Section A.2.5 or A.2.6 of this appendix. Section A.2.5 contains a set of tables corresponding to each of the public hearings. Section A.2.6 includes scanned images of the comments received via U.S. mail, e-mail, toll-free phone line,

toll-free fax line, or personal submission at the public hearings. DOE's response to each comment is presented on the opposite side of the page. Transcriptions of the oral comments submitted at each of the public hearings are presented in the appropriate tables, along with DOE's responses to each comment.

Table A–6 is an index of all of the commentors who made statements or submitted comments at the public hearings or during the public comment period, including members of the public, representatives of organizations or agencies, and public officials. Commentors are listed alphabetically by their last name, along with the page on which their comments appear in Sections A.2.5 or A.2.6. **Table A–7** identifies separately Federal, State, and local officials and agencies, companies, organizations and special interest groups that submitted comments. **Table A–8** correlates comment categories with comment identification numbers; thus, permitting the reader to readily locate similarly categorized comments.

Table A–6 Commentors Index

Commentor	*Commentor Number*	*Comment/Response Page Numbers*
David E. Adelman, Natural Resources Defense Council, Washington, DC	36	A-140
Richard Albrecht, Wilson, WY	2	A-76
Anonymous	18	A-112
Anonymous	15	A-92
Anonymous	19	A-113
Robert Bobo, The Shoshone-Bannock Tribes, Fort Hall, ID	55	A-209
Charles Bailey	6	A-80
Julie Bowles, Boise, ID	40	A-148
Jean Boyles	7	A-81
Beatrice Brailsford, Snake River Alliance, Pocatello, ID	706	A-57
Ted L. Carpenter, The Shoshone-Bannock Tribes, Fort Hall, ID	47, 703	A-172, A-54
Ernest S. Chaput, Economic Development Partnership of Aiken and Edgefield Counties of South Carolina, Aiken, SC	13, 504	A-88, A-42
Pat Clark, Snake River Alliance, Boise, ID	5	A-79
John Commander, Coalition 21, Idaho Falls, ID	27, 56, 701	A-125, A-213, A-52
Peter J. Dirkmaat, DOE-ID, Shelley, ID	3	A-77
dpdufur@micron.net	21	A-116
Beth Duke, Sun Valley, ID	20	A-114
Maureen Eldredge, Alliance for Nuclear Accountability, Washington, DC	800	A-59
Nancy Fenn	25	A-122
Dan Freeman	39	A-147
Rick Gheddis	502	A-38
Ellen Glaccum, Ketchum, ID	1	A-73
Kathryn Graves, Hailey, ID	44	A-159
Jeep Hardinge, Ketchum, ID	12	A-87
David Hensel, Driggs, ID	31	A-131
Steve Herring, Idaho Section of ANS, Idaho Falls, ID	704	A-55
Steve Hopkins, Snake River Alliance, Boise, ID	17, 41, 600	A-111, A-149, A-44
Laird Irvin, Ketchum, ID	9	A-83

Commentor	*Commentor Number*	*Comment/Response Page Numbers*
Lowell Jobe, Coalition 21, Idaho Falls, ID	8, 32, 56	A-82, A-133, A-213
Lisa Johnson, Victor, ID	33	A-134
Dan Johnston, Richland, WA	34	A-137
Dick Kenney, Coalition 21, Idaho Falls, ID	702	A-53
David Kipping, Snake River Alliance, Boise, ID	30	A-128
Lisa Ledwidge, Institute for Energy & Environmental Research, Takoma Park, MD	46	A-162
Edwin Lyman, Nuclear Control Institute, Washington, DC	52, 802	A-196, A-68
Susan Mathees, Ketchum, ID	11	A-86
Barbara Mathison, Meridian, ID	54	A-207
Betina Mattesen, Bristol, VT	10	A-84
Patricia McCracken, Augusta, GA	16, 503	A-93, A-39
Don McWhorter, North Augusta, SC	14	A-90
Carol Murphy, Ketchum, ID	35, 37, 39	A-138, A-145, A-147
Susan Pengilly Neitzel, Idaho State Historical Society, Boise, ID	4	A-78
Suzy Nielond, Jackson, WY	38	A-146
Richard Parkin, U.S. Environmental Protection Agency, Seattle, WA	53	A-202
Debra Patla, Victor, ID	48	A-173
Lee Poe, Aiken, SC	500	A-35
Randy Ponic	501	A-37
Bennett Ramberg, Committee to Bridge the Gap, Los Angeles, CA	50	A-185
Charles Rice, INEEL Citizens Advisory Board, Idaho Falls, ID	51	A-191
Matt Smith	23	A-118
Margaret Stewart, Ketchum, ID	42	A-154
John Tanner, Coalition 21, Idaho Falls, ID	26, 705	A-124, A-56
Willie R. Taylor, U.S. Department of Interior, Washington, DC	43	A-157
Marlise Teasley, Twin Falls, ID	45	A-160
Kathleen E. Trever, State of Idaho INEEL Oversight Program, Boise, ID	49	A-177
Doug Turner, Bechtel Jacobs Company LLC, Oak Ridge, TN	22	A-117
Robert H. Wilcox, Martinez, GA	29	A-127
Terry & Theresa Williams, Hailey, ID	28	A-126
Monte Wilson, Potlatch, ID	24	A-120
Hisham Zerriffi, Institute for Energy & Environmental Research, Takoma Park, MD	46, 801	A-162, A-61

Table A–7 Index of Public Officials, Organizations, and Public Interest Groups

Commentor Information	*Document Number*	*Page Number*
Alliance of Nuclear Accountability, Maureen Eldredge, Washington, DC	800	A-59
Coalition 21, Idaho Falls, ID	8, 26, 27, 32, 701, 702, 705	A-82, A-124, A-125, A-133, A-52, A-53, A-56
Committee to Bridge the Gap, Benett Ramberg, Ph.D., Director of Research, Los Angeles, CA	50	A-185
Economic Development Partnership of Aiken and Edgefield Counties of South Carolina, Ernest Chaput, Aiken, SC	13, 504	A-88, A-42
Idaho State Historical Society, Susan Pengilly Neitzel, Deputy State Historic Preservation Officer and Compliance Coordinator, Boise, ID	4	A-78
INEEL Citizens Advisory Board, Charles Rice, Chair, Idaho Falls, ID	51	A-191
Institute for Energy & Environmental Research, Hisham Zerriffi, Project Scientist, and Lisa Ledwidge, Outreach Coordinator, Takoma Park, MD	46, 801	A-162, A-61
Natural Resources Defense Council, David E. Adelman, Project Attorney, Washington, DC	36	A-140
Nuclear Control Institute, Edwin Lyman, Scientific Director, Washington, DC	52, 802	A-196, A-68
Shoshone-Bannock Tribes, Robert Bobo, Project Director, and Ted Carpenter, DOE Project Environmentalist, Fort Hall, ID	47, 55, 703	A-172, A-210, A-54
Snake River Alliance, David Kipping, President, Board of Directors, and Steve Hopkins, Program Assistant, Boise, ID	17, 30, 41, 600, 706	A-111, A-128, A-149, A-46, A-57
State of Idaho INEEL Oversight Program, Kathleen Trever, Coordinator-Manager, Boise, ID	49	A-177
U.S. Department of the Interior, Office of the Secretary, Willie Taylor, Director, Office of Environmental Policy and Compliance, Washington, DC	43	A-157
U.S. Environmental Protection Agency, Region 10, Richard Parkin, Manager Geographic Implementation Unit, Seattle, WA	53	A-203

Table A–8 Comment Categories and Comment Identification Numbers

Comment Categories	*Comment Identification Numbers*
1.0 Purpose, Need for, and Timing of Proposed Action	1-4, 16-26, 16-62, 16-77, 17-2, 25-11, 27-3, 27-5, 31-8, 35-2, 41-2, 41-3, 41-13, 45-2, 46-3, 46-4, 46-7, 46-8, 46-11, 46-13, 47-3, 48-4, 52-3, 52-4, 53-1, 55-4, 55-8, 600-7, 600-8, 600-14, 702-4, 800-2, 800-3, 800-4, 800-6, 801-3, 801-4, 801-7, 801-8, 801-9, 801-11
2.0 Waste Disposition, Waste Acceptance Criteria	10-1, 10-6, 14-1, 14-2, 16-6, 16-8, 16-13, 16-14, 16-22, 16-23, 16-24, 16-27, 16-51, 16-52, 19-1, 20-6, 24-5, 25-2, 25-10, 26-4, 30-7, 31-6, 33-3, 33-10, 35-3, 36-10, 39-5, 41-8, 41-9, 41-11, 42-5, 46-6, 48-6, 49-4, 49-8, 49-24, 49-25, 49-26, 49-28, 49-29, 49-35, 49-36, 51-9, 52-7, 54-3, 55-7, 56-7, 500-6, 600-10, 705-4, 801-2, 801-6, 801-10, 802-3, 802-8
3.0 NEPA and Extension of Public Comment Period	1-1, 1-2, 1-3, 5-1, 7-1, 8-1, 8-3, 9-1, 10-3, 11-1, 12-1, 16-2, 16-3, 16-17, 16-34, 16-35, 16-39, 16-41, 16-44, 16-45, 16-65, 16-78, 19-2, 20-1, 20-2, 21-1, 23-1, 24-1, 25-5, 28-1, 29-1, 29-2, 30-1, 30-2, 30-8, 31-1, 32-1, 33-6, 35-5, 35-7, 36-1, 36-3, 36-4, 36-7, 36-14, 37-2, 38-1, 39-1, 39-2, 41-1, 41-5, 41-7, 42-1, 42-2, 42-6, 42-8, 42-9, 43-3, 44-4, 45-3, 48-10, 49-1, 49-10, 49-12, 49-17, 49-21, 49-31, 49-32, 49-39, 51-1, 51-4, 51-8, 51-10, 52-1, 53-2, 54-5, 55-1, 56-1, 56-12, 503-4, 600-1, 600-2, 600-3, 600-4, 600-6, 600-12, 706-2, 706-3, 800-1, 802-1
4.0 Relationship to other DOE Programs	1-7, 16-19, 16-25, 16-28, 16-29, 16-31, 16-32, 16-40, 16-50, 16-64, 23-2, 23-6, 24-2, 25-6, 29-4, 30-3, 31-2, 33-7, 35-6, 41-4, 41-12, 42-7, 44-2, 45-1, 46-5, 46-10, 49-5, 49-6, 49-27, 51-7, 54-6, 54-10, 503-1, 702-3, 801-5, 802-4

Comment Categories		Comment Identification Numbers
5.0	Out of Scope - Cost	10-4, 13-5, 15-1, 16-7, 16-9, 16-11, 16-12, 16-20, 16-30, 16-42, 16-43, 16-46, 16-48, 16-49, 16-55, 16-57, 16-58, 16-59, 20-5, 23-4, 25-4, 25-8, 29-3, 29-6, 30-5, 31-4, 31-9, 32-2, 33-4, 36-8, 36-9, 36-12, 37-4, 39-4, 40-2, 42-4, 48-8, 51-5, 54-4, 54-8, 56-3, 56-4, 56-5, 56-6, 504-4, 600-15, 700-1, 802-2
6.0	Out of Scope - Nuclear Nonproliferation Policy	10-2, 17-1, 20-4, 23-5, 24-4, 25-3, 25-9, 26-3, 27-4, 30-6, 31-5, 31-7, 33-5, 33-9, 35-4, 41-6, 41-15, 44-1, 46-1, 46-16, 46-17, 46-18, 46-19, 46-20, 46-21, 46-22, 48-3, 50-1, 51-6, 52-8, 52-9, 52-10, 52-11, 52-12, 52-13, 52-14, 54-2, 54-9, 56-11, 501-1, 600-5, 600-13, 600-17, 700-3, 701-3, 801-12
7.0	Technologies (Technical Issues)	13-4, 14-3, 14-4, 14-5, 16-10, 16-15, 16-16, 16-18, 16-36, 26-1, 34-2, 36-5, 46-2, 46-9, 46-12, 47-1, 49-7, 49-9, 49-37, 55-5, 55-6, 500-5, 504-3, 700-2, 703-1, 705-1, 705-2, 802-5
8.0	Alternatives (NEPA-Related Issues)	2-1, 3-2, 6-1, 13-1, 13-2, 13-3, 16-21, 16-33, 18-1, 20-3, 22-1, 24-6, 24-7, 26-2, 27-1, 27-2, 28-2, 29-5, 33-2, 35-1, 36-6, 36-11, 36-13, 37-1, 39-3, 40-1, 41-10, 41-14, 44-3, 46-23, 48-1, 49-2, 51-2, 51-3, 52-5, 54-1, 55-2, 55-9, 56-2, 56-8, 56-9, 56-10, 500-2, 500-3, 500-4, 504-5, 502-1, 504-1, 504-2, 600-16, 600-18, 600-19, 701-1, 701-2, 701-4, 702-2, 704-1, 705-5, 706-1, 801-1, 802-6, 802-7
9.0	Affected Environment/Environmental Consequences	1-5, 1-6, 1-8, 3-1, 4-1, 16-1, 16-4, 16-5, 16-37, 16-38, 16-47, 16-53, 16-54, 16-56, 16-60, 16-61, 16-63, 16-66, 16-67, 16-68, 16-69, 16-70, 16-71, 16-72, 16-73, 16-74, 16-75, 16-76, 23-7, 33-1, 34-1, 40-3, 43-1, 43-2, 43-4, 46-14, 46-15, 47-2, 48-7, 48-9, 49-3, 49-11, 49-13, 49-14, 49-15, 49-16, 49-18, 49-19, 49-20, 49-22, 49-23, 49-30, 49-33, 49-38, 49-40, 49-41, 49-42, 49-43, 52-6, 53-3, 53-4, 53-5, 53-6, 53-7, 53-8, 53-9, 55-3, 500-1, 503-3, 503-5, 702-1, 703-2, 800-5
10.0	Out of Scope - Other	10-5, 21-2, 23-3, 24-3, 25-7, 30-4, 31-3, 33-8, 36-2, 42-3, 48-11, 54-7, 503-2, 600-9, 600-11

A.2.4 Issues Raised During the Public Comment Period

Four hundred and ninety-four comments were received during the public comment period. Most of the comments focused on the following: (1) the purpose, need for, and timing of the proposed action; (2) the introduction of new waste forms produced by the proposed action, their acceptability in a geologic repository, and the disposition of uranium and plutonium by-products; (3) the public availability of information considered relevant to reviewing the draft EIS, the extension of the comment period, and the relationship of the EIS to other DOE programs; (4) the cost of the various alternatives; (5) the impacts of the proposed action on U.S. nuclear nonproliferation policy; (6) technical and/or NEPA-related questions regarding technologies and alternatives; and (7) questions related to the affected environment and the environmental consequences. DOE's responses to these issues are summarized below. The comments also dealt with a number of other subjects, including technologies considered and dismissed from further evaluation, long-term (beyond institutional control) performance of the sodium-bonded spent nuclear fuel during storage on site, and questions on the methodology and assumptions of the health and safety analysis. Many commentors expressed their opposition or support for DOE's action in general or for specific alternatives under the proposed action or the No Action Alternative. Section A.2 of Appendix A provides DOE's responses to all comments on a comment-by-comment basis.

Purpose, Need for, and Timing of the Proposed Action

Many comments expressed the opinion that DOE failed to demonstrate the purpose and need for the proposed action or to provide a rationale for its timing. Some of the reasons given included the lack of a compelling argument that there is a safety risk associated with current storage; the lack of a regulatory framework and final waste acceptance criteria; the lack of an approved site for a geologic repository; insufficient information on the results of the Electrometallurgical Treatment Research and Demonstration Project; and the lack of analysis showing that direct disposal of the sodium-bonded spent nuclear fuel without sodium removal would be detrimental to the performance of the geologic repository.

DOE's position as presented in the EIS is that the need to examine options for the management and treatment of sodium-bonded spent nuclear fuel is based on the existing regulatory environment concerning long-term disposal of spent nuclear fuel and high-level radioactive waste. It is assumed that DOE's sodium-bonded spent nuclear fuel, as well as other DOE-owned spent nuclear fuel, eventually will be disposed of in a geologic repository. One of the key requirements, as specified in the current April 1999 version of the DOE'S *Waste Acceptance Systems Requirements Document* and in the U.S. Nuclear Regulatory Commission requirements for acceptance of spent nuclear fuel or high-level waste in a geologic repository, is that it cannot contain or generate materials that are explosive, pyrophoric, or chemically reactive in a form or amount that could compromise the repository's ability to perform its waste isolation function or to satisfy its performance objective (10 CFR 60.135(b)(1)). The sodium-bonded spent nuclear fuel, if left in its existing state, would contain pyrophoric and chemically reactive metallic sodium and, therefore, would not likely meet DOE or U.S. Nuclear Regulatory Commission repository acceptance criteria.

The timing for the proposed action is a programmatic issue rather than a safety issue. The EIS does not conclude that current storage of sodium-bonded spent nuclear fuel presents a threat to the health and safety of workers or the public. The programmatic risk associated with implementing the proposed action or not treating the sodium-bonded spent nuclear fuel is the uncertainty surrounding the acceptability of this fuel for placement in a geologic repository. The process of establishing a repository is dependent on not only the site but also the materials to be disposed of. As part of this process, a total system performance assessment that describes the probable behavior of a repository is performed. This total system assessment includes the performance of the specific waste forms and inventories proposed for disposal. As part of the process of establishing a repository, data for the waste forms are needed prior to making a final selection of the repository, not after. In fact, if specific waste forms are not represented in crucial documents like this EIS, additional documentation will be needed to allow for the possibility of disposing of those materials in the repository. The performance of sodium-bonded spent nuclear fuel in a geologic repository depends on many factors (e.g., long-term fuel integrity, repository environment fuel/waste package survivability, etc.), and the presence of metallic sodium would complicate the modeling even further. Stabilization of the spent nuclear fuel and/or removal of the metallic sodium would provide greater protection for human health and the environment.

The Electrometallurgical Treatment Research and Demonstration Project began in June 1996 and, although the review of the test results has not been finalized in a single report, a number of status reports were issued by DOE and reviewed by the National Academy of Sciences' National Research Council Committee. They are referenced in the EIS. The success criteria established at the outset of the project have been fulfilled. The environmental impact analysis associated with the electrometallurgical treatment process alternatives was based on actual data from the demonstration project. The final EIS includes a new section on the status and results of the project. Having completed the demonstration project and in planning the closure of its PUREX processing capabilities, DOE now needs to decide whether these processes are suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the EIS could result in a loss of

capability and of experienced, knowledgeable technical staff, should DOE decide at a later date to use the electrometallurgical process to treat the sodium-bonded spent nuclear fuel.

New Waste Forms and Disposition of Uranium and Plutonium By-Products

Some of the comments questioned the generation of new waste forms from treating the sodium-bonded spent nuclear fuel and the possible acceptance of these forms in a geologic repository. Also, a number of commentors remarked on the generation of uranium and plutonium as by-products of the treatment process. Related issues were the disposition of uranium metal, a by-product of the electrometallurgical process, and the compliance of both the PUREX and the electrometallurgical process with U.S. nuclear nonproliferation policy in terms of the separation of these elements.

All of the alternatives evaluated in this EIS would produce some form of high-level radioactive waste. Electrometallurgical treatment would produce two new waste forms (metallic, ceramic) and the melt and dilute process would produce a new metallic form (i.e., melt and dilute product or conditioned spent nuclear fuel). These forms would be more stable than the untreated sodium-bonded spent nuclear fuel. The ceramic and metallic waste forms generated during the electrometallurgical treatment process represent chemically stable materials compared to untreated sodium-bonded spent nuclear fuel. The production of a chemically stable waste form to replace a chemically reactive waste form (i.e., sodium-bonded spent nuclear fuel) represents an improvement in the safe, long-term storage of this spent nuclear fuel. DOE expects the new waste forms to be suitable for disposal in a repository and to meet the requirements of the final waste acceptance criteria. The high-level radioactive waste form resulting from the PUREX process is borosilicate glass, which has been extensively tested and analyzed under conditions relevant to a geologic repository.

With respect to uranium and plutonium disposition, the EIS states that only uranium that would be separated under the electrometallurgical process would be blended down and stored on site if it originates from driver spent nuclear fuel, or would be stored on site as depleted uranium if it originates from blanket spent nuclear fuel. The final disposition of the stored uranium has not been decided and is not discussed in the EIS. The disposition of the uranium will be subject to a separate NEPA review. The nuclear nonproliferation policy aspects of this separation is subject to the nuclear nonproliferation policy assessment of the alternatives. The approximately 260 kilograms (575 pounds) of plutonium that would be separated under the PUREX process would be disposed of in accordance with the Record of Decision (65 FR 1608) for the *Surplus Plutonium Disposition Environmental Impact Statement* (DOE/EIS-0283) issued in November 1999. This separation is the subject of the nuclear nonproliferation assessment, which is independent of this EIS.

Public Availability of Information and Related Documentation

Many commentors asked for a 60-day extension of the 45-day public comment period on the draft EIS. Commentors said they wanted additional time to obtain and review relevant documents such as the Yucca Mountain Draft EIS and the National Academy of Sciences' National Research Council's final report on the Electrometallurgical Treatment Research and Demonstration Project, as well as the Cost Study and Nonproliferation Impacts Assessment. The comments frequently stated that DOE needs to make all of this information publicly available before the end of the EIS comment period and the issuance of the final EIS and the Record of Decision.

In an effort to ensure that all interested parties had time to comment on the draft EIS, the due date for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169). With respect to the need for more information, DOE made that information available to the public. Background materials were placed in public reading rooms and were made available to the public through a series of hearings held August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho;

August 26, 1999, in Idaho Falls, Idaho; and August 31, 1999, in Arlington, Virginia. Materials placed in the reading rooms included the electrometallurgical demonstration environmental assessment, the Finding of No Significant Impact for the environmental assessment, National Research Council reports, the 1995 Settlement Agreement and Consent Order with the State of Idaho, the scoping meeting transcripts and comments, and the draft EIS hearing presentations and fact sheets. In addition, completion of the Cost Study and Nonproliferation Impacts Assessment was expedited so that they would be available to the public at the beginning of the comment period. These reports were mailed to interested parties on August 12, 1999, and were made available to attendees at all of the public hearings on the draft EIS. Although these reports are not critical to the evaluation of the analysis presented in the draft EIS, they will provide input to the Record of Decision. While the final National Research Council report on the demonstration project was published in April 2000, interim status reports were produced throughout the project. Data generated during the demonstration project were used in preparing the EIS.

Cost Issues

A number of commentors raised cost issues and provided comments directly related to the Cost Study, which was not part of the EIS.

Comments concerning the costs of the proposed action were considered beyond the scope of the EIS. The EIS was prepared in accordance with NEPA, as well as the Council on Environmental Quality's regulations on implementing NEPA (40 CFR 1500 through 1508) and DOE's NEPA regulations (10 CFR 1021). None of these regulations require the inclusion of a cost analysis in an EIS. The basic objective of the SBSNF EIS is to provide the public and DOE decision-makers with a description of the reasonable alternatives for treating and managing sodium-bonded spent nuclear fuel and information about their potential impacts on public health and safety and the environment. While cost could be an important factor in the ultimate Record of Decision, the purpose of this and other EISs is to address the environmental consequences of the proposed action and the No Action Alternative. DOE distributed cost information through the independent Cost Study released in August 1999, and this information is available to the public on request and in the DOE's public reading rooms. Responses to specific comments related to cost issues are included in Sections A.2.5 and A.2.6 of this appendix.

Nuclear Nonproliferation Policy Issues

The nuclear nonproliferation implications of the proposed action were the subject of a number of comments. Some commentors expressed strong opinions about how the use of specific technologies such as electrometallurgical treatment might impact U.S. nonproliferation policy.

Nonproliferation is another issue that was considered beyond the scope of the EIS. A separate Nonproliferation Impacts Assessment was prepared by DOE's Office of Arms Control and Nonproliferation. After assessing the potential nonproliferation impacts that may result from each of the alternatives and technologies analyzed in the SBSNF Draft EIS, the Office of Arms Control and Nonproliferation found that all the alternatives, except that involving PUREX processing at Savannah River, are fully consistent with U.S. policy concerning reprocessing and nuclear nonproliferation. Electrometallurgical treatment, for example, would not increase national inventories of weapons-usable fissile material because, although highly enriched uranium is an interim product of the process, it would be blended down to low-enriched uranium during treatment. Within the current equipment configuration and design, it is not possible to produce weapons-usable plutonium merely by adjusting the operating parameters. To do this, traditional aqueous processing would be required after electrometallurgical treatment. However, traditional aqueous processing could be used to produce weapons-usable plutonium directly from the spent nuclear fuel, without electrometallurgical treatment, so electrometallurgical treatment itself does not present a special proliferation

concern. Responses to specific comments related to nonproliferation are included in Sections A.2.5 and A.2.6 of this appendix.

Technologies, Alternatives

Various comments dealt with technical questions and issues regarding the treatment technologies addressed in the EIS or NEPA-related issues regarding the selected alternatives.

The variety of the issues precludes a summary response. Responses to these questions on a comment-by-comment basis are included in Sections A.2.5 and A.2.6 of this appendix. A number of the responses indicate that revisions to the EIS were made as a result of the comments.

Affected Environment and Consequences

A number of comments included questions concerning the description of the affected environment in the SBSNF Draft EIS, and the results of the environmental impact analysis.

As in the case above, responses to these comments on a comment-by-comment basis are included in Sections A.2.5 and A.2.6 of this appendix.

A.2.5 Public Hearing Comments and DOE Responses

Comments presented in this section were submitted during oral presentations at the public hearings held on August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho; and August 31, 1999, in Arlington, Virginia. DOE's responses to these comments are also presented.

Comments from the North Augusta, South Carolina, Public Hearing August 17, 1999		
No.	***Comment***	***DOE Response***
Lee Poe		
500-1	"In your charts you show the maximum potential radiological impacts...that the PUREX process has those rates that exceed background. It just seems unreasonable...knowing the canyons and their operations like they do. Would you explain how you got a dosage of one and a half times background?" *[The commentor is referring to DOE's presentation of the worker dose at SRS of 500 millirem per year compared to a background dose of 360 millirem per year.]*	The average SRS worker dose used to evaluate environmental impacts is routinely assumed to be 500 millirem per year. This dose value is conservative and has been published in numerous environmental impact statements on SRS. As indicated in Section E.4.3 of the EIS, this average worker dose estimate was also used in the SRS Spent Nuclear Fuel Management EIS for activities similar to those described in this SBSNF EIS.
500-2	"I notice that when you showed the pictures of the alternatives, all but one of the drivers are processed through the electrorefining process at INEEL ANL-West. That was a surprise to me, that there were no other alternatives other than the melt and dilute."	Technologies such as GMODS and the direct plasma arc-vitreous ceramic processes have the potential to be used to treat driver sodium-bonded spent nuclear fuel. However, as discussed in Section 2.6 of the EIS, these technologies are less mature than those evaluated in detail in the EIS.
500-3	"If we've got a technology that's marginal, is there something out there that will mature in the next 10 years that would allow that material to be processed? ...I think that's an issue you need to address more than what I saw. Now, maybe it's addressed in there, but what I saw was those alternatives were fairly written off."	As discussed in Section 2.5.1, the EIS evaluates two options under the No Action alternative: (1) direct disposal of the sodium-bonded spent nuclear fuel without sodium removal, and (2) continued storage until 2035 in its current location or until a technology, currently dismissed as less mature, is developed. From an environmental point of view, the development of a promising technology could require a considerably long time (20 to 30 years) and would still have to be viable to complete treatment of all or part of the sodium-bonded spent nuclear fuel before 2035.

Comments from the North Augusta, South Carolina, Public Hearing August 17, 1999		
No.	***Comment***	***DOE Response***
500-4	"The one thing that's different in the No Action is that you didn't analyze failure of the material...as spent fuel storage...way out into the future as the repository has done for that material. And if you don't bury it.... If it doesn't go to the mountain and stays at Idaho or wherever, you know, wherever DOE wants to put it, what's the consequence of No Action? And I would think that ought to be more clearly analyzed in the document."	Normal operation radiological effluent from potential fuel degradation during storage at INEEL up to 2035 is evaluated under the No Action Alternative in Section 4.2 of the EIS. As discussed in revised Section 2.5.1 of the EIS, a fundamental assumption made under the No Action Alternative is that sodium-bonded spent nuclear fuel would be disposed of in a repository along with the rest of the DOE-owned spent nuclear fuel within a finite period of time while under the institutional control of DOE. This EIS covers a time period up to 2035, at which time sodium-bonded spent nuclear fuel stored in Idaho would have to be transported out of the state and either stored or treated at another DOE site. For such an eventuality, additional NEPA documentation would be required. The unlikely scenario that treated sodium-bonded spent nuclear fuel would remain at its current site beyond 2035 because there is no geologic repository to accept it has been evaluated as part of the No Action Alternative in the Yucca Mountain Draft EIS, which was issued by DOE in July 1999. The Yucca Mountain EIS is discussed in Section 1.6.2.2.
500-5	"I think of melt and dilute as being a process that you need to isotopically dilute the uranium in the driver fuel. I wonder why you call it melt and dilute. It would seem like to me it's melt and—you know, it's not melt and dilute, then, so you ought to call it by a name that's appropriate. I understand that it's using the equivalent. You may be saying dilute it with aluminum but, you know, that's not clear to the — to the reader from the EIS as to what it is that makes it called melt and dilute."	The melt and dilute process described in the EIS is consistent with the general definition; i.e., it produces a larger volume and a lower concentration by adding material fillers (aluminum, stainless steel, or uranium metal).

Comments from the North Augusta, South Carolina, Public Hearing August 17, 1999		
No.	***Comment***	***DOE Response***
500-6	"I'm terribly disappointed to see that the progress of getting disposal criteria, Waste Acceptance Criteria, for the various fuel other than the commercial power reactor fuel has been almost nonexistent. It certainly appears from reading the Yucca Mountain EIS that...the high-level waste is...way ahead of the government spent nuclear fuel, our stepchildren, and they don't have...anybody there driving it....I would encourage the DOE folks to get out there and to get the DOE spent nuclear fuel, whatever it takes, to get the WAC requirements for those. And if that means a different level of treatment than we're all thinking about or if it means something else, then we ought to be working in that direction. Let's don't stabilize it twice. Let's don't do it now and then turn around 10 years from now and, when it comes time, they open the mountain and all of a sudden they say, 'Ah, you don't have any requirements for that.' So to the DOE folks, let me encourage you to do whatever you can to force RW into working with you to get specifications for waste disposal."	The borosilicate glass waste form for the PUREX alternative has been extensively tested and analyzed under conditions relevant to a geologic repository. One objective of the Electrometallurgical Treatment Research and Demonstration Project was to characterize the electrometallurgical treatment waste forms to facilitate their acceptability in a geologic repository. To ensure the treatment option that might be selected by DOE would produce a product that is likely to meet the acceptance criteria, DOE is working with the National Research Council to obtain comments on the research and development activities DOE will perform to establish treatment technology specifications. The EIS discusses the status of the waste acceptance criteria in Section 2.7 and the environmental impacts of the No Action Alternative in Section 4.2. The timing of DOE's decision on the treatment and management of sodium-bonded spent nuclear fuel in relation to the availability of a geologic repository is discussed in Section 4.12.2.
Randy Ponic		
501-1	"I was looking at the nonproliferation study to support this and one of the comments was they found the canyon operations in this report to be somewhat inconsistent with nonproliferation policy. Yet, in a similar report that was done for the melt and dilute process, they did not find that inconsistency. They found that the canyon operations would be consistent with policy. And using this report actually biases the canyon operations as far as this alternative. So that needs to be addressed, why there's reliance here and not in the previous report that was done for dealing with clad fuels."	The assessment of nonproliferation impacts is not part of the scope of the EIS. However, the "Nonproliferation Impact Assessment for the Management of the Savannah River Site Aluminum-Based Spent Nuclear Fuel" stated that use of conventional reprocessing (PUREX processing) to mitigate safety and health vulnerabilities is consistent with U.S. policy on plutonium reprocessing and the use of plutonium. Since safety and health vulnerabilities do not currently exist for the sodium-bonded spent nuclear fuel, use of conventional reprocessing (PUREX) in this case is somewhat inconsistent with U.S. nonproliferation policy. In this instance, the inconsistency would be due to the generation of potentially usable weapons-grade plutonium. The plutonium product from PUREX processing would be addressed by the Surplus Plutonium Disposition EIS.

Comments from the North Augusta, South Carolina, Public Hearing *August 17, 1999*		
No.	***Comment***	***DOE Response***
Rick Gheddis		
502-1	"It seems ... strange that the melt and dilute at SRS is not applied for the driver fuels. Its design is an HEU treatment process, yet you're applying it only on the blanket fuels, which are depleted uranium, and it's not particularly well suited for depleted uranium operations. Therefore, I'd like to make a comment that you consider an alternative of melt and dilute on the driver fuels at SRS. And by the way, I'd like to see that paired up with the PUREX processing of the blanket fuels, see that as an area of alternative...the blanket fuels match up very well with the PUREX processing."	The commentor's preference for the treatment of both driver and blanket sodium-bonded spent nuclear fuel at SRS is noted. As a result of the commentor's remarks, the possibility of using the melt and dilute process at SRS to treat sodium-bonded driver spent nuclear fuel was considered. See revised Section 2.6 of the EIS for a discussion on why this alternative was dismissed from further evaluation.

Comments from the North Augusta, South Carolina, Public Hearing *August 17, 1999*		
No.	***Comment***	***DOE Response***
Patricia McCracken		
503-1	"One of the things that really...struck me about this EIS...was that there seems to be a predecisional legal agreement that the DOE has made with Idaho, and that decision really preempts the EIS. And it really makes the DOE not have a national environmental policy, but rather is, in the case of Idaho, setting a precedent to look at a waste before you have the EIS or before there's some comment or where people have an opportunity to comment at all on it. So I think that's one of the things that this—this has really struck me as...being not a national policy. I hope I can get some more information on that case, and really that was a comment that should have been included in the EIS."	DOE is responsible for developing and maintaining a capability to safely manage its spent nuclear fuel. As stated in the introduction to the EIS, the SBSNF EIS follows the June 1995 Record of Decision (60 FR 28680) for DOE's Programmatic Spent Nuclear Fuel EIS, in which DOE decided to regionalize spent nuclear fuel management by fuel type for DOE-owned spent nuclear fuel. DOE also decided to: (1) continue environmental restoration activities at INEEL; (2) develop cost-effective treatment technologies for spent nuclear fuel and waste management; and (3) implement projects and facilities to prepare waste and treat spent nuclear fuel for interim storage and final disposition. This Record of Decision provides the programmatic umbrella for the site-specific actions addressed in the SBSNF EIS, as well as the Savannah River Spent Nuclear Fuel Management EIS and the Idaho High-Level Waste and Facilities Disposition EIS. The Savannah River Spent Nuclear Fuel Management EIS evaluates the impacts from the treatment of aluminum-clad and other spent nuclear fuel designated for treatment at SRS. The Idaho High-Level Waste Draft EIS evaluates the impacts from processing specific amounts of calcined high-level and sodium-bearing radioactive waste material currently located at INEEL. The materials (spent nuclear fuel and high-level radioactive waste) addressed in these EISs have unique characteristics and requirements which necessitate their separate evaluation. In a related action alluded to by the commentor, in a 1995 agreement with the State of Idaho (the Settlement Agreement and Consent Order issued on October 17, 1995), DOE committed to removing all spent nuclear fuel from Idaho by 2035. More than 98 percent of DOE's sodium-bonded spent nuclear fuel is located at INEEL and is subject to the requirements of this Settlement Agreement and Consent Order. Copies of the Settlement Agreement and Consent Order were made available to the public at the public meetings and are also located in the public reading rooms, and in Appendix K of the EIS.

Comments from the North Augusta, South Carolina, Public Hearing *August 17, 1999*		
No.	***Comment***	***DOE Response***
503-2	"I've commented, even in Nevada, mainly about how small business could be incorporated into some of these...various processes. And I did get a copy of the cost report and reviewed your references. We would certainly like in our area to get a volunteer group together and possibly make some phone calls along with the people that your agency is calling. I think your contractor and his procurement process has a very narrow group of people in which personal communication—I mean, I just felt like some of this was not documented real well and hope we can work with y'all [*sic*] later. And we have some small businesses that would certainly like to have a chance, whatever you decide to do, that we can also give you some of the cost here. If we could get some specifications which I think are lacking in the EIS, I have commented more on that. Who do we contact...in terms of maybe expanding your base of phone calls in terms of...I noticed you called the U.S. Tool and Die on their cost to fabricate C-22, some kind of pipe. Maybe we could do that too. You think we could call some of our people? Who would I contact at your agency so that we could get some volunteer calling going on in our area? We'd like to have some business here. When some of the people here say they think they can do some processes, I hope you'll look at that. I think they have given some excellent presentations at the meetings I've been to and I've been very impressed with them. I think I heard we can do it back here. So I hope y'all [*sic*] do look at some of the other technical issues."	Contacts with the businesses identified in the Cost Study were made to get estimates that were used for comparative purposes in the Cost Study. These contacts were not part of a procurement process.

Comments from the North Augusta, South Carolina, Public Hearing August 17, 1999		
No.	***Comment***	***DOE Response***
503-3	"I think your computer model is lacking in those numbers in terms of health effects because, without the technology, I don't know how you could decide what the numbers are in many cases."	The GENII computer program used to estimate the human health effects from releases of radioactive material during normal operation and accidental conditions is a well-known program, and its applicability has been demonstrated in various DOE EISs. The program models the dispersion of releases and calculates potential doses to the public and individuals residing in the vicinity of the facility. All required input to this program is well defined and the process is well understood. The evaluation is independent of the technology and equipment used. The only input from each process to this program is the quantity of radioactive material released during normal and accident conditions. As explained in the response to comment 16-47, the releases were estimated based on facility safety analysis reports. The atmospheric dispersion of radioactive material releases vary depending on the type and duration of the release. The selection of a dispersion model is an input to the GENII computer program. The dispersion models used in the program are well defined and are explained in Appendix E. These models are independent of the technologies used. The expression "new environmental equipment" is not used in the EIS and new environmental equipment is not related to the use of a computer program. Contamination in the off-gas system filters originates from the process. Each process is well defined. For example, because of the high temperature used in the melt and dilute process, some radionuclide elements with boiling temperatures below the process temperature would evaporate, while some elements would be oxidized and released to the off-gas system. The gaseous flow through the off-gas system first would be condensed and adsorbed, and then would be filtered before entering the atmosphere. All noble gases would pass through the filters, but only a small fraction of particulates would pass through the filters. The specific assumptions on various filtration factors are given in Appendix E and Appendix F. These appendices also provide the source terms associated with each of the releases considered.
503-4	"I've been very impressed with the EISs at Savannah River. And I've reviewed some of this and I hope I can continue to... give comment on this."	The commentor's statement concerning EISs at SRS is noted. DOE welcomes comments on all of its NEPA actions.
503-5	"Well, I disagree totally with it by the way your computer models and how they.... I would...really like to look at how they got those numbers." *[Commentor refers to computer modeling of PUREX wastewater discharges]*	PUREX at SRS is the only treatment that would result in discharges of radionuclides or nonradioactive hazardous chemicals to surface water. The major sources of this liquid effluent would be process cooling water and steam condensate from the auxiliary facilities that support PUREX processing. As described in Section 4.5.2, the mechanism associated with releases of liquid effluent from PUREX processing is essentially independent of the type of fuel processed. The released quantities are the measured values provided in the SRS Site Environmental Report for 1997.

Comments from the North Augusta, South Carolina, Public Hearing *August 17, 1999*		
No.	***Comment***	***DOE Response***
Ernest Chaput		
504-1	"I want to congratulate the Department for recognizing the need to develop a disposition strategy for this fuel which is intended to go to Yucca Mountain. We all hope Yucca Mountain comes out. I know this is a direct issue for the draft EIS on Friday and so that's — that's a very big step. We congratulate you for trying to recognize your responsibility, nuclear responsibility, to safely disposition the fuels that were left over now that the Cold War is won and other nuclear programs ...are being shut down and other programs are taking over the cleaning up that you've done. We believe, from...my understanding of the waste acceptance criteria of the draft, that some kind of a treatment will be mandatory, and so we commend you for doing that."	The commentor's expressed support for DOE's action to proceed with an EIS for the treatment and management of sodium-bonded spent nuclear fuel is noted. In accordance with the Nuclear Waste Policy Act of 1982, DOE is committed to the development of a licensed national repository for spent nuclear fuel and high-level radioactive waste and is engaged in activities to fulfill this commitment. A Yucca Mountain Draft EIS was issued by DOE in July 1999.
504-2	"...we notice that, as you pointed out, two of the six alternatives included in the draft include the shipment of the blanket materials to Savannah River for treatment either by the PUREX process or by the proposed melt and dilute facility. As a policy in my organization, we do not support the shipment of waste materials to Savannah River unless it can be clearly demonstrated that Savannah River has a significant capability or advantage to perform the task which cannot be reasonably established at the generated site. In other words, don't bring your waste to South Carolina unless you can clearly demonstrate you can't handle it somewhere else, particularly, preferably, the generating site."	The commentor's objections to the shipment of spent nuclear fuel to SRS for treatment is noted. The selection of reasonable alternatives evaluated in the EIS was made in accordance with Council on Environmental Quality Regulations (40 CFR 1500-1508) and DOE's NEPA-related regulations (10 CFR 1021) and procedures. In addition, as discussed in Section 1.3 of the EIS, the selection of reasonable alternatives was done in response to the issues raised during the public scoping period.

Comments from the North Augusta, South Carolina, Public Hearing August 17, 1999		
No.	***Comment***	***DOE Response***
504-3	"...if the Department determines that the shipment of blanket elements to the Savannah River Site is in the national interest, then we strongly recommend that only the PUREX treatment option be considered. Our reasons are twofold: One, PUREX is currently operational. The big concern, our big fear in South Carolina, is people ship us waste that eventually ends up being untreatable or it doesn't get treated at all and ends up resident in South Carolina. We want a clear path of any waste coming into the state, we want a path going out. And that path is the PUREX-DWPF-National Repository. The proposed melt and dilute facility is currently in development. The waste forms have not been extensively reviewed for acceptance in the national repository. The program is underfunded, potentially behind schedule. The inclusion of this material will further complicate its process development and facility operation. And...there is no assurance that the product form will be ultimately accepted into the National Repository and so, therefore, we...our strong recommendation is, if you do consider Savannah River, canyons is the only thing that my organization personally finds acceptable."	The commentor's preference for using PUREX processing instead of melt and dilute at SRS is noted. The final decision on the process to be selected for treating the sodium-bonded spent nuclear fuel will be based on the impacts provided in this EIS along with the conclusions presented in the Cost Study and Nonproliferation Impacts Assessment. The commentor is correct that the melt and dilute process at SRS is currently under development. However, based on recent research and development activities, preliminary conceptual design work, and technical maturity, DOE considers melt and dilute to be a viable technology option that can be implemented at SRS or ANL-W. DOE expects the waste generated from this process would meet the geological repository acceptance criteria.
504-4	"If it does come to the canyons, it has to come with adequate budgetary resources. We've got lots of other important missions on this site and we've got to make sure they...are carried on also. And so we would expect or require a firm DOE commitment for incremental funding....And if Savannah River capabilities are being considered, then only PUREX should be considered and then only if additional—adequate funding is provided."	If DOE selects Alternative 3 in the Record of Decision, use of the F-Canyon at SRS for blanket spent nuclear fuel treatment would not begin without the assurance of adequate funding. However, Congress determines how funds are allocated. DOE spends monies consistent with Congressional direction. DOE is not in a position to make the difficult tradeoffs that may be required between alternative Federal programs and spending priorities. The issue of funding for the treatment and management of sodium-bonded spent nuclear fuel is beyond the scope of the SBSNF EIS.
504-5	"The draft EIS identifies the electrometallurgical facility which currently exists at Argonne-West and...it initially appears...that [facility] can meet that criteria."	As discussed in Section 2.4.1 and 2.5.2 of the EIS, with a few equipment modifications, existing facilities at ANL-W would be suitable to accommodate the electrometallurgical treatment of sodium-bonded spent nuclear fuel.

Comments from the Boise, ID, Public Hearing *August 24, 1999*		
No.	*Comments*	*DOE Responses*
Steve Hopkins		
600-1	"I would like to see the comment period extended since the nonproliferation and cost reports have just been released."	In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169). This extension also provided additional time for public review of the Cost Study and Nonproliferation Impacts Assessment. However, it should be noted that comments related to these reports are not within the scope of the EIS.
600-2	"Even though it is realized that these [nonproliferation and cost] reports are not part of the NEPA process, it is the only chance for the public to comment on them."	As noted by the commentor, although the Nonproliferation Impacts Assessment and Cost Study are not part of the NEPA process, the public may comment on them during the comment period for the draft EIS. In fact, DOE expedited the completion of these reports so that they would be available to the public to review in conjunction with the draft EIS. These reports were mailed to interested parties on August 12, 1999, and were made available to attendees at all of the public hearings on the draft EIS. DOE also extended the comment period from September 13 to September 28, 1999, (64 FR 49169) to provide the public with additional time to make comments.
600-3	"This is the public's only opportunity to comment, and you're starting an environmental impact statement process before having the final results [of the demonstration project] in. The demonstration project that you made, you have got enough already to do your draft EIS, but the public has to be taken into account in terms of it [how] should be completed before moving on with an EIS. The purpose was to demonstrate that it could work. It's called a demonstration project. And you're moving forward, analyzing an alternative that the public doesn't have any data [on] at this point in terms of the results."	The Electrometallurgical Treatment Research and Demonstration Project was successfully completed in August 1999, and the final results of the National Research Council's independent review of the project was published in April 2000. The commentor is correct in stating that DOE used the results of the demonstration project in preparing the draft EIS. Information available on the demonstration project includes the environmental assessment, published in 1996, as well as a series of independent status reports published by the National Research Council. This information was placed in the public reading rooms and, thus, was made available to the public.
600-4	"I understand there's a second comment period after the Final [EIS] is issued with the preferred alternative. However, it's, like, 99 percent of the time or greater that when you have a preferred alternative that's what's [*sic*] the Record of Decision. So you can argue that you can have a public comment period, but the comments are not taken into consideration. Supposedly, in this process, you're factoring in the public's comments to make your preferred alternative, although you can argue you're not doing that at all."	Although the NEPA process does not provide a formal comment period with public hearings following publication of the final EIS, DOE welcomes comments. These comments can be made during the 30-day period between publication of the EIS and issuance of the Record of Decision. DOE considered all of the comments received during the public comment period on the draft EIS. Public comments are one of several factors considered in identifying a preferred alternative. The selection of a method for treating and managing DOE's sodium-bonded spent nuclear fuel will be published in the Record of Decision. Factors taken into consideration when making that decision include the analyses presented in the EIS, public comments, cost, schedule, technical assurance, policy, and program objectives.

Comments from the Boise, ID, Public Hearing *August 24, 1999*		
No.	*Comments*	*DOE Responses*
600-5	"...at one point in this [Electrometallurgical treatment] process you're separating out highly enriched uranium. That's reprocessing. That may not be a final waste stream, but it's a reprocessing technology for separating out highly enriched uranium.... [*in response to a presenter's statement that the nonproliferation report concludes that electrometallurgical treatment is in compliance with all of the U.S. nonproliferation goals and policy*]...That's bunk. It's a reprocessing technology ....The Department of Energy has conveniently reworked the definition of reprocessing to fit the situation, so it's not technically reprocessing under the new definition. But under the definition of what reprocessing does, this is absolutely reprocessing."	The assessment of nonproliferation impacts is not part of the scope of the EIS. However, none of the alternatives analyzed in this EIS, except PUREX processing at SRS, would generate weapons-usable fissile materials. Although highly enriched uranium would be an interim product, it would be down-blended to low-enriched uranium during electrometallurgical treatment. Within the current equipment configuration and design, it is not possible to produce weapons-usable plutonium by adjusting operating parameters. Traditional aqueous processing would have to be used after electrometallurgical treatment (pyroprocessing). However, traditional aqueous processing could also be used to produce weapons-usable plutonium directly from the spent nuclear fuel, without pyroprocessing. The United States' policy on nonproliferation is contained in Presidential Decision Directive 13, a classified document. At the time the Presidential Directive was signed, an unclassified press release stated that, "The U.S. will seek to eliminate where possible the accumulation of stockpiles of highly-enriched uranium or plutonium." This would be done by down-blending the highly enriched uranium in the driver spent nuclear fuel and immobilizing the plutonium in the ceramic waste form. The press release also stated that the United States "does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes."
600-6	[*in reference to the Nuclear Waste Policy Act*]: "That Act can be amended. Congress spent all of an hour on that before they went off on their vacation for Christmas. That's one of the most bogus acts that's ever come across the radar screen in this country."	The actions of elected officials are beyond the scope of this EIS.

Comments from the Boise, ID, Public Hearing *August 24, 1999*		
No.	*Comments*	*DOE Responses*
600-7	"...even though the Department is supposedly committed to building a repository, it's still very possible that a repository will not be open in the near future. I mean, at the earliest possible date, it would be open to accept spent fuel would be what—2010, 2012, something like that. That's 10 years away. And yet, there's lots of other spent fuel that could go directly to the repository where the Waste Acceptance Criteria are currently from INEEL. So, it's not like you're looking at the earliest possible date 10 years away that anything needs to be done with the spent fuel, especially when it's continually reasserted that it poses no significant environmental problem right now. You're only talking about a problem as it exists in a repository."	In accordance with the Nuclear Waste Policy Act of 1982, DOE is committed to the development of a licensed national repository for spent nuclear fuel and high-level radioactive waste and is engaged in activities to fulfill this commitment. As stated in the introduction to the EIS, the programmatic risk in implementing any of the potential alternatives for the treatment and management of sodium-bonded spent nuclear fuel, or of not treating this fuel, is the uncertainty surrounding the acceptability of DOE spent nuclear fuel for emplacement in a potential geologic repository. Although not final, the latest guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999 (see Section 4.12.1 of the EIS), indicates that it is highly probable that sodium-bonded spent nuclear fuel would not be acceptable in the repository without some stabilization and/or removal of the metallic sodium. The stabilization of the spent nuclear fuel and/or removal of the metallic sodium will provide greater protection of human health and the environment. Having completed the Electrometallurgical Treatment Research and Demonstration Project (see Section 1.6.3) and in planning the closure of its PUREX processing capabilities, DOE now needs to decide whether these processes are suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the EIS could result in the loss of capability and of experienced, knowledgeable technical staff should DOE decide at a later date to use the electrometallurgical process to treat sodium-bonded spent nuclear fuel. Section 1.2 of the EIS has been revised for clarification.
600-8	"...[Electrometallurgical treatment] treatment [of the sodium-bonded spent nuclear fuel] ... may not be required. That's my main point. You don't know that it's going to be required."	The focus of this EIS is to assess the potential environmental and health impacts associated with the treatment and management of sodium-bonded spent nuclear fuel. See response to comment 600-7.
600-9	"...without that [NAS National Research Council Waste Characterization] report, it's hard for the public to know what's going to happen with all these different waste streams."	The expected fate of each waste stream is identified in the EIS. The National Academy of Sciences' National Research Council Committee assessment of waste form development and characterization is available in the DOE public reading rooms.

Comments from the Boise, ID, Public Hearing *August 24, 1999*		
No.	*Comments*	*DOE Responses*
600-10	"Because you're basically, without treatment, the spent fuel, you have got one form of waste even though it's not technically referred to as waste now by the Department of Energy. You do the processing and you have got various waste streams that have not been characterized yet. How is the public to react to that in terms of what we're going to do with this and that waste stream if they're not defined? If they're not defined, they don't have a destination."	All of the alternatives evaluated in this EIS would produce some forms of high-level radioactive waste. Electrometallurgical treatment (pyroprocessing) would produce two new waste forms, both of which are more stable than untreated sodium-bonded spent nuclear fuel. DOE expects that these waste forms would be suitable for disposal in a geologic repository.
600-11	"You don't seem to take [the National Research Council's report on DOE's claims concerning the Electrometallurgical treatment demonstration project] too seriously, but the public does, because I don't think the public has a whole lot of trust in Argonne, sorry to say. But the U.S. Nuclear Regulatory Commission is an independent body, and I'm not saying they have instantly more credibility. But that's important, that verification or nonverification, and we don't have that yet."	DOE commissioned the National Academy of Sciences' National Research Council review of the electrometallurgical treatment technology in 1995. Early Committee reports were instrumental in the DOE's redirection of the Argonne program to concentrate on demonstrating the technology for sodium-bonded metal fuel. DOE will consider the final National Research Council report in making a decision on how to proceed with the treatment and management of the sodium-bonded spent nuclear fuel.
600-12	"The other thing [is] we can't use [the Nuclear Regulatory Commission report on the Electrometallurgical treatment demonstration project] to comment until the final EIS is out and [it] doesn't do much to hear the comment at that point, because you basically take what the preferred alternative is in the final EIS, and that's your Record of Decision. So it's a formality at that point."	While the final National Research Council report on the Electrometallurgical Treatment Research and Demonstration Project was published in April 2000, the Council's interim status reports on the project were made available in the public reading rooms. Thus, prior to making comments on the draft EIS, the public had an opportunity to review all of the information that was made available by the National Research Council and was used to prepare the EIS. DOE will consider the data contained in the final National Research Council report in preparing the Record of Decision.

Comments from the Boise, ID, Public Hearing *August 24, 1999*		
No.	*Comments*	*DOE Responses*
600-13	"...to refer to this technology as not reprocessing is so dishonest, so disingenuous. This is absolutely a reprocessing technology. ...Hazel O'Leary actually said in 1994 that this technology is the essential processing technology for IFR. And I know that you're saying that it's been amended but, in essence, this technology was designed to separate out plutonium. And that plutonium, based upon our nonproliferation stance, ran contrary to our nonproliferation stance, so we essentially killed IFR on those grounds. And here we have the most proliferable dangerous aspect of IFR still alive. And that runs very contrary to what we were given in the early '90s, which we were taking some responsible steps to set an example for the rest of the world not to reprocess. It doesn't mean that there aren't countries that are reprocessing. But our intent was to discourage other countries from reprocessing, to take that step in order to acquire bomb grade material. And here, you have a reprocessing technology that's being used. I know this material, for instance, the highly-enriched uranium is not going to be used for bombs, but it is bomb material; therefore, it's a reprocessing technology. And you're keeping alive a reprocessing technology that's, from my point, more dangerous than PUREX, because it can be more easily concealed. You can put this technology underground, where PUREX would be very difficult to do. Quote from a previous NAS study, because there have been many, quote: 'Probably the greatest hazard arises from spreading sophisticated technologies around the world, technologies which make reprocessing spent fuel easier and possible in facilities small enough to conceal underground.' That's directly from the NAS related to this technology. To quote professor James Warf from the University of Southern California, Professor of Chemistry, Emeritus, 'with some modifications plutonium could be produced.' To quote an Argonne spokesperson at the site in 1995, 'We could easily modify the technology to produce plutonium.' Another NAS conclusion, quote: 'could be redirected to produce material with nuclear detonation capability.' That report also raised questions about the interim storage of the waste streams and other aspects of pyroprocessing.	As stated in the Nonproliferation Impacts Assessment, the alternatives involving PUREX reprocessing and broad application of electrometallurgical treatment of both driver and blanket fuel have a greater potential to provide encouragement to other countries to engage in plutonium reprocessing. Given the small quantity and unique characteristics of the sodium-bonded spent nuclear fuel and the reason for the treatment, however, such encouragement, if any, would be limited. In addition, electrometallurgical treatment (pyroprocessing) would not result in an increase in weapons-usable fissile material inventories. Although highly enriched uranium would be an interim product, it is would be down-blended to low-enriched uranium during electrometallurgical treatment. As stated in response to comment 600-5, within the current equipment configuration and design, it is not possible to produce weapons-usable plutonium by adjusting operating parameters. Traditional aqueous processing would have to be used after electrometallurgical treatment. However, traditional aqueous processing could also be used to produce weapons-usable plutonium directly from the spent nuclear fuel, without electrometallurgical treatment. The commentor also makes reference to the Integral Fast Reactor program. The purpose for the Integral Fast Reactor program was to develop an efficient, safe process for recycling nuclear fuel by using a liquid metal-cooled reactor in combination with an integral fuel reprocessing facility. As part of this program, the EBR-II was used for fuel-design and fuel irradiation testing. Congress canceled funding for the Integral Fast Reactor program in 1994.

Comments from the Boise, ID, Public Hearing *August 24, 1999*		
No.	*Comments*	*DOE Responses*
600-14	"It [the question of whether Electrometallurgical treatment should or should not be considered reprocessing and, therefore, proliferation-prone] kind of raises the question of exactly why you're proceeding with this technology at this point, which I have asked several times tonight, and I definitely have not gotten a reasonable response."	Although not final, the latest guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999 (see Section 4.12.1 of the EIS), indicates that it is highly probable that sodium-bonded spent nuclear fuel would not be acceptable in the repository without some stabilization and/or removal of the metallic sodium. The stabilization of the spent nuclear fuel and/or removal of the metallic sodium will provide greater protection of human health and the environment. Having completed the Electrometallurgical Treatment Research and Demonstration Project (see Section 1.6.3) and in planning the closure of its PUREX processing capabilities, DOE needs to decide whether this process is suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the EIS could result in the loss of capability and of experienced, knowledgeable technical staff involved with the demonstration project should DOE decide at a later date to use the electrometallurgical process to treat sodium-bonded spent nuclear fuel. Section 1.2 of the EIS has been revised for clarification. DOE also conducted four independent nonproliferation assessments of the electrometallurgical treatment technology over the last 11 years. These assessments found the electrometallurgical treatment technology to be in accordance with U.S. nuclear nonproliferation policy for this specific application, and concluded that electrometallurgical treatment is not capable of separating plutonium in a form that would be suitable for weapons production.
600-15	"A DOE source was quoted in a trade journal...saying, quote: 'Just about the only thing they have left to do,' meaning Argonne, 'is this procedure.' And quote: 'it's a jobs issue.' That's what the DOE source said directly about this procedure. It's corporate welfare. This project has been featured twice on *The Fleecing of America*. I don't know of any other thing that's ever been featured twice. That's very significant. That never happens."	Congress determines how funds are allocated. DOE spends monies consistent with Congressional direction. DOE is not in a position to make the difficult tradeoffs that may be required between alternative Federal programs and spending priorities. The issue of funding for the treatment and management of sodium-bonded spent nuclear fuel is beyond the scope of the SBSNF EIS.
600-16	"From what I understand, too, the reactor has not even been completely drained of the spent fuel, which the money that's been going all along, $20 million a year since 1994, part of that was supposed to have gone towards draining the reactor. And from what I understand, that's not even done at this point."	The commentor's reference to the draining of sodium from the EBR-II reactor is not related to the subject matter of this EIS, which is the treatment and management of sodium-bonded spent nuclear fuel. The sodium-bonded spent nuclear fuel that is the subject of this EIS was removed from the EBR-II reactor and is currently stored at the Radioactive Scrap and Waste Facility at ANL-W.

Comments from the Boise, ID, Public Hearing *August 24, 1999*		
No.	*Comments*	*DOE Responses*
600-17	"Another NAS quote: 'Although developers of the electrometallurgical technique argue that the technology is proliferation-resistant, any spent fuel processing approach that's capable of separating fissionable materials from associated fission products and transuranic elements could be redirected to produce material with nuclear detonation capability. Demonstration of the process could, however, add to the risk that a nation intent on weapons production might consider adapting this technology for possible production of fissile material, although such material would be of poor quality for a weapon.' And that's disputable."	The Nonproliferation Impacts Assessment is not part of the scope of the EIS. Electrometallurgical treatment technology is not capable of separating weapons-usable plutonium. Traditional aqueous processing would have to be used after electrometallurgical treatment to produce weapons-usable material. However, traditional aqueous processing could also be used to produce weapons-usable plutonium directly from the spent nuclear fuel.
600-18	"I guess you just want to give money to Argonne. If that's the issue, then I'd just as soon that you not pursue reprocessing as the technology that's used."	The commentor's opposition to electrometallurgical treatment (pyroprocessing) is noted. The issue of spending money for electrometallurgical treatment is beyond the scope of the EIS.
600-19	"At this point, I have to support the No Action alternative, because it's the most reasonable alternative. There's no facility to accept waste. The Waste Acceptance Criteria are not finally known. The waste doesn't present any environmental threat due to the presence of sodium at this point. Obviously, spent fuel is dangerous. That spent fuel without sodium is still dangerous. So there's no clear justification for going forth with this technology at this point. So I support the No Action alternative."	The commentor's support for the No Action Alternative is noted. The EIS discusses the status of the waste acceptance criteria in Section 2.7 and the environmental impacts of the No Action Alternative in Section 4.2. The timing of DOE's decision on the treatment and management of sodium-bonded spent nuclear fuel in relation to the availability of a geologic repository is discussed in Section 4.12.2.

Comments from the Idaho Falls, Idaho, Public Hearing August 26, 1999		
No.	*Comments*	*DOE Responses*
Anonymous		
700-1	"We haven't appropriated the money for the [SRS melt and dilute] facility, and our cost study is based on that facility being operational when we compare disposal method. That looks like, to me, it's flawed."	DOE assumes that the SRS melt and dilute facility will be available to process blanket spent nuclear fuel in 2022. Many of the costs associated with this alternative, such as those for preparing and packaging the fuel for shipment to SRS, occur at ANL-W. Congress appropriates funds for the treatment of spent nuclear fuel. DOE spends monies consistent with Congressional direction. The issue of funding for the treatment and management of sodium-bonded spent nuclear fuel is beyond the scope of the SBSNF EIS. DOE believes that the Cost Study is adequate for the purpose intended. The results of the Cost Study will be among the factors considered during the decision-making process leading to the Record of Decision.
700-2	"The driver fuel, of course, is the one that's not usable in terms of the PUREX process because of the infiltrated sodium. So the candidates for taking care of the sodium there really lend themselves to...the electrometallurgical process. But that's only three metric tons.... But the big part of the project really is 57 metric tons of depleted uranium, in which plutonium is inbred. The sodium is removable from the surface of the uranium rods. And we [ANL-W/INEEL] have done that process mechanically and chemically a number of times to the tune of probably several thousand fuel rods. And they were, in fact, shipped to Atomic International, and then to Savannah River. The technology worked. It's very cheap. It's very gross. ...Where is it going to go? It's going to go someplace. It has to be removed if it's sodium. ...Why do we consider anything else, in terms of the blanket rods, because it has been done many, many times before at Argonne-West, and at Atomic International and at Savannah River?"	DOE agrees with the commentor that decladding and removal of sodium from blanket spent fuel have been performed many times in the past. Section 2.3.9 and Appendix C of the EIS describe the processes used in the past. As described in Section 2.5.3, DOE evaluated an alternative in which the cleaned (metallic sodium removed) blanket spent nuclear fuel would be packaged in high-integrity cans for storage and disposal in a geologic repository. In addition, DOE evaluated other alternatives where the cleaned blanket fuel would be treated further. The selection of various alternatives is a required step in performing an EIS that is in compliance with NEPA and Council of Environmental Quality regulations.
700-3	"Unless there's an incentive to reclaim or separate the plutonium from the depleted uranium rods, it makes absolutely no sense to me to do anything more than remove the cladding, remove the sodium, and store those rods, store those slugs, at Savannah River, or wherever they are in storage, much like spent fuel is stored. To... downgrade, or to whatever, just increases the proliferation problem."	The commentor's recommendation to remove sodium and place blanket spent nuclear fuel in cans is noted and is discussed in Section 2.5.3.

Comments from the Idaho Falls, Idaho, Public Hearing *August 26, 1999*		
No.	*Comments*	*DOE Responses*
John Commander		
701-1	"We support the treatment of the sodium-bonded spent nuclear fuel by the electrometallurgical process. The process should be used for all the fuel as described in Alternative 1 of the Draft Environmental Impact Statement. The electrometallurgical treatment has been proven to be satisfactory. Many of the other alternatives are in the concept or research stage. Nearly all of the sodium-bonded fuel is now at Argonne National Laboratory-West. It makes both common and economic sense to do the entire treatment there. ...Again, we support Alternative 1 very strongly."	The commentor's support for the electrometallurgical treatment of both driver and blanket sodium-bonded spent nuclear fuel (Alternative 1) is noted.
701-2	"I'm also concerned about the loss of jobs and skills if the treatment is not done at Argonne National Laboratory-West. These skills are particularly important at this time. The current administration is finally putting some new funding into the research—nuclear research and technology. And DOE has designated the INEL [*sic*] as a lead laboratory for this effort. We want to keep these qualified people here."	The commentor's concern that jobs and skills will be lost if treatment of sodium-bonded spent nuclear fuel is not conducted at ANL-W is noted. DOE recognizes the value and the presence of important skills at ANL-W and INEEL. As part of the decision-making process, DOE will consider the consequences of potential impacts to various environmental resources, including socioeconomics. The Record of Decision will explain the rationale and factors for DOE's decision.
701-3	"The electrometallurgical treatment has little risk that nuclear material could be diverted to use in nuclear bombs. The Draft-EIS has adequately answered the comments of those concerned about that risk."	The commentor is correct. Electrometallurgical treatment of sodium-bonded spent nuclear fuel would not produce weapons-usable material, thereby reducing the risk that this spent nuclear fuel might be diverted for other uses.
701-4	"Whatever alternative is chosen, it must meet the terms of the 1995 Governor's Agreement on Nuclear Waste. If treatment is done at the Savannah River [site], material must be moved there before the year 2035. And it is not clear to me that those facilities will be available to do any treatment before that year. This date is the deadline for all spent fuel to be out of Idaho."	Section 4.12.2 of the EIS presents a discussion on schedule consideration for the treatment and management of sodium-bonded spent nuclear fuel for each of the alternatives considered in the EIS. According to these schedules, the treatment of sodium-bonded spent nuclear fuel could be completed by 2035 for all treatment alternatives, including the direct disposal option of the No Action Alternative. Under the continued storage option of the No Action Alternative, the sodium-bonded spent nuclear fuel would be transferred out of the State of Idaho before the 2035 deadline. The availability of the SRS facilities for treatment of blanket spent nuclear fuel is also discussed in Section 4.12.2.

Comments from the Idaho Falls, Idaho, Public Hearing *August 26, 1999*		
No.	*Comments*	*DOE Responses*
Dick Kenney		
702-1	"I think that your calculation of background radiation of 360 millirems per year is considerably less than what the residents of Idaho Falls receive. I think you've left out several elements...in that calculation."	As shown in Table 3–8 of the EIS, the approximately 360 millirem per year natural background radiation dose is the sum of the calculated effective dose equivalent from terrestrial and cosmic sources (external dose) specific to the Snake River Plain area, as well as the estimated doses from cosmogenic sources and radon gas (internal dose) provided in the National Council on Radiation Protection and Measurements Report No. 93, which lists the average dose to an American. An individual in the Idaho Falls area may or may not receive this dose because of variations between geographic areas. The EIS provides a summary of various contributing sources of radiation in the vicinity of the INEEL site.
702-2	"Coalition 21 strongly supports the treatment of sodium-bonded spent fuel by the electrometallurgical process. The process should be used for both the driver and the blanket fuel, as described in Alternative No. 1. The ANL-West is...has successfully demonstrated that the electrometallurgical treatment works. We see no reason for additional research in other technologies. Let's do it, get the job done and be done with it."	The commentor's support for using the electrometallurgical treatment process to treat driver and blanket sodium-bonded spent nuclear fuel (Alternative 1) is noted.
702-3	"This alternative [Alternative 1], properly done, will make the remnants of the IFR program ready for final disposal. It will be done in a timely manner by a technology that is compatible with the IFR concept, we do not want sodium-bonded fuel still in storage. We do not want that fuel to be used as an example of another failed technology. This position is consistent with the objectives of our lawsuit against the Department of Energy regarding the IFR."	The commentor's support for Alternative 1, the electrometallurgical treatment of sodium-bonded spent nuclear fuel at ANL-W, is noted. The commentor makes reference to the Integral Fast Reactor program. The purpose for the Integral Fast Reactor program was to develop an efficient, safe process for recycling nuclear fuel by using a liquid metal-cooled reactor in combination with an integral fuel reprocessing facility. As part of this program, the EBR-II was used for fuel-design and fuel irradiation testing. Congress canceled funding for the Integral Fast Reactor program in 1994. The commentor's concern that the sodium-bonded spent nuclear fuel could be used as an example of "another failed technology" and whether DOE decides to retrieve or revive the Integral Fast Reactor concept is beyond the scope of this EIS. In the lawsuit referred to by the commentor ("Coalition 21 v. U.S. Department of Energy and Tammy L. Hobbes," Civil Case No. CV 98-0299-B-BLW), Coalition 21 seeks to require DOE to prepare an EIS to address the shutdown of the EBR-II and claims that DOE failed to examine the potential environmental consequences of this action. Since deactivation of EBR-II does not involve the treatment and management of sodium-bonded spent nuclear fuel, the objectives referred to by the commentor are beyond the scope of this EIS.

Comments from the Idaho Falls, Idaho, Public Hearing *August 26, 1999*		
No.	*Comments*	*DOE Responses*
702-4	DOE does not plan to generate more sodium-bonded fuel; thus, it is a limited program, one that can be solved and should be solved sooner, rather than later."	The commentor's support for the proposed action, the treatment and management of sodium-bonded spent nuclear fuel, is noted. As the commentor noted, with the shutdown and removal of all fuel from the EBR-II, DOE can no longer generate any additional sodium-bonded spent nuclear fuel at INEEL. Ninety-eight percent of the DOE-owned sodium-bonded fuel is now at the ANL-West and INTEC. Having completed the Electrometallurgical Treatment Research and Demonstration Project (see Section 1.6.3) and in planning the closure of its PUREX processing capabilities, DOE now needs to decide whether these processes are suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the EIS could result in the loss of capability and of experienced, knowledgeable technical staff should DOE decide at a later date to use the electrometallurgical process to treat sodium-bonded spent nuclear fuel. Section 1.2 of the EIS has been revised for clarification.
Ted Carpenter		
703-1	"The tribes are renowned for use of resources efficiently and maximally. I support the electrometallurgical process because it does produce a separated uranium metal product. Once the earth has been invaded and the crust has been broken up to remove the rocks and the metal's been refined, let's keep using it, instead of considering it waste. The same thing goes for the fact that it separates out the stainless steel and noble metals—zirconium, niobium, nickel, chromium—all of those things. Those are resources; they are not waste."	Most of the noble metal fission products (e.g., niobium, technetium, ruthenium, rubidium, silver, cadmium, and zirconium) and fuel alloy (zirconium) in the electrorefiners would remain with the fuel cladding hull in the anode basket. In addition, some actinides would also remain with the noble fission products. The amount of material retained in the anode basket would strictly depend on the electrorefining operation conditions. If more actinides and the fuel matrix were dissolved in the molten salts, the retention of noble fission products would be lowered. The metal remains in the anode basket would be radioactive, and would be classified as high-level radioactive waste. It is true that electrometallurgical treatment has been used to produce metals from impure feedstock. However, that impure feedstock included metals with chemical contamination, not radioactive isotopes of the same metals. Noble metal recovery from the metallic waste would have limited uses because the metal would still be radioactive, (i.e., it would contain radioactive isotopes of the metal elements) and would still be considered radioactive metallic waste. However, uranium would be separated and could be used for other purposes. The disposition of this uranium, along with DOE's inventory of surplus uranium, will be determined through another NEPA review.

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No.	*Comments*	*DOE Responses*
703-2	"Also, of course, the fact that this Alternative 1 has minimal transportation across reservations simply avoids the issues of some of...the members who have fears."	As explained in the EIS, the risks associated with the fuel transport are very small. Regardless of the alternative, DOE would need to transport spent nuclear fuel and/or high-level waste out of the INEEL site. DOE will proceed in accordance with the DOE/Shoshone-Bannock Tribes Agreement-in-Principal, which covers notification and coordination of the transport of radioactive materials across the Fort Hall Reservation. Risks, including transportation, have been addressed in the EIS and will be considered by DOE prior to making any decisions regarding the treatment and management of sodium-bonded spent nuclear fuel.
Steve Herring		
704-1	"The options for the driver are really driven by the amount of sodium that is contained in the pores within the fuel. And, consequently, the electrometallurgic process is about the only viable alternative for getting that sodium out. For the blanket, it seems to me that we have a viable choice based on how well we can characterize the long-term longevity of those high-integrity cans. I understand that specifications can be written for them. But, if we write those specifications, that they have to be shown to be integral for 10,000 years, then we have a major testing program ahead of us for that. ...therefore,...if that is a driver on the cost of the options, then the electrometallurgical process should be used for the blanket, as well. However, if that is not a driver on the cost, then the use of high-integrity cans for the blanket assembly should be used for both of those, both Options 1 and 2, minimizing the amount of transportation.... And so, therefore, I would like to speak in favor of either Options 1 or 2."	The commentor's support for the use of the electrometallurgical process to treat driver sodium-bonded spent nuclear fuel is noted. The EIS does not present a cost comparison of the alternatives. However, a separate DOE Cost Study does compare the costs of each alternative. This Cost Study assumes that isolation of the treated spent nuclear fuel in a 10,000-year repository would rely on the integrity of other containment barriers rather than high-integrity can packaging.

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John Tanner		
705-1	"The treatment of the driver portion of the sodium-bonded nuclear fuel by the electrometallurgical process is the most sensible option proposed for the following reasons: It would allow recovery and use of the high-enriched uranium, which is valuable material that was costly to produce. This [driver] fuel is not suitable for the PUREX process, as already explained in the DEIS. The other methods, melt and dilute, chloride volatility, plasma arc ceramic, and so forth, are less well developed, are likely to be more expensive even after development, and involve heating the fuel to high temperatures, which will worry some people about whether the volatile elements would pollute the air."	The commentor's support for the treatment of driver sodium-bonded spent nuclear fuel by the electrometallurgical treatment method is noted. The EIS discusses all of the commentor's areas of concern. Separate studies consider the nonproliferation characteristics of the various alternative technologies and the costs associated with each of the alternatives. The EIS assessment and the conclusions presented in the separate studies will be considered during DOE's decision-making process, the results of which will be published in the Record of Decision.
705-2	"The plutonium in the blanket fuel is also valuable and should be recovered. If this [plutonium recovery from the blanket fuel] were done by the PUREX process, the recovered plutonium would be pure enough to be made into mixed oxide fuel to generate electricity in commercial power reactors. Much of the development of this [PUREX] process is already contemplated for plutonium recovered from weapons. The cost of decladding, sodium removal, and shipment from Idaho would, of course, need to be considered. The plutonium could also be recovered by the electrometallurgical process. Why is this not mentioned as an alternative in the DEIS? This is as reasonable as many of the other alternatives presented. Although the recovered plutonium would be too contaminated with other transuranic elements to be useful as MOX fuel, it would be useful in a future fast neutron reactor, such as the one which produced it.	The commentor's remarks about the value of plutonium present in the sodium-bonded spent nuclear fuel are noted. The intent of this EIS, as discussed in Section 1.2, is to resolve issues associated with the sodium content of sodium-bonded spent nuclear fuel. The disposition of the fissile material content of the fuel is not within the scope of the EIS and is not considered an issue in the formulation of the reasonable alternatives. It is, however, an important consideration in the Nonproliferation Impacts Assessment of the alternatives that was prepared separately from the EIS. The conclusions of the Nonproliferation Impacts Assessment, along with those of the EIS, will be considered during the decision-making process leading to the Record of Decision.

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No.	*Comments*	*DOE Responses*
705-3	"But to answer the question just raised, recovery of plutonium by the electrometallurgical process was omitted in order to please influential antinuclear critics who raised weapons proliferation concerns, ignoring the fact that the electrometallurgical process is far more proliferation- resistant than the well-known PUREX process. The demonstration of plutonium separation by the electrometallurgical process would do nothing to aid anyone's ability to obtain weapons-usable material." "However, putting this plutonium in the waste, as proposed for most of the alternatives in the DEIS, will only temporarily please these critics. When it is later proposed to bury this waste, whether in Yucca Mountain or elsewhere, they will again object, pointing to plutonium's long half-life and to recent evidence that trace amounts of plutonium can migrate in groundwater under special artificial conditions. Note that the critics have been vehemently opposing the transport and burial of waste with only trace amounts of plutonium in the WIPP. What will they say when it is proposed to bury waste with substantial amounts of plutonium?"	DOE, consistent with U.S. nuclear nonproliferation policy, would not separate plutonium except for the PUREX process. DOE expects that the plutonium-containing waste from the electrometallurgical treatment process would be acceptable in a geologic repository for the same reasons that plutonium-containing commercial spent nuclear fuel is already acceptable.
705-4	Any method of dealing with plutonium will be criticized. Therefore, we should do the sensible thing and recover it for later use."	The commentor's remarks about the value of plutonium present in the sodium-bonded spent nuclear fuel are noted. The intent of this EIS, as discussed in Section 1.2, is to resolve issues associated with the sodium content of sodium-bonded spent nuclear fuel. The disposition of the fissile material content of the fuel is not within the scope of the EIS and is not considered an issue in the formulation of the reasonable alternatives. It is, however, an important consideration in the Nonproliferation Impacts Assessment of the alternatives that DOE prepared separately from this EIS. The conclusions of the Nonproliferation Impacts Assessment and those of the EIS will be considered during the decision-making process.
Beatrice Brailsford		
706-1	"I think you have done a good job in the draft EIS, demonstrating that nothing needs to be done with the blanket fuel, as far as for the processing beyond the removal of the sodium in mechanical ways in which we know how to do...certainly for the blanket, no action is the appropriate course."	The commentor's opinion that the appropriate course for blanket sodium-bonded spent nuclear fuel is sodium removal and direct disposal (Alternative 2 for blanket fuel), is noted.

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706-2	"As you know, we have asked for an extension of this comment period. ...And it seems to me that...you really are looking at a real rush job to try to finish this up by the end of the year. So, I would encourage you to extend the comment period on the draft EIS..."	In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169). DOE did not rush the preparation of the EIS. By extending the comment period, it provided the public with additional time to consider and make comments on the document.
706-3	"[Extend the comment period] ...at least until the NRC [National Research Council] analysis comes out. I received the cost study and the nonproliferation report today. And I won't receive the NRC report until December, simply because you won't either."	While the final National Research Council report on the Electrometallurgical Treatment Research and Demonstration Project was published in April 2000, the Council's interim status reports on the project were made available in the public reading rooms. Thus, prior to making comments on the draft EIS, the public had an opportunity to review all of the information that was made available by the National Research Council and was used to prepare the EIS. DOE will consider the data contained in the final National Research Council report in preparing the Record of Decision.

Comments from the Arlington, Virginia, Public Hearing August 31, 1999		
No.	*Comments*	*DOE Responses*
Maureen Eldredge		
800-1	"I take offense at talking about nuclear processes and telling the public that it's like common table salt—that you can go buy it in the grocery store. It's just an aside that I urge you not to use that kind of language."	The commentor is referring to an analogy used in the DOE presentation on August 31, 1999, to explain the disposition of metallic sodium in the sodium-bonded spent nuclear fuel during electrometallurgical treatment. As stated in the EIS, during electrometallurgical treatment the metallic sodium would be converted into a nonreactive form (sodium chloride) and would be disposed of with the high-level ceramic radioactive waste product. In the DOE presentation, the nonreactive sodium chloride form was described as analogous to "common table salt." It was not DOE's intent to mislead the public to believe that they could buy this "salt" in a grocery store; rather, DOE sought to communicate to the public what happens to the metallic sodium during treatment.
800-2	"...you mentioned the need to make a decision regarding PUREX because the [SRS] canyons will be shutting down. Do you have a schedule for that shutdown? I was not aware there was an actual date certain."	The plans for shutdown are being developed. Therefore, if PUREX processing were selected, sodium-bonded blanket fuel would need to be placed on the schedule.

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No.	*Comments*	*DOE Responses*
800-3	"This project and the need for it in terms of the repository is completely incompatible with the schedule that Yucca Mountain is on. Not only are the waste criteria not set, there are growing concerns about the feasibility of that site as a repository and at least five years out, if not longer, before those kinds of decisions would be made." "I think probably you could add to a list of 'why now', the Federal Budget process with the Fiscal year 2000 starting on October 1st and the problem this project ran into in that they wouldn't be able to justify spending money if suddenly they weren't going to have a ROD into the middle of the fiscal year. Perhaps I'm just being cynical."	In accordance with the Nuclear Waste Policy Act of 1982, DOE is committed to the development of a licensed national repository for spent nuclear fuel and high-level radioactive waste and is engaged in activities to fulfill this commitment. This commitment is ongoing. The EIS does not assume that Yucca Mountain will be selected as the high-level waste repository. It only assumes that, at some time in the future, a geologic waste repository will be licensed and operated by DOE which will receive spent nuclear fuel and high-level radioactive waste. As stated in the introduction to the EIS, the programmatic risk in implementing any of the potential alternatives for the treatment and management of sodium-bonded spent nuclear fuel, or of not treating this fuel, is the uncertainty surrounding the acceptability of DOE spent nuclear fuel for emplacement in a potential geologic repository. Although not final, the latest guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999 (see Section 4.12.1 of the EIS), indicates that it is highly probable that sodium-bonded spent nuclear fuel would not be acceptable in the repository without some stabilization and/or removal of the metallic sodium. The stabilization of the spent nuclear fuel and/or removal of the metallic sodium will provide greater protection of human health and the environment. Having completed the Electrometallurgical Treatment Research and Demonstration Project (see Section 1.6.3) and in planning the closure of its PUREX processing capabilities, DOE needs to decide whether these processes are suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the EIS could result in the loss of capability and of experienced, knowledgeable technical staff should DOE decide at a later date to use the electrometallurgical process to treat sodium-bonded spent nuclear fuel. Section 1.2 of the EIS has been revised for clarification.
800-4	"I believe that the whole point of looking at cumulative impacts was that you might have a series of nonsignificant impacts which, when added up would become an impact. So I urge you to look at that again."	As described in Section 4.11 of the EIS, cumulative impacts are defined by the Council on Environmental Quality as the environmental impacts that result from the incremental impact of the action when added to other, past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or nonfederal) or person undertakes such other actions. This section provides the discussion on the cumulative impacts for all resources evaluated in the EIS. For each resource, where the incremental impact from an action would be very small, its contribution to the cumulative impacts would be insignificant.

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No.	*Comments*	*DOE Responses*
800-5	"Once again, as always, we do not believe there is a need for this action. It's our continued belief that this project is not proceeding because of any need, but rather the political need to retain jobs at Argonne West, retain missions, and leave the door open for their future dream of getting more waste forms to process. That hope has been revitalized in many ways, including Senator Domenici's attempts to start a new Office of Reprocessing. So I think it's a realistic hope on their part and one of the reasons we are continuing to oppose this project."	DOE is responsible for developing and maintaining a capability to safely manage its spent nuclear fuel. To ensure that the State of Idaho Settlement Agreement and Consent Order is met, and to facilitate disposal, DOE needs to reduce the uncertainties associated with qualifying the sodium-bonded spent nuclear fuel for disposal. While DOE notes the commentor's belief that the need for the proposed action is concerned with the political need to retain jobs and missions at ANL-W and the hope of having more waste forms to process, this comment is beyond the scope of this EIS. See response to comment 800-3.
Hisham Zerriffi		
801-1	"...the major purpose of this action is to remove the reactive sodium, toxic-sodium from the spent fuel. Now, for most of the alternatives...or some of the alternatives at least, for the blanket spent fuel you are going to do that removal process at Argonne using the process described in Section 2.4.9, which is a fairly simple process, it seems. And then run it through PUREX? What's the point of the second part of that, exactly, if you've already removed the sodium in the Argonne hot cell?"	The programmatic risk in implementing any of the potential alternatives for the treatment and management of sodium-bonded spent nuclear fuel, or of not treating this fuel, is the uncertainty surrounding the acceptability of DOE's spent nuclear fuel for emplacement in a potential geologic repository. While DOE has drafted preliminary waste acceptance criteria for a geologic repository, the final acceptance criteria will be more refined. If the repository is developed, final acceptance criteria will not be available until after the U.S. Nuclear Regulatory Commission issues its construction authorization based on successful demonstration of the safe, long-term performance of the repository in accordance with the U.S. Nuclear Regulatory Commission regulations. The presence of metallic sodium is the primary but not the only reason for the proposed action. The presence of metallic uranium or highly enriched uranium, could also complicate the process of certifying the repository. Such certification would require sufficient data and predictive analyses to demonstrate that emplacement of the spent nuclear fuel would not adversely affect a repository's ability to protect the environment and worker and public health and safety. To ensure that requirements of the State of Idaho Settlement Agreement and Consent Order are met and to facilitate disposal, DOE needs to reduce the uncertainties associated with qualifying sodium-bonded spent nuclear fuel for disposal. Appropriate treatment and management of the sodium-bonded spent nuclear fuel (e.g., PUREX processing) would significantly reduce complications related to disposal qualifications. The borosilicate glass waste form resulting from PUREX processing has been extensively tested and analyzed under conditions relevant to a geologic repository. DOE expects that other waste forms (e.g., ceramic and metallic) would be suitable for repository disposal.

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No.	*Comments*	*DOE Responses*
801-2	"...I think the final EIS does need to clarify—yes, I understand that you have metallic uranium in the fuel and that is also an issue for the repository, as is the HEU. And I think that's not -- I mean, it's clear to me when I read through it but I think most of the public reading through it is not going to be very clear on that. That this is an issue of both sodium and the other metals and the HEU, and what of each of these are going to handle which part of that process? And I think that needs to be much more defined in the final EIS if you're going to do it."	Section 2.2 of the EIS states that the 60 metric tons of heavy metal of sodium-bonded spent nuclear fuel constitutes approximately 2 percent of DOE's total current spent nuclear fuel inventory of nearly 2,500 metric tons of heavy metal. According to the latest guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999, DOE spent nuclear fuel "may be accepted as bare fuel. The specific acceptance criteria for this bare fuel will be developed on a case by case basis." The decision, therefore, whether or not to treat spent nuclear fuel, including the N-Reactor fuel, before placement in a geologic repository has not been made. As discussed in Section 1.2 of the EIS, the presence of metallic sodium is the primary but not the only reason for the proposed action. The presence of metallic uranium, or the presence of highly enriched uranium, could also complicate the process of certifying the geologic repository. Such certification would require sufficient data and predictive analyses to demonstrate that placement of the spent nuclear fuel would not adversely affect a repository's ability to protect the environment and worker and public health and safety. To ensure that the State of Idaho Settlement Agreement and Consent Order is met, and to facilitate disposal, DOE needs to reduce the uncertainties associated with qualifying sodium-bonded spent nuclear fuel for disposal. Appropriate treatment and management of the sodium-bonded spent nuclear fuel would significantly reduce complications related to disposal qualifications.

Comments from the Arlington, Virginia, Public Hearing August 31, 1999		
No.	*Comments*	*DOE Responses*
801-3	"The IEER [Institute for Energy and Environmental Research] is disappointed that the Department has again issued a draft EIS which seems to sacrifice some pretty important environmental and nonproliferation goals to meet some programmatic goals which are questionable."	DOE is responsible for developing and maintaining a capability to safely manage its spent nuclear fuel. As stated in the introduction to the EIS, this EIS follows the June 1995 Record of Decision (60 FR 28680) for the "Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement," in which DOE decided to regionalize spent nuclear fuel management by fuel type for DOE-owned spent nuclear fuel. DOE also decided to: (1) continue environmental restoration activities at INEEL; (2) develop cost-effective treatment technologies for spent nuclear fuel and waste management; and (3) implement projects and facilities to prepare waste and treat spent nuclear fuel for interim storage and final disposition. The Record of Decision provides the programmatic umbrella for the site-specific actions addressed in this EIS, as well as the Savannah River Spent Nuclear Fuel Management EIS and the Idaho High-Level Waste and Facilities Disposition EIS. DOE is committed to improving its environmental management practices; to operating its facilities in a manner that meets or exceeds all applicable environmental, safety, and health requirements; and to cleaning up its environmental problems. The focus of this EIS is to assess the potential environmental and health impacts associated with the treatment and management of sodium-bonded spent nuclear fuel. Although not final, the latest guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999 (see Section 4.12.1 of the EIS), indicates that it is highly probable that sodium-bonded spent nuclear fuel would not be acceptable in the repository without some stabilization and/or removal of the metallic sodium. Stabilization of the spent nuclear fuel and/or removal of the metallic sodium would provide greater protection of human health and the environment. Having completed the Electrometallurgical Treatment Research and Demonstration Project (see Section 1.6.3) and in planning the closure of its PUREX processing capabilities, DOE now needs to decide whether these processes are suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the EIS could result in a loss of capability and of experienced and knowledgeable technical staff should DOE decide at a later date to use the electrometallurgical process to treat sodium-bonded spent nuclear fuel. Section 1.2 of the EIS has been revised for clarification. DOE has also conducted an independent Nonproliferation Impacts Assessment of the treatment technologies analyzed in the this EIS. The Nonproliferation Impacts Assessment found all of the treatment technologies, except for PUREX processing at SRS, to be in accordance with U.S. nuclear nonproliferation policy.

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No.	*Comments*	*DOE Responses*
801-4	"...there are no immediate health, environmental, and safety risks that need to be addressed immediately or that cannot be addressed through some sort of simple minimal preparation and fuel storage. I believe that's basically what the draft EIS states."	The timing for this action is a programmatic issue rather than a safety issue. As stated in Section 1.2 of the EIS, DOE considers it prudent to evaluate the alternative technologies now while DOE is performing site characterization activities for the potential repository at Yucca Mountain. See response to comment 801-3.
801-5	"There's no guarantee that Yucca Mountain is going to be selected as the high-level waste repository, and there's considerable technical controversy still over suitability."	The SBSNF EIS does not assume that Yucca Mountain will be selected as the high-level waste repository. It only assumes that, at some time in the future, a geologic waste repository will be licensed and operated by DOE and will receive spent nuclear fuel and high-level radioactive waste.
801-6	"If Yucca Mountain is chosen, the final waste acceptance criteria have not yet been established and there's a programmatic risk, as the DEIS states, that the final waste forms won't meet whatever criteria are chosen."	See response to comment 801-3.
801-7	"The argument in the EIS that potential waste forms should be developed in parallel with the repository is inconsistent with the fact that processing will start in the year 2000. This is five years before the estimated time for receiving a construction permit from the NRC [U.S. Nuclear Regulatory Commission], which will be a necessary step in developing the final waste form. You're actually proposing to process this spent fuel, not develop potential waste forms, as it states in the purpose and need for action. And these are not parallel processes; these are sequential processes, with one coming very much before the other and in my opinion, the wrong order."	The siting and development of a repository, the finalization of the waste acceptance criteria, and the treatment and management of sodium-bonded spent nuclear fuel are not necessarily sequential actions, but are interdependent parts of a larger action outlined in the Record of Decision for the Programmatic Spent Nuclear Fuel EIS (60 FR 28680). The relationship between this EIS and these interdependent actions is discussed and addressed, where appropriate, in the EIS. As stated in Section 1.2 of the EIS, DOE considers it prudent to evaluate the alternative technologies now while it is performing site characterization activities for the potential repository at Yucca Mountain. Also, to ensure the State of Idaho Settlement Agreement and Consent Order is met, and to facilitate disposal, DOE needs to reduce the uncertainties associated with qualifying sodium-bonded spent nuclear fuel for disposal. Appropriate treatment and management of the sodium-bonded spent nuclear fuel would significantly reduce complications related to disposal qualifications. The borosilicate glass waste form resulting from PUREX processing has been extensively tested and analyzed under conditions relevant to a geologic repository. DOE expects that other forms (e.g., ceramic, metallic, and high-integrity cans that do not contain metallic sodium) would be suitable for repository disposal. The development of waste forms in parallel with the development of the repository is one of many considerations discussed under the purpose and need section of the EIS (see Section 1.2). The primary consideration is the removal or conversion of metallic sodium to a nonreactive form. See response to comment 801-3.

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No.	*Comments*	*DOE Responses*
801-8	"There also are no immediate time constraints posed by the State of Idaho settlements. As I said earlier, you know, spent fuel doesn't have to be removed until 2035. Even if you take a certain number of years to develop alternative processing, if so desired, and a certain number of years to process those, 2035 is a long ways off still."	See response to comment 801-3.
801-9	"I think it needs to be clear in the EIS that, of 60 metric tons of this spent fuel, as you stated earlier, 57 metric tons can have the sodium removed without any of these proposed processes. And also that these 57 metric tons also don't contain any HEU, which is another issue stated in the EIS as a purpose and need for action."	The EIS, under Alternative 2 (Section 2.5.3), analyzes the environmental impacts of removing sodium from 57 metric tons of blanket sodium-bonded spent nuclear fuel and the subsequent packaging of this fuel in high-integrity cans without any additional treatment and/or stabilization of the spent nuclear fuel. The environmental consequences of this action are presented in Section 4.4. As described in Appendix D, Section D.3.2.2, the uranium in the 57 metric tons of blanket fuel is depleted uranium and not highly-enriched uranium. Section 2.2 of the EIS was revised to be consistent with the information presented in Appendix D. If the finalized waste acceptance criteria for the repository requires the removal of sodium from the spent nuclear fuel, this requirement would apply to all 60 metric tons of sodium-bonded spent nuclear fuel addressed in this EIS. As described in Sections 2.2 and 2.3.9 of the EIS (formerly Section 2.4.9 of the draft EIS issued in July 1999), different treatment methods are required for the removal of sodium from driver fuel (3 metric tons) and blanket fuel (57 metric tons).

Comments from the Arlington, Virginia, Public Hearing *August 31, 1999*		
No.	*Comments*	*DOE Responses*
801-10	"So really what we're talking about is three metric tons in terms of the sodium removal, and possibly another 57 metric tons in terms of the uranium issues. But that needs to be clear and needs to be stated under what criteria those would be an issue in terms of the repository."	As discussed in Section 1.2 of the EIS, the need for the proposed action is to ensure that the requirements of the State of Idaho Settlement Agreement and Consent Order are met and to facilitate disposal of the sodium-bonded spent nuclear fuel in a geologic repository. The need for this facilitation is the reduction of the programmatic risk associated with the presence of metallic sodium, the presence of metallic uranium or highly enriched uranium in the spent nuclear fuel, and the ongoing development of high-level radioactive waste acceptance criteria for repository disposal. The goal of each of the reasonable alternatives evaluated in the EIS is to reduce the programmatic risk in different ways. The commentor's assertion that the treatment of driver spent nuclear fuel is about sodium removal and the treatment of blanket spent nuclear fuel, beyond sodium removal, is about other issues discussed in the purpose and need section of the EIS is correct. For example, Alternative 2 in the EIS addresses only sodium removal. The other alternatives go beyond sodium removal. It should be noted that PUREX processing at SRS was included as a reasonable alternative in response to the National Research Council recommendation that only PUREX processing would provide a viable alternative to the electrometallurgical treatment technology. DOE believes that the EIS is clear on the issues related to the waste acceptance criteria for repository disposal.
801-11	"So not only have, you know, you not necessarily made the case, at least in our opinion, as to why you need to do this now and what the purpose is of this process...,"	See response to comment 801-3.

Comments from the Arlington, Virginia, Public Hearing *August 31, 1999*		
No.	*Comments*	*DOE Responses*
801-12	"...there are a number of proliferation risks which have not been brought up yet in this meeting, which I'm a little disappointed. So let me discuss just really briefly this nonproliferation review that was put out. It does note a few of the important proliferation risks posed by EMT. And you know, it can produce weapons-usable HEU. It is a subset of a larger process which can separate plutonium and, therefore, it parallels with traditional reprocessing techniques. It does involve both processing, which makes international safeguards harder to implement, and safeguards have not been demonstrated on this technology. I'm not going to go into very much detail since there is nobody here from the Non-Proliferation Office. Let me state though, that review does underplay a lot of the risks of EMT in particular. And I focus on EMT simply because it is such a major portion of this EIS, despite the fact of the name change and the addition of other proposed actions. This started off as an EMT EIS. EMT is a major part of why these are alternatives." You know, the fact that DOE concludes in this review that EMT fully maintains consistency with U.S. nonproliferation policy is very puzzling to me considering its potential implications, both in the U.S. And globally. ...So as I say, I'm not going to go through a lot of these other nonproliferation comments, since they don't seem relevant here, but let me just note that, in terms of EMT, something that needs to be really taken into consideration is the fact that it is a process which is a subset of pyroprocessing, which could have the cadmium cathode and cathode processor put back in. You'd then end up with a substance—once you've removed that cadmium cathode and processed it—which is up to 70 percent plutonium. If a proliferator decided to then take that plutonium product—70 percent plutonium, about 30 percent uranium, less than one percent fission products, according to the OTA study from '94, and I imagine those numbers haven't changed all that much—an aqueous process to then separate out the plutonium from that would be a much different aqueous process than international safeguards are used to dealing with..." Much smaller scale of materials to be processed [*sic*]. You don't have the fission products to worry about. Yes, you have a bit of a higher radiation dose than separated plutonium, but a poor Asian country is not going to worry about that. So I think you've got to be clear as to what the implications of this are in that nonproliferation review. It kind of was a bit of a whitewash."	The assessment of nonproliferation impacts is not part of the scope of the EIS. However, none of the alternatives analyzed in this EIS, except PUREX processing at SRS, would generate weapons-usable fissile materials. Although highly enriched uranium would be an interim product, it would be down-blended to low-enriched uranium during electrometallurgical treatment. There are several features of the electrometallurgical treatment process that make it adaptable to international safeguards. The process cell, made inaccessible to humans by high radiation, inert atmosphere, and thick concrete walls, has a minimal number of penetrations through which materials can be moved in and out. These openings are secured and can be readily monitored for material transfers. There are no liquid waste streams through which materials can be piped out of the facility. All by-products and waste from the process would be in solid form, and so would be accountable by unit inventory. Finally, all by-products and waste moving out of the facility could be subjected to nondestructive examination if additional assurances were required under international safeguards agreements. As conceived for the canceled Integral Fast Reactor project, the liquid cadmium cathode would have produced a metal alloy product containing up to 70 percent plutonium which could only have been obtained after subsequent processing in a high-temperature vacuum furnace. The balance of materials would be those elements most difficult to separate from plutonium by any chemical means, such as uranium, americium, neptunium, curium, and the rare earth fission products. The plutonium metal-alloy product would have high fission product and transuranic content, a high heat source, a high neutron radiation source, and a high gamma radiation source, any one of which would make design of a weapon extremely difficult. Neutron and gamma radiation would be three to four orders of magnitude higher than weapons-grade or reactor-grade material. These levels of radiation are lethal and would prohibit any handling of the material or weapon by other than remote means. Development of the cathode progressed only to the point of technical feasibility. No prototype or working model was ever commissioned for the Fuel Conditioning Facility. Under the electrometallurgical treatment process, plutonium would stay mixed with the fission products and electrolyte salt. Plutonium and fission products would then be immobilized in the ceramic waste form. The ceramic waste form is more resistant to plutonium recovery than the metallic forms that result from other alternatives that use the melt and dilute process and high-integrity cans.

Comments from the Arlington, Virginia, Public Hearing *August 31, 1999*		
No.	*Comments*	*DOE Responses*
Edwin Lyman		
802-1	"I would like to commend the people in charge of this process for responding, I think, really in a surprising way to some of the comments that Nuclear Control Institute and others made during the scoping process. Restructuring the shape of the EIS so that at least the title didn't reflect—the emphasis on Electrometallurgical treatment was a pleasant surprise, as well as the acknowledgment more explicitly that the characteristics of the blanket and the driver were different; that the blanket which formed the bulk of the fuel could have the sodium removed much more simply than the driver fuel."	The comment is noted. DOE revised the scope of the EIS based on comments provided during the public scoping period.
802-2	"And even the acknowledgment that the option that involves mechanical decladding and sodium removal, the blanket, seems to be cheaper according to the Cost Study, which is another pleasant surprise, but something we might have anticipated."	Actual costs for treating and managing the sodium-bonded spent nuclear fuel are not part of the scope of the EIS. However, according to the August 1999 Cost Study, the least expensive alternative to No Action is Alternative 2, which includes blanket spent nuclear fuel sodium removal, but does not include mechanical decladding. Information such as costs, schedules, environmental consequences, and technical risk will factor into the Record of Decision for the treatment and management of sodium-bonded spent nuclear fuel.

Comments from the Arlington, Virginia, Public Hearing *August 31, 1999*		
No.	*Comments*	*DOE Responses*
802-3	"That said, I don't think that the draft EIS in its present form really addresses the key issue which has come up before and I'd like to reiterate it; the fact that if you're only looking now at three tons of fuel there has been no demonstration other than hand-waving referring to draft waste acceptance criteria, referring to RCRA; why this fuel cannot be directly disposed of in any repository being that it's such a small fraction of the overall inventory of radionuclides in the repository. ...I'm not advocating that corners be cut on safety, but I'd say we haven't seen a demonstration yet of why this small amount of sodium-bonded fuel would actually contribute in a significant way to the overall environmental consequences of the repository."	The uncertainties associated with qualifying sodium-bonded spent nuclear fuel for repository disposal are based on the existing regulatory environment. As discussed in Section 4.12.1 of the EIS, one of the key Nuclear Regulatory Commission requirements for acceptance of spent nuclear fuel or high-level radioactive waste is that it cannot contain or generate materials that are explosive, pyrophoric, or chemically reactive (in a repository environment) in a form or amount that could compromise the repository's ability to perform its waste isolation function or to satisfy its performance objective (10 CFR 60.135(b)(1)). In addition, in accordance with the April 1999 version of the DOE Office of Civilian Radioactive Waste Management's Waste Acceptance Systems Requirements Document, only spent nuclear fuel and high-level radioactive waste that is not subject to regulation under RCRA, Subtitle C, and meets all other acceptance criteria (e.g., packaging, uranium content), will be accepted for disposal. Although this determination for sodium-bonded spent nuclear fuel has not been made, it is a possible outcome. Based on the current regulatory environment, it is highly probable that sodium-bonded spent nuclear fuel will not be qualified for repository disposal without removal or conversion of the metallic sodium to a nonreactive form.

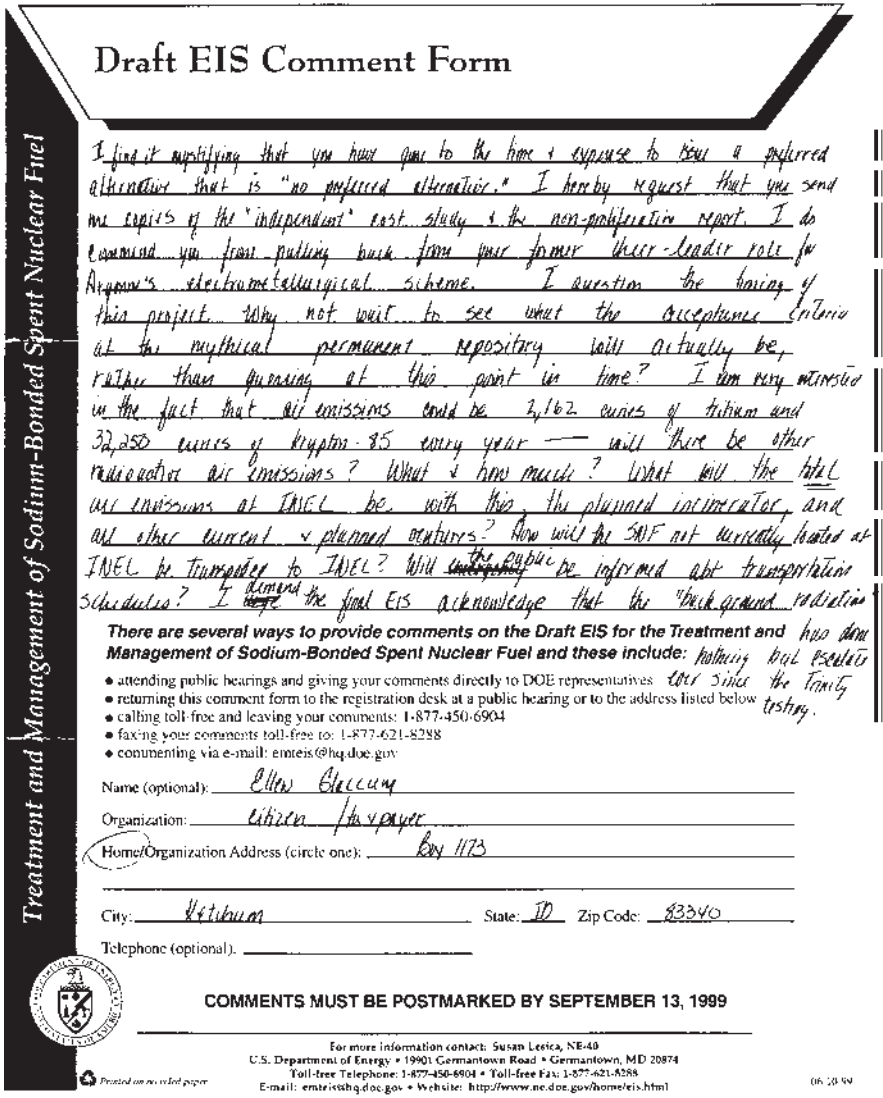
Comments from the Arlington, Virginia, Public Hearing *August 31, 1999*		
No.	*Comments*	*DOE Responses*
802-4	"And I'd just like to point out that DOE seems to embrace certain risk constraints when it sees fit and try to amend or seek waivers for others, and just comparing Yucca Mountain and WIPP makes it pretty clear.... I just read that DOE is now proposing shipping sand slag and crucibles from Rocky Flats directly to WIPP despite the fact that it contains a variety of reactive metals in it and it's going to seek a waiver for any safety issues associated with that. ...So it seems that these rules can be bent when it's feasible."	While the commentor's opinion about DOE embracing risk constraints when appropriate or seeking waivers for safety issues involving waste disposal is noted, the comment is beyond the scope of this EIS. The commentor also makes reference to the shipment of sand slag and crucibles from Rocky Flats directly to the Waste Isolation Pilot Project, which is also outside the scope of the EIS. However, in response to the commentor's statement, DOE would like to note the following activities regarding the shipment of sand, slag, and crucible residues to the Waste Isolation Pilot Project that were completed in 1999: (1) In July, after conducting a sampling analysis of the sand, slag, and crucible residues, DOE concluded there would be no pyrophoric hazards with this material. The analysis showed that these residues are sufficiently nonreactive to be shipped to the Waste Isolation Pilot Project. (2) DOE obtained the U.S. Nuclear Regulatory Commission approval in June 1999 for a change to shipping codes for the movement of material to the Waste Isolation Pilot Project. This revision allows DOE to ship residues with a passivated calcium constituent greater than that present in the sand, slag, and crucible residues. Basically, it has been determined that the sand, slag, and crucible residues are not hazardous waste and, therefore, are not subject to RCRA regulations. DOE has concluded, with the U.S. Nuclear Regulatory Commission approval, that disposal of these types of residues at the Waste Isolation Pilot Project will not adversely affect public health and safety.
802-5	"I'd like to see actual laboratory leach studies on samples of this fuel to see how this sodium, the residual sodium, and the driver fuel actually is [*sic*] released in the chemical form if you actually have the kinds of violent and potentially explosive reactions that are postulated. There's nothing like that in this document."	As discussed in Section E.4.6, the EBR-II fuel at INTEC's Basins 666 and 66 are stored inside sealed stainless steel cans that prevent the contact of basin water with the fuel cladding. During the average 17 years of storage in Basin 666, 10 of the 2148 cans were confirmed to have water in-leakage. With water inside these cans, a fuel-water reaction had produced hydrogen gas, which created bubbles that allowed detection of the water. These observations are consistent with the fact that sodium and metallic uranium react with water to produce hydrogen and this is the reason that all the sodium-bonded spent nuclear fuel is stored in dry storage or sealed containers that prevent the exposure of the fuel cladding to water. In a storage condition in a geologic repository, fuel cladding could disintegrate over time, leading to the collection of a large amount of sodium within the confines of the storage can. If this fuel can were to fail, a large amount of sodium would be available to react with any water in the repository. This could result in a violent reaction. DOE considers this condition to be unacceptable. The EIS, under the No Action alternative, analyzed a direct disposal option that was conditional on the acceptability of untreated sodium-bonded spent nuclear fuel in a repository. However, the feasibility and acceptability of such action remains to be determined.

Comments from the Arlington, Virginia, Public Hearing August 31, 1999		
No.	*Comments*	*DOE Responses*
802-6	"And as a matter of fact, in its evaluation of the No Action Alternative you refer to the fact that you're going to look at the question of the repository—of direct disposal of unprocessed driver fuel—and yet there's no mention of it other than we're going to do it. There's no discussion. And then that really has to be a key part. Because now we're talking about a very small amount of material [in comparison to overall inventory of the repository]."	The environmental impacts of the direct disposal of driver and blanket sodium-bonded spent nuclear fuel are discussed in Section 4.2 of the EIS. This is the option in which the sodium-bonded spent nuclear fuel would be disposed of in a geologic repository without sodium removal. Before the waste acceptance criteria are finalized, it is difficult to know whether this option is viable. It is possible, depending on how the final criteria are expressed, to demonstrate that, although metallic sodium is reactive and ignitable, its presence does not give the same characteristics to the sodium-bonded spent nuclear fuel and, therefore, untreated driver fuel could meet the criteria. As discussed in Section 2.5 of the EIS, DOE could decide on a hybrid alternative that includes no action for the driver fuel in the Record of Decision.
802-7	"Moving on, so in that regard, you also don't evaluate the option of mechanical sodium removal for the blanket fuel and direct disposal of the driver fuel. That is not one of the options that's considered and I think it should be. Right now—in other words, the No Action— combining the No Action Alternative and the Alternative Two should be another one that's considered."	As discussed in Section 2.5 of the EIS, DOE considered the separate treatment of the driver and blanket spent nuclear fuel in identifying a preferred alternative. DOE will consider this separate treatment in the Record of Decision. The environmental impact analyses in the EIS allow DOE to consider all combinations of technologies, options, and fuel types, including combinations not included among the specific combinations explicitly analyzed in the EIS. As the commentor suggests, "no action" could be considered for the driver spent nuclear fuel, and "high-integrity can packaging" for the blanket spent nuclear fuel.
802-8	"I'd just like to point out a few other inconsistencies, or just one. For instance, the uranium which is recovered from the Electrometallurgical treatment of the fuel. This is not being credited with a— it does not have a value according to the Cost Study, which is reasonable because DOE is not going to be selling any of its uranium for 10 years to support the market price in the context of the U.S.-Russian Agreement." However, you then do not consider it part of the waste stream and, since Anna Aurillo isn't here and she likes to reiterate this issue, it should be, especially if it's not a commodity that has a value. If you can't sell it, then it's a waste, and so the volume associated with that should certainly be added to the table."	The uranium recovered from the electrometallurgical treatment process contains radioactive isotopes that render it unusable as surplus uranium without further processing to remove these impurities. DOE has not yet determined the final disposition of this uranium. For the purpose of the EIS, it is assumed that metal uranium ingots from the electrometallurgical treatment process would be stored in the Materials Building within the Zero Power Physics Reactor at ANL-W. The uranium recovered from the electrometallurgical treatment process has not been treated as a waste because of its potential value if it is further processed. This uranium will be categorized when DOE determines if it will be further processed.

A.2.6 Written Comments and DOE Responses

Comments presented in this section were submitted to DOE via the U.S. mail, e-mail, toll-free number, toll-free fax line, or in person at the public hearings. All comments received during the comment period, which began on July 31, 1999, and ended on September 28, 1999, as well as submittals received after September 28, are reproduced in this section. This section provides a side-by-side display of the written comments received (full-text reproductions) and DOE's responses. Individual comments are numbered in the margins of the comment letters, and DOE responses to each of the numbered comments are provided on the right side of each page.

Commentor No. 1: Ellen Glaccum



Draft EIS Comment Form

Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

I find it mystifying that you have gone to the time & expense to issue a preferred alternative that is "no preferred alternative." I hereby request that you send me copies of the "independent" cost study & the non-proliferation report. I do commend you from pulling back from your former "leader-leader role for Argonne's electrometallurgical scheme. I question the timing of this project. Why not wait to see what the acceptance criteria at the mythical permanent repository will actually be, rather than guessing at this point in time? I am very interested in the fact that air emissions could be 2,162 curies of tritium and 32,250 curies of krypton-85 every year — will there be other radioactive air emissions? What & how much? What will the total air emissions at INEL be with this, the planned incinerator, and all other current & planned ventures? How will the SNF not currently located at INEL be transported to INEL? Will the public be informed abt transportation schedules? I demand the final EIS acknowledge that the "background radiation" has done nothing but escalate since the Trinity testing.

There are several ways to provide comments on the Draft EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel and these include:

- attending public hearings and giving your comments directly to DOE representatives
- returning this comment form to the registration desk at a public hearing or to the address listed below
- calling toll-free and leaving your comments: 1-877-450-6904
- faxing your comments toll-free to: 1-877-621-8288
- commenting via e-mail: emteis@hq.doe.gov

Name (optional): Ellen Glaccum

Organization: Citizen / taxpayer

Home/Organization Address (circle one): Box 1173

City: Ketchum State: ID Zip Code: 83340

Telephone (optional):

COMMENTS MUST BE POSTMARKED BY SEPTEMBER 13, 1999

For more information contact: Susan Leeica, NE-40
U.S. Department of Energy • 19901 Germantown Road • Germantown, MD 20874
Toll-free Telephone: 1-877-450-6904 • Toll-free Fax: 1-877-621-8288
E-mail: emteis@hq.doe.gov • Website: http://www.ne.doe.gov/home/eis.html

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06/28/99

1-1
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Response to Commentor No. 1:

1-1: Council on Environmental Quality regulations (40 CFR 1502.14[e]) do not require a preferred alternative to be included in a draft EIS if one has not been identified at the time of publication. However, the regulations do require that a preferred alternative be identified in a final EIS. DOE initially identified electrometallurgical treatment at ANL-W as the Preferred Alternative in its Notice of Intent (64 FR 8553). However, in response to public comments received during the scoping period, a preferred alternative was not identified in the draft EIS. This was done so that the EIS would better reflect a broader range of potential treatment alternatives. Section 2.8 of this EIS identifies Alternative 1, electrometallurgical treatment, as the Preferred Alternative for the proposed action.

1-2: Copies of the Cost Study and Nonproliferation Impacts Assessment were sent to the commentor. These reports were mailed to all interested parties on August 12, 1999, during the comment period and were also made available at the public hearings on the draft EIS. Although these reports are not critical to the evaluation of the analysis presented in the EIS, they will be considered during the decision-making process in the preparation of the Record of Decision.

1-3: DOE initially identified electrometallurgical treatment at ANL-W as the proposed action in its Notice of Intent (64 FR 8553). However, in response to public comments received during the scoping period, a preferred alternative was not identified in the draft EIS. This was done so that the EIS would better reflect a broader range of potential treatment alternatives.

1-4: Although the waste acceptance criteria have not been finalized, there is substantial guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999, which is referenced in the EIS. Based on this guidance (see Section 4.12.1 of the EIS), it is highly probable that sodium-bonded spent nuclear fuel would not be acceptable in the repository without some stabilization and/or removal of the metallic sodium. Having successfully completed the Electrometallurgical Treatment Research and Demonstration Project (see Section 1.6.3) and in planning the closure of its PUREX processing capabilities, DOE needs to decide whether these processes are suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the EIS could result in a loss of capability and of experienced, knowledgeable technical staff, should DOE decide at a later date to use the electrometallurgical

Commentor No. 1: Ellen Glaccum

Response to Commentor No. 1 (Cont'd):

process to treat sodium-bonded spent nucler fuel. Section 1.2 of the EIS has been revised for clarification.

1-5: The maximum annual radiological gaseous (air) emissions would occur during simultaneous melt and dilute processing of the EBR-II driver and blanket spent nuclear fuel under Alternative 6. This simultaneous operation would occur over two years. The estimated total curies released during treatment of the sodium-bonded spent nuclear fuel at ANL-W under Alternative 6 would be about 4,300 curies of elemental tritium and about 67,000 curies of krypton-85. As indicated in the EIS, the radiological dose impacts from these releases to the general public residing within 80 kilometers (50 miles) of the facility would be well below regulatory limits. These two radionuclides (tritium and krypton-85) would account for greater than 99.9 percent of estimated dose to the population. Appendix E of the EIS lists all potential radionuclides that could be released by the proposed action. As indicated in this appendix, other airborne releases would be orders of magnitude smaller than these two nuclides. After two years, the krypton and tritium releases would be 520 and 70 curies per year, respectively. Overall, the radiological impacts associated with these releases would result in individual maximum doses much smaller than the 10 millirem per year limit set by the EPA for radioactive air emissions under 40 CFR 61.

1-6: As explained in Section 3.2.3.1 of the EIS, total releases of tritium and krypton-85 at INEEL from all operations during 1997 (the most currently available data) resulted in approximately 430 and 3,580 curies, respectively. The planned incinerator at INEEL, which was evaluated under the Advanced Mixed Waste Project Final EIS (DOE/EIS-0290), is expected to produce about 27 curies of tritium and a very small amount of krypton-85 per year. Releases during other, proposed and planned activities for the future are documented in various EISs that are listed in Section 1.6 of this EIS. Maximum impacts from air emissions associated treatment of the sodium-bonded spent nuclear fuel and those of future activities at INEEL are summarized in Section 4.11.1.4 of the EIS. The results clearly indicate that the cumulative impacts (collective doses to the maximally exposed offsite individual and the general public over the duration of the operation) from the expected releases would be well below the regulatory limit.

1-7: Sodium-bonded spent nuclear fuel not currently located at INEEL will be transported to INEEL in accordance with the amended Record of Decision for the DOE Programmatic Spent Nuclear Fuel EIS (61 FR 9441). All information regarding the transport of this spent nuclear fuel will be

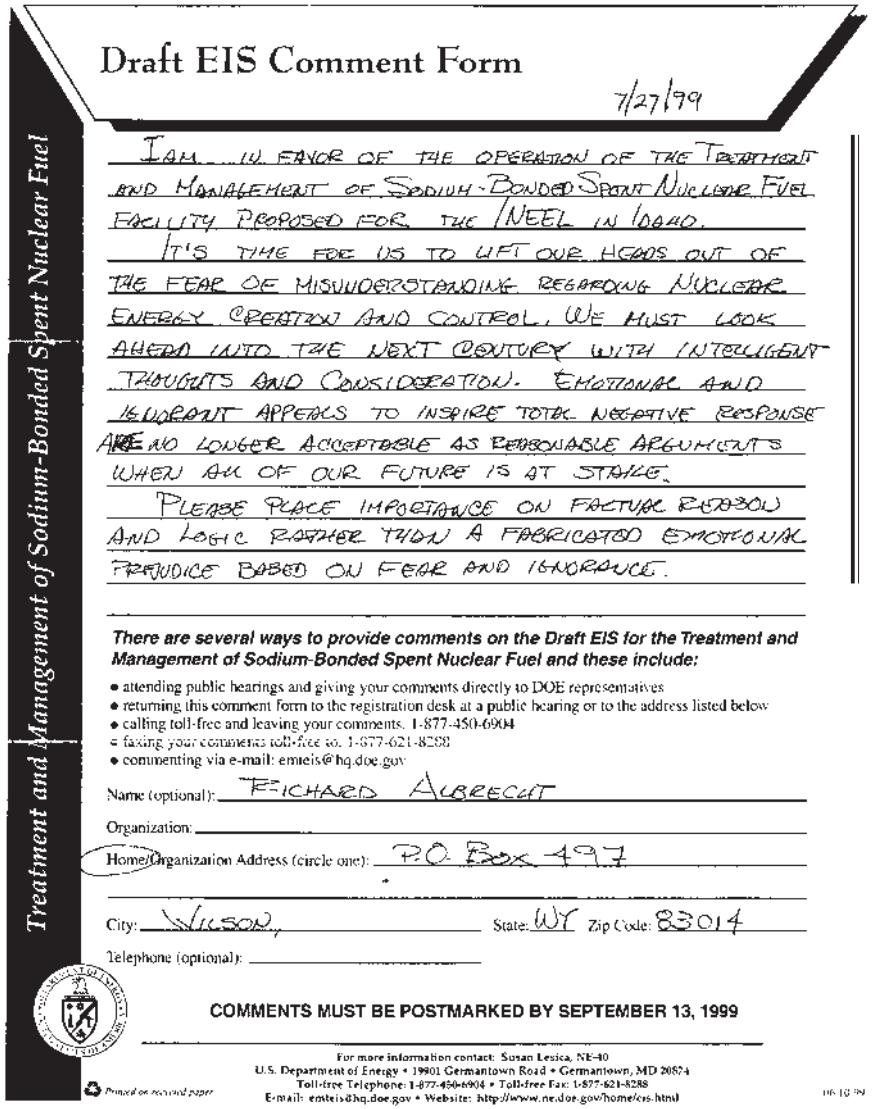
Commentor No. 1: Ellen Glaccum

Response to Commentor No. 1 (Cont'd):

disseminated in accordance with the programmatic EIS and is not considered part of the scope of this SBSNF EIS. This is discussed in Section 4.9 and Appendix G of this EIS. DOE will inform the state and Tribal governments about transportation schedules regarding the spent nuclear fuel addressed in this EIS.

1-8: As indicated in Appendix E, Section E.2.1, an average American would receive about 300 millirem per year from cosmic, terrestrial (Earth's rock formations), and natural (radon gas) radiation sources. The background radiation dose from atmospheric bomb tests (including the Trinity testing) is a fraction of 1 millirem per year.

Commentor No. 2: Richard Albrecht



Draft EIS Comment Form

7/27/99

I AM IN FAVOR OF THE OPERATION OF THE TREATMENT AND MANAGEMENT OF SODIUM-BONDED SPENT NUCLEAR FUEL FACILITY PROPOSED FOR THE INEEL IN IDAHO.

IT'S TIME FOR US TO LIFT OUR HEADS OUT OF THE FEAR OF MISUNDERSTANDING REGARDING NUCLEAR ENERGY CREATION AND CONTROL. WE MUST LOOK AHEAD INTO THE NEXT CENTURY WITH INTELLIGENT THOUGHTS AND CONSIDERATION. EMOTIONAL AND IGNORANT APPEALS TO INSPIRE TOTAL NEGATIVE RESPONSE ARE NO LONGER ACCEPTABLE AS REASONABLE ARGUMENTS WHEN ALL OF OUR FUTURE IS AT STAKE.

PLEASE PLACE IMPORTANCE ON FACTUAL REASON AND LOGIC RATHER THAN A FABRICATED EMOTIONAL PREJUDICE BASED ON FEAR AND IGNORANCE.

2-1

There are several ways to provide comments on the Draft EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel and these include:

- attending public hearings and giving your comments directly to DOE representatives
- returning this comment form to the registration desk at a public hearing or to the address listed below
- calling toll-free and leaving your comments. 1-877-450-6904
- faxing your comments toll-free to. 1-877-621-8288
- commenting via e-mail: emteis@hq.doe.gov

Name (optional): RICHARD ALBRECHT

Organization:

Home/Organization Address (circle one): P.O. Box 497

City: WILSON, State: WY Zip Code: 83014

Telephone (optional):

COMMENTS MUST BE POSTMARKED BY SEPTEMBER 13, 1999

For more information contact: Susan Lesica, NE-40
U.S. Department of Energy • 19901 Germantown Road • Germantown, MD 20874
Toll-free Telephone: 1-877-450-6904 • Toll-free Fax: 1-877-621-8288
E-mail: emteis@hq.doe.gov • Website: http://www.ne.doe.gov/home/eis.html

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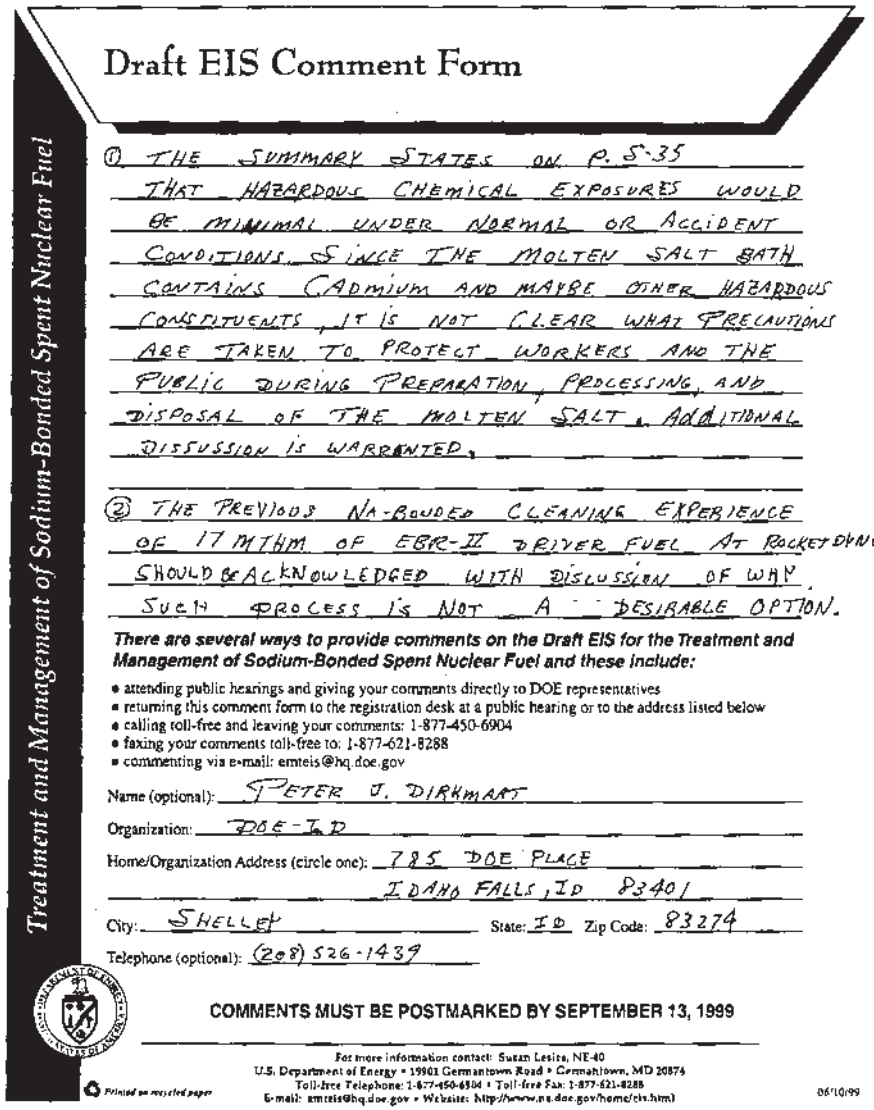
Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

Response to Commentor No. 2:

2-1: The commentor's support for the treatment and management of sodium-bonded spent nuclear fuel at INEEL is noted.

Commentor No. 3: Peter J. Dirkmaat



Draft EIS Comment Form

Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

① THE SUMMARY STATES ON P. S-35 THAT HAZARDOUS CHEMICAL EXPOSURES WOULD BE MINIMAL UNDER NORMAL OR ACCIDENT CONDITIONS. SINCE THE MOLTEN SALT BATH CONTAINS CADMIUM AND MAYBE OTHER HAZARDOUS CONSTITUENTS, IT IS NOT CLEAR WHAT PRECAUTIONS ARE TAKEN TO PROTECT WORKERS AND THE PUBLIC DURING PREPARATION, PROCESSING, AND DISPOSAL OF THE MOLTEN SALT. ADDITIONAL DISSUSSION IS WARRANTED. 3-1

② THE PREVIOUS NA-BONDED CLEANING EXPERIENCE OF 17 MTHM OF EBR-II DRIVER FUEL AT ROCKETDYNE SHOULD BE ACKNOWLEDGED WITH DISCUSSION OF WHY SUCH PROCESS IS NOT A DESIRABLE OPTION. 3-2

There are several ways to provide comments on the Draft EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel and these include:

- attending public hearings and giving your comments directly to DOE representatives
- returning this comment form to the registration desk at a public hearing or to the address listed below
- calling toll-free and leaving your comments: 1-877-450-6904
- faxing your comments toll-free to: 1-877-621-8288
- commenting via e-mail: emteis@hq.doe.gov

Name (optional): PETER J. DIRKMAAT

Organization: DOE-ID

Home/Organization Address (circle one): 785 DOE PLACE

IDAHO FALLS, ID 83401

City: SHELLEY State: ID Zip Code: 83274

Telephone (optional): (208) 526-1439

COMMENTS MUST BE POSTMARKED BY SEPTEMBER 13, 1999

For more information contact: Susan Lesica, NE-40
U.S. Department of Energy • 19901 Germantown Road • Germantown, MD 20874
Toll-free Telephone: 1-877-450-6904 • Toll-free Fax: 1-877-621-8288
E-mail: emteis@hq.doe.gov • Website: http://www.ne.doe.gov/home/eis.html

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06/10/99

Response to Commentor No. 3:

3-1: In one of the electrorefiner designs for the electrometallurgical treatment of sodium-bonded driver spent nuclear fuel contains a layer of cadmium to allow recovery of the uranium that falls off the cathode during treatment. This electrorefiner design provides a cadmium vapor trap that collects, condenses, and returns any cadmium vapor generated during operation. In addition, ANL-W has incorporated cadmium worker safety in its operations through administrative procedures and worker training. Therefore, the workers are considered to be protected from cadmium hazards. The only abnormal condition that could lead to accidental releases of cadmium in the hot cell and the environment is hypothesized in the EIS to occur during a beyond-design-basis earthquake with an estimated frequency of 0.00001 per year. Given such an earthquake, the EIS estimates the consequences of a cadmium release to the noninvolved worker would be orders of magnitude lower than the Emergency Response Planning Guideline-1 (ERPG-1) value, so it would have a minimal impact.

3-2: The sodium cleaning process used at Rocketdyne and the reasons why this process was not explicitly evaluated in the EIS are described in revised Section 2.3.9 and Section C.2 of Appendix C of the EIS.

Commentor No. 4: Susan Pengilly Neitzel

IDAHO STATE HISTORICAL SOCIETY

Our mission: to educate through the identification, preservation, and interpretation of Idaho's cultural heritage.

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Oral History

Memberships and Outreach and Development

Publications

State Archives Manuscripts

July 29, 1999

Ms. Susan Lesica
EIS Document Manager
Office of Nuclear Energy
Science and Technology (NE-40)
19901 Germantown Road
Germantown, Maryland 20874-1290

RE: Treatment and Management of Sodium-Bonded Spent Nuclear Fuel, Argonne National Laboratory-West, Idaho National Engineering and Environmental Laboratory, Idaho

Dear Ms. Lesica:

Thank you for sending the draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel. The project may take place at Argonne National Laboratory-West.

We are concerned about any actions associated with the project that may affect potentially significant buildings and structures located at ANL-West. If interior or exterior alterations to the existing facilities are planned, we will need to receive a report containing the historic context of ANL-West and documentation of the individual facilities. We will also be requesting a final draft of the historic context for DOE-Id facilities at the INEEL for reference in evaluating properties located at ANL-West.

4-1

To prepare the report, we recommend that you contract with a cultural resource professional who meets the Secretary of the Interior's professional qualifications for historian or architectural historian. Robert Stark and the cultural resource staff at Lockheed-Martin will be able to assist you in identifying a professional contractor.

We appreciate your cooperation. If you have any questions, feel free to contact me at 208-334-3827.

Sincerely,

Susan Pengilly Neitzel
Deputy SHPO and
Compliance Coordinator

cc: Robert Stark, DOE-Id

The Idaho State Historical Society is an Equal Opportunity Employer.

Response to Commentor No. 4:

4-1: DOE has examined all reasonable alternatives that involve facilities at ANL-W, and none have been found that would have an adverse affect on the interior or exterior of any facility at the site. The alternatives vary primarily by the type of equipment that would be installed inside the Fuel Conditioning Facility, the Hot Fuel Examination Facility, and other facilities at ANL-W. There are, therefore, no alterations planned that would change the historic value of these buildings. Thus, an ANL-W historic context report is not required for the proposed action described in the EIS.

Commentor No. 5: Pat Clark

SB SNF Toll Free Line

8/5/99

Pat Clark
Snake River Alliance
hm: 208-344-3932
Snake River Alliance: 208-344-9161

I'm a concerned, well I'd like some information on the hearings that are coming up on the draft EIS of the sodium treatment. What I'd like to know is I'd like to ask if we can have a 60 day extension and I'd like to know who to direct this question to. **5-1**

Response to Commentor No. 5:

5-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

Commentor No. 6: Charles Bailey

SB SNF Toll Free Line

8/6/99

Charles Bailey
803-725-4435

I'd like to make a public comment about having the stabilization material process through the SRS F-Canyon with the melt and dilute process in the 105-L area due to the fact that we have the infrastructure in place. We have community and public support. We have Congressional and political support and we can do it cost effective and more importantly we can do it safely, more so than any other site can possibly imagine. This is my feelings on the subject and I just wanted to call and let you people know. Thank you and have a good day. **6-1**

Response to Commentor No. 6:

6-1: The commentor's support for the treatment and management of sodium-bonded spent nuclear fuel at SRS is noted.

Commentor No. 7: Jean Boyles

SB SNF Toll Free Line

8/6/99

Jean Boyles
208-343-0919

I'd like to request a 60 day extension for the comment period. Yeah, we need more information needs to be gathered. **7-1**

Response to Commentor No. 7:

7-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169). With respect to the need for more information, DOE obtained and analyzed the relevant information and made that information available to the public. Background materials were placed in public reading rooms and were made available to the public through a series of hearings held August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho; and August 31, 1999, in Arlington, Virginia. Materials placed in the reading rooms included the electrometallurgical demonstration project environmental assessment, the Finding of No Significant Impact for the environmental assessment, National Research Council interim status reports on the electrometallurgical treatment demonstration project, the 1995 Settlement Agreement and Consent Order with the State of Idaho, the scoping meeting transcripts and comments, and the draft EIS hearing presentations and fact sheets. In addition, completion of the Cost Study and Nonproliferation Impacts Assessment was expedited so that they would be available to the public during the comment period. These reports were mailed to interested parties on August 12, 1999, and were made available to attendees at all of the public hearings on the draft EIS. Although these reports are not critical to the environmental impact analysis presented in the EIS, they will provide input to the Record of Decision. While the final National Research Council report on the demonstration project was published in April 2000, interim status reports were produced throughout the project. Data generated during the demonstration project were used in preparing the EIS, as discussed in Section 1.6.3 of the EIS.

Commentor No. 8: Lowell Jobe

SB SNF Toll Free Line

8/12/99

Lowell Jobe
Coalition 21
14469 N 55th East
Idaho Falls, ID 83401
208-524-7271
fax: 208-524-0998

I received the copies of the documents pertain to the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel DEIS. However, on page S-6 and S-7 they refer to two things that I was interested in and would like to receive either information as to whether it is available or copies of those documents and the two of them deal with the costs as referred to on page S-6 and also the nuclear nonproliferation items. Both of them were supposed to be expedited so they would available about the same time as the main DEIS. However, I believe since I'm working for Coalition 21 on evaluating the document I would like to receive these two which I think are an integral part of the entire problem. **8-1**

Response to Commentor No. 8:

8-1: Copies of the Cost Study and Nonproliferation Impacts Assessment were sent to the commentor. DOE did expedite completion of the Cost Study and the Nonproliferation Impacts Assessment. These reports were mailed to interested parties on August 12, 1999, and were made available to attendees at the public hearings on the SBSNF Draft EIS. These public hearings were held on August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho; and August 31, 1999, in Arlington, Virginia. Although these reports are not critical to the environmental impact analysis presented in the EIS, they will provide input to the Record of Decision.

Commentor No. 9: Laird Irvin

SB SNF Toll Free Line

8/18/99

Laird Irvin
PO Box 2885
Ketchum, ID 83340

I'd like to get a 60 day extension on the comment period so we can further work on this. **9-1**

Response to Commentor No. 9:

9-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

Commentor No. 10: Betina Mattesen

B. Mattesen
434 Lower Notch
Bristol, VT 05443

PM

USA20

Ms Susan Losica
US Dept of Energy, Office of Nuclear
Fac. Management NE 40
19901 Germantown Rd
Germantown, Maryland 20874-1290

I would like to comment on the Draft EIS for the Management of Sodium-Bonded Spent Nuclear Fuel. I am concerned about the wasteful cost and environmental problems of increased nuclear waste. The US has nonproliferation goals and this technology runs counter to that. The comment period must be extended - the EIS omits cost analysis of alternatives, Nat. Academy of Science review + a plan for waste disposal, among other things. A 60 day extension is requested.
Thank you.
Betina Mattesen

10-1
10-2
10-3
10-4
10-5
10-6
10-3

Response to Commentor No. 10:

10-1: Chapter 4 of the EIS presents data that demonstrates that, compared to leaving the sodium-bonded spent nuclear fuel in its current form, treatment and management of the sodium-bonded spent nuclear fuel would significantly reduce the volume of high-level radioactive waste that needs to be disposed of in a geologic repository. Cost is not part of the scope of this EIS. A Cost Study was completed and distributed to interested public members during the public comment period.

10-2: The assessment of nonproliferation impacts is not a part of the EIS process; however, it should be noted that DOE's Office of Arms Control and Nonproliferation assessed the potential nonproliferation impacts that may result from each of the alternatives and technologies analyzed in this EIS. This Nonproliferation Impacts Assessment stated that, for this specific application, all alternatives except PUREX processing at SRS are fully consistent with U.S. policy with respect to reprocessing and nonproliferation.

10-3: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

10-4: The SBSNF EIS was prepared in accordance with NEPA, Council on Environmental Quality regulations on implementing NEPA (40 CFR 1500-1508), and DOE's NEPA implementation procedures (10 CFR 1021). None of these require the inclusion of a cost analysis in an EIS. As discussed in the introduction, the basic objective of this EIS is to provide the public and DOE decision-makers with a description of the reasonable alternatives for treatment and management of DOE's sodium-bonded spent nuclear fuel and their potential environmental impacts. However, DOE has issued a separate Cost Study that analyzes and compares the costs of the alternatives analyzed in the EIS. Cost will be considered during the decision-making process in preparing the Record of Decision.

10-5: The National Academy of Sciences' National Research Council prepared interim status reports on the results of the Electrometallurgical Treatment Research and Demonstration Project that have been reviewed by DOE. The National Research Council completed their evaluation of the electrometallurgical treatment demonstration project in September 1999 and published their final summary report in April 2000. The final report findings will be considered during the decision-making process leading to the Record of Decision.

Commentor No. 10: Betina Mattesen

Response to Commentor No. 10 (Cont'd):

10-6: The EIS identifies and quantifies the volume and type of waste for each alternative. A geologic repository is planned to be completed and licensed to receive spent nuclear fuel and/or high-level radioactive waste. The EIS assumes that high-level radioactive waste and/or spent nuclear fuel from each alternative of this EIS would be sent to this geologic repository. Section 4.1.2 of the EIS discusses the planned disposition of other waste generated by the proposed action.

Commentor No. 11: Susan Mathees

SB SNF Toll Free Line

8/19/99

Susan Mathees
Ketchum, ID
208-726-3471

I am requesting a 60 day extension of the comment period for the pyroprocessing draft EIS hearing schedule. I'll comment later on the rest. But please make note that it's a 60 day extension request for the comment period. Thanks very much. **11-1**

Response to Commentor No. 11:

11-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

Commentor No. 12: Jeep Hardinge

SB SNF Toll Free Line

8/23/99

Jeep Hardinge
Ketchum, ID 83340
208-726-4819

I would like to request an extension on the comment period for the pyroprocessing draft EIS hearing period, comment period. And feel that there will be more information available following the closing of the scheduled comment period of September 13 and would request an extension of the comment period. Thank you. **12-1**

Response to Commentor No. 12:

12-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169). With respect to the need for more information, DOE obtained and analyzed the relevant information and made that information available to the public. Background materials were placed in public reading rooms and were made available to the public through a series of hearings held August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho; and August 31, 1999, in Arlington, Virginia. Materials placed in the reading rooms included the electrometallurgical demonstration project environmental assessment, the Finding of No Significant Impact for the environmental assessment, National Research Council interim status reports on the electrometallurgical treatment demonstration project, the 1995 Settlement Agreement and Consent Order with the State of Idaho, the scoping meeting transcripts and comments, and the draft EIS hearing presentations and fact sheets. In addition, completion of the Cost Study and Nonproliferation Impacts Assessment was expedited so that they would be available to the public during the comment period. These reports were mailed to interested parties on August 12, 1999, and were made available to attendees at all of the public hearings on the draft EIS. Although these reports are not critical to the evaluation of the analysis presented in the draft EIS, they will provide input to the Record of Decision. While the final National Research Council report on the demonstration project was published in April 2000, interim status reports were produced throughout the project. Data generated during the demonstration project were used in preparing the EIS.

Commentor No. 13: Ernest S. Chaput

ECONOMIC DEVELOPMENT PARTNERSHIP
Serving Aiken & Edgefield Counties

Fred E. Humes
Director

Comments for the Record
Treatment and Management of Sodium-Bonded Spent Nuclear Fuel
Draft Environmental Impact Statement

My name is Ernest S. Chaput and I represent the Economic Development Partnership of Aiken and Edgefield Counties, South Carolina. The Savannah River Site is located immediately adjacent to Aiken, South Carolina. The Partnership routinely reviews and provides comment on proposed Department of Energy activities which may be conducted at SRS for consistency with local capabilities and community expectations.

We have three comments regarding the subject draft EIS:

- We support Department efforts to safely manage and prepare spent nuclear fuel for disposal in the National Repository. We believe that the Federal Government has the obligation to expeditiously place these and other waste materials into forms which will provide adequate long-term protection of the public health and environment. These sodium-bonded fuels are no exception. Unless the Department has an unequivocal commitment that these fuels will be accepted in the National Repository without treatment, then **we believe that treatment is mandatory**. **13-1**

- We note that two of the six alternatives included in the draft EIS include the shipment of a portion of these fuels to the Savannah River Site for treatment. Alternative three treats blanket elements in the SRS canyons by the PUREX process. Alternative five treats blanket elements in the proposed SNF Melt and Dilute facility. As policy, we do not support the shipment of waste materials to SRS unless it can be clearly demonstrated that the SRS has a significant capability advantage to perform the task which cannot be reasonable established at the generating site. That is not the case for these sodium-bonded fuels. The draft EIS identifies the electrometallurgical facility which currently exists at Argonne-West, and it appears that this facility can adequately prepare the Sodium-bonded SNF for shipment to the National Repository. Because an adequate treatment capability currently exists at Argonne-West, **we object to the shipment of these wastes to the Savannah River Site.** **13-2**

- If the Department determines that shipment of blanket elements to the Savannah River Site is in the national interest, then **we strongly recommend that only the PUREX treatment option (Alternative three) be considered.** Our reasons are twofold: **13-3**

  The PUREX process is currently operational at SRS, and its waste form has the highest probability of acceptance at the National Repository. The vitrification of canyon high level liquid wastes in the Defense Waste Processing Facility has been

Post Office Box 1708 Aiken, SC 29802 171 University Parkway USCA
(803) 648-3362 FAX (803) 641-3369 edpsc@aol.com http://www.edpsc.org

Response to Commentor No. 13:

13-1: The commentor's support for the treatment and management of sodium-bonded spent nuclear fuel to facilitate its disposal in a repository is noted.

13-2: The commentor's objections to the shipment of spent nuclear fuel to SRS for treatment is noted. The selection of reasonable alternatives evaluated in the EIS was made in accordance with the Council on Environmental Quality Regulations (40 CFR 1500-1508) and DOE's NEPA-related regulations (10 CFR 1021) and procedures. In addition, as discussed in Section 1.3 of the EIS, the selection of reasonable alternatives is responsive to the issues raised during the public scoping period.

13-3: The commentor's preference for the PUREX process over the melt and dilute process at SRS is noted. The environmental impacts of all potential technologies are evaluated in the EIS and these will be considered, along with the assessments in the Nonproliferation Impacts Assessment and the Cost Study, during the decision-making process prior to publication of the Record of Decision. It should be noted that, although vitrified high-level radioactive waste meets current repository waste acceptance criteria, DOE expects that other waste forms would also be acceptable. DOE does not envision a situation in which sodium-bonded spent nuclear fuel would be shipped to SRS without the assurance of its ultimate disposition.

13-4: The commentor's objection to the melt and dilute process at SRS is noted. Although the products of the melt and dilute treatment process and those of the other treatment technologies have not been evaluated using existing waste acceptance criteria, it is expected that these products will be acceptable under the final waste acceptance criteria for the geologic repository when they are available. DOE does not envision a scenario in which blanket sodium-bonded spent nuclear fuel would be shipped to SRS for treatment without the assurance of its ultimate disposition.

13-5: Congress determines how funds are allocated. DOE spends monies consistent with Congressional direction. DOE is not in a position to make the difficult tradeoffs that may be required between alternative Federal programs and spending priorities. The issue of funding for the treatment and management of sodium-bonded spent nuclear fuel is beyond the scope of the SBSNF EIS.

Commentor No. 13: Ernest S. Chaput (Cont'd)

extensively reviewed and meets Repository acceptance criteria. Thus **we are assured that the wastes brought into South Carolina have a path out to final disposition.**

13-3 (Cont'd)

The Melt and Dilute process is currently in the development phase and the proposed waste form has not been extensively reviewed for acceptance in the National Repository. The Melt and Dilute program is currently underfunded and behind schedule. The inclusion of sodium-bonded blanket materials will further complicate process development and facility operation. There is no assurance that the product form from treatment of sodium-bonded fuels by the Melt and Dilute process will be subsequently shipped to the National Repository. Thus we are faced with the possibility that **sodium-bonded fuel could be shipped to South Carolina with no path out to final disposition. This is an unacceptable situation.**

13-4

It is essential that adequate budgetary resources are provided to Savannah River to meet the incremental facility operating and processing costs of treating this fuel. **We object to consideration of any Savannah River Site option without a firm DOE commitment for incremental funding**.

13-5

In summary, we support DOE efforts to prepare the subject fuels for shipment to the National Repository; however we believe that treatment should be performed at Argonne-West if at all possible. If Savannah River capabilities are to be considered for treatment, then only the PUREX process should be considered and only if adequate financial resources are provided.

13-1
13-2
13-3

Thank you for the opportunity to comment on this draft EIS.

Response to Commentor No. 13 :

Commentor No. 14: Don McWhorter

Draft EIS Comment Form

Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

1. The presented waste volumes do not seem technically correct. The PUREX are overstated and electrometallurgical process is understated. — 14-1
2. Why doesn't the EIS consider disposition? The PUREX could dispose of the uranium via the Surplus HEU Disposition as commercial fuel. The electrometallurgical process will require additional processing before disposal. — 14-2, 14-3
3. Sodium is easily removed and should not be considered technically difficult — 14-4
4. The fuel can be chopped prior to the PUREX and the S/S could disposed as low level waste. This option should be included in option 3 — 14-5
5. Better describe what happens to the uranium ingots produced by the electrometallurgical process. — 14-3

There are several ways to provide comments on the Draft EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel and these include:

- attending public hearings and giving your comments directly to DOE representatives
- returning this comment form to the registration desk at a public hearing or to the address listed below
- calling toll-free and leaving your comments: 1-877-450-6904
- faxing your comments toll-free to: 1-877-621-8288
- commenting via e-mail: sodium.fuel.eis@hq.doe.gov

Name (optional): Don McWhorter

Organization:

Home/Organization Address (circle one): 304 Greenwood Drive

City: North Augusta State: SC Zip Code: 29841-2007

Telephone (optional): (803) 278-0017

COMMENTS MUST BE POSTMARKED BY SEPTEMBER 13, 1999

For more information contact: Susan Lesica, NE-40
U.S. Department of Energy • 19901 Germantown Road • Germantown, MD 20874
Toll-free Telephone: 1-877-450-6904 • Toll-free Fax: 1-877-621-8288
E-mail: sodium.fuel.eis@hq.doe.gov • Website: http://www.ne.doe.gov/home/eis.html

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Response to Commentor No. 14:

14-1: The waste volumes given in the EIS are the final solid disposal volumes. The waste volumes generated from the PUREX processing of declad and cleaned blanket spent nuclear fuel, presented in Chapter 4 of the EIS, are consistent with those presented in the SRS Spent Nuclear Fuel Management EIS for processing similar spent nuclear fuel. For example, the SRS Spent Nuclear Fuel Management EIS estimated that the PUREX processing of about 20 metric tons of heavy metal of declad and cleaned blanket spent nuclear fuel would produce a total of 170 cubic meters of liquid high-level radioactive waste. As described for Alternative 3 in this EIS, PUREX would process about 57 metric tons of heavy metal of cleaned and declad blanket spent nuclear fuel. Therefore, it was estimated that PUREX processing would generate about 510 cubic meters (667 cubic yards) of liquid high-level radioactive waste. Section 4.5.6 of the EIS describes waste generation from the PUREX processing of cleaned and declad blanket spent nuclear fuel. Estimates of the ceramic and metallic high-level radioactive waste volumes generated during electrometallurgical treatment were based on the type of fuel, zeolite, glass frit, and process characteristics, all of which are known quantities. The volume of high-level radioactive waste generated by electrometallurgical treatment that were reported in the SBSNF EIS were based on data generated from the completed demonstration project at ANL-W.

14-2: As described in Section 2.6 of the EIS, PUREX processing would not be used to treat the sodium-bonded driver spent nuclear fuel. Treatment of cleaned (sodium removed) and declad blanket spent nuclear fuel at SRS' F-Canyon (via the PUREX process) would not generate highly enriched uranium; it would produce depleted uranium. The electrometallurgical treatment process would separate the highly enriched uranium from the driver spent nuclear fuel and would downblend it to low enriched uranium. A separate NEPA action will address the disposition of uranium.

14-3: As discussed in Appendix C, Section C.1, the products of the electrometallurgical treatment are: uranium metal ingots, metallic waste forms, and ceramic waste forms. The metallic and ceramic waste forms would be considered high-level radioactive waste and would be certified for disposal in a geologic repository in accordance with repository acceptance criteria. Although the acceptance criteria are still not finalized, it is not expected that additional processing would be required for the certification of these waste forms. The uranium metal ingots, containing low enriched uranium (from the treatment of driver fuel) or depleted uranium

Commentor No. 14: Don McWhorter

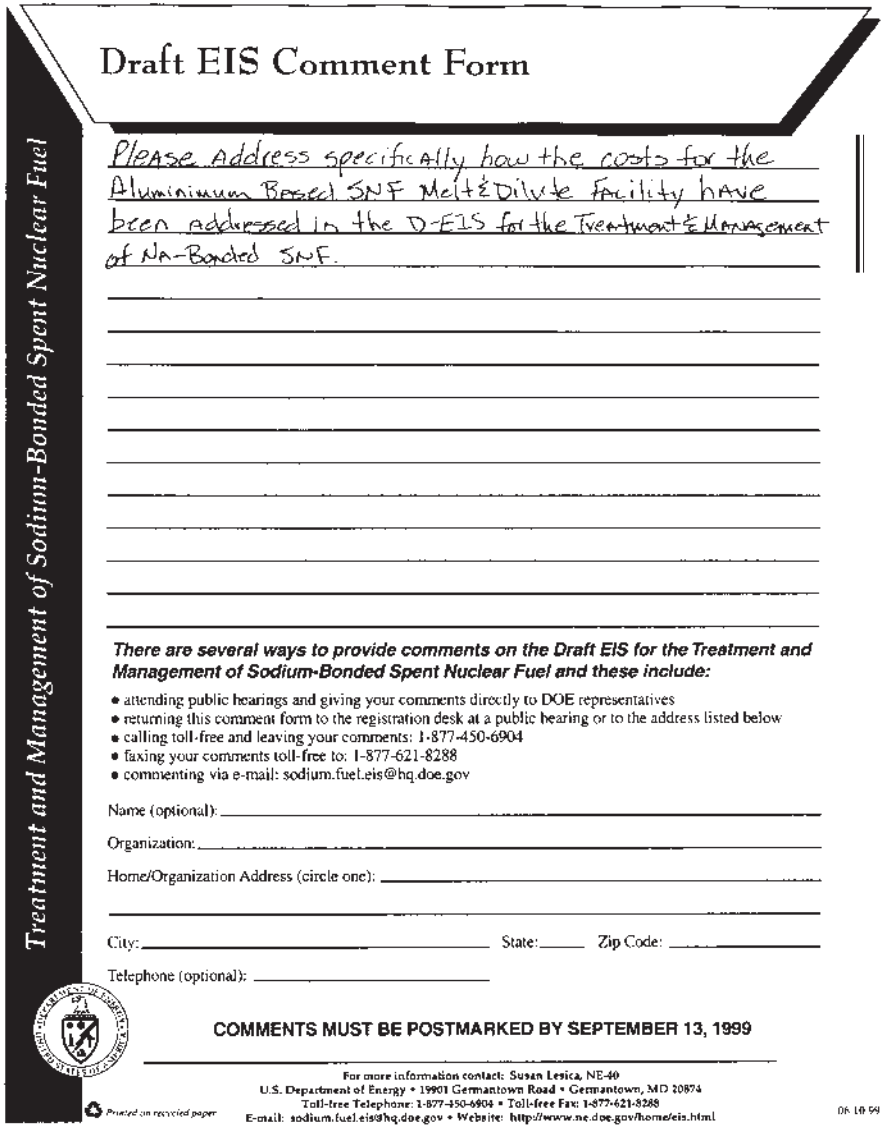
Response to Commentor No. 14 (Cont'd):

(from the treatment of blanket fuel) are not currently considered high-level radioactive waste, and are not destined for disposal in a geologic repository. Their final disposition, further use or disposal, will be determined in a future NEPA review.

14-4: As discussed in Section 2.2 of the EIS, the physical presence of sodium in the driver sodium-bonded spent nuclear fuel is different than that in the blanket spent nuclear fuel. Consequently, the technique and degree of difficulty for its removal depends on the type of the fuel. The EIS describes these techniques in Section 2.3.9.

14-5: As discussed in Section 2.6, the possibility of treating driver or cladded blanket spent nuclear fuel using the SRS PUREX Process was considered and dismissed from further evaluation because of the significant design modifications that would be required at SRS.

Commentor No. 15: Anonymous



Draft EIS Comment Form

Please address specifically how the costs for the Aluminum Based SNF Melt & Dilute facility have been addressed in the D-EIS for the Treatment & Management of Na-Bonded SNF.

15-1

Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

There are several ways to provide comments on the Draft EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel and these include:

- attending public hearings and giving your comments directly to DOE representatives
- returning this comment form to the registration desk at a public hearing or to the address listed below
- calling toll-free and leaving your comments: 1-877-450-6904
- faxing your comments toll-free to: 1-877-621-8288
- commenting via e-mail: sodium.fuel.eis@hq.doe.gov

Name (optional): _____

Organization: _____

Home/Organization Address (circle one): _____

_____

City: _____ State: _____ Zip Code: _____

Telephone (optional): _____

COMMENTS MUST BE POSTMARKED BY SEPTEMBER 13, 1999

For more information contact: Susan Lesica, NE-40
U.S. Department of Energy • 19901 Germantown Road • Germantown, MD 20874
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Response to Commentor No. 15:

15-1: Actual costs for the treatment and management of sodium-bonded spent nuclear fuel are not part of the EIS process. The SBSNF EIS was prepared in accordance with NEPA, Council on Environmental Quality regulations on implementing NEPA (40 CFR 1500-1508), and DOE's NEPA implementation procedures (10 CFR 1021). None of these require the inclusion of a cost analysis in an EIS. As discussed in the introduction, the basic objective of this EIS is to provide the public and DOE decision-makers with a description of the reasonable alternatives for the treatment and management of DOE's sodium-bonded spent nuclear fuel and their potential environmental impacts. However, DOE has issued a separate Cost Study that analyzes and compares the costs of the alternatives analyzed in the EIS. An estimate of the costs associated with treating sodium-bonded spent nuclear fuel using the melt and dilute facility at SRS is provided in Section 2.6 and Appendix B.2 of the Cost Study.

Commentor No. 16: Patricia McCracken

To: Department of Energy

August 12, 1999

From: Patricia McCracken
413 Scotts Way
Augusta, Georgia 30909
706-738-9451
fax 706-738-0637

Re: Draft Environmental Impact Statement for the treatment and management of Sodium-bonded spent Nuclear Fuel

Questions:

How do the alternatives rank in **energy consumption?** **16-1**

How important is **the experience of the workforce** in the selection process? **16-2**

Who has the **patents** on the processes presented? **16-3**

How well equipped are the facilities to handle any **accidents that may relate to this treatment**? What would happen if a **power outage** or **overload** occurred during the electric voltage of the electrometallurgical treatment process? **16-4** **16-5**

What is the agency planning to do with the **filters** used to capture the off-gases of the melt and dilute process? What is the name of the filters to be used and how much do they cost? **16-6** **16-7**

What is the anticipated **treatment of the filters** and how will they be categorized as a waste stream? Page S-10 of the Summary (DOE/EIS-0306D July 1999. **16-6**

What happens to the **salt(electrometallurgical treatment process) that is removed and solidified**? What is the **disposal method**? **What is the level of contamination of the salt that becomes sorbed into the zeolite structure**? How much does the glass powder cost(and who makes it) that is added to the zeolite mixture? Current market prices? **16-8** **16-9**

What is the level of voltage that is required for the application described on page S-13? Does this voltage vary **16-10**

Response to Commentor No. 16:

16-1: The six alternatives analyzed in this EIS use the existing infrastructure at the both INEEL and SRS sites. Section 2.4 of the EIS identifies the facilities within the sites where treatment and management of the sodium-bonded spent nuclear fuel would occur. These facilities currently exist and are operational. The site-wide infrastructure characteristics are given in Sections 3.2.2 and 3.3.2 of the EIS, including annual energy consumption at each site. The energy consumed by the facilities that would be used to treat the sodium-bonded spent nuclear fuel is a small fraction of the total energy used at each site. Furthermore, none of the technologies evaluated appears to demand significantly higher or lower energy to treat the spent nuclear fuel. Section 4.14.3 provides a discussion on the relative energy consumption associated with technologies evaluated in the EIS.

16-2: Work force experience will be one of many factors taken into consideration by DOE when it selects an alternative for the treatment and management of its sodium-bonded spent nuclear fuel. At present both ANL-W and SRS have work forces that have the experience necessary to perform any of the proposed alternatives. The potential loss of experienced personnel at ANL-W was one of the factors considered when it was decided to proceed with the EIS at this time.

16-3: ANL-W did not produce any patents during the demonstration project. However, the scientists and engineers who developed the processes used in the Electrometallurgical Treatment Research and Demonstration Project patented a number of inventions related to the processes and the process equipment. Four patents were issued to cover production of the ceramic waste forms. Four more patents were issued for electrorefiner and electrorefining process inventions related to the demonstration project. All of the patents associated with the treatment processes presented in the EIS are owned by the U.S. Government.

16-4: The management facilities identified for the treatment and management of the sodium-bonded spent nuclear fuel (see Section 2.4 of this EIS) are equipped to handle spent nuclear fuel. Each facility has a well defined, approved Safety Analysis Report that documents the equipment needed to prevent and mitigate a spectrum of accidents with a likelihood of occurrence ranging from anticipated to extremely unlikely.

16-5: A disturbance in electric power supply during electrometallurgical treatment would not cause any damage to the equipment and would not lead to accidental releases of radiation to the atmosphere. The facilities where the

Commentor No. 16: Patricia McCracken (Cont'd)

16-10 (Cont'd)

from the voltage of other uses of the facilities being considered? **What is the price of the energy at each site?** 16-11

How much does zeolite cost? 16-12

Page S-13 states that, "In addition to the ceramic and metal waste forms of high level radioactive waste, some **low-level radioactive waste would be generated." Where will this waste be stored, treated or** disposed? How low is low? 16-13

Can the low-enriched **uranium ingots be blended to be more enriched**? What are the radiological numbers for the ingots? 16-14

Has the **Purex process been modified since 1954** as described in the EIS? 16-15

Does DOE have the technology to address the incompatibility of alloys with the SRS dissolution process as described in the EIS on page S-14? 16-16

Please indicate which one of the comments in the EIS was from SRS? 16-17

Does the Purex process produce materials that could receive some treatment at the MOX facility to be built at SRS? 16-18
Does any other EIS have a process that would also help with this waste? This would be cost savings. 16-19 16-20

The University of Missouri announced some kind of new technology regarding nuclear packaging. **Does this EIS have a process for evaluating various new technologies** that may be under investigation? 16-21

The section S.3.3 on S-14 is confusing as it raises the question of why you should declad and /or do sodium removal when the waste can be packaged for shipment to a repository. The cover sheet states that, "One type of spent nuclear fuel that may not be suitable for disposal in a geologic repository without treatment is the DOE-owned sodium-bonded spent nuclear fuel." **What does "may not" mean?** 16-22

Does the waste stream vary in components from say batch to batch? Has DOE conducted a comprehensive review of all waste? **May not** does not sound like something that would be 16-23 16-24 16-22

2

Response to Commentor No. 16: (Cont'd)

treatment would be performed are equipped with multiple electric feeders and have onsite emergency diesel generators to power the equipment needed to maintain the process in a safe condition.

16-6: The off-gas system in the melt and dilute process would capture various nuclides such as cesium, tellurium, and iodine that have boiling points below or up to 1,400 °C (2,250 °F), and would be vaporized during the heating and melting process. The vaporized nuclides would be condensed and absorbed. In addition, the process would generate small quantities of oxidized actinides (e.g., plutonium, americium) that would also be captured in the filters. Depending on the level of contamination of the filters, they will be disposed of as either low-level or high-level radioactive waste. As indicated in Section 4.7.6 of the EIS, these filters would be periodically cleaned and decontaminated. The decontamination of the filters and the absorbent used to collect the volatile nuclides would produce high-level radioactive waste to be disposed of in a DOE standardized canister. The filters have not yet been designed and built. They are expected to be adsorbent to collect the volatile and gaseous fission products. Absorbents like zeolites may be used to collect cesium. Zeolite costs approximately $10 per pound. A high-efficiency particulate air filter also would be used.

16-7: The filters have not yet been designed and built, although successful tests of filter media have been conducted; therefore, the costs for the filters have not been finalized. The actual costs for the filters that would be used during treatment and management of the sodium-bonded spent nuclear fuel are not part of the EIS scope.

16-8: As described in Section 2.3.1 and Section C.1 of Appendix C of the EIS, the salt removed from the electrorefiner would be solidified, crushed, and milled; mixed with zeolite and heated where the salt is sorbed into zeolite; mixed with glass frit; and converted into a monolithic ceramic waste in a hot isostatic press. The ceramic waste form would be expected to be disposed of as a high-level radioactive waste in a geological repository. The salt would contain almost all of the fission products, including cesium and transuranic elements from the spent nuclear fuel, and would be highly radioactive.

16-9: The glass is manufactured commercially by PEMCO. For orders on the research and development scale, it costs approximately $10 per pound. The actual costs for the glass powder that would be used during the treatment and management of sodium-bonded spent nuclear fuel are not part of the EIS scope.

Commentor No. 16: Patricia McCracken (Cont'd)

stated in a document that has reached this stage of public comment?

Please explain the regulatory reasons for such a statement?

16-22

What did Argonne National Laboratory-West do with the research material? Did they produce any patents?

16-25

The EIS is vague on the subject of the reactive problems of the presence of metallic sodium; "**frequently by metallic uranium, which is stated to be potentially reactive; and in some cases, highly enriched uranium.**" **The examples of** metallic sodium reacting with water to produce hydrogen gas and sodium hydroxide did not give chemical formulars for these properties or volumes as compared to what? The repository problems are vague also. **Your explanations are not reasonable.**

16-26

Where is the explanation or details for stating that there is some "**uncertainty**" surrounding the acceptability of DOE spent nuclear fuel for placement in a potential geologic repository? **Please give all sources that you relied on to make that statement.**

16-27

Where can we locate the **Settlement Agreement and Consent** Order (Idaho 1995) issued on October 17, 1995, in the actions of Public Service Co. of Colorado v. Batt, No. CV 91-0035-S-EJL (D.Id.) and United States v. Batt, No. CV 91-0054-EJL(D.Id). The EIS states that 98% of the the fuel is somehow governed by this settlement and consent order. This information should be part of the EIS. **Is DOE under the consent order or free to consider other comments?** One of the comments in Appendix A states: "Political decisions, such as the Idaho Settlement Agreement (which says that spent nuclear fuel must be out of Idaho by 2035) should not preclude any of the No Action Alternatives from being considered."

16-28

Does any of DOE's global partners have any of this waste and what do they do?

Did any of the comments come from DOE's global partners?

16-29

Why did you issue an EIS without some comparative costs with each process and location?

16-30

3

Response to Commentor No. 16 (Cont'd):

16-10: During electrorefining operations, the voltage between the electrorefiner's electrodes is maintained below 1.3 volts. The electricity for the in-cell equipment comes from 480/208 volt power supplies. The electrorefining operation has been demonstrated over the last three years. The voltages employed at the electrorefiner do not have an effect on other voltage requirements for the facility.

16-11: The price of electricity at different sites is not a discriminating feature between the alternatives. The actual costs for the energy that would be consumed during treatment and management of the sodium-bonded spent nuclear fuel are not part of the EIS scope.

16-12: Zeolite costs approximately $10 per pound.

16-13: As described in the waste management subsections of Chapter 4 of the EIS, each of the processes would generate some volume of low-level radioactive waste at INEEL. This low-level radioactive waste would be packaged in management facilities at INEEL and sent to the Waste Experimental Reduction Facility for volume reduction (e.g., compaction), and then would be disposed of at the Radioactive Waste Management Complex. Low-level radioactive waste is defined in DOE Order 435.1 and in the glossary of the EIS. As explained in Section 3.2.11.4 of the EIS, the level of contamination must be below 10 nanocuries per gram to be disposed of on site. The low-level radioactive waste generated by the electrometallurgical treatment process meets this definition.

16-14: If low-enriched uranium ingots are blended with a more highly enriched uranium metal, then the enrichment of the new ingot will be higher than the original low-enriched uranium ingots, but lower than the material with which it was blended. Conversely, if low-enriched uranium ingots are blended with a lower-enriched uranium metal, then the enrichment of the new ingot will be lower than the original low-enriched uranium ingot. The uranium ingots would contain trace contamination from some fission products and actinide elements, and would generate a radiation field of about 1 to 10 rad per hour at contact, which would require shielding and remote handling. However, DOE plans to blend down the uranium metal derived from the electrometallurgical process.

16-15: The PUREX process described in the EIS is the same as that which is currently in operation at SRS's F-Canyon. PUREX has been used since 1954 and is a well-known process. While the F-Canyon has undergone

Commentor No. 16: Patricia McCracken (Cont'd)

SRS has been chosen for several missions and it would seem that cumulative activity would be important for solving unknown problems that might arise. Are two heads better than one in this science arena? **16-31**

Has this type of material ever undergone some treatment? There is some reference to remaining EBR-II spent nuclear fuel. **16-32**

How many alternatives have been dismissed and how many alternative processes are in a research stage in this science? **16-33**

In the Appendix DOE responses page A-7: **Information on cost will be made available to the public via the Cost Analysis Report, which will be issued during the Draft EIS public** comment period. We requested the package for the hearing in North Augusta on August 17, 1999. We did not receive the Cost Analysis Book in the DOE package. We received a cover letter and three volumes of material including DOE/EIS-0306D summary and volume I and volume II. **16-34**

Please indicate where DOE has this information? We would like to comment at the public meeting in North Augusta. We have called every number in the cover page of the material and left messages.

Who is preparing the comment books and who is responsible for printing the material for the public? **Who is reading the material that is going to the public?** **16-35**

Thank You to be continued….

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Response to Commentor No. 16 (Cont'd):

various safety upgrades through the years, the main process itself has remained essentially unchanged.

16-16: The dissolution technology used to process spent nuclear fuel containing zirconium is well-known. A processing plant operated by Nuclear Fuel Services Inc., known as West Valley, operated from 1972 to 1978. There is also a Fluorinel Dissolution Process Facility at INEEL's INTEC facility that can process spent fuel containing zirconium. However, this facility is permanently shut down. The use of dissolution technology was considered in the list of alternatives, but was dismissed from evaluation in Section 2.6 of the EIS.

16-17: It is not clear whether the commentor is referring to technical support provided by SRS in the preparation of the EIS or public comments received from the SRS region. DOE and contractor personnel from SRS provided technical support in preparing and reviewing the EIS, especially sections that involve SRS facilities and the PUREX and melt and dilute treatment processes. Commentors on the draft EIS are identified in the comment response section of the EIS.

16-18: PUREX processing of declad and cleaned blanket spent fuel at SRS would separate plutonium from the depleted uranium and fission products in the spent fuel. The separated depleted uranium and plutonium would be stored at SRS until decisions are made about their disposition. The decision to use these materials at the mixed oxide (MOX) facility is beyond the scope of this EIS.

16-19: Some of the processes evaluated in this SBSNF EIS are also included in other EISs (e.g., the Savannah River Spent Nuclear Fuel Management EIS addresses conventional processing [PUREX], melt and dilute, and electrometallurgical treatment technologies). All potential processes have been considered for their applicability and feasibility in treating sodium-bonded spent nuclear fuel.

16-20: There is no opportunity for cost savings except for selecting the least costly treatment and management alternative in the Record of Decision. The actual costs for treating and managing sodium-bonded spent nuclear fuel are not part of the EIS process. The costs of treating and managing the sodium-bonded spent nuclear fuel are addressed in a separate Cost Study that was issued by DOE in August 1999.

Commentor No. 16: Patricia McCracken (Cont'd)

To: DOE

From: Patricia McCracken
413 Scotts Way
Augusta, Georgia 30909
706-738-9451

Re: Comments: DOE/EIS-0306D continuation of comments first sent to DOE on August 11, 1999
August 12, 1999

Page C-11 states that, "Sodium-based uranium oxide, uranium carbide, and uranium nitride fuels cannot be treated using the melt and dilute process because of their high melting points. What percentage of the material discussed pertains to these elements? **16-36**

The Volume I page 248 discussion of Environmental Consequences did not discuss issues as other EIS's. For example, other DOE reports discuss **"abrupt releases"** that could be part of the risks. **16-37**

Volume I 4.9.1 discusses an assumption of …"sodium-bonded Fast Flux Test Facility driver spent nuclear fuels and **other miscellaneous fuels assumed to be or brought to Idaho." We hope that** your public meetings include all parties and locations. Exactly what are the miscellaneous fuels? No facility wants to process fuels under the title of miscellaneous. This statement is real **vague in terms of worker safety.** **16-38** **16-39** **16-38**

The July SRS draft report on Paths to Closure states on page 84/Public Worker/Environmental hazards and Risks/ **that, "Some declad fuel or fuel with failed cladding can unacceptably degrade current fuel storage facilities. Long-term risk develops from degradation of aluminum** cladding or loss of cooling water followed by atmospheric dispersion of radioactive material. Activities planned to mitigate the risk associated with the stored fuels include: **16-40**

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Response to Commentor No. 16 (Cont'd):

16-21: It is assumed that the commentor is referring to ongoing research being conducted at the University of Missouri's Graduate Center for Materials Research on iron phosphate glass vitrification. This research is funded by DOE and is being conducted in collaboration with the Westinghouse Savannah River Company and Battelle Pacific Northwest National Laboratories. The purpose of this research is to develop a vitrification material for use in the treatment of nuclear waste. It is also worth noting that the University of Missouri's nuclear engineering program has been conducting research for Rockwell International Corporation on the electrochemical processing of spent nuclear oxide fuel. The purpose of this research is to determine if electrochemical processing of spent nuclear fuel could be conducted more economically than the conventional PUREX wet-chemistry process. While similar in nature to the processes evaluated in the EIS, the research being conducted at the University of Missouri does not directly support the treatment and management of sodium-bonded spent nuclear fuel. DOE evaluates new and ongoing treatment technologies on an ongoing basis. While the work at the University of Missouri has not been specifically identified in the EIS, the EIS does address the potential development of new and less mature technologies under the continued storage option of the No Action Alternative.

16-22: Section S.3.3 of the EIS Summary states that the placement of sodium-bonded spent nuclear fuel without decladding or sodium removal is considered as the direct disposal option under the No Action Alternative. The uncertain acceptability of this No Action Alternative is discussed in Section 4.12.1 of the EIS. The placement of declad and cleaned (sodium removed) blanket sodium-bonded spent nuclear fuel in high-integrity cans is considered under Alternative 2, which is described in the EIS Summary, Section S.5.3. The use of the term "may" in the cover page statement reflects the current status of the geologic repository acceptance criteria. These criteria have not been finalized and do not currently address the acceptability of placing spent nuclear fuel containing a chemically reactive material such as sodium within the repository. Until the final waste acceptance criteria are issued, it is uncertain whether spent nuclear fuel containing chemically reactive sodium would be accepted for emplacement in a geologic repository.

16-23: The waste streams can vary between batches. As part of the electrometallurgical demonstration project, waste form characterization testing has been performed on different batches to bound the performance of the waste forms. In the analyses of this EIS, it was conservatively

Commentor No. 16: Patricia McCracken (Cont'd)

Experimental Breeder Reactor II (EBR II) fuel (16.8MTHM0 to be processed in the canyons.Treatment and Storage Facility **(TSF) will be constructed by 2005 for processing aluminum clad fuel (melt and dilute procedure)**. The processed SNF will be packaged for off site shipment. Final Al-clad SNF disposal forms will be less mobile, more manageable, and much more chemically stable; the security risk will be eliminated. It is currently assumed that transfers to the repository will begin in 2015…Stainless Steel and zircally **clad SNF will be transferred to INEEL.**

16-40 (Cont'd)

How does this information correspond with the EIS for availability of storage space?

Has each proposed site worked out the permits from regulators to approve these plans in Federal Facility Agreements? If not some costs would be part of the budgets.

16-41

16-42

How much money was spent to develop any research to solve some of the unanswered questions of the EIS? WE noticed that the electrometallurgical treatment was an experimental demonstration project. What is the name of the report of this project and what is the contract number for reference?

16-43

16-44

On August 16, 1999, we did receive the Cost Study of Alternatives Presented in the Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded spent Nuclear Fuel and a document called Nonproliferation Impacts Assessment for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel. **We received this information only after great effort.**

16-45

The references of **the cost study do not reflect a complete study of costs related to the alternatives.**

Page S-2 of the **cost summary** really sums up the situation very well. Number three states:

Some of the cost estimates underlying Table S-1 are based upon conceptual designs or a partial understanding of the technical requirements for processing the spent nuclear fuel or qualifying the high-level radioactive waste products. These uncertainties are sufficiently large to make it difficult to differentiate between the cost for Alternatives 1 through 3 and Alternatives 4 and 6.

16-46

6

Response to Commentor No. 16 (Cont'd):

assumed that at the time of an accident the process would contain the maximum amount of fission products within each process.

16-24: DOE has assessed, and continues to assess, the performance of waste forms that are potential candidates for disposal in a geologic repository. Waste forms from electrometallurgical treatment, the melt and dilute process, and the Defense Waste Processing Facility are included as part of that assessment.

16-25: ANL-W did not produce any patents during the demonstration project. However, the scientists and engineers who developed the processes used in the demonstration project patented a number of inventions related to the processes and the process equipment. Four patents were issued to cover production of the ceramic waste forms. Four more patents were issued for electrorefiner and electrorefining process inventions related to the demonstration project. The results of the demonstration project were published in a series of reports for DOE and the National Academy of Sciences.

16-26: The chemically reactive nature of metallic sodium is a known property. The products of such reactions are also well known and described in numerous chemistry references. Metallic uranium can react with chemicals and elements in the environment, but the unique chemically reactive feature of the spent nuclear fuel that is the subject of this EIS is its metallic sodium content. Highly enriched uranium raises a criticality concern, but it is not a unique feature of the sodium-bonded spent nuclear fuel considered in this EIS.

16-27: There is uncertainty with regard to the disposal of sodium-bonded spent nuclear fuel at this time since there are no final waste acceptance criteria for a geologic repository. DOE will be developing a final waste acceptance criteria document. The subject of waste acceptance criteria is discussed in EIS Sections 2.7 and 4.12.1. Due to the chemically reactive nature of the metallic sodium present in sodium-bonded spent nuclear fuel, its acceptability as untreated spent nuclear fuel for direct disposal currently cannot be determined. The most current version of DOE's *Waste Acceptance Systems Requirements Document* indicates that acceptable materials destined for the repository shall contain no more than trace quantities of reactive substance. Because of the chemically reactive nature of metallic sodium, it is not likely that sodium-bonded spent nuclear fuel would be acceptable in the proposed geologic respository.

Commentor No. 16: Patricia McCracken (Cont'd)

DOE did not do a complete study of the costs as evidenced by the references in the document. So how did they conduct their environmental assessments and dose studies on such incomplete information? **16-46 (Cont'd) 16-47**

What is really confusing is the statement on S-3 of the cost report that states: " **Costs for disposal of transuranic waste (which are charged incrementally) and costs for disposal of low-level radioactive waste are insignificant." The volume of wastes produced by each process and its disposal costs would seem to be significant.** **16-48**

If you don't have the technology then how do you begin to determine risks or environmental impacts? For example, the furnace needed for a process. **16-47**

The references for cost do not show that the contractor representative called for furnace information, **specifications, or other needed items for all the processes.** **16-49**

DOE has apparently made some agreement with Idaho that amounts to a record of decision outside the statutory regulations of the EIS. That record of decision should have been part of this EIS as a comment. Please provide all the comments in your public documents. Since this EIS is so uncertain as to risks of this waste, we do not understand any agreement that put any type of treatment or time frame for any actions by the DOE.

The idea that DOE has special environmental agreements with some states outside the regulatory NEPA policies is difficult to comprehend. A national policy of determining the Record of Decision is either in the EIS process or in the legal arena of each state. DOE's legal policies vary from state to state. We would guess without seeing the Idaho agreement that DOE did not conduct a full appeal process, thus denying the public complete representation. **It does not seem legal for an EIS to be submitted to a process that has already been determined. This is fooling the public. Unless you really studied this EIS, you would** not have realized that a record of decision was already determined by a DOE agreement. Considering 98% of the waste is in Idaho, this is an important issue. Furthermore, **16-50 16-51**

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Response to Commentor No. 16 (Cont'd):

16-28: The State of Idaho Settlement Agreement and Consent Order is cited in Section 1.1 of the EIS and has been added as Appendix K in the final EIS.

16-29: DOE's global partners have not used sodium-bonded nuclear fuel and have not commented on or been involved with this EIS.

16-30: The SBSNF EIS was prepared in accordance with NEPA, Council on Environmental Quality regulations on implementing NEPA (40 CFR 1500-1508), and DOE's NEPA implementation procedures (10 CFR 1021). None of these require the inclusion of a cost analysis in an EIS. As discussed in the introduction, the basic objective of this EIS is to provide the public and DOE decision-makers with a description of the reasonable alternatives for the treatment and management of DOE's sodium-bonded spent nuclear fuel and their potential environmental impacts. However, DOE has issued a separate Cost Study that analyzes and compares the costs of the alternatives analyzed in the EIS. Cost will be considered during the decision-making process in preparing the Record of Decision.

16-31: SRS was included in the SBSNF EIS preparation process. Technologies planned for or in use at SRS are part of the EIS alternatives analyzed for the treatment and management of sodium-bonded spent nuclear fuel.

16-32: As stated in the EIS, Section 1.1, some EBR-II driver and blanket sodium-bonded spent nuclear fuel assemblies have undergone electrometallurgical treatment under the research and demonstration project that has been underway at ANL-W since 1996. Also, in the 1980s 17 metric tons of heavy metal of EBR-II blanket sodium-bonded spent nuclear fuel were declad and cleaned with the U.S. Nuclear Regulatory Commission approval at the Rocketdyne facilities in California (see Section 2.3.9 in the EIS). The treated spent nuclear fuel was then shipped to SRS for further processing. It is currently stored at SRS in aluminum cans. This spent nuclear fuel is not part of the sodium-bonded spent nuclear fuel considered in this EIS, but is addressed in the Savannah River Site Spent Nuclear Fuel Management EIS.

16-33: Appendix C of the EIS describes all of the alternative treatment processes considered in the EIS. Appendix C also provides information about the maturity and the relative stage of development for each process. Section 2.6 of the EIS identifies all of the alternative treatment technologies that were considered and dismissed from detailed evaluation and the reasons for their dismissal.

Commentor No. 16: Patricia McCracken (Cont'd)

the waste of this EIS is not being presented for the miscellaneous waste by volume or by any other properties. **16-51 (Cont'd)**

You need to be more specific in the terms of the EIS. For example, your glossary states that certain by-product material as defined by Section 11e(2) of the Atomic Energy Act of 1954, as amended. We would expect the contractor to define the waste in this type of scientific terms. **16-52**

This EIS says that we don't know the technology but we know the risks? Just how can that be so? We haven't explained the miscellaneous waste but we know the risks. How can that be so? **16-53** **16-54**

The EIS can't explain most of the technology and they haven't really investigated all the costs, but they know that all these technologies are going to cost this much. How can that be so? **16-55**

If DOE hasn't determined the waste form acceptance criteria then how do you know cost or risk? If you don't know timing of storage for any stage of the process, then how do you determine costs? **16-56**

S-3 of the cost analysis states.."Table S-3 shows the annual costs for each alternative from 2000 to 20006, which represents the majority of the costs of the program. The time table for this chart may be very different if you consider that one process may not be ready. **Readiness of a process could be important for cost. Maybe a chart of** readiness projected timetables would help prioritize your decisions as the agency has already made decisions without the processes to carry out your legal agreements. **16-55**

We believe that DOE and their contractors need to do more **extensive review of these alternatives as these cost figures and risk numbers might change with more investigation.** **16-57**

The cost estimates and references did not show any consultations with electrical engineering persons regarding the voltage issue and risks. A demonstration project and actual operation might need some modifications not in this cost analysis. **16-58** **16-59**

Volume I of the EIS has some very positive language about environmental impacts. How can DOE say that Chaper 4 **16-60**

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Response to Commentor No. 16 (Cont'd):

16-34: The Cost Study was issued during the public comment period, as indicated in Appendix A of the EIS. This report was mailed to interested parties on August 12, 1999, and was made available to attendees at all of the public hearings on the draft EIS

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16-35: DOE is responsible for preparing this comment response document. DOE's contractors assist DOE in this task. After each comment document (e.g., letter, phone call, e-mail) is received from the public, it is read and all the comments identified within it are categorized according to their content. DOE addresses all policy-related and "out of scope" comments, while its contractors answer comments concerning technical and NEPA-related issues. As the responsible agency, DOE reviews and revises the responses to all comments, as appropriate. The completed comment response document is reviewed and approved by DOE. The Government Printing Office is responsible for printing the EIS, including the comment response document.

16-36: As indicated in Section 2.5.7 of the EIS, there are about 0.1 metric tons of heavy metal (0.2 percent) sodium-bonded spent nuclear driver fuel that is composed of uranium oxide, uranium carbide or uranium/plutonium carbide, and uranium nitride that could not be treated using the melt and dilute process. Section C.5 of Appendix C has been revised to reflect the amount of fuel that could not be treated using the melt and dilute process.

16-37: "Abrupt releases" are caused by accidents, the effects of which are analyzed in the EIS. As stated in Section 4.1 of the EIS, the evaluation of human health effects from facility accidents are presented in Appendix F. This appendix explains the methodology used to estimate the human health effects and provides descriptions of various accident scenarios, as well as the associated consequences and risks for each of the alternatives and/or management sites considered.

16-38: Fast Flux Test Facility spent nuclear fuel and other miscellaneous fuel is described in Section 2.2.3 and Appendix D, Section D.5 of the EIS. The discussion of miscellaneous fuel in Section 4.9 has been expanded to reference Appendix D for additional information.

16-39: Public hearings on the SBSNF Draft EIS were held in Idaho Falls, Idaho (August 26, 1999); Boise, Idaho (August 24, 1999); North Augusta, South Carolina (August 17, 1999); and Arlington Virginia (August 31, 1999). These were the same locations in which the public scoping meetings were held earlier in the year. In an effort to ensure that all interested parties were

Commentor No. 16: Patricia McCracken (Cont'd)

provides a "detailed discussion" of the impacts on the potentially affected environmental areas when they don't even know the technology of the furnace or other environmental equipment needed for a process? **16-60 (Cont'd)**

The Environmental Justice issue has not been discussed fully because the EIS does not have the complete pre-decisional report from the DOE legal group working with Idaho. For all we know the material may be deteriating rapidly and need to be moved immediately, or it may be stable until 2035. How did DOE establish the dates in the EIS for action? **16-61** **16-62**

"For the alternatives evaluated, DOE has determined that the proposed action would have minimal or no impacts on the remaining environmental areas (e.g., land resources, visual resources, noise, geology, and soils, ecological resources, and cultural and paleontological resources) at the proposed sites. This is because the proposed facilities already exist so, except for internal building modifications and new equipment installation, no construction activities would be required." **Since the technology is vague, and some of these alternatives indicate construction, how do you say no construction activities? What electrical equipment might be needed?** **16-63**

All of the alternatives did not get a funded demonstration process. **The direct plasma Arc-Vitreous Ceramic process did not have a complete demonstration for filtration and treatment projections.** **16-64**

The computer models and language used in this assessment is not reasonable and nobody can understand what all those terms not in the glossary mean. The EIS states that the "GENII computer model is well documented for assumptions". If the EIS has not clarified the technology then how was the computer programmed to make assumptions on unknowns? How did you calculate dose? How did they figure dose on these demonstration alternatives and on an alternative with no demonstration? **16-65** **16-66**

How did the computer figure finite plume air submersion options, dispersion calculations, and preliminary energy-dependent finite plume dose factors on modified equipment like furnaces with no specifications in the EIS? **16-67**

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Response to Commentor No. 16 (Cont'd):

aware of the public hearings, a Notice of Availability of the draft EIS was published in the Federal Register (64 FR 41404) on July 30, 1999. In addition, the public hearings were advertised in local newspapers and 1,800 post cards were sent to individuals and other interested parties.

16-40: Section 4.12.2 addresses the programmatic schedule considerations associated with alternatives involving SRS and is consistent with the current schedule of SRS activities regarding the treatment of aluminum-clad spent nuclear fuel. This EIS uses consistent assumptions regarding the use and availability of treatment and storage facilities at SRS.

16-41: Federal Facility Agreements are Agreements negotiated between DOE and EPA and/or the appropriate state regulator. These Agreements establish schedules for particular actions (i.e., compliance or cleanup activities), define responsibilities among the parties, and establish a framework for cooperation between parties. These Agreements do not contain provisions for permits. It will be noted that all facilities proposed for the treatment and management of sodium-bonded spent nuclear fuel either have or would acquire the necessary operating permits. Since there will be no substantial increase in waste generated from the treatment of sodium-bonded spent nuclear fuel, no modification to existing permits at storage and disposal facilities is necessary.

16-42: Actual costs for treating and managing the sodium-bonded spent nuclear fuel are not part of the scope of the EIS. The costs associated with obtaining any permits from regulatory agencies outside of DOE were included in the engineering cost estimate assigned to each alternative in the separate Cost Study issued in August 1999.

16-43: Figures on the total cost for the EIS (including the cost of research to address unanswered questions on the EIS) will be available after the EIS is completed and the Record of Decision is published.

16-44: The citation for the environmental assessment on the Electrometallurgical Treatment Research and Demonstration Project is provided below.

Department of Energy, 1996, "Environmental Assessment, Electrometallurgical Treatment Research and Demonstration Project in the Fuel Conditioning Facility at Argonne National Laboratory-West," DOE/EA-1148, Office of Nuclear Energy, Science and Technology, Washington, DC, May 15.

16-45: As stated in Appendix A (Table A-3), DOE committed to provide the public with a Cost Study and a Nonproliferation Impacts Assessment during the

Commentor No. 16: Patricia McCracken (Cont'd)

One alternative needed some "new environmental equipment" just to transport. How was that factored in the computer? How did they figure contamination of filters with no scientific numbers for contamination and no disposal methods? Those conversion models could not have been accurate for radiation dose or anything else. The computer discussion did not give a list of radiation or non-radiation parameters for the reader to know what was programmed for dose.

16-68

E.3.2 Data and General Assumptions…

"To perform the dose assessments for this EIS, different types of data were collected and generated."

This section is all assumptions with no real specifications or specific data. The data cannot be generic as reported.

The statement that worker doses associated with the processing alternatives were determined from historical data associated with similar operations is not appropriate for unknown technology. **The (WSRC 1999) group may have the historical data for the Purex operation but we question the numbers for a modified system. This program is** oversimplified and not site specific enough for worker protection. Some of the sentences don't make sense. What does…"Thus, the only processes considered are those that are credible for the conditions under which the physical system being modeled operates." **The complete specifications for these systems have not been designed so what is this language! " Although the radionuclide** composition of source terms are reasonable estimates, there are uncertainties in the radionuclide inventory and release reactions that affect estimated impacts." These are not reasonable estimates because the data relied too much on estimation. We acknowledge that more data may exist than has been presented in the EIS. The references may just have been omitted.

16-69

We believe your estimated impacts should include more data based on specifications and design numbers.

There was no discussion of the various sites ability to aid **workers or contain accidents (buffer zones) with each alternative. Some of these technologies may be more prone to "abrupt releases" than others.**

16-70

10

Response to Commentor No. 16 (Cont'd):

draft EIS public comment period. The Cost Study and the Nonproliferation Impacts Assessment were mailed to interested parties on August 12, 1999, and were made available to attendees at all of the public hearings on the EIS.

16-46: During the decision-making process prior to publishing a Record of Decision, Federal agencies typically do not have detailed design information for proposed actions and alternatives. In fact, Council on Environmental Quality and DOE NEPA regulations discourage proceeding to detailed design before the NEPA process is completed and a Record of Decision is published. Cost estimates for the six alternatives and the No Action Alternative, direct disposal option, are presented in the August 1999 Cost Study and are based largely on conceptual or preliminary design information. However, cost estimates for alternatives utilizing existing spent nuclear fuel treatment facilities and/or processes (e.g., Alternative 1, electrometallurgical treatment at ANL-W and Alternative 3, PUREX at SRS) are more certain than the estimates for alternatives based on less mature technologies. Investing resources to complete detailed designs for each alternative during the NEPA review process would not be cost-effective. DOE believes the Cost Study provides the public with a reasonable comprehensive estimate of the cost of each alternative.

16-47: The EIS was prepared in accordance with Council on Environmental Quality regulations (40 CFR 1500-1508) and DOE's NEPA-related regulations (10 CFR 1021) and procedures. Environmental assessment of a new technology or a modified/enhanced version of an existing technology can be done without a complete and detailed design. In the case of a new technology, a conceptual design was used. The environmental impact analyses consider potential releases that could occur during both normal operations and accident conditions. The estimated releases were based on facility safety analysis reports. For a modified design, the environmental impacts were based on the analysis of the original design and the impacts associated with the modification were added. Both of these evaluations would be performed prior to installation and operation of the equipment. Uncertainties associated with the equipment and operation of a specific technology were captured in the evaluation by making conservative assumptions in the hazard analysis. No technology would go into service until all the requirements of the Federal and state codes and regulations were met.

16-48: The costs of disposing of the transuranic waste and the low-level radioactive waste are only insignificant within the context of the Cost Study. Relative

Commentor No. 16: Patricia McCracken (Cont'd)

The human health evaluation places great emphasis on dose resulting from a release and its chemical form. Yet, this **EIS does not give complete chemical forms for all the alternatives and discusses miscellaneous waste.** 16-71

The use of historical doses is unclear. What time period was used for the computer models on Purex? **Estimates based on similar operations would seem difficult if no other such operations existed.** 16-72

How did you do population doses for air emissions for the melt and dilute with no equipment or filter specifications? 16-73

Some of the basic assumptions like **"Ground Surfaces were assumed to have no previous deposition of radionuclides." How did the computer programmer determine that conclusion?** 16-74

How could you determine **water releases** when the process **would be modified from previous operations?** 16-75

The summary book page S-31 discusses the public and occupational health and safety. "The only risk to the health and safety of the workers and the public under either option of the No Action Alternative would be from **the potential exposure to radiological or hazardous chemical emissions during normal operation or accident conditions."**

The **risks for accidents and hazardous chemical emissions in the EIS appeared to be incomplete for the sources quoted** as references E.6. We didn't even see electrical injuries listed. There was no list to determine the extent of the discussion on all potential health effects by specific chemical and site specific. The volume and changes in liquid effluent discharges would be required for state regulators and facility agreements. Facility agreements were not listed in the references. Legal agreements were not listed in the references. The EPIcode model was not site-specific and the loading of estimates and release rates on unknown parameters may not reflect a complete picture. This model is very exacting in information and not well suited to this EIS. It did not calculate all type of exposures. 16-76

What is the complete list of chemicals that react to sodium to cause adverse impacts? What would be the release 16-77

11

Response to Commentor No. 16 (Cont'd):

to the overall cost of the project, these costs contribute less than 1 percent and are insignificant in terms of discriminating between the cost of one alternative versus another.

16-49: Actual costs for treating and managing sodium-bonded spent nuclear fuel are not part of the EIS process. However, the estimates presented in the Cost Study for installing and operating furnaces were based on information from existing furnaces.

16-50: The DOE agreement with Idaho specifies that all spent nuclear fuel will be removed from Idaho by 2035. It does not specify any treatment or management alternatives for sodium-bonded spent nuclear fuel, which is approximately 2 percent of DOE's total DOE spent nuclear fuel inventory. The scope of this EIS is to evaluate and present the environmental impacts of different alternatives, as well as no action, for the treatment of one specific type of spent nuclear fuel in Idaho.

16-51: The term "miscellaneous waste" is not used in this EIS. The commentor may be referring to miscellaneous fuel, which is defined in Section 2.2.3 and Appendix D, Section D.5, of the EIS.

16-52: The definition provided in the glossary for the low-level radioactive waste is based on, and essentially equivalent to, the definition used in the Nuclear Waste Policy Act of 1982, as amended, and given in DOE Order 435.1. As stated in its accompanying manual, "[L]ow-level radioactive waste is defined by what it is not. The definition provides the framework for this concept by listing the basic radioactive waste types that are not low-level waste, thereby limiting the waste that is to be managed as low-level waste."

16-53: The EIS clearly explains the alternative technologies considered for the treatment of sodium-bonded spent nuclear fuel. Discussions of these technologies are provided in Section 2.3 and Appendix C of the EIS. Information regarding the technologies considered in the EIS is sufficient for the purposes of the EIS analysis. As explained in the response to comment 16-47, uncertainties related to equipment and technology are captured in the evaluation of impacts. These uncertainties do not prohibit and/or invalidate the evaluation of environmental impacts and the identification of the potential risks associated with each alternative.

16-54: DOE assumes the comment to be referring to "miscellaneous fuel" and not "miscellaneous waste," as stated. In response to miscellaneous fuel, the EIS has clearly identified the elements of this fuel category in

Commentor No. 16: Patricia McCracken (Cont'd)

rates for each of the substances released? **For example, the EIS mentions wet storage rupture for SRS.**

16-77 (Cont'd)

DOE may need to update its dialogue with proposed sites as persons referenced in the EIS may no longer be in that program. Also DOE contractor persons apparently have changed jobs.

16-78

Thank you for the opportunity to comment.

Response to Commentor No. 16 (Cont'd):

Section 2.2.3 and Appendix D.5, as explained in the response to comment 16-38. This fuel category was considered to be driver spent fuel type, and its risks were evaluated in the EIS.

16-55: The Cost Study was based on an extrapolation of historical costs for comparable operations. The cost for waste form qualification is consistent with other experiences and assumptions within the DOE complex. Uncertainties in the maturity of the technologies are accounted for by the contingency factors used in the Cost Study, with less mature technologies requiring a higher contingency factor. The Cost Study incorporates schedule considerations for each alternative. Estimating the actual costs for treating and managing sodium-bonded spent nuclear fuel is not part of the scope of the EIS.

16-56: As stated in the introduction to the EIS, the programmatic risk in implementing any of the potential alternatives for the treatment and management of sodium-bonded spent nuclear fuel, or of not treating this fuel, is the uncertainty surrounding the acceptability of DOE spent nuclear fuel for placement in a potential geologic repository. Although not final, the latest guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999 (see Section 4.12.1 of the EIS), indicates that it is highly probable that sodium-bonded spent nuclear fuel would not be acceptable in the repository without some stabilization and/or removal of the metallic sodium. The stabilization of the spent nuclear fuel and/or removal of the metallic sodium will provide greater protection of human health and the environment.

16-57: During the decision-making process prior to publishing a Record of Decision, Federal agencies typically do not have detailed design information for proposed actions and alternatives. In fact, Council on Environmental Quality and DOE NEPA regulations discourage proceeding to detailed design before the NEPA process is completed and a Record of Decision is published. Cost estimates for the six alternatives and the No Action Alternative, direct disposal option, are presented in the August 1999 Cost Study and are based largely on conceptual or preliminary design information. However, cost estimates for alternatives utilizing existing spent nuclear fuel treatment facilities and/or processes (e.g., Alternative 1, electrometallurgical treatment at ANL-W and Alternative 3, PUREX at SRS) are more certain than the estimates for alternatives based on less mature technologies. Investing resources to complete detailed designs for each alternative during the NEPA review process would not be cost-effective. DOE believes the Cost Study

provides the public with a reasonable comprehensive estimate of the cost of each alternative.

16-58: A number of electrical engineers and industrial safety engineers were involved in the design, installation, and qualification of the equipment used during the electrometallurgical demonstration project. The costs associated with the demonstration project were used as the basis for estimating the cost of electrometallurgical treatment in the Cost Study. The risks from electrometallurgical treatment related to voltage are small (see response to comment 16-11).

16-59: Such modifications are anticipated. They are taken into account in the Cost Study through contingency factors.

16-60: The uncertainties associated with the development and testing of a new furnace for the melt and dilute treatment process would require a demonstration project that would delay process readiness and implementation. Any technical uncertainties would be resolved before the start of operation. The environmental impacts associated with operation of the furnace, which is an electric induction furnace, for the melt and dilute process were estimated consistent with the methodology described in response to comment 16-47 above.

16-61: It is not clear what predecisional report the commentor is citing. DOE is committed to full compliance with all provisions of Executive Order 12898. The environmental justice analysis was prepared in compliance with the Council on Environmental Quality's guidelines for inclusion of environmental justice under NEPA. The EIS addresses the issue of whether implementation of the proposed action or alternatives would result in disproportionately high and adverse environmental effects on minority populations or low-income populations. The Council's guidance further states that an environmental effect must be significant to qualify as disproportionately high and adverse. The term "significant" is discussed in the Council's implementation regulations (see 40 CFR 1508.27 and Appendix H, Section H.2 of this EIS). As discussed in Chapter 4 of the EIS, implementation of the alternatives for the treatment and management of sodium-bonded spent nuclear fuel would pose no significant radiological or nonradiological health risks to the public. The maximum estimated incremental dose to an average individual from the treatment and management of sodium-bonded spent nuclear fuel would be approximately 0.05 percent of natural background radiation. These risks would not be significant

Commentor No. 16: Patricia McCracken

Response to Commentor No. 16 (Cont'd):

regardless of the racial, ethnic, and economic composition of the potentially affected populations.

16-62: In accordance with DOE's Programmatic Spent Nuclear Fuel EIS, the No Action Alternative for this EIS assumes that each sodium-bonded spent nuclear fuel assembly is examined for integrity (i.e., stabilization activities) before it is placed in storage. Dates in the EIS are based on the availability of facilities and treatment time for each alternative and technology.

16-63: Section 4.1 of the EIS further explains why impacts to land resources, visual resources, noise, geology, soils, ecological resources, and cultural and paleontological resources will not occur. It should be noted that, although some of the technologies are less well developed than others, enough is known about them to indicate that only internal equipment modifications are needed. Current electrical equipment is expected to be adequate to meet project demands.

16-64: Each potential sodium-bonded spent nuclear fuel treatment technology was evaluated based on current knowledge and experience with that technology. The direct plasma arc-vitreous ceramic process was considered in the EIS and, as discussed in Section 2.6 of the EIS, was dismissed for further evaluation. Not all of the technologies analyzed have had a complete demonstration project.

16-65: The SBSNF EIS was prepared in accordance with Council on Environmental Quality regulations (40 CFR 1500-1508) and DOE's NEPA-related regulations (10 CFR 1021) and procedures. The computer codes used in the preparation of this EIS are well documented for assumptions, technical approach, methodology, and quality assurance issues. These codes have been subjected to extensive quality assurance and quality control, including a comparison of the results from the model computations with those from hand calculations and the performance of internal and external peer reviews.

16-66: The GENII computer program that was used to estimate the human health effects from releases of radioactive material during normal operation and accidental conditions is a well-known program, and its applicability has been demonstrated in various DOE EISs. The program models the dispersion of releases and calculates potential doses to the public and individuals residing in the vicinity of the facility. All required input to this program is well defined and the process is well understood. The evaluation is independent of the technology and equipment used. The only input from each process to this program is the quantity of radioactive material released

during normal and accident conditions. As explained in the response to comment 16-47, the releases were estimated based on facility safety analysis reports.

16-67: Atmospheric dispersion of radioactive material releases vary depending on the type and duration of the release. The selection of a dispersion model is an input to the GENII computer program. The dispersion models used in the program are well defined and are explained in the program manual. These models are independent of the technologies used.

16-68: The expression "new environmental equipment" is not used in the EIS and new environmental equipment is not related to the use of a computer program. Contamination in the off-gas system filters originates from the process. Each process is well defined. For example, because of the high temperature used in the melt and dilute process, some radionuclide elements with boiling temperatures below the process temperature would evaporate. Some elements would be oxidized and released to the off-gas system. The gaseous flow through the off-gas system first would be condensed and adsorbed, and then filtered before entering the atmosphere. All noble gases would pass through the filters, but only a small fraction of particulates would pass through filters. The specific assumptions on various filtration factors are given in Appendix E and Appendix F. These appendices also provide the source terms associated with each of the releases considered.

16-69: Appendix E, Section E.3.2, of the EIS provides the data and general assumptions for both generic and site-specific data. Clarifications have been added to each data category to differentiate between the generic and site-specific data. For example, meteorological, population, and source terms data are all site-specific, whereas annual exposure time to plume and ground contaminations are generic data. The estimated worker dose under each alternative is given in Section E.4 of Appendix E. EIS preparers used a standard approach for estimating average and total worker doses that is based on doses received during similar activities within each management facility. The text describing the analysis of uncertainties has been revised for clarification and is applicable to the spent nuclear fuel processed under this EIS.

16-70: Facility and site emergency procedures for accident conditions are included in the operational procedure manual and are documented in the facility Safety Analysis Report. The facility Safety Analysis Report identifies and analyzes the various accident scenarios that could occur during operation and determines their consequences to the public. The operation

Commentor No. 16: Patricia McCracken

Response to Commentor No. 16 (Cont'd):

of a new technology would start only after the facility has met all required regulations, including those that protect the worker and general public. Appendix F of the EIS evaluates a spectrum of accidents that could occur during the treatment process, and also estimates the human health effects associated with each of the accidental radiological and chemical material releases.

16-71: The severity of internal exposure from radiation sources entering the human body through either inhalation or ingestion depends on the chemical form (solubility) of the radioactive material. The analysis in this EIS assumes the worst case solubility scenario, which results in the maximum dose. This is an input parameter to the GENII code. The use of the worst case solubility scenario was added to the list of basic assumptions in Section E.3.2 of Appendix E.

16-72: ANL-W worker doses were estimated based on historical data associated with similar activities. No computer modeling was used to estimate such doses. Similar activities are not necessarily identical activities. For example, electrometallurgical treatment activities include fuel handling activities (i.e, retrieving, dismantling, assembling, transporting) that were performed at ANL-W during experimental breeder reactor operation. Almost all of these activities would occur in a hot cell with remote operation (robotic) tools. Historical dose data on these activities can be used to estimate the worker dose. The average SRS worker dose used to evaluate environmental impacts is routinely assumed to be 500 millirem per year. This dose value is conservative and has been published in numerous EISs. As indicated in Section E.4.3 of Appendix E of this EIS, this average SRS worker dose estimate was used in the SRS Spent Nuclear Fuel Management EIS to estimate the impact of activities similar to those described in this SBSNF EIS.

16-73: It is standard practice to install one or more banks of high-efficiency particulate air filters, known as high efficiency particulate air filters, in the off-gas system. Filter specifications would not be needed to evaluate environmental impacts. Each bank of high efficiency particulate air filters would absorb at least 99.9 percent of the particulates. The use of two banks of filters would reduce the particulate release to the atmosphere by a factor of 1 million from that generated in the process. Only gaseous fission products such as krypton, iodine, and tritium would pass through high efficiency particulate air filters without being absorbed. The iodine gases would be absorbed in charcoal filters installed after the high efficiency particulate air

filters. At least 99 percent of iodine would be absorbed in a bed of charcoal filters. The off-gas system exhaust would enter the facility exhaust system and would pass through another bank of high efficiency particulate air filters. Therefore, a very small fraction (one in a billion) of particulates generated in the melt and dilute process would be released to the environment.

16-74: The analysis in this EIS determined the incremental heath effects associated with the implementation of each alternative. Previously contaminated ground is part of the baseline dose, which is independent of the health effects associated with operation of any one of the treatment processes. Baseline doses to the public at each of the management sites are given in Chapter 3 of the EIS.

16-75: A modification to a process would identify potential changes to a liquid or gaseous effluent. Therefore, for the purposes of environmental impact evaluation, it is known whether a modification would lead to liquid effluent releases.

16-76: For each alternative, the EIS summarizes the risks from releases of hazardous chemicals during both normal operation and accident conditions. Discussions of risk in Chapter 4 are cross-referenced to Appendices E and/or F for further details. For example, under Alternative 1, Section 4.3.4.2 provides the consequences of accidents involving hazardous chemicals in Table 4-17, with a reference to Section F.3.1.2 of Appendix F for details. The chemicals involved in these accidents were uranium and cadmium. Appendix E, Section E.6, lists the references used in that appendix. As indicated, the Savannah River Spent Fuel Management EIS was the source for information about chemical releases during normal operation at SRS. Electrical injuries are considered industrial accidents and are not expected to be affected by any of the alternatives evaluated in this EIS. For example, electrical equipment used in the electrometallurgical treatment process, which has been in operation for over three years, is located in a hot cell (remotely operated); no electrical injuries are expected to result from the remote operation of this equipment. Every operation under the proposed action would be carried out under procedural and operational controls. With regard to permits and regulatory/facility agreements, Chapter 3 of the EIS provides the baseline conditions at each site and lists the applicable standards and/or regulations in each of the resources described. Since there would be no new construction as a result of the proposed action, no regulation and/or standard would be affected. As explained in various sections of Chapter 4 of the EIS, the volume and changes in the effluent discharges would be

Commentor No. 16: Patricia McCracken

Response to Commentor No. 16 (Cont'd):

within the applicable permits and standards. With regards to analysis using the EPIcode™, the only input that was not site- and accident-specific was meteorology. The code does not have the capability to use site meteorology data and is limited to a specific condition (e.g., stability and wind speed). The calculations in this EIS and the applicability of the EPIcode™ and its characteristics are based on a conservative meteorological condition. The applicability of the EPIcode™ and its characteristics are described in Appendix F, Section F.3.1.1. The methodology used to estimate accidental releases of hazardous chemicals also is discussed in Appendix F. In addition, see the responses to comments 16-47, 16-61, and 16-37.

16-77: Openly available chemical references provide details on the nature of chemical reactions with sodium. The release rates for each substance are not relevant to this EIS because the fact that metallic sodium reacts with air and water to produce hydrogen is sufficient to characterize the sodium as chemically reactive and potentially unstable in a geologic repository environment. Current storage conditions for sodium-bonded spent nuclear fuel are monitored. Some sodium-bonded spent nuclear fuel is currently in wet storage at INEEL, not SRS. Some wet storage container leakage has been inferred by the presence of bubbles on the containers, but no dangerous conditions have been found. This EIS does not mention wet storage rupture at SRS.

16-78: DOE Headquarters staff has maintained a dialogue with the site personnel working on the EIS throughout the preparation of the document to ensure that all information is as accurate and up-to-date as possible. Chapter 7 of the EIS accurately reflects the personnel who worked on this EIS.

Commentor No. 17: Steve Hopkins

Notes from Steve Hopkins
8/24/99 - Boise, Idaho

Pyroprocessing raises significant proliferation risks. A National Academy of Sciences (NAS) report commissioned by DOE explained that the process "could be redirected to produce material with nuclear detonation capability." The report also raised questions about interim storage of the waste streams and other aspects of pyroprocessing.

…with some modifications, plutonium could be produced…" James Warf

"Probably the greatest hazard arises from spreading sophisticated technologies around the world, technologies which make reprocessing spent fuel easier and possible in facilities small enough to conceal underground." **17-1**

In 1994, DOE secretary Hazel O'Leary asked Congress to stop funding the IFR. "Because it is based on plutonium reprocessing and recycle, continued development of the Integral Fast Reactor would undercut our efforts to discourage other countries from plutonium reprocessing and recycle."

A DOE source quoted in an industry trade journal (Inside Energy) said that at Argonne-West, pyroprocessing is "just about the only thing they have left to do…It's a jobs issue." Nucleonics Week, June 8, 1995. **17-2**

A 1996 NAS study: "could be used by another country to obtain plutonium for a weapons program."

Another NAS study:
"Although the developers of the electra...technique argue that the technology is proliferation resistant, any SNF processing approach that is capable of separating fissionable materials from associated fission products and transuranic elements could be redirected to produce material with nuclear detonation capability…Demonstration of the process could, however, add to the risk that a nation intent on weapons production might consider adapting this technology for possible production of fissile material, although such material would be of poor quality for a weapon. **17-1**

Response to Commentor No. 17:

17-1: Assessment of nonproliferation impacts is not a part of the scope of the EIS. However, DOE's Office of Arms Control and Nonproliferation assessed the potential nonproliferation impacts that may result from each of the alternatives and technologies analyzed in this EIS. This Nonproliferation Impacts Assessment stated that, for this specific application, electrometallurgical treatment is acceptable in terms of nonproliferation risk.

17-2: ANL-W is involved in other DOE missions in addition to electrometallurgical treatment. Ongoing activities unrelated to electrometallurgical treatment at ANL-W include long-term waste storage gas generation testing at the Zero Physics Power Reactor; characterization and repackaging of mixed hazardous waste for shipment to the Waste Isolation Pilot Project at the Hot Fuel Examination Facility; conversion of sodium coolant from the EBR-II and Fermi reactors to chemically inert low-level radioactive waste in the sodium process facility; and deactivation of the EBR-II facility. The number of jobs affected by the electrometallurgical treatment alternative at ANL-W is presented in Section 4.2.3 of the EIS.

Commentor No. 18: Anonymous

Draft EIS Comment Form

Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

I SUPPORT THE PLAN AS OUTLINED. THIS SHOULD BE DONE AT ANL-W Electrometallurgical Treatment plan

18-1

There are several ways to provide comments on the Draft EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel and these include:

- attending public hearings and giving your comments directly to DOE representatives
- returning this comment form to the registration desk at a public hearing or to the address listed below
- calling toll-free and leaving your comments: 1-877-450-6904
- faxing your comments toll-free to: 1-877-621-8288
- commenting via e-mail: sodium.fuel.eis@hq.doe.gov

Name (optional): _____

Organization: _____

Home/Organization Address (circle one): _____

City: _____ State: ____ Zip Code: _____

Telephone (optional): _____

COMMENTS MUST BE POSTMARKED BY SEPTEMBER 13, 1999

For more information contact: Susan Lesica, NE-40
U.S. Department of Energy • 19901 Germantown Road • Germantown, MD 20874
Toll-free Telephone: 1-877-450-6904 • Toll-free Fax: 1-877-621-8288
E-mail: sodium.fuel.eis@hq.doe.gov • Website: http://www.ne.doe.gov/home/eis.html

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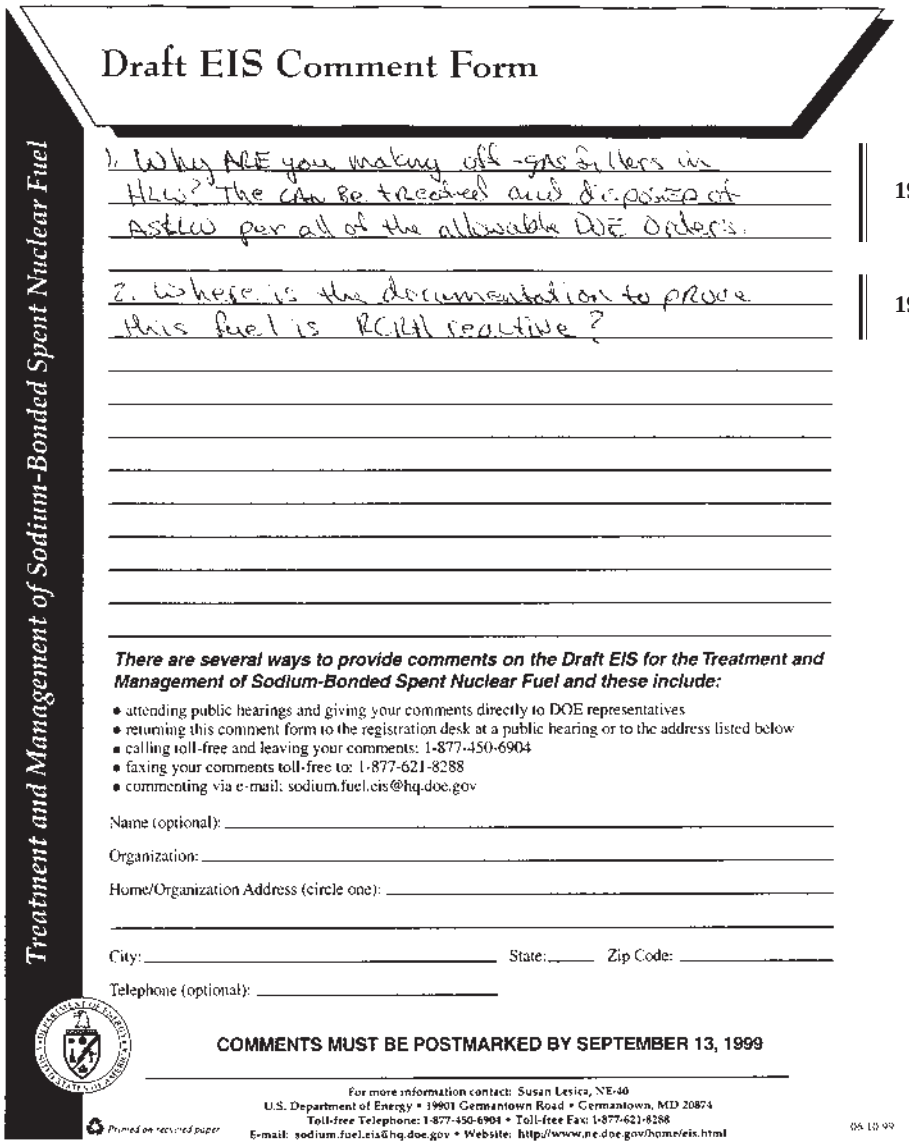
06-10-99

Response to Commentor No. 18:

18-1: The commentor's support for the electrometallurgical treatment of sodium-bonded spent nuclear fuel at ANL-W is noted.

Commentor No. 19: Anonymous



Draft EIS Comment Form

Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

1. Why ARE you making off-gas filters in HLW? The can be treated and disposed of as LLW per all of the allowable DOE Orders.

19-1

2. Where is the documentation to prove this fuel is RCRA reactive?

19-2

There are several ways to provide comments on the Draft EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel and these include:

- attending public hearings and giving your comments directly to DOE representatives
- returning this comment form to the registration desk at a public hearing or to the address listed below
- calling toll-free and leaving your comments: 1-877-450-6904
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- commenting via e-mail: sodium.fuel.eis@hq.doe.gov

Name (optional): _____

Organization: _____

Home/Organization Address (circle one): _____

City: _____ State: ____ Zip Code: _____

Telephone (optional): _____

COMMENTS MUST BE POSTMARKED BY SEPTEMBER 13, 1999

For more information contact: Susan Lesica, NE-40
U.S. Department of Energy • 19901 Germantown Road • Germantown, MD 20874
Toll-free Telephone: 1-877-450-6904 • Toll-free Fax: 1-877-621-8288
E-mail: sodium.fuel.eis@hq.doe.gov • Website: http://www.ne.doe.gov/home/eis.html

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Response to Commentor No. 19:

19-1: The off-gas system in the melt and dilute process would capture various nuclides such as cesium, tellurium, and iodine that have boiling points below up to 1,400 °C (2,250 °F) and would be vaporized during the heating and melting process. The vaporized nuclides would be condensed and absorbed. In addition, the process would generate small quantities of oxidized actinides (e.g., plutonium, americium) that also would be captured in the filters. Depending on the level of contamination of the filters, they will be disposed of as either low-level or high-level radioactive waste. As indicated in Section 4.7.6 of the EIS, these filters would be periodically cleaned and decontaminated. The decontamination of the filters and the absorbent used to collect the volatile nuclides would produce high-level radioactive waste to be disposed of in a DOE standardized canister.

19-2: Metallic sodium reacts vigorously with water or moist air to produce heat, potentially explosive hydrogen gas, and sodium hydroxide, a corrosive substance. One of the primary goals of RCRA is to ensure that waste is managed in an environmentally sound manner. As discussed in Section 4.12.1 of the EIS, untreated sodium-bonded spent nuclear fuel may be regulated by RCRA, since it exhibits certain characteristics considered hazardous; that is, it is ignitable as defined in 40 CFR 261.21, corrosive as defined in 40 CFR 261.22, and reactive as defined in 40 CFR 261.23. However, this determination has not been made. Thus, the presence of metallic sodium could complicate qualification of this spent nuclear fuel for ultimate disposal in a geologic repository.

Commentor No. 20: Beth Duke

Forward Header

Subject: Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel
Author: beth@sunvalleymag.com at_INTERNET
Date: 8/23/99 11:34 AM

August 22, 1999

As a citizen of the United States, and a resident of Idaho, I would like to make the following comments on the Draft Environmental Impact Statement for the Treatment and Management of Sodium Bonded-Spent Nuclear Fuel.

First, I would ask that you extend the public comment period at least 60 days, since much information that is relevant to the procedure will not be available until after the current comment period is closed. For the public to be able to accurately access this draft EIS, and to make accurate comments, this is the very least the Department of Energy should do. **20-1** **20-2**

Secondly, I would like to go on record as objecting to pyroprocessing by the INEEL for the following reasons: **20-3**

1. The entire concept runs counter to the US nonproliferation goals since it separates out bomb-grade uranium from spent fuel and the technology can be modified to separate out bomb-grade plutonium. **20-4**

2. Take taxpayer dollars away from greater environmental problems at the INEEL. **20-5**

3. Creates new forms of nuclear waste. **20-6**

4. Wastes taxpayer dollars (as emphasized on NBC's "Bleeding of America). **20-5**

Thank you,

Beth M. Duke
PO Box 964
Sun Valley, Idaho 83353
788-0770 (work)

Response to Commentor No. 20:

20-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

20-2: DOE made materials supporting preparation of the EIS available in the public reading rooms and at the public hearings held on August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho; and August 31, 1999, in Arlington, Virginia. These materials included the environmental assessment for the Electrometallurgical Treatment Research and Demonstration Project, the Finding of No Significant Impact for the environmental assessment, National Research Council reports, the 1995 Settlement Agreement and Consent Order with the State of Idaho, scoping period meeting transcripts and comments, and the draft EIS hearing presentations and fact sheets. In addition, completion of the Cost Study and Nonproliferation Impacts Assessment was expedited so that they also would be available to the public during the comment period. These reports were mailed to interested parties on August 12, 1999, and were available at the public hearings on the draft EIS. Although these reports are not critical to the environmental impact analysis presented in the EIS, they will be considered during the decision-making process in the preparation of the Record of Decision. While the final National Research Council report on the Electrometallurgical Treatment Research and Demonstration Project at ANL-W was published April 2000, interim status reports were produced throughout the project. Data generated during the demonstration project were used in preparing the EIS, as discussed in Section 1.6.3 of the EIS.

20-3: The commentor's objection to electrometallurgical treatment (pyroprocessing) of sodium-bonded spent nuclear fuel at INEEL is noted.

20-4: The assessment of nonproliferation impacts is not a part of the EIS process. The Nonproliferation Impacts Assessment stated that electrometallurgical treatment, for this specific application, would not result in an increase in weapons-usable fissile material inventories. Although highly enriched uranium would be an interim product of electrometallurgical treatment, it would be downblended to low-enriched uranium during treatment. Within the current equipment configuration and design, it is not possible to produce weapons-usable plutonium by adjusting operating parameters. Traditional aqueous processing would have to be used after electrometallurgical treatment. However, traditional aqueous processing could also be used to produce weapons-usable plutonium directly from the spent nuclear fuel, without electrometallurgical treatment.

Commentor No. 20: Beth Duke

Response to Commentor No. 20 (Cont'd):

20-5: Congress determines how funds are allocated. DOE spends monies consistent with Congressional direction. DOE is not in a position to make the difficult tradeoffs that may be required between alternative Federal programs and spending priorities. The issue of funding for the treatment and management of sodium-bonded spent nuclear fuel is beyond the scope of the SBSNF EIS.

20-6: All of the alternatives evaluated in this EIS would produce some forms of high-level radioactive waste. Electrometallurgical treatment (or pyroprocessing) would produce two new waste forms, both of which are more stable than untreated sodium-bonded spent nuclear fuel. DOE expects that these waste forms would be suitable for disposal in a geologic repository.

Commentor No. 21: Bpdufur@micron.net

Forward Header

Subject: Draft Environmental Impact Statement of the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel
Author: bpdufur@micron.net_At_INTERNET
Date: 8/25/99 9:33 PM

I am commenting on the Draft Environmental Impact Statement of the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel.

Please extend the comment period for the above subject. The study done by the National Academy of Sciences of the proposed treatment needs to be honestly reviewed. **21-1** **21-2**

Response to Commentor No. 21:

21-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

21-2: The National Academy of Sciences' National Research Council prepared interim status reports on the results of the Electrometallurgical Treatment Research and Demonstration Project that have been reviewed by DOE. The National Research Council completed their evaluation of the electrometallurgical treatment demonstration project in September 1999 and published their final summary report in April 2000. The final report findings will be considered during the decision-making process leading to the Record of Decision.

Commentor No. 22: Doug Turner

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_____Forward Header_____
Subject:    Fwd:Comments on Draft EIS for Na Bonded SNF
Author:     <EMTEIS@hq.doe.gov>
Date:       9/16/99 8:32 AM


_____Forward Header_____
Subject:    Comments on Draft EIS for Na Bonded SNF
Author:     dwz@ornl.gov at INTERNET
Date:       9/15/99 11:47 AM

Comments on the Draft Environmental Impact Statement for the
Treatment and Management of Sodium-Bonded Spent Nuclear Fuel
Section S.2 of the EIS describes the types of sodium bonded fuel
in the DOE inventory in terms of five distinct categories:  EBR-II
Driver, EBR-II Blanket, Fermi-1 Blanket, Fast Flux Test Facility
Driver, and Miscellaneous.  The Miscellaneous category includes
small lots of sodium bonded SNF at various sites (Hanford, Oak
Ridge, Savanah River, and Sandia) which are to be shipped to INEEL
per the record of decision on the PEIS for SNF.   However, section
S.5 of the EIS describes the six evaluated alternatives (which are
combinations of No Action, Electrometallurgical Treatment at ANL-W,
PUREX at SRS, and Melt & Dilute at SRS or ANL-W) solely in terms of
application for either blanket fuel or driver fuel categories.

There is no mention of the Miscellaneous category in the evaluated
alternatives.  If this EIS is intended to address the disposition
of the Miscellaneous sodium bonded SNF category, the relationship
between the Miscellaneous category and the driver and blanket fuel
disposition alternatives should be explicitly stated.


If there are any questions about these comments, please contact
either me or Brian Oakley at 423-241-3061.

Doug Turner
Bechtel Jacobs Company LLC
7078F, MS 6402
ph 423-576-2017; fax 423-241-5049
pager 873-5378; dwz@ornl.gov
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22-1

Response to Commentor No. 22:

22-1: The miscellaneous sodium-bonded spent nuclear fuel is described in Appendix D, Section D.5. For the purposes of this EIS, all miscellaneous sodium-bonded spent nuclear fuel is considered to be driver fuel. Section 2.2.3 of the EIS has been revised to provide this clarification.

Commentor No. 23: Matt Smith

From: msmith@computer-depot.com_at_INTERNET at X400PO
Date: 8/22/99 11:12AM -0700
To: EMTEIS at NE-02
Cc: SSmith7235@aol.com_at_INTERNET at X400PO
Subject: Pyroprossing

I am writing you in regard to the proposed Pyroprocessing program At INEEL.

There must be a 60 day extension of the comment period in order to adequately address all the concerns. **23-1**

It appears the DOE is missing **23-2**

1. The demonstration project results on pyroprocessing. **23-3**
2. A National Academy of Sciences review of the project. **23-4**
3. Cost analysis of the various alternatives. **23-5**
4. A nuclear weapons proliferation assessment by the Department of Energy. **23-6**
5. Yucca Mountain, the purported destination of the waste, has not done a detailed environmental impact study on accepting the waste. The history to date indicates that neither Yucca Mountain or WIPP will accept this type of waste.

Once again Idaho with a volatile record of earth quakes in this area and an acquifer that is world renown will be forced to hold indefinitely this dangerous material along with our breath in the hopes that the predictions of future eruptions will not occur. This is highly unacceptable with no more assurances and concrete Evidence that we have at the present time that we are not at risk. **23-7**

Yours truly,

Matt Smith

Response to Commentor No. 23:

23-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

23-2: The Electrometallurgical Treatment Research and Demonstration Project began in June 1996 and, although the test results have not yet been finalized in a single report, a number of status reports issued by the National Academy of Sciences' National Research Council Committee were considered in the preparation of the draft EIS. The success criteria established at the outset of the project were fulfilled. The environmental impact analysis associated with the electrometallurgical treatment process alternatives was based on actual data from the project. Section 1.6.3 of the EIS summarizes the status and the results of the demonstration project.

23-3: The National Academy of Sciences' National Research Council prepared interim status reports on the results of the Electrometallurgical Treatment Research and Demonstration Project that have been reviewed by DOE. The National Research Council completed their evaluation of the electrometallurgical treatment demonstration project in September 1999 and published their final summary report in April 2000. The final report findings will be considered during the decision-making process leading to the Record of Decision.

23-4: The SBSNF EIS was prepared in accordance with NEPA, Council on Environmental Quality regulations on implementing NEPA (40 CFR 1500-1508), and DOE's NEPA implementation procedures (10 CFR 1021). None of these require the inclusion of a cost analysis in an EIS. As discussed in the introduction, the basic objective of this EIS is to provide the public and DOE decision-makers with a description of the reasonable alternatives for the treatment and management of DOE's sodium-bonded spent nuclear fuel and their potential environmental impacts. However, DOE issued a separate Cost Study on August 12, 1999, that analyzes and compares the costs of the alternatives analyzed in the EIS. Cost will be considered during the decision-making process in preparing the Record of Decision.

23-5: Although the assessment of nonproliferation impacts is not a part of the EIS process, DOE's Nonproliferation Impacts Assessment was mailed out to interested members of the public on August 12, 1999, and is available by request. The assessment was also placed in the DOE public reading rooms and distributed at the public hearings held during the public comment period on the draft EIS. Information from the assessment, along with other factors such as costs, schedules, environmental consequences, and technical

risk will be considered during the decision-making process leading to the Record of Decision.

23-6: This SBSNF EIS does not specify a site for an ultimate geologic repository. Only preliminary waste acceptance criteria currently exist. Conclusions regarding the acceptability of the different waste forms for each alternative are addressed in the EIS. As discussed in Section 1.6.2.2 of this EIS, the Yucca Mountain Draft EIS has been issued by DOE. The draft waste acceptance criteria for Yucca Mountain currently only address defense waste processing facility high-level waste logs and commercial spent nuclear fuel as acceptable. DOE expects that the waste products described for all the alternatives analyzed in detail in the SBSNF EIS will be acceptable in the final waste acceptance criteria for Yucca Mountain.

23-7: As a result of its agreement with the State of Idaho, DOE is developing a treatment process to facilitate the disposal of the sodium-bonded spent nuclear fuel. Under this agreement, all spent nuclear fuel will be moved out of Idaho by the year 2035. The alternatives analyzed in this EIS treat the sodium-bonded nuclear fuel and create waste forms that would most likely be acceptable for disposition in a geologic repository. As described in Chapter 4 of this EIS, under all alternatives no radiological liquid effluent would be discharged to the groundwater or the aquifer at the INEEL site. Evaluations of the radiological impacts associated with an earthquake have shown the risk of latent cancer fatalities to a member of the public residing within 80 kilometers (50 miles) of the site to be much lower than 1. Therefore, as a result of the proposed action, no measurable increase in the number of latent cancer fatalities in the surrounding population is expected for a postulated earthquake in the INEEL area.

Commentor No. 24: Monte Wilson

TO: Susan Lesica, USDOE
FROM: Monte D. Wilson, 1055 Dobyns Lane, Potlatch, ID 83855
DATE: August 29, 1999
RE: Comments on the Draft EIS for Treatment and Management of Sodium-Bonded SNF

Inasmuch as the draft EIS places primary emphasis on Electrometallurgical technology, I request that the comment period be extended until: **24-1**

a) the electrometallurgical treatment demonstration project has been completed and thoroughly evaluated, and b)the National Academy of Sciences completes its review of the electrometallurgical treatment process. **24-2** **24-3**

I recommend that the two separation technologies under consideration (EMT and PUREX) be rejected because they would be in conflict with US nonproliferation goals and because they would produce multiple, and new waste forms. **24-4** **24-5**

I recommend that a non-separation technology be used for Treatment of all sodium-bonded spent nuclear fuel.

I recommend that the High Integrity Cans be used for disposal of The blanket fuel.

I recommend that further development work be done to determine if it is feasible to remove sodium from the driver fuel and then dispose of the driver fuel in High Integrity Cans. If the process is feasible, I recommend that it be utilized for disposal of all driver fuel. **24-6**

If the sodium removal and disposal in High Integrity Cans is Ultimately shown to be not feasible for the driver fuel, then I recommend that it be prepared for disposal by some other non-separation technology such as the Glass Material Oxidation and Dissolution System (GMODS) or the Direct Plasma Arc-Vitreous Ceramic Treatment process. **24-7**

Response to Commentor No. 24 :

24-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

24-2: The draft EIS did not emphasize the electrometallurgical treatment technology over the other process technologies. The Electrometallurgical Treatment Research and Demonstration Project began in June 1996 and, although the test results have not been finalized in a single report, a number of status reports issued by the National Academy of Sciences' National Research Council Committee were considered in the preparation of the draft EIS. The success criteria established at the outset of the project were fulfilled. The environmental impact analysis associated with the electrometallurgical process alternatives was based on actual data from the project. Section 1.6.3 of the EIS summarizes the status and the results of the project.

24-3: The National Academy of Sciences' National Research Council prepared interim status reports on the results of the Electrometallurgical Treatment Research and Demonstration Project that have been reviewed by DOE. The National Research Council completed their evaluation of the electrometallurgical treatment demonstration project in September 1999 and published their final summary report in April 2000. The final report findings will be considered during the decision-making process leading to the Record of Decision.

24-4: The commentor's opposition to electrometallurgical treatment and PUREX is noted. DOE is concerned with the nonproliferation impacts of all its proposed actions, although the assessment of nonproliferation impacts is not a part of the EIS process. For this reason a separate Nonproliferation Impacts Assessment was prepared by DOE's Office of Arms Control and Nonproliferation. This assessment stated that, for this specific application, all alternatives except PUREX processing at SRS are fully consistent with U.S. policy concerning reprocessing and nonproliferation. Information from this assessment, along with factors such as costs, schedules, environmental consequences, and technical risk will factor into the Record of Decision for the treatment and management of sodium-bonded spent nuclear fuel.

24-5: The high-level radioactive waste form resulting from PUREX process is borosilicate glass, which has already been extensively tested and analyzed under conditions relevant to a geologic repository. The ceramic and metallic waste forms generated during the electrometallurgical treatment process represent chemically stable materials compared to untreated sodium-bonded

Commentor No. 24: Monte Wilson

Response to Commentor No. 24 (Cont'd):

spent nuclear fuel. The production of a chemically stable waste form to replace a chemically reactive waste form (i.e., sodium-bonded spent nuclear fuel) represents an improvement in the safe, long-term storage of this spent nuclear fuel. DOE expects the new waste forms resulting from the electrometallurgical treatment process will be suitable for disposal in a repository and will meet the requirements of the final waste acceptance criteria.

24-6: The commentor's recommendation of a nonseparation technology is noted. Also noted is the commentor's recommendation for packaging cleaned blanket sodium-bonded spent nuclear fuel in high-integrity cans. At the present time the complete removal of metallic sodium from driver sodium-bonded spent nuclear fuel is not feasible. However, the commentor's recommendation for further development leading to the removal of sodium from driver spent nuclear fuel is noted.

24-7: The commentor's preference for a nonseparation technology to treat sodium-bonded spent nuclear fuel is noted. In addition to the GMODS and direct plasma arc-vitreous ceramic treatment processes, which are considered and dismissed from evaluation in this EIS as less mature technologies, the melt and dilute treatment process is another nonseparation technology. The melt and dilute treatment process is analyzed in this EIS and is being considered for treating driver and blanket fuel at ANL-W and blanket fuel at SRS.

Commentor No. 25: Nancy Fenn

Date: 8/30/99 2:03 PM
Priority: Normal
Subject: Fwd(2):STOP THE MADNESS!

I am commenting on the Draft Environmental Impact Statement for
The Treatment and Management of Sodium-Bonded Spent Nuclear Fuel.

Please stop nuclear weapons work in Idaho! The proposed project at **25-1**
the INEEL creates new forms of waste, creates nuclear bomb **25-2**
ingredients which runs counter to US nonproliferation goals, and **25-3**
takes valuable money away from greater environmental problems at **25-4**
INEEL. Not to mention that it is a waste of taxpayer dollars.

Please grant an extension of the comment period of at least 60 **25-5**
days. This extension should be granted because the DOE is missing
the following:
a) the demonstration project results on pyroprocessing **25-6**
b) National Academy of Sciences review of the proposed treatment **25-7**
c) cost analysis of the various alternatives **25-8**
d) nuclear weapons proliferation assessment by the Department of **25-9**
Energy
e) Yucca Mountain Environmental Impact Statement-the waste **25-10**
acceptance criteria are not known.

Please, come to your senses before this century ends and do the **25-11**
right thing for Idaho and this country. If nothing else, grant the **25-5**
extension so that you have all relevent information before you make **25-11**
a decision. This country is too great to destroy.

Sincerely,
Nancy W. Fenn

Response to Commentor No. 25:

25-1: As stated in Section 1.1 of the EIS, the proposed action of this EIS is to treat and manage sodium-bonded spent nuclear fuel and facilitate its ultimate disposal in a geologic repository, not to perform nuclear weapons work in Idaho.

25-2: All of the alternatives evaluated in this EIS would produce some forms of high-level radioactive waste. Electrometallurgical treatment (or pyroprocessing) would produce two new waste forms, both of which are more stable than untreated sodium-bonded spent nuclear fuel. DOE expects that these waste forms would be suitable for disposal in a geologic repository.

25-3: The assessment of nonproliferation impacts is not a part of the EIS process. None of the alternatives analyzed in this EIS would generate weapons-usable fissile materials at INEEL. Although highly enriched uranium would be an interim product, it would be downblended to low-enriched uranium during electrometallurgical treatment.

25-4: Congress determines how funds are allocated. DOE spends monies consistent with Congressional direction. DOE is not in a position to make the difficult tradeoffs that may be required between alternative Federal programs and spending priorities. The issue of funding for the treatment and management of sodium-bonded spent nuclear fuel is beyond the scope of the SBSNF EIS.

25-5: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

25-6: The Electrometallurgical Treatment Research and Demonstration Project began in June 1996 and, although the test results have not been finalized in a single report, a number of status reports issued by the National Academy of Sciences' National Research Council Committee were considered in the preparation of the draft EIS. Success criteria established at the outset of the project have been fulfilled. The environmental impact analysis associated with the electrometallurgical process alternatives was based on actual data from the project. Section 1.6.3 of the EIS summarizes the status and the results of the project.

25-7: The National Academy of Sciences' National Research Council prepared interim status reports on the results of the Electrometallurgical Treatment Research and Demonstration Project that have been reviewed by DOE. The National Research Council completed their evaluation of the

Commentor No. 25: Nancy Fenn

Response to Commentor No. 25 (Cont'd):

electrometallurgical treatment demonstration project in September 1999 and published their final summary report in April 2000. The final report findings will be considered during the decision-making process leading to the Record of Decision.

25-8: The SBSNF EIS was prepared in accordance with NEPA, Council on Environmental Quality regulations on implementing NEPA (40 CFR 1500-1508), and DOE's NEPA implementation procedures (10 CFR 1021). None of these require the inclusion of a cost analysis in an EIS. As discussed in the introduction, the basic objective of this EIS is to provide the public and DOE decision-makers with a description of the reasonable alternatives for the treatment and management of DOE's sodium-bonded spent nuclear fuel and their potential environmental impacts. However, DOE issued a separate Cost Study on August 12, 1999, that analyzes and compares the costs of the alternatives analyzed in the EIS. Cost will be considered during the decision-making process in preparing the Record of Decision.

25-9: Although the assessment of nonproliferation impacts is not a part of the scope of the EIS, DOE's Nonproliferation Impacts Assessment was mailed out to interested members of the public on August 12, 1999, and is available by request. The assessment was also placed in the DOE public reading rooms and distributed at the public hearings held during the public comment period on the draft EIS. Information from the assessment, along with other factors such as costs, schedules, environmental consequences, and technical risk will be considered during the decision-making process leading to the Record of Decision.

25-10: No final waste acceptance criteria for a geologic repository have been established at this time. DOE expects that the waste forms described in this EIS will be acceptable. The Draft Yucca Mountain EIS was issued in July 1999 and is discussed in Section 1.6.2.2 of this EIS.

25-11: The scope of this EIS encompasses a comprehensive evaluation of the environmental impacts of alternatives for the treatment and management of sodium-bonded spent nuclear fuel. This EIS indicates that the environmental impacts of using any of the alternatives to treat and manage sodium-bonded spent nuclear fuel are very small. The removal of chemically reactive sodium creates a safer product for disposal in a repository, thus reducing risks to the environment.

Commentor No. 26: John Tanner

Testimony August 26, 1999

The treatment of the driver portion of the sodium-bonded nuclear fuel by the electro-metallurgical process is the most sensible option proposed, for the following reasons.

It would allow recovery and use of the high-enriched uranium, which is valuable material that was costly to produce.

This fuel is not suitable for the PUREX process at Savannah River Laboratory because the sodium cannot be completely removed from this fuel by any reasonable process.

26-1

The other methods--melt and dilute, chloride volatility, plasma arc ceramic process, and the glass material process (GMODS)--are less well developed, are likely to be more expensive even after development, and involve heating the fuel to high temperatures, which will worry some people about whether the volatile elements would pollute the air.

The plutonium in the blanket fuel is valuable and should be recovered.

If this were done by the PUREX process, the recovered plutonium would be pure enough to be made into mixed oxide fuel to generate electricity in commercial power reactors. Much of the development of this process is already contemplated for plutonium recovered from weapons. The costs of decladding, sodium removal, and shipment from Idaho would need to be considered.

26-2

The plutonium could also be recovered by the electrometallurgical process. Why is this not mentioned as an alternative in the DEIS? This is as reasonable as many of the other alternatives presented. Although the recovered plutonium would be too contaminated with other transuranic elements to be useful as MOX fuel, it would be useful in a future fast neutron reactor, such as the one which produced it.

But to answer the question just raised, recovery of plutonium by the electrometallurgical process was omitted in order to please influential anti-nuclear critics, who raise weapons proliferation concerns, ignoring the fact that the electrometallurgical process is far more proliferation resistant than the well known PUREX process. The demonstration of plutonium separation by the electrometallurgical process would do nothing to aid anyone's ability to obtain weapons usable material.

However, putting this plutonium in the waste, as proposed for most of the alternatives in the DEIS, will only temporarily please these critics. When it is later proposed to bury this waste, whether in Yucca Mountain or elsewhere, they will again object, pointing to plutonium's long half-life, and to recent evidence that trace amounts of plutonium can migrate in ground water under special, artificial conditions. Note that the critics have been vehemently opposing the transport and burial of waste with only trace amounts of plutonium in the WIPP. What will they say when it is proposed to bury waste with substantial amounts of plutonium?

26-3

Any method of dealing with plutonium will be criticized, therefore we should do the sensible thing and recover it for later use.

26-2

John Tanner
529-5605

Response to Commentor No. 26:

26-1: The commentor's support for electrometallurgical treatment of driver sodium-bonded spent nuclear is noted. The EIS discusses all of the commentor's concerns. Separate studies consider the nonproliferation characteristics of the various alternative technologies and the costs associated with each of the alternatives. The EIS assessment and the conclusions presented in the separate studies will provide some of the information that will be considered during DOE's decision-making process, the results of which will be published in the Record of Decision.

26-2: The commentor's remarks about the value of plutonium present in the sodium-bonded spent nuclear fuel are noted. The intent of this EIS, as discussed in Section 1.2, is to resolve issues associated with the sodium content of sodium-bonded spent nuclear fuel. The disposition of the fissile material content of the fuel is not within the scope of the EIS and is not considered an issue in the formulation of the reasonable alternatives. It is, however, an important consideration in the Nonproliferation Impacts Assessment of the alternatives that was prepared separately from the EIS. The conclusions of the Nonproliferation Impacts Assessment, along with those of the EIS, will be considered during the decision-making process leading to the Record of Decision.

26-3: DOE, consistent with U.S. nuclear nonproliferation policy, would not separate plutonium except for the PUREX process. DOE expects that the plutonium-containing waste from the electrometallurgical treatment process would be acceptable in a geologic repository for the same reasons that plutonium-containing commercial spent nuclear fuel is already acceptable.

Commentor No. 27: John Commander

ELECTROMETALLURGICAL EIS TALKING POINTS FOR AUGUST 26 1999

O I support the treatment of sodium-bonded spent nuclear fuel by the electrometallurgical process. The process should be used for all such fuel. as described in alternative 1 of the Draft Environmental Impact Statement. **27-1**

O The electrometallurgical treatment has been proven to be satisfactory. Many of the other alternatives are in the concept or research stage.

O Nearly all the sodium-bonded fuel is now at ANL-West. It makes both common and economic sense to do the entire treatment there. **27-2**

O I am concerned about the loss of jobs and skills, if the treatment is not at ANL-W. These skills are particularly important at this time. The current administration is finally putting some new funding into nuclear research and technology. DOE has designated INEEL as the lead laboratory for this effort. **27-3**

O The electrometallurgical treatment has little risk that nuclear material could be diverted to use in nuclear bombs. The Draft EIS has adequately answered the comments of those concerned about that risk. **27-4**

O Whatever alternative is chosen, it must meet the terms of the 1995 Governor's Agreement on Nuclear Waste. If treatment is done at Savannah River, material must be moved there before the Year 2035. This date is the deadline for all spent fuel to be out of Idaho. **27-5**

Submitted by:

John Commander

Member: IAWS & INEL Retired Employee Association

Telephone (208) 523 5738

Response to Commentor No. 27:

27-1: The commentor's support for the electrometallurgical treatment of both driver and blanket sodium-bonded spent nuclear fuel (Alternative 1) is noted.

27-2: The commentor's support for treatment of all sodium-bonded spent nuclear fuel at ANL-W is noted. The cost implications compared to other alternatives are evaluated in a separate Cost Study.

27-3: The commentor's concern about the loss of jobs and skills if treatment of sodium-bonded spent nuclear fuel is not conducted at ANL-W is noted. DOE recognizes the value and the presence of important skills at ANL-W and INEEL. As part of the decision-making process, DOE will consider the consequences of potential impacts to various environmental resources, including socioeconomics. The Record of Decision will explain the rationale and factors for DOE's decision.

27-4: The commentor is correct. Under this specific application, electrometallurgical treatment of sodium-bonded spent nuclear fuel would not produce weapons-usable material, thereby reducing the risk that this spent nuclear fuel might be diverted for other uses.

27-5: The terms of the State of Idaho Settlement Agreement and Consent Order (Governor's Agreement) are accounted for in all of the alternatives evaluated in this EIS. A copy of the agreement is provided in Appendix K.

Commentor No. 28: Terry & Theresa Williams

Terry & Theresa Williams
P. O. Box 1627
Hailey, ID 83333

August 25, 1999

Ms. Susan Lesica
U.S. Department of Energy
Office of Nuclear Facilities Management, NE-40
19901 Germantown Road
Germantown, Maryland 20874-1290

Dear Ms. Lesica:

We are writing to register our comments on the "Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel."

We request that you extend the comment period past September 13, 1999 by at least 60 days since much of the information relevant to the procedure won't be available until after the comment period is closed. **28-1**

In closing, we would like to add that we are against Pyroprocessing. **28-2**

Thank you very much for registering our comments.

Terry & Theresa Williams

Response to Commentor No. 28:

28-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169). DOE made materials relevant to the review of the draft EIS available in public reading rooms and at a series of public hearings that were held on August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho; and August 31, 1999, in Arlington, Virginia. The materials placed in the reading rooms included the electrometallurgical demonstration project environmental assessment, the Finding of No Significant Impact for the environmental assessment, National Research Council interim status reports on the demonstration project, the 1995 Settlement Agreement and Consent Order with the State of Idaho, the EIS scoping meeting transcripts and public hearing comments, and the draft EIS hearing presentations and fact sheets. In addition, completion of the Cost Study and Nonproliferation Impacts Assessment was expedited so that they would be available to the public during the comment period. These reports were mailed to interested parties on August 12, 1999, and were made available to the public at the public hearings on the draft EIS. Although these reports are not required for the environmental impact analysis presented in the EIS, they will provide input to the Record of Decision. While the final National Research Council report on the electrometallurgical treatment demonstration project at ANL-W was published in April 2000, interim status reports were produced throughout the project and this data was used to prepare the EIS.

28-2: The commentor's objection to electrometallurgical treatment (pyroprocessing) of sodium-bonded spent nuclear fuel is noted.

Commentor No. 29: Robert H. Wilcox

Forward Header
Subject: DOE/EIS-0306D, Draft EIS for Treatment & Management of Na-Bonded Spent Nuclear Fuel
Author: RBTHWILCOX@aol.com at INTERNET
Date: 9/6/99 3:30 PM

William D Magwood, IV, Director
Office of Nuclear Energy, Science & Technology
U. S. Department of Energy (DOE)

In my opinion, the DOE has outdone itself in following blindly, once again, its ill-advised process of using EIS's instead of sound management to carry out its business. **29-1**

In this instance, it has even "no preferred alternative at this time". And, it has determined that the alternatives evaluated in detail would have minimal or no impacts n the remaining environmental areas. **29-2**
Really! Must we continue to waste the taxpayers money on such analyses as opposed to getting on with the job at hand? **29-3**

As an aside, it is intriguing to note that DOE appears to feel committed to its 1995 agreement with the State of Idaho to remove all SNF from Idaho by 2035. Yet, DOE has appeared singularly uninterested in honoring its legal commitment to accept custody of SNF from the nation's power reactors, a far more urgent and pressing matter. **29-4**

My recommendations are:
1. With respect to Sodium-Bonded SNF: Get on with doing this in Idaho, which was the plan from day one. If given the necessary attention, DOE surely ought to be able to accomplish this by 2035. (How long did it take us to put a man on the moon?) **29-5**

2. Please, please reexamine the need to WASTE significant portions of the DOE budget on the stupid EIS process. I'm not saying that the environment should be ignored, only that DOE needs to be more action-oriented. Sure this might need new legislation, but when was the last time anyone in DOE suggested to the CEO that that might be a good idea? **29-3**

If anyone there would like further suggestions on this subject, or clarification of the above, from this reviewer, please let me know.

Yours truly,

Robert H. Wilcox,
Former USAEC Employee, Retired Foreign Service Officer & SRS Employee,
711 Pevero Abbey Circle, Martinez, GA 30907
Tel.: (706) 855-5824

Response to Commentor No. 29 :

29-1: DOE is required under NEPA to prepare an EIS when its actions could significantly affect the environment, as in the case of the treatment and management of DOE's sodium-bonded spent nuclear fuel. In its Finding of No Significant Impact for the environmental assessment of the Electrometallurgical Treatment Research and Demonstration Project (May 1996), DOE committed to preparing an EIS before making any significant additional use of the electrometallurgical treatment technology. DOE strongly believes that preparation of this EIS is consistent with sound management principles and its policy of fully informing both decision-makers and the public of the potential environmental consequences of any proposed action.

29-2: Council on Environmental Quality regulations (40 CFR 1502.14[e]) do not require a preferred alternative to be included in a draft EIS if one has not been identified at the time of publication. However, the regulations do require that a preferred alternative be identified in a final EIS. Section 2.8 of this EIS identifies the Preferred Alternative. The reader's comment related to minimal or no impacts is noted.

29-3: Congress determines how funds are allocated. DOE spends monies consistent with Congressional direction. DOE is not in the position to make the difficult tradeoffs that may be required between alternative Federal programs and spending priorities. The issue of spending money for the treatment and management of sodium-bonded spent nuclear fuel is beyond the scope of the SBSNF EIS.

29-4: The scope of this EIS is for the treatment and management of sodium-bonded spent nuclear fuel only. It does not include commercial nuclear power spent nuclear fuel. However, it should be noted that some of the sodium-bonded spent nuclear fuel was generated by the Fermi-1 commercial power reactor, which operated in the 1960s. In addition, DOE has issued a draft EIS for the Yucca Mountain waste repository which does address the disposal of commercial spent nuclear fuel.

29-5: The commentor's support for treating the sodium-bonded spent nuclear fuel at INEEL is noted.

Commentor No. 30: David Kipping

Forward Header
Subject: Comment on Pyroprocessing EIS
Author: kipping@compuserve.com at INTERNET
Date: 9/7/99 5:49 PM

Message authorized by: kipping@compuserve.com at INTERNET at X400PO

Dear Ms. Lesica,

Ref: "Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel"

It is essential that the comment period for the EIS be extended a minimum of 60 days (to at least 15 Nov 99). This draft EIS is very premature; much of the important information the public needs to make informed comments will not be ready for at least another month. Therefore the September 13 deadline does not allow enough time. **30-1** **30-2**

There is a great deal of information that is essential to making sound technical and policy decisions that is not in the draft EIS and, in fact, is not available at all. In particular, the following items are missing:

* The demonstration project at Argonne West on the proposed treatment--final results will not be available until the end of the September at the earliest. **30-3**

* National Academy of Sciences review of the proposed treatment. **30-4**

* Cost analysis of the various alternatives. **30-5**

* Nuclear weapons proliferation assessment by the Department of Energy. It is my understanding that this was just released last week. **30-6**

* Yucca Mountain (the purported destination of pyroprocessing waste) Environmental Impact Statement--the waste acceptance criteria are not known. **30-7**

The current draft EIS is seriously flawed due to the lack of information mentioned above. As a minimum, DOE needs to wait until all this information is available before closing the comment period. But merely extending the comment period will not achieve the result desired: an EIS that presents all the facts and allows the public to make informed comments. Much of the public will not be aware of the additional documents and/or will not have access to them. It is clear that the best approach is incorporate the above-mentioned information in a second draft EIS which then can be made available for well-informed public comment. **30-2** **30-8**

Thank you for your consideration.

David Kipping
President, Board of Directors
Snake River Alliance

Response to Commentor No. 30:

30-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

30-2: DOE does not believe that the draft EIS was produced prematurely because of a failure to present all the facts necessary for the public to make informed comments. However, DOE did extend the comment period to ensure that all interested parties had time to adequately review the draft document (64 FR 4916). DOE made material supporting the preparation of the EIS available in public reading rooms and through a series of public hearings held August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho; and August 31, 1999, in Arlington, Virginia. Materials placed in the public reading rooms included the environmental assessment for the Electrometallurgical Treatment Research and Demonstration Project, the Finding of No Significant Impact for the environmental assessment, National Research Council reports, the 1995 Settlement Agreement and Consent Order with the State of Idaho, scoping period meeting transcripts and comments, and the draft EIS hearing presentations and fact sheets. In addition, completion of the Cost Study and Nonproliferation Impacts Assessment was expedited so that these also would be available to the public during the comment period. These reports were mailed to interested parties on August 12, 1999, and were made available to the public at the public hearings on the draft EIS. Although these reports are not critical to the environmental impact analysis presented in the EIS, they will be considered during the decision-making process leading to the Record of Decision. While the final National Research Council report on the Electrometallurgical Treatment Research and Demonstration Project at ANL-W was published in April 2000, interim status reports were produced throughout the project. Data generated during the demonstration project was used in preparing the EIS, as discussed in Section 1.6.3 of the EIS.

30-3: Final test results were made available in August 1999 and were used in the EIS. The success criteria established at the outset of the project were fulfilled. The environmental impact analysis associated with the electrometallurgical process alternatives was based on actual data from the project. Section 1.6.3 of the EIS summarizes the status and the results of the project.

30-4: The National Academy of Sciences' National Research Council prepared interim status reports on the results of the Electrometallurgical Treatment

Research and Demonstration Project that have been reviewed by DOE. The National Research Council completed their evaluation of the electrometallurgical treatment demonstration project in September 1999 and published their final summary report in April 2000. The final report findings will be considered during the decision-making process leading to the Record of Decision.

30-5: The SBSNF EIS was prepared in accordance with NEPA, Council on Environmental Quality regulations on implementing NEPA (40 CFR 1500-1508), and DOE's NEPA implementation procedures (10 CFR 1021). None of these require the inclusion of a cost analysis in an EIS. As discussed in the introduction, the basic objective of this EIS is to provide the public and DOE decision-makers with a description of the reasonable alternatives for the treatment and management of DOE's sodium-bonded spent nuclear fuel and their potential environmental impacts. However, DOE issued a separate Cost Study on August 12, 1999, that analyzes and compares the costs of the alternatives analyzed in the EIS. Cost will be considered during the decision-making process in preparing the Record of Decision.

30-6: Although the assessment of nonproliferation impacts is not a part of the EIS process, DOE's Nonproliferation Impacts Assessment was mailed out to interested members of the public on August 12, 1999, and is available by request. The assessment was also placed in the DOE public reading rooms and distributed at the public hearings held during the public comment period on the draft EIS. Information from the assessment, along with other factors such as costs, schedules, environmental consequences, and technical risk will be considered during the decision-making process leading to the Record of Decision.

30-7: As discussed in Section 2.7 of this EIS, final waste acceptance criteria for a geologic repository are still being developed. DOE expects the waste forms that would be produced by the proposed action would be suitable for disposal in a geologic repository. In July 1999, DOE published a Draft Yucca Mountain EIS, which is discussed in Section 1.6.2.2 of this EIS. The Yucca Mountain EIS assumes that sodium-bonded spent nuclear fuel is treated using the electrometallurgical process prior to emplacement in the geologic repository.

30-8: DOE has made material supporting the preparation of the EIS available in public reading rooms and through a series of public hearings which were advertised in the Federal Register, as well as local newspapers. In addition, completion of the Cost Study and Nonproliferation Impacts Assessment was expedited so that these would be available to the public during the

Commentor No. 30: David Kipping

Response to Commentor No. 30 (Cont'd):

comment period. These reports were mailed to interested parties on August 12, 1999, and were made available to attendees at all of the public hearings on the draft EIS. While the final National Research Council report on the Electrometallurgical Treatment Research and Demonstration Project at ANL-W was published in April 2000, interim status reports have been produced throughout the project and these are available in the public reading rooms. Considering the additional time provided by the extension of the comment period and the availability of the data used to prepare the EIS, DOE does not feel that a second draft is warranted.

Commentor No. 31: David Hensel

09/06/1999 21:41 2083548636 HENSEL/ROBINSON PAGE 1

David Hensel
PO Box 1104
313 S. 200E.
Driggs, Id.
83422
208-354-8636
hensel@tetonvalley.net

Dear Ms. Lesica

I want to comment on the DEIS for treatment and management of sodium-bonded spent nuclear fuel.

First, I wish to ask for an extension. Far too much information is missing from the deis: **31-1**

1. the demonstration results on pyroprocessing **31-2**
2. NAS's review of the proposed treatment **31-3**
3. Cost analysis of the alternatives **31-4**
4. Nuclear weapons proliferation's risk assessment **31-5**
5. The acceptance criteria for Yucca Mt., and the EIS on Yucca Mt. **31-6**

Pyroprocessing is a bad idea. It separates out nuclear bomb grade uranium from spent fuel. Developing this technology runs counter to the USA's nonproliferation goals. The technology can be modified to separate out bomb-grade plutonium. There is nothing more fleeting than a military secret. Witness the uproar over China's stealing our bomb making secrets. Why spend tax dollars developing technology that eventually will find its way into unfriendly hands. Further developing this technology sends the rest of the world the message that the US is not serious about stopping the spread of nuclear weapons technology. **31-7**

As the DOE is aware, I hope, the INEEL is awash in extremely dangerous waste. Waste that it lacks the technology and resources to clean up. Much of this waste was produced during reprocessing. Rather than dealing with the crucial problem of cleanup, the DOE now proposes to produce more waste? This makes no sense. The cleanup budget is flat for the foreseeable future; many projects have no funding (the liquid waste tanks at the INEEL for instance). Pyroprocessing takes money that could be used much better on environmental projects. There is plenty, too much, weapons grade material and nuclear waste already-this project only produces more of the same. It is a waste of precious resources and taxpayer money. **31-8** **31-9** **31-7** **31-8** **31-9**

Thank you.

David Hensel

Response to Commentor No. 31:

31-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

31-2: The Electrometallurgical Treatment Research and Demonstration Project began in June 1996 and, although the test results have not been finalized in a single report, a number of status reports issued by the National Academy of Sciences' National Research Council Committee were considered in the preparation of the draft EIS. The success criteria established at the outset of the project were fulfilled. The environmental impact analysis associated with the electrometallurgical process alternatives was based on actual data from the project. Section 1.6.3 of the EIS summarizes the status and the results of the project.

31-3: The National Academy of Sciences' National Research Council prepared interim status reports on the results of the Electrometallurgical Treatment Research and Demonstration Project that have been reviewed by DOE. The National Research Council completed their evaluation of the electrometallurgical treatment demonstration project in September 1999 and published their final summary report in April 2000. The final report findings will be considered during the decision-making process leading to the Record of Decision.

31-4: The SBSNF EIS was prepared in accordance with NEPA, Council on Environmental Quality regulations on implementing NEPA (40 CFR 1500-1508), and DOE's NEPA implementation procedures (10 CFR 1021). None of these require the inclusion of a cost analysis in an EIS. As discussed in the introduction, the basic objective of this EIS is to provide the public and DOE decision-makers with a description of the reasonable alternatives for the treatment and management of DOE's sodium-bonded spent nuclear fuel and their potential environmental impacts. However, DOE issued a separate Cost Study on August 12, 1999, that analyzes and compares the costs of the alternatives analyzed in the EIS. Cost will be considered during the decision-making process in preparing the Record of Decision.

31-5: Although the assessment of nonproliferation impacts is not a part of the EIS process, DOE's Nonproliferation Impacts Assessment was mailed out to interested members of the public on August 12, 1999, and is available by request. The assessment was also placed in the DOE public reading rooms and distributed at the public hearings held during the public comment period on the draft EIS. Information from the assessment, along with other factors such as costs, schedules, environmental

Commentor No. 31: David Hensel

Response to Commentor No. 31 (Cont'd):

consequences, and technical risk will be considered during the decision-making process leading to the Record of Decision.

31-6: As discussed in Section 2.7 of this EIS, final waste acceptance criteria are still being developed for a geologic repository. DOE expects the waste forms produced by the proposed action would be suitable for disposal in a geologic repository. In July 1999, DOE published a Draft Yucca Mountain EIS, which is discussed in Section 1.6.2.2 of this EIS. The Yucca Mountain EIS assumes that sodium-bonded spent nuclear fuel is treated using the electrometallurgical process prior to emplacement in the geologic repository.

31-7: The assessment of nonproliferation impacts is not a part of the EIS process. None of the alternatives analyzed in this EIS would generate weapons-usable fissile materials at INEEL. Although highly enriched uranium would be an interim product, it is would be down-blended to low-enriched uranium during electrometallurgical treatment.

31-8: The sodium-bonded spent nuclear fuel at INEEL contains metallic sodium, which is chemically reactive and so can be a potentially dangerous substance in the spent nuclear fuel. This EIS evaluates the impacts of treating and managing this sodium-bonded spent nuclear fuel so that, for the analyzed alternatives, this chemically reactive and potentially dangerous sodium is removed or converted to a nonreactive form. Such treatment would reduce the danger of radioactive material releases to the environment from emplacement of this radioactive material in a geologic repository. The environmental impact of waste generated from the proposed action is addressed in Chapter 4 of the EIS.

31-9: Congress determines how funds are allocated. DOE spends monies consistent with Congressional direction. DOE is not in a position to make the difficult tradeoffs that may be required between alternative Federal programs and spending priorities. The issue of funding for the treatment and management of sodium-bonded spent nuclear fuel is beyond the scope of the SBSNF EIS.

Commentor No. 32: Lowell Jobe

SB SNF Toll Free Line

9/8/99

Lowell Jobe
Coalition 21
14469 N 55th East
Idaho Falls, ID 83401
hm: 208-524-7271
fax: 208-524-0998

Coalition 21: 208-542-1575

I am calling to ask if there will be an extension on the comment period. We have found some serious questions regarding the cost report figures and tables and feel they need answering before we can finalize our conclusions and comments. Please advise us by phone. Please leave an answer on our answering machines if we are not there. **32-1** **32-2**

Response to Commentor No. 32:

32-1: In an effort to ensure that all interested parties had time to comment on the Draft EIS, the deadline for transmittal of comments was extended from September 13, 1999, to September 28, 1999 (64 FR 49169).

32-2: Actual costs for treating and managing sodium-bonded spent nuclear fuel are not part of the scope of the EIS. DOE welcomes questions concerning the August 1999 Cost Study.

Commentor No. 33: Lisa Johnson

Ms. Susan Lesica
US Department of Energy
Office of Nuclear Facilities Management, NE-40
19901 Germantown Road
Germantown, Maryland 20874-1290

Dear Ms. Lesica,

I am commenting on the DEIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel.

Our family, which includes young children, lives downwind of the Idaho National Engineering and Environmental Lab. I am very concerned about our family's health and the quality of the environment in the region due to the many activities that occur at the lab. **33-1**

I have several comments about this project and DEIS. The general feeling among our friends is that pyroprocessing is not an acceptable project for INEEL because of the following factors: **33-2**

- It creates new forms of nuclear waste, an issue that is already a huge problem at INEEL. **33-3**
- It takes money away from greater environmental problems at INEEL. **33-4**
- It wastes taxpayer money (Don't forget it has been mentioned twice on NBC new's "Fleecing of America"). **33-5**
- And it creates bomb-grade uranium from spent fuel and thus runs counter to US nonproliferation goals.

It seems clear that a 60-day extension of the comment period is necessary because so much relevant information is not yet available. For example: **33-6**

- The DOE does not have the results of the demonstration project on pyroprocessing. **33-7**
- The review from the National Academy of Sciences of the proposed treatment is not yet available. **33-8**
- The Department of Energy's nuclear weapons proliferation assessment is not included. **33-9**
- The waste acceptance criteria is not known because the Yucca Mountain EIS is not included (the purported destination of the waste). **33-10**

Once again, I do not support pyroprocessing at INEEL and a 60-day extension of the comment period is necessary because so much pertinent information is missing from the document. **33-2** **33-6**

Sincerely,

Lisa Johnson
PO Box 542
Victor ID 83455

Response to Commentor No. 33:

33-1: As indicated in the EIS, the human health effects resulting from operational activities to treat and manage the sodium-bonded fuel are very small. The estimated cumulative health effects to the public residing in the vicinity of INEEL from current and reasonably foreseeable future activities are summarized in Section 4.11.1.4 of the EIS. As indicated in this section, the expected health effects from these activities are very small. For example, an individual residing at the INEEL site boundary would be expected to receive a maximum radiation dose of 0.4 millirem per year from all releases, compared to natural background doses of 360 millirem per year, and are well below the regulatory limit of 10 millirem per year. Appendix E, Section E.2.1, of the EIS provides the Federal and DOE regulatory limits on radiation exposures.

33-2: The commentor's objection to electrometallurgical treatment (pyroprocessing) of sodium-bonded spent nuclear fuel at INEEL is noted.

33-3: All of the alternatives evaluated in this EIS would produce some forms of high-level radioactive waste. Electrometallurgical treatment (or pyroprocessing) would produce two new waste forms, both of which are more stable than untreated sodium-bonded spent nuclear fuel. DOE expects that these waste forms would be suitable for disposal in a geologic repository. Treatment of current high-level radioactive waste at INEEL is being evaluated in the Idaho High-Level Waste and Facilities Disposition Draft EIS, which is discussed in Section 1.6.2.3 of this EIS.

33-4: Congress determines how funds are allocated. DOE spends monies consistent with Congressional direction. DOE is not in a position to make the difficult tradeoffs that may be required between alternative Federal programs and spending priorities. The issue of funding for the treatment and management of sodium-bonded spent nuclear fuel is beyond the scope of the SBSNF EIS.

33-5: The assessment of nonproliferation impacts is not a part of the scope of the EIS. None of the alternatives analyzed in this EIS would generate weapons-usable fissile materials at INEEL. Although highly enriched uranium would be an interim product, it would be down-blended to low-enriched uranium during electrometallurgical treatment.

33-6: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169). DOE made materials relevant to the review of the draft EIS available in public reading rooms and at a series of public hearings that were held on August 17, 1999, in North

Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho; and August 31, 1999, in Arlington, Virginia. The materials placed in the reading rooms included the electrometallurgical demonstration project environmental assessment, the Finding of No Significant Impact for the environmental assessment, National Research Council interim status reports on the demonstration project, the 1995 Settlement Agreement and Consent Order with the State of Idaho, the EIS scoping meeting transcripts and public hearing comments, and the draft EIS hearing presentations and fact sheets. In addition, completion of the Cost Study and Nonproliferation Impacts Assessment was expedited so that they would be available to the public during the comment period. These reports were mailed to interested parties on August 12, 1999, and were made available to the public at the public hearings on the draft EIS. Although these reports are not critical to the environmental impact analysis presented in the EIS, they will provide input to the Record of Decision. While the final National Research Council report on the electrometallurgical treatment demonstration project at ANL-W was published in April 2000, interim status reports were produced throughout the project and this data was used to prepare the EIS as discussed in Section 1.6.3 of the EIS.

33-7: Final test results were made available in August 1999 and were used in the EIS. The success criteria established at the outset of the project were fulfilled. The environmental impact analysis associated with the electrometallurgical process alternatives was based on actual data from the project. Section 1.6.3 of the EIS summarizes the status and the results of the project.

33-8: The National Academy of Sciences' National Research Council prepared interim status reports on the results of the Electrometallurgical Treatment Research and Demonstration Project that have been reviewed by DOE. The National Research Council completed their evaluation of the electrometallurgical treatment demonstration project in September 1999 and published their final summary report in April 2000. The final report findings will be considered during the decision-making process leading to the Record of Decision.

33-9: Although the assessment of nonproliferation impacts is not a part of the EIS process, DOE's Nonproliferation Impacts Assessment was mailed out to interested members of the public on August 12, 1999, and is available by request. The assessment was also placed in the DOE public reading rooms and distributed at the public hearings held during the public comment period

Commentor No. 33: Lisa Johnson

Response to Commentor No. 33 (Cont'd):

on the draft EIS. Information from the assessment, along with other factors such as costs, schedules, environmental consequences, and technical risk will be considered during the decision-making process leading to the Record of Decision.

33-10: As discussed in Section 2.7 of the EIS, final waste acceptance criteria for a geologic repository are still being developed. DOE expects the waste forms that would be produced by the proposed action would be suitable for disposal in a geologic repository. In July 1999, DOE published a Draft Yucca Mountain EIS, which is discussed in Section 1.6.2.2 of this EIS. The Yucca Mountain EIS assumes that sodium-bonded spent nuclear fuel is treated using the electrometallurgical process prior to emplacement in the geologic repository.

Commentor No. 34: Dan Johnston

From: Daniel.C.Johnston@rl.Doe.gov_at_INTERNET at X400PO
Date: 9/13/99 8:37PM -0700
To: EMTEIS at NE-02
*cc: dcjohnston@rl.doe.gov_at_INTERNET at X400PO
Subject: Comments to Na-bonded Fuel EIS

Please see the following comments.

Comments to the Draft Environmental Impact Statement for the
Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

(Doc No DOE EIS-03060, July 1999)

The document appears complete and addresses the FFTF Sodium-Bonded fuel. The transportation issues are not specifically identified, but the different radiation and risk values shown for the various alternatives indicate they have been addressed. **34-1**

My only major concern is what appears to be a difference in how the PU and U are handled as the sodium-bonded spent nuclear fuel is run through the Electro-metallurgical Treatment Process as described in paragraph S.3.1 on page S-13. The PU is lumped in with the other fission products whereas the U is specifically collected and removed, then diluted as necessary. **34-2**

Does this uncontrolled gathering of PU guarantee sufficient criticality control for the PU in this process, or should the likelihood of pockets of PU and PU compounds of varying concentrations be acknowledged and monitored with identified actions to be taken to ensure safe handling?

From: Dan Johnston
1471 Amon Ct.
Richland, Wa. 99352

Response to Commentor No. 34:

34-1: As stated in Sections 2.2.3 and 4.2 of this EIS, pursuant to the amended Record of Decision for the DOE Programmatic Spent Nuclear Fuel EIS (61 FR 9441), the sodium-bonded Fast Flux Test Facility fuel would be transported from Hanford to INEEL. The environmental impacts associated with transport of the Fast Flux Test Facility fuel to INEEL are summarized in Appendix G of this EIS by referencing the Programmatic Spent Nuclear Fuel EIS.

34-2: As stated in Appendix C, Section C.1 of the EIS, during electrometallurgical treatment of the sodium-bonded fuel, there are strict criticality controls in place for all aspects of the process. In the electrorefiner, the plutonium would be in a chloride compound in liquid state and would be homogeneously mixed with the other salts. Abnormal localized concentrations of plutonium within the electrorefiner have been analyzed for a number of scenarios. These analyses have confirmed that an adequate margin of criticality safety would exist even under these conditions. Nevertheless, actual operations would carefully monitor the level of plutonium at all stages of the process in order to ensure the early detection of any abnormal conditions that should arise. The concentration of plutonium in the salt would be monitored through repeated sampling. When the salt is stabilized into the ceramic waste, the transuranic and fission products would be uniformly distributed throughout the waste form, which has been confirmed by sampling. The maximum plutonium concentration in the salt would be about 8 weight percent. A conservative criticality assessment was performed on the ceramic waste form. The results of this assessment showed that the plutonium concentration in the waste form would pose no criticality safety concerns.

Commentor No. 35: Carol Murphy

09/13/1999 13:19 208/2005?? ...

CAROL MURPHY
PO BOX 4714
KETCHUM ID 83340
(208) 726 5129

TO: MS SUSAN LESICA
US DEPT of ENERGY
OFFICE OF NUCLEAR FACILITIES MGMNT.
19901 GERMANTOWN RD.
GERMANTOWN, MD. 20874-1290

Dear Ms. Lesica,

My family and I are opposed to pyroprocessing at the INEEL in Idaho for several reasons. First, it is a tremendous waste of taxpayers dollars. Second, we do not need new forms of nuclear waste, which this process will create. Third, the money should be diverted + used elsewhere for more pressing environmental problems at the INEEL. Last, we do not need to be seperating our more "bomb-grade" uranium. **35-1**

We also are urging you to extend the comment period for 60 to 90 days or until well after the Yucca Mountain EIS has been released. This is important because if Yucca Mtn. is to be the destination of the pyro-processing waste, we cannot rationally evaluate it until we have an EIS from Yucca Mtn. We also need cost evaluations from all alternatives. **35-2** **35-3** **35-2** **35-4** **35-5** **35-6** **35-7**

Too much is unanswered, unspecified and unstudied. Too much is not documented and not reviewed. **35-8**

Please extend the comment period past Sept 28, 1999 and note that we are opposed to pyro-processing in general.

Thank you, Carol Murphy + family
DAN Bob Malida

Response to Commentor No. 35:

35-1: The commentor's objection to electrometallurgical treatment (pyroprocessing) of sodium-bonded spent nuclear fuel at INEEL is noted.

35-2: Congress determines how funds are allocated. DOE spends monies consistent with Congressional direction. DOE is not in a position to make the difficult tradeoffs that may be required between alternative Federal programs and spending priorities. Although not within the scope of this EIS, a separate Cost Study of the alternatives analyzed in the EIS has been developed and is available to the public. This Cost Study evaluates the cost of each alternative, including no action.

35-3: All of the alternatives evaluated in this EIS would produce some forms of high-level radioactive waste. Electrometallurgical treatment (pyroprocessing) would produce two new waste forms, both of which are more stable than untreated sodium-bonded spent nuclear fuel. DOE expects that these waste forms would be suitable for disposal in a geologic repository. Treatment of current high-level radioactive waste at INEEL is being evaluated in the Idaho High-Level Waste and Facilities Disposition EIS, which is discussed in Section 1.6.2 of this EIS.

35-4: None of the alternatives analyzed in this EIS would generate weapons-usable fissile materials at INEEL. Although highly enriched uranium would be an interim product, it would be down-blended to low-enriched uranium during electrometallurgical treatment.

35-5: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

35-6: The Yucca Mountain Draft EIS was released in July 1999. Relevant information from the Yucca Mountain Draft EIS was incorporated into Section 1.6.2 of this SBSNF EIS.

35-7 DOE issued a separate Cost Study that analyzes and compares the cost of alternatives analyzed in the EIS. Cost will be considered during the decision-making process in preparing the Record of Decision

35-8: The information needed to make a decision concerning the treatment and management of DOE's sodium-bonded spent nuclear fuel was obtained and analyzed in the EIS. This information included input from the public, as well as from Federal, state and local agencies, and Tribal governments. Also included was site-specific information on the environmental conditions prevailing at ANL-W, INEEL, and SRS, as well as documentation related to each of the proposed treatment technologies. For example, data from

Commentor No. 35: Carol Murphy

Response to Commentor No. 35: (Cont'd)

DOE's Electrometallurgical Treatment Research and Demonstration Project were used to prepare the EIS. The results of this project are documented in a series of reports published by ANL-W and reviewed by the National Research Council. All of the materials used to prepare the EIS are referenced at the end of each chapter.

Commentor No. 36: David E. Adelman

September 13, 1999

Ms. Susan Lesica
U.S. Department of Energy
Office of Nuclear Facilities Management, NE-40
19901 Germantown Road
Germantown, Maryland 20874-1290

Dear Ms. Lesica:

Please find the enclosed comments of the Natural Resources Defense Council, Inc., on the Department of Energy's Draft Environment Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel (DOE/EIS-0306D). Should you have any questions, I can be reached at (202) 289-6868. Thank you very much for your assistance.

Sincerely,

David E. Adelman
Project Attorney, Nuclear Program

Response to Commentor No. 36:

Commentor No. 36: David E. Adelman (Cont'd)

Comments of the Natural Resources Defense Council on The Department of Energy's Draft Environment Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

The Draft Environmental Impact Statement ("EIS") for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel represents a substantial improvement from the Notice of Intent for the EIS. In particular, the EIS treats separately the analysis of high-burnup driver fuel elements and low-burnup blanket fuel elements. This is a critical distinction to make because the sodium in blanket fuel can be readily removed using mechanical methods. In addition, although not complete, DOE has broadened the alternatives analysis by considering technologies beyond electrometallurgical treatment ("EMT") and PUREX reprocessing. The inclusion of direct disposal of blanket fuel elements and melt-and-dilute treatment of blanket and driver fuel elements are of particular importance because of their reduced environmental and non-proliferation impacts. **36-1**

A number of deficiencies persist, both in terms of the process and the substance of the EIS itself. First, the EIS process is proceeding despite the pending National Academy of Sciences report evaluating the EMT technology. The EIS would benefit substantially from the determinations of the Academy's report, particularly in assessing its viability and impacts relative to other methods. DOE has also arbitrarily prepared separate reports on the costs and non-proliferation implications of the alternatives considered in the EIS, and released them without any opportunity for public comment. These assessments should have been incorporated into the Draft EIS and released for public comment. Further research and development of the alternatives considered should also be completed prior to finalizing the EIS to ensure that their viability and environmental impacts are considered fully. **36-2** **36-3** **36-4**

I. DOE Marginalizes Methods Other Than EMT for Processing Driver Fuel Elements

DOE's primary justification for proposing treatment of sodium-bonded fuel using the EMT technology is the reactivity of the bonded-sodium in the fuel, which according to DOE precludes direct disposal of these fuel elements. As DOE has acknowledged, this justification applies, at most, to the driver fuel elements because the sodium can be removed mechanically from the blanket fuel, making it acceptable for direct disposal in a geologic repository. Blanket fuel constitutes more than 95 percent of the fuel to be processed; driver fuel accounts for only three tons of the total 60 tons in storage. With such a limited amount of material to be processed, it makes little sense to invest the time and money in the EMT technology, particularly given the non-proliferation risks associated with its capacity to be used for plutonium extraction.[1] **36-5**

[1] The National Academy of Sciences has already expressed concern about this risk: "Although the developers of the electrometallurgical technique argue that the technology is proliferation resistant, any SNF processing approach that is capable of separating fissionable materials from associated fission products and transuranic elements could be redirected to produce material with nuclear detonation capability . . . . Demonstration of the process could, however, add to the risk that a nation intent on weapons production might consider adapting this technology for possible production of fissile material, although such material would be of poor quality for a weapon." Fred Basolo et al., *An Assessment of Continued R&D Into an Electrometallurgical Approach for Treating DOE Spent Nuclear Fuel*, S-2 (National Research Council, 1995).

Response to Commentor No. 36 (Cont'd):

36-1: The comment is noted. DOE revised the scope of the EIS based on comments provided during the public scoping period.

36-2: The National Academy of Sciences' National Research Council prepared interim status reports on the results of the Electrometallurgical Treatment Research and Demonstration Project that have been reviewed by DOE. The National Research Council completed their evaluation of the electrometallurgical treatment demonstration project in September 1999 and published their final summary report in April 2000. The final report findings will be considered during the decision-making process leading to the Record of Decision.

36-3: The Cost Study and Nonproliferation Impacts Assessment were prepared to provide additional pertinent information to the Secretary of Energy so that he may make an informed decision concerning the treatment and management of DOE's sodium-bonded spent nuclear fuel. These documents were mailed to interested parties on August 12, 1999, and were made available to attendees at all of the public hearings on the draft EIS. It should be noted that, although NEPA does not require inclusion of the information provided in the Cost Study and the Nonproliferation Impacts Assessment in the EIS, this information will be considered along with other pertinent data when the Record of Decision is prepared. Also, members of the public are free to direct any comments they may have on the Cost Study and Nonproliferation Impacts Assessment to DOE.

36-4: The current state of development of each treatment technology is described in Chapter 2 of the EIS. DOE recognizes that the treatment methods vary in their current state of development, and this was a factor in dismissing GMODS and the direct plasma arc-vitreous ceramic and chloride volatility processes from evaluation at this time. However, it was felt that the technologies analyzed in the EIS were developed to a sufficient level of maturity to permit consideration of their environmental impacts. It was not practical or necessary to wait until research on each technology has proceeded to a similar point prior to preparing the EIS. It should be noted that, under the option of continued storage under the No Action Alternative, the sodium-bonded spent nuclear fuel would continue to be stored safely until a less mature technology is developed to the point that it becomes a reasonable treatment alternative.

36-5: The commentor feels that DOE has not given other methods of treating sodium-bonded spent nuclear fuel the same consideration as electrometallurgical treatment. As stated in Section 1.3 of the EIS, as a

Commentor No. 36: David E. Adelman (Cont'd)

Reliance on other existing technologies or technology development programs must be adequately assessed in the EIS. Yet, in the Draft EIS only one of the six alternatives evaluated assesses a treatment method for the driver fuel other than the EMT technology. Further, this alternative ends up being the most costly because it involves melt-and-dilute treatment of the entire 60 tons of sodium-bonded fuel, as opposed to the 3 tons of driver fuel, and the treatment site is ANL-W, rather than the existing facility at the Savannah River Site ("SRS"). This illustrates a limitation of the current structure of the EIS. It would be more informative to provide environmental impact and cost information for the treatment of the two types of spent nuclear fuel separately. This would help identify the most environmentally protective (and cost effective) combination of treatment methods. **36-6** **36-7** **36-8** **36-7**

For example, DOE has not evaluated an alternative in which the blanket fuel is disposed of directly after removal of the bonded-sodium and the driver fuel is treated using the melt-and-dilute technology and facilities being developed at SRS.[2] Utilization of the existing SRS program would reduce costs by eliminating duplicative DOE research and development programs and facilities and benefit from economies of scale, which would in turn reduce their aggregate environmental impacts. The EIS must also include an evaluation of the reactivity of the sodium in the driver fuel and the potential risks this creates for its long-term disposal. It may be that the interdiffusion of the fuel, sodium, and cladding substantially reduces the reactivity of the sodium, making it acceptable for direct disposal in a geologic repository without further treatment. These alternatives, and their variants, must be evaluated in the EIS to arrive at the appropriate combination of treatment technologies for the driver and blanket fuel elements. **36-6** **36-9** **36-10** **36-6**

II. Conclusion

It is critical that DOE evaluate treatment strategies for the blanket and driver fuel elements separately. The EIS would benefit substantially from having the environmental and costs analyses of each treatment method presented separately for each fuel type. It is also essential that DOE evaluate alternatives that take advantage of existing technologies and programs, particularly the rapidly progressing melt-and-dilute project at SRS and well established mechanical methods for removing sodium from fuel elements. Finally, DOE cannot arbitrarily remove certain portions of its analysis, particularly its non-proliferation assessment, from the EIS; all aspects of DOE's assessment should be part of the EIS and available for public review and comment. **36-11** **36-8** **36-12** **36-13**

David E. Adelman
Project Attorney, Nuclear Program

[2] According to Natraj Iyer, the manager of the SRS melt-and-dilute program, "it is very realistic to make [the melt-and-dilute program a] success[]." He has also stated that they can allay the concerns that the Defense Nuclear Safety Board has raised.

Response to Commentor No. 36 (Cont'd):

result of comments received during the scoping period, DOE changed the proposed action of the EIS, the structure of alternatives, and the title of the EIS from the "Electrometallurgical Treatment of Sodium-Bonded Spent Nuclear Fuel in the Fuel Conditioning Facility at Argonne National Laboratory-West" to the "Treatment and Management of Sodium-Bonded Spent Nuclear Fuel." This change was made to address public concern about potential bias toward one treatment technology over others. The alternatives evaluated in the EIS were restructured to reflect differences in the characteristics of driver and blanket sodium-bonded spent nuclear fuel. Several alternatives were added to the EIS to address the treatment of driver and blanket spent nuclear fuel by different technologies. Conversely, because of the characteristics of sodium-bonded spent nuclear driver fuel, the maturity of existing technologies, and the availability of existing facilities to treat and manage the driver spent nuclear fuel, treatment technologies for driver spent nuclear fuel are currently limited to electrometallurgical and melt and dilute treatment technologies. A range of reasonable alternatives and technologies for the treatment of driver and blanket sodium-bonded spent nuclear fuel, as well as the No Action Alternative that includes direct disposal with no treatment, were evaluated in the EIS. In parallel, a separate assessment was conducted on the nonproliferation characteristics of all the treatment technologies considered in the EIS. The EIS and the conclusions of the Nonproliferation Impacts Assessment, along with other factors, will be considered during the decision-making process prior to publication of the Record of Decision.

36-6: As discussed in Section 2.5 of the EIS, although each alternative evaluates the treatment of both driver and blanket sodium-bonded spent nuclear fuel, the environmental impact analyses are sufficient to allow DOE to consider the separate treatment of driver and blanket fuel. As a result of the commentor's remarks, the possibility of treating sodium-bonded driver spent nuclear fuel using the melt and dilute process at the Savannah River Site was considered. It was dismissed from further evaluation, however, as indicated in the revised Section 2.6 of the EIS.

36-7: In response to public comments received at the public scoping meetings, DOE decided to analyze the driver and blanket spent nuclear fuel separately. Six treatment alternatives were evaluated in the EIS that included various combinations of fuel type and site location. However, as stated in Section 2.6 of the EIS, when preparing the Record of Decision DOE will consider all combinations of technologies, options, and fuel types, including those not among the specific combinations explicitly considered in the EIS.

Commentor No. 36: David E. Adelman

Response to Commentor No. 36 (Cont'd):

36-8: The SBSNF EIS was prepared in accordance with NEPA, Council on Environmental Quality regulations on implementing NEPA (40 CFR 1500-1508), and DOE's NEPA implementation procedures (10 CFR 1021). None of these require the inclusion of a cost analysis in an EIS. As discussed in the introduction, the basic objective of this EIS is to provide the public and DOE decision-makers with a description of the reasonable alternatives for the treatment and management of DOE's sodium-bonded spent nuclear fuel and their potential environmental impacts. However, DOE issued a separate Cost Study on August 12, 1999, that analyzes and compares the costs of the alternatives analyzed in the EIS. Cost will be considered during the decision-making process in preparing the Record of Decision.

36-9: Actual costs for treating and managing sodium-bonded spent nuclear fuel are not part of the EIS process. However, the cost of using SRS facilities is included in the August 1999 Cost Study. Cost will be one of the factors considered in preparing the Record of Decision for the treatment and management of sodium-bonded spent nuclear fuel.

36-10: As discussed in Section E.4.6, the EBR-II fuel at INTEC's Basins 666 and 66 are stored inside sealed stainless steel cans that prevent the contact of basin water with the fuel cladding. During the average 17 years of storage in Basin 666, 10 of the 2,148 cans were confirmed to have water in-leakage. With water inside these cans, a fuel-water reaction produced hydrogen gas, which created bubbles that allowed detection of the water in-leakage. These observations are consistent with the fact that sodium and metallic uranium react with water to produce hydrogen and this is the reason that all the sodium-bonded spent nuclear fuel is stored in dry storage or sealed containers that prevent the exposure of the fuel cladding to water. Under storage conditions in a geologic repository, fuel cladding could disintegrate over time, leading to the collection of a large amount of sodium within the confines of the storage can. If this fuel can were to fail, a large amount of sodium would be available to react with water in the repository. This could produce a violent reaction. DOE considers this condition to be unacceptable. The EIS, under the No Action alternative, analyzes a direct disposal option that is conditional on the acceptability of untreated sodium-bonded spent nuclear fuel in a repository. However, the feasibility and acceptability of such action remains to be determined.

36-11: Although each alternative presented in the EIS addresses the combined treatment and management of both driver and blanket sodium-bonded spent nuclear fuel, the analyses presented in Chapter 4 evaluate the impacts of the separate treatment of driver and blanket spent nuclear fuel. As

Commentor No. 36: David E. Adelman (Cont'd)

Response to Commentor No. 36 (Cont'd):

discussed in Section 2.5, DOE will consider the separate treatment of driver and blanket spent nuclear fuel in identifying a preferred alternative. In other words, DOE will consider combinations of technologies, options, and fuel types, including combinations not included among the specific combinations considered in the EIS.

36-12: The EIS evaluates reasonable treatment technologies (including existing technologies and programs) for the treatment and management of sodium-bonded spent nuclear fuel. The melt and dilute treatment process is part of Alternative 5, which is described in Section 2.5.6 of the EIS. The melt and dilute treatment process is also described in greater detail in Section 2.3.4 and Appendix C, Section C.5. The methods considered for removing metallic sodium from blanket sodium-bonded spent nuclear fuel elements are described in Section 2.3.9.

36-13: The Nonproliferation Impacts Assessment was prepared to provide additional pertinent information to the Secretary of Energy so that he may make an informed decision with respect to the treatment and management of DOE's sodium-bonded spent nuclear fuel. This document was mailed to interested parties on August 12, 1999, and was made available to attendees at all of the public hearings on the draft EIS. It should be noted that, although NEPA does not require inclusion of the information provided in the Nonproliferation Impacts Assessment in the EIS, it will be considered along with other pertinent data when the Record of Decision is prepared. Also, members of the public are free to direct any comments they may have on the Nonproliferation Impacts Assessment to DOE.

Commentor No. 37: Carol Murphy

SB SNF Toll Free Line

9/13/99

Carol Murphy
Dan Freeman

208-726-5929

I am calling to comment on the draft EIS. I am against pyroprocessing at the INEEL in Idaho and I'm also calling to request a 60 day extension. I understand that its been extended to September 28th but I believe it should be extended to at least the middle of November to get an EIS for Yucca Mountain and also until a full cost analysis has been done on different alternatives and several other reasons. I've written a letter. **37-1** **37-2** **37-3**

Response to Commentor No. 37:

37-1: The commentor's objection to electrometallurgical treatment (pyroprocessing) of sodium-bonded spent nuclear fuel at INEEL is noted.

37-2: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13, to September 28, 1999 (64 FR 49169).

37-3: At the request of several members of the public, DOE prepared and issued a separate Cost Study during the public comment period on the draft EIS. Copies of the Cost Study were mailed to interested members of the public and were also available at the four public hearings during August 1999. The Yucca Mountain EIS was issued in July 1999.

Commentor No. 38: Suzy Nielond

SB SNF Toll Free Line

9/20/99

Suzy Nielond

307-739-2430

My comment is that I think you should extend the comment period. We need at least 60 days minimum to at least find out about this and get all the information about this before we decide that it`s a bad idea which some of us have decided already. And that`s my comment I'm calling from Jackson, Wyoming. **38-1**

Response to Commentor No. 38:

38-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169). DOE made materials relevant to the review of the draft EIS available in public reading rooms and at a series of public hearings that were held on August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho and August 31, 1999, in Arlington, Virginia. The materials placed in the reading rooms included the electrometallurgical demonstration project environmental assessment, the Finding of No Significant Impact for the environmental assessment, National Research Council interim status reports on the demonstration project, the 1995 Settlement Agreement and Consent Order with the State of Idaho, the EIS scoping meeting transcripts and public hearing comments, and the draft EIS hearing presentations and fact sheets. In addition, completion of the Cost Study and Nonproliferation Impacts Assessment was expedited so that they would be available to the public during the comment period. These reports were mailed to interested parties on August 12, 1999, and were made available to the public at the public hearings on the draft EIS. Although these reports are not critical to the environmental impact analysis presented in the EIS, they will provide input to the Record of Decision. While the final National Research Council report on the electrometallurgical treatment demonstration project at ANL-W was published in April 2000, interim status reports were produced throughout the project and this data was used to prepare the EIS, as discussed in Section 1.6.3 of the EIS.

Commentor No. 39: Carol Murphy and Dan Freeman

CAROL MURPHY
PO BOX 4714
KETCHUM, ID.
83340

DAN FREEMAN
PO BOX 4285
KETCHUM, ID
83340

Ms. Susan Lesica
US DEPT of ENERGY
OFFICE OF NUCLEAR FACILITIES MNGMNT, NE 40
19901 GERMANTOWN RD
GERMANTOWN, MD. 20874-1290

Dear Ms. Lesica, Sept. 11, 1999

We are writing for two reasons.

One, is to ask for an extension on the comment period for the "DEIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel." We would like to see this comment period extended at least 60 days. We feel this is necessary because so much of the information relevant to the procedure is still unavailable. The public has the right to review this information, especially those of us in Idaho, therefore the comment period must be extended. PLEASE! **39-1** **39-2**

Secondly, we are writing to express our dissatisfaction with this proposed project for pyroprocessing. It is wasteful, takes money away from even greater environmental problems at the INEEL, and is just too efficient at "corporate welfare." Please DO NOT WASTE OUR TAXPAYER DOLLARS. PLEASE, DO NOT CREATE MORE NUCLEAR WASTE IN IDAHO or ANYWHERE ELSE. **39-3** **39-4** **39-5**

In summary, we are opposed to the procedure of pyroprocessing at the INEEL, and we feel that the comment period on the DEIS for this procedure needs to be extended for at least 60 days, and especially until the Yucca Mountain EIS is released.

Thank you for reading our comments.

Sincerely,

Carol Murphy
B.A. Economics
The Colorado College

Dan Freeman
B.A. Philosophy
Harvard University

Response to Commentor No. 39:

39-1: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

39-2: DOE made materials supporting preparation of the EIS available in the public reading rooms and at the public hearings held on August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho; and August 31, 1999, in Arlington, Virginia. These materials included the environmental assessment for the Electrometallurgical Treatment Research and Demonstration Project, the Finding of No Significant Impact for the environmental assessment, National Research Council reports, the 1995 Settlement Agreement and Consent Order with the State of Idaho, scoping period meeting transcripts and comments, and the draft EIS hearing presentations and fact sheets. In addition, completion of the Cost Study and Nonproliferation Impacts Assessment was expedited so that they also would be available to the public during the comment period. These reports were mailed to interested parties on August 12, 1999, and were available at the public hearings on the draft EIS. Although these reports are not critical to the environmental impact analysis presented in the EIS, they will be considered during the decision-making process in the preparation of the Record of Decision. While the final National Research Council report on the Electrometallurgical Treatment Research and Demonstration Project at ANL-W was published in April 2000, interim status reports were produced throughout the project. Data generated during the demonstration project were used in preparing the EIS, is discussed in Section 1.6.3 of the EIS.

39-3: The commentor's objection to electrometallurgical treatment (pyroprocessing) of sodium-bonded spent nuclear fuel is noted.

39-4: Congress determines how funds are allocated. DOE spends monies consistent with Congressional direction. DOE is not in a position to make the difficult tradeoffs that may be required between alternative Federal programs and spending priorities. The issue of funding for the treatment and management of sodium-bonded spent nuclear fuel is beyond the scope of the SBSNF EIS.

39-5: Chapter 4 of the EIS presents data that demonstrates that, compared to leaving the sodium-bonded spent nuclear fuel in its current form, treatment and management of the sodium-bonded spent nuclear fuel would significantly reduce the volume of high-level radioactive waste that needs to be disposed of in a geologic repository.

Commentor No. 40: Julie Bowles

SB SNF Toll Free Line

9/27/99

Julie Bowles
7209 Valley Heights Drive
Boise, ID 83709

I am in favor of not doing the pryoprocessing and that I think that it's a cost issue. I think it's a health issue and I understand that the DOE is looking at not doing it at INEEL and I think that's the right way to go. **40-1,-2** **40-3,-1**

Response to Commentor No. 40:

40-1: The commentor's objections to electrometallurgical treatment (pyroprocessing) of sodium-bonded spent nuclear fuel at INEEL is noted. The commentor's support for other alternatives is also noted.

40-2: Actual costs for treating and managing sodium-bonded spent nuclear fuel are not part of the EIS process. However, the Cost Study shows that electrometallurgical treatment (pyroprocessing) of the sodium-bonded spent nuclear fuel is neither the most nor least expensive alternative. Information from the Cost Study, the EIS, the public comments, and other sources will factor into the decision-making process leading to the Record of Decision.

40-3: As indicated in the EIS, the human health effects resulting from operational activities to treat and manage sodium-bonded fuel are very small. The estimated cumulative health effects to the public residing in the vicinity of INEEL from current and reasonably foreseeable future activities are summarized in Section 4.11.1.4 of the EIS. As indicated in this section, the expected health effects from these activities are very small. For example, an individual residing at the INEEL site boundary would be expected to receive a maximum radiation dose of 0.065 millirem per year from all releases, compared to natural background doses of 360 millirem per year, and are well below the regulatory limit of 10 millirem per year. Appendix E, Section E.2.1, of the EIS provides the Federal and DOE regulatory limits on radiation exposures.

Commentor No. 41: Steve Hopkins

FROM : FAX NO. : Sep. 28 1999 01:49PM P1

Snake River Alliance

Box 1731 · Boise ID 83701 · 208/344-9161 · Fax 208/344-9365 · Email: allister@snakeriveralliance.org
Box 4090 · Ketchum ID 83340 · 208/726-7271 · Fax 208-726-1531 · Email: mstewart@snakeriveralliance.org
310 E. Center · Pocatello ID 83201 · 208/234-4782 · Fax 232-4922 · Email: srabb@earthlink.net

September 28, 1999

Susan Lesica, Document Manager
Office of Nuclear Facilities Management
Office of Nuclear Energy, Science, and Technology
US Department of Energy, NE-40
19901 Germantown Road
Germantown, MD 20874-1290

Re: Comments of the Snake River Alliance on the "Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel"

Dear Ms. Lesica,

The following comments are made on behalf of the 1,300 members of the Snake River Alliance, an Idaho-based grassroots group that has monitored activities at the Idaho National Engineering and Environmental Laboratory since 1979.

Thank you for the opportunity to comment on this DEIS and for extending the public comment period. In addition, we thank you for analyzing the blanket and driver fuel separately due to their different chemical and radiological properties, and for refocusing the scope of the project to reflect possible need for treatment in general as opposed to need for treatment by pyroprocessing. **41-1**

As we previously stated during the scoping process on the Department of Energy's preparation of an environmental impact statement on electrometallurgical treatment (pyroprocessing) of sodium-bonded spent nuclear fuel, the preparation of this EIS is premature. In fact, if you should proceed with selecting pyroprocessing of this special case spent fuel at this time you will be admitting you are doing so for reasons that clearly have nothing to do with protection of human health and the environment. **41-2**

The fact that the DOE has reinstated funding to hold the Argonne pyroprocessing workforce in place between the start of FY2000 (for which no funding was previously requested) and the record of decision that will grow from the draft EIS is ample grounds for suspecting that the budget process rather than sound science is the driving force behind this EIS process. A DOE source quoted in Nucleonics Week, June 8, 1995, admitted to as much when he described pyroprocessing at Argonne-West as "just about the only thing they have left to do. . . . It's a jobs issue." **41-3**

During the environmental assessment process for the pyroprocessing demonstration project, Argonne argued that the number of blanket and driver spent fuel elements proposed for treatment through the EA was the absolute minimum required for **41-4**

Response to Commentor No. 41:

41-1: The comment is noted. DOE revised the scope of the EIS based on comments provided during the public scoping period.

41-2: DOE is committed to improving its environmental management practices, to operating its facilities in a manner that meets or exceeds all applicable environmental, safety, and health requirements, and to the cleanup of its environmental problems. The focus of the EIS is to assess the potential environmental and health impacts associated with the treatment and management of sodium-bonded spent nuclear fuel. Although not final, the latest guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999 (see Section 4.12.1 of the EIS), indicates that it is highly probable that sodium-bonded spent nuclear fuel would not be acceptable in the repository without some stabilization and/or removal of the metallic sodium. The stabilization of the spent nuclear fuel and/or removal of the metallic sodium will provide greater protection of human health and the environment. In addition, having completed the Electrometallurgical Treatment Research and Demonstration Project (see Section 1.6.3) and in planning the closure of its PUREX processing capabilities, DOE needs to decide whether this process is suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the EIS could result in the loss of capability and experienced, knowledgeable technical staff should DOE decide at a later date to use the electrometallurgical process to treat sodium-bonded spent nulcear fuel. Section 1.2 of the EIS has been revised for clarification.

41-3: ANL-W is involved in other DOE missions in addition to electrometallurgical treatment. Ongoing activities unrelated to electrometallurgical treatment at ANL-W include long-term waste storage gas generation testing at the Zero Physics Power Reactor; characterization and repackaging of mixed hazardous waste for shipment to the Waste Isolation Pilot Project at the Hot Fuel Examination Facility; conversion of sodium coolant from the EBR-II and Fermi reactors to chemically inert low-level radioactive waste in the sodium process facility; and deactivation of the EBR-II facility. The number of jobs affected by the electrometallurgical treatment alternative at ANL-W is presented in Section 4.2.3 of the EIS.

41-4: Final test results were made available in August 1999 and were used in the EIS. The success criteria established at the outset of the project were fulfilled. The environmental impact analysis associated with the

Commentor No. 41: Steve Hopkins (Cont'd)

FROM : FAX NO. : Sep. 28 1999 01:50PM P2

meaningful research to determine the effectiveness of pyroprocessing and thus the advisability of expanding the project. Now the DOE is moving forward with the EIS on expansion long before Argonne's demonstration project results have been analyzed. **41-4**

Key areas of concern about pyroprocessing for both the public and Congress have always been its cost and its impact on US nonproliferation efforts. Though these separate documents were released during the public comment period, they were not initially available along side the DEIS, and having them as separate documents makes it harder for the public to review all the impacts associated with the various proposed treatments. The Alliance was told these documents would be mailed out on August 9th, however they were not made available to us until the Boise hearing on August 24th. Initially, this gave us only three weeks to review the documents, incorporate that information into information gathered from the DEIS, and pass the information onto our members. That is not nearly enough time and again speaks to the haste with which this process is proceeding. **41-5**

Short-circuiting the nonproliferation analysis is particularly egregious in light of the pledge in the Notice of Intent to include this assessment in the draft EIS and the existence of such a DOE assessment from December 1998.

In 1994, then-DOE secretary Hazel O'leary asked Congress to stop funding the IFR. "Because it is based on plutonium reprocessing and recycle, continued development of the Integral Fast Reactor would undercut our efforts to discourage other countries from plutonium reprocessing and recycle." **Pyroprocessing represents the reprocessing component of the IFR program.** The fact that this technology could be, according to the DOE's recent non-proliferation assessment, at least perceived by other countries as a reprocessing technology for weapons material is compounded by INEEL's historical reprocessing role related to weapons production and the current on-site presence of plutonium and uranium suitable for bombs. **41-6**

The National Academy of Science has regularly evaluated the pyroprocessing demonstration project, which has increased the scientific integrity of Argonne's project. But the NAS final report on pyroprocessing will not be complete until well after the EIS public comment period has ended, hampering both the public's ability to comment and Argonne's ability to evaluate its own work. **41-7**

In 1995, Sandia National Laboratories recommended that "**...most decisions on** [spent fuel] **treatment or conditioning should wait until a repository type and site are known**" [bold italics in original]. Many observers, including the NAS, have repeatedly raised the issue of uncertainty vis a vis the waste forms that pyroprocessing will produce and their acceptability at a geologic repository. Since getting waste ready for a geologic repository is the justification for Argonne's project, it must not go forward until the waste produced by the demonstration project has been fully characterized, which will occur early in the next century. The necessity for this is made more apparent by indications that Argonne is still adjusting the pyroprocessing waste forms. **41-8**

Response to Commentor No. 41 (Cont'd):

electrometallurgical process alternatives was based on actual data from the project. Section 1.6.3 of the EIS summarizes the status and the results of the project.

41-5: In response to comments received during the scoping period, DOE expedited completion of the Cost Study and the Nonproliferation Impacts Assessment. These reports were mailed to interested parties on August 12, 1999, and also were made available to attendees at the public hearings on the draft EIS, which were held August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho; and August 31, 1999, in Arlington, Virginia. NEPA does not require inclusion of the information presented in these documents in the EIS; however, it will be considered along with other pertinent data when the Record of Decision is prepared. DOE extended the comment period from September 13 to September 28, 1999 (64 FR 49169) to provide commentors with an additional two weeks to review the draft EIS and associated documents and to pass the information on to other interested parties.

41-6: Although the Nonproliferation Impacts Assessment is not part of the EIS process, it fully analyzes the potential nonproliferation impacts of each of the proposed alternatives and technologies addressed in the EIS. The Notice of Intent to prepare the EIS stated, "The combination of the information contained in the draft EIS, the public comments in response to the draft EIS, and the Nonproliferation Impacts Assessment will enable the Department to make a sound decision…." As stated in the Nonproliferation Impacts Assessment, the alternatives involving PUREX reprocessing and broad application of electrometallurgical treatment of both driver and blanket fuel have a greater potential to provide encouragement to other countries to engage in plutonium reprocessing. Given the small quantity and unique characteristics of the sodium-bonded spent nuclear fuel and the reason for its treatment, however, such encouragement, if any, would be limited. The proposed use of electrometallurgical treatment technology would not add to the stockpile of weapons-usable fissile materials.

41-7: While the final report on the Electrometallurgical Treatment Research and Demonstration Project from the National Academy of Science's National Research Council was not available to the public during the comment period on the draft EIS, interim status reports were available in the public reading rooms. Thus, the public had an opportunity to review the information made available by the National Research Council prior to making comments on the draft EIS. The final National Research Council report on the

Commentor No. 41: Steve Hopkins (Cont'd)

FROM : FAX NO. : Sep. 28 1999 01:50PM P3

Though the Alliance's confidence in the governor's settlement agreement is not high, it should be noted that, if Idaho's sodium laced and/or bonded spent fuel is not reprocessed, the agreement mandates 2035 as its departure date. If it is reprocessed and therefore becomes high-level waste, there is no departure date in the agreement only a "target date" for road readiness. Argonne therefore has to account for long-term, not interim, storage costs (economic and environmental) at INEEL as well as all other costs associated with its production and disposition. **41-9**

It's worth noting here that the proposed action for the 17 MTHM of EBR2 fuel at Savannah River is not pyroprocessing. **41-10**

The Snake River Alliance has long supported the designation of spent fuel as a waste. The DOE has resisted that course. One result of this is that Argonne's 45% waste reduction argument for pyroprocessing is "off." At the very least, the DOE must account for the low enriched uranium pyroprocessing produces. To say it is a product, not a waste is to ignore the fact that, in the DOE's world, spent fuel is not a waste either. Discussion of the LEU stream must include a full analysis of what happens to this stream and when. **41-11**

In the past, the Alliance has prevailed upon the DOE to include ANL-W as a part of INEEL in environmental analyses. We would now encourage the DOE to consider ANL-W a part of the DOE's complex itself. If this occurs, it would highlight the necessity for coordinating the analysis in the present draft EIS (and the action chosen in the ROD) with the EIS on spent fuel management at Savannah River and the EIS on stabilization of high-level waste at INEEL. The INEEL EIS has particular relevance here. If the two studies (and decisions) are not coordinated, there may well be three high-level waste forms in one Idaho county. Again, analysis of those waste forms requires a full accounting of the economic and environmental costs of long-term management at INEEL. **41-12** **41-9**

Summary:

According to the section on potential facility accidents (pg.4-11), the sodium-bonded fuel ". . . is in a very safe and stable configuration and no reasonable foreseeable accident scenarios could be identified." If the spent fuel in question presented a near term risk to human health and the environment, the Alliance would support an alternative that could best stabilize it to lessen that risk. It is also the case that if a repository were open (and waste acceptance criteria known), and if such a facility was supported by the public through an open and scientifically credible public process, treatment of this fuel could potentially be justified. However, the DOE has not made even a weak case for treating this fuel at this time; there is no current repository for this spent fuel (not even *known* waste acceptance criteria), and there may never be. These facts and our previously related concerns about the issuance of this DEIS before important data are in **lead us to support the no action alternative at this time** in accordance with the ROD for the Programmatic Spent Nuclear Fuel EIS. If a case can be made in the future for treatment of this spent fuel due to risks posed to human health and the environment, we ask the **41-13** **41-14** **41-15**

Response to Commentor No. 41 (Cont'd):

demonstration project at ANL-W was published in April 2000. DOE will consider the data contained in this report in preparing the Record of Decision.

41-8: The process of establishing a repository is dependent on not only the site but also the materials to be disposed of. As part of most of the steps in this process a total system performance assessment that describes the probable behavior of a repository at Yucca Mountain is performed. The total system performance assessment includes the performance of the specific waste forms and inventories proposed for disposal. As part of this work to establish a repository, data for the waste forms are needed prior to final choice of the repository not after it. In fact, if specific waste forms are not represented in crucial documents like this EIS, additional documentation will be needed to allow the possibility of disposing of those materials in the repository. As part of the Electrometallurgical Treatment Research and Demonstration Project, ANL-W has interacted regularly with DOE and have provided conservative waste form data for the EIS.

41-9: This EIS evaluated the environmental impacts from treatment and management of sodium-bonded spent nuclear fuel up to 2035. This date is consistent with the State of Idaho Settlement Agreement and Consent Order that all spent nuclear fuel and high-level radioactive waste be removed from the State of Idaho by 2035. The commentor is correct in stating that the Settlement Agreement and Consent Order only requires the road-readiness of the high-level waste by the target date. Normal operation radiological effluent from potential fuel degradation during storage at INEEL up to 2035 are evaluated under the No Action Alternative in Section 4.2 of the EIS. As discussed in revised Section 2.5.1 of the EIS, a fundamental assumption made under the No Action Alternative is that sodium-bonded spent nuclear fuel would be disposed of in a repository, along with the rest of the DOE-owned spent nuclear fuel, within a finite period of time and under the institutional control of DOE. This SBSNF EIS covers a time period up to 2035, at which time sodium-bonded spent nuclear fuel stored in Idaho would need to be transported out of the state and either stored or treated at another DOE site. For such an eventuality, additional NEPA documentation would be required. The unlikely scenario that treated sodium-bonded spent nuclear fuel remains at its current site beyond 2035 because there is no geologic repository to accept it was evaluated as part of the No Action Alternative in Yucca Mountain Draft EIS, which was issued by DOE in July 1999. The Yucca Mountain EIS is discussed in Section 1.6.2.2.

41-10: EBR-II fuel currently located at SRS is declad blanket spent nuclear fuel that has been cleaned of sodium and placed in aluminum cans. This fuel is

Commentor No. 41: Steve Hopkins (Cont'd)

FROM : FAX NO. : Sep. 28 1999 01:51PM

DOE to reissue a Draft EIS incorporating the aforementioned information yet to be gathered, including a new nonproliferation assessment that assumes a more realistic view of pyroprocessing as a reprocessing technology. 41-15 (cont'd)

Again, thank you for the opportunity to comment on the draft EIS and for the deadline extension.

Respectfully submitted,

Steve Hopkins
Program Assistant
Snake River Alliance

Response to Commentor No. 41 (Cont'd):

not part of the sodium-bonded spent nuclear fuel considered in this EIS.

41-11: Section 4.1.2 and Section C.1 of Appendix C of the EIS describes the low enriched uranium product that would result from electrometallurgical treatment of sodium-bonded blanket spent nuclear fuel. After electrometallurgically treating the sodium-bonded spent nuclear fuel, metal ingots containing either low enriched or depleted uranium would be stored in the Materials Building within the Zero Power Physics Reactor at ANL-W, pending DOE's decision regarding final disposition of this uranium. Final disposition of the uranium product from electrometallurgical treatment is not within the scope of this EIS. DOE plans to conduct a separate NEPA review that will evaluate the disposition of surplus uranium.

41-12: As stated in the introduction, this SBSNF EIS follows the June 1995 Record of Decision (60 FR 28680) for DOE's Programmatic Spent Nuclear Fuel EIS, in which DOE decided to regionalize spent nuclear fuel management by fuel type for DOE-owned spent nuclear fuel. DOE also decided to: (1) continue environmental restoration activities at INEEL; (2) develop cost-effective treatment technologies for spent nuclear fuel and waste management; and (3) implement projects and facilities to prepare waste and treat spent nuclear fuel for interim storage and final disposition. The Record of Decision for the Programmatic Spent Nuclear Fuel EIS (60 FR 28680) provides the programmatic umbrella for the site-specific actions addressed in the EISs identified by the commentor, the SBSNF EIS, the Savannah River Spent Nuclear Fuel Management EIS, and the Idaho High-Level Waste and Facilities Disposition Draft EIS. As tiered NEPA documents, these EISs analyze the site-specific environmental impacts of implementing the actions proposed in each. The Savannah River Spent Nuclear Management Fuel EIS evaluates the impacts from the treatment of aluminum-clad and other spent nuclear fuel designated for treatment at SRS. The Idaho High-Level Waste and Facilities Disposition Draft EIS evaluates the impacts from processing specific amounts of calcined and sodium-bearing, high-level radioactive waste material currently located at INEEL. The materials (spent nuclear fuel and high-level radioactive waste) addressed in these EISs have unique characteristics and requirements which necessitate their separate evaluation. Each of the EISs identified by the commentor was incorporated by reference and used, as appropriate, in this SBSNF EIS. The contributory effects of these other ongoing NEPA actions at INEEL and SRS are evaluated as part of the cumulative impacts analysis for those sites (see Section 4.11 in the SBSNF EIS). The cumulative effect of the number and volume of high-level waste forms that could be located at INEEL is addressed

Commentor No. 41: Steve Hopkins

Response to Commentor No. 41 (Cont'd):

in Section 4.11.1.6 of the SBSNF EIS. DOE, in their Record of Decision, takes into account many factors besides this EIS, including ongoing DOE programs, missions, and related NEPA actions that have relevance (see Section 1.6 in the SBSNF EIS).

41-13: The timing for this action is a programmatic issue rather than a safety issue. As stated in Section 1.2 of the EIS, DOE considers it prudent to evaluate the alternative technologies now, while DOE is performing site characterization activities for the potential repository at Yucca Mountain. Although not final, the latest guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999 (see Section 4.12.1 of the EIS), indicates that it is highly probable that sodium-bonded spent nuclear fuel would not be acceptable in the repository without some stabilization and/or removal of the metallic sodium. The stabilization of the spent nuclear fuel and/or removal of the metallic sodium will provide greater protection of human health and the environment. Having completed the Electrometallurgical Treatment Research and Demonstration Project (see Section 1.6.3) and in planning the closure of its PUREX processing capabilities, DOE needs to decide whether these processes are suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the EIS could result in the loss of capability and of experienced, knowledgeable technical staff should DOE decide at a later date to use the electrometallurgical process to treat the sodium-bonded spent nuclear fuel. Section 1.2 of the EIS has been revised for clarification.

41-14: The commentor's support for a No Action Alternative, under which the only activities taking place concerning sodium-bonded spent nuclear fuel would be those dictated by the Record of Decision for the Programmatic Spent Nuclear Fuel EIS, is noted.

41-15: As stated in the Nonproliferation Impacts Assessment, DOE's Office of Arms Control and Nonproliferation has determined that, for this specific application, electrometallurgical treatment of this spent nuclear fuel is fully consistent with U.S. policy with respect to reprocessing and nonproliferation since it does not separate plutonium for reuse. Plutonium would be part of the ceramic waste form, which is more resistant to plutonium recovery than metallic waste forms such as those resulting from the melt and dilute and high-integrity can alternatives.

Commentor No. 42: Margaret Macdonald Stewart

_____Forward Header_____

Subject: Comments on DEIS on treatment and mgmt of sodium-bonded spent nuclear fuel
Author: mstewart@snakeriveralliance.org at INTERNET
Date: 9/28/99 2:55 PM

COMMENTS BY MARGARET MACDONALD STEWART ON DRAFT EIS FOR TREATMENT AND MANAGEMENT OF SODIUM-BONDED SPENT NUCLEAR FUEL

Attention: Sue Lesica 28 September 1999
NEPA Document Manager
Office of Nuclear Facilities Management
Department of Energy

The following are but a few of the comments I have to make on the Draft EIS on Treatment and Management of Sodium-Bonded Spent Nuclear Fuel:

To begin with, this DEIS is a very typical DOE document in that it is a magnificent example of "cart before the horse" mentality. The public is being asked to make comments on a document that is inadequate and is based on yet-unknown criteria. In order for people to make informed and intelligent comments, it would therefore make sense to allow them access to all pertinent information upon which to base those comments. **42-1**

The comment period extension was not adequate. A 15-day extension is almost a joke considering the information made available by DOE is still not adequate. This extension period is a flimsy ploy to placate a public that has not been given all the information it needs to comment. **42-2**

The DEIS is incomplete for the following reasons and more:

Where is the National Academy of Science's review of the proposed treatment? **42-3**

The cost analysis of various alternative treatment methods is missing. **42-4**

This entire document is based on transporting the pyroprocessing waste to Yucca Mountain. The Yucca Mountain EIS has not yet been released and no one knows the waste acceptance criteria. It could well end up that the pyro waste would be unacceptable for Yucca Mountain storage. What would be the end scenario in such an event? **42-5**

I have not received a copy of the recently released DOE nuclear weapons proliferation assessment. Why? Has it really been released? How do I get a copy, since I receive nearly everything DOE ever prints? **42-6**

Response to Commentor No. 42:

42-1: DOE has made every effort to obtain and analyze all of the information it needs to make a decision on the treatment and management of its sodium-bonded spent nuclear fuel. DOE has analyzed input from the public (during the public scoping and comment periods on the draft EIS), as well as from Federal and state agencies and local and Tribal governments. It has also reviewed site-specific information on the environmental conditions prevailing at ANL-W, INEEL, and SRS, as well as documentation related to each of the proposed treatment technologies. DOE made material supporting the preparation of the EIS available in public reading rooms and at a series of public hearings that were advertised in the Federal Register, as well as local newspapers. In addition, completion of the Cost Study and Nonproliferation Impacts Assessment was expedited so that they would be available to the public during the comment period. These reports were mailed to interested parties on August 12, 1999, and were made available to attendees at all of the public hearings on the draft EIS, which were held August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho; and August 31, 1999, in Arlington, Virginia. While the final National Research Council report on the demonstration project at ANL-W was published in April 2000, interim status reports were produced throughout the project and are available in the public reading rooms. Considering the additional time provided by the extension of the comment period and the availability of the data used to prepare the EIS, DOE does not believe that a second draft is warranted.

42-2: The original comment period on the draft EIS was set at 45 days in compliance with the Council on Environmental Quality's "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act" (40 CFR 1506.10(c)). In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169). The extension of the comment period reflects DOE's commitment to the NEPA process by ensuring that the public had more time to review the EIS than the 45-day period required by Council on Environmental Quality guidelines.

42-3: The National Academy of Sciences' National Research Council prepared interim status reports on the results of the Electrometallurgical Treatment Research and Demonstration Project that have been reviewed by DOE. All of these reports are available in DOE public reading rooms. The National Research Council completed their evaluation of the electrometallurgical

Commentor No. 42: Margaret Macdonald Stewart (Cont'd)

The test or demonstration project on the proposed treatment of this sodium-bonded spent nuclear fuel being done at Argonne-West will not be completed with results available until the end of September at the earliest. How can the public comment on this proposed treatment without the results of this critical demo project??

42-7

I respectfully request that the DOE complete all the necessary documentation and resubmit a second DEIS on this subject, when it has included ALL the information necessary for the public to make informed and accurate comments. With only the information made available in this inadequate DEIS, it is obvious that DOE has already made up its mind on the preferred alternative, and this leaves the public - once again - feeling they have been left out of the democratic process when it comes to decisions made by DOE. A very poor attempt that needs to be redone.

42-8

42-9

42-8

Sincerely,

Margaret Macdonald Stewart
Box 4090
Ketchum, ID 83340

Response to Commentor No. 42 (Cont'd):

treatment demonstration project in September 1999 and published their final summary report in April 2000. The final report findings will be considered during the decision-making process leading to the Record of Decision.

42-4: The SBSNF EIS was prepared in accordance with NEPA, Council on Environmental Quality regulations on implementing NEPA (40 CFR 1500-1508), and DOE's NEPA implementation procedures (10 CFR 1021). None of these require the inclusion of a cost analysis in an EIS. As discussed in the introduction, the basic objective of this EIS is to provide the public and DOE decision-makers with a description of the reasonable alternatives for the treatment and management of DOE's sodium-bonded spent nuclear fuel and their potential environmental impacts. However, DOE issued a separate Cost Study on August 12, 1999, that analyzes and compares the costs of the alternatives analyzed in the EIS. Cost will be considered during the decision-making process in preparing the Record of Decision.

42-5: As discussed in Section 2.7 of this EIS, final waste acceptance criteria are still being developed for a geologic repository. DOE expects the waste forms that would be produced by the proposed action would be suitable for disposal in a geologic repository. In July 1999, DOE published a Draft Yucca Mountain EIS, which is discussed in Section 1.6.2.2 of this EIS. The Yucca Mountain EIS assumes that sodium-bonded spent nuclear fuel is treated using the electrometallurgical process prior to emplacement in the repository.

42-6: The Nonproliferation Impacts Assessment was mailed to those persons on the SBSNF EIS mailing list on August 12, 1999. It was also made available to attendees at the public hearings on the draft EIS, which were held August 17, 1999, in North Augusta, South Carolina; August 24, 1999, in Boise, Idaho; August 26, 1999, in Idaho Falls, Idaho; and August 1, 1999, in Arlington, Virginia. A copy of the report has been forwarded to the commentor.

42-7: Final test results were made available in August 1999 and were used in the EIS. The success criteria established at the outset of the project were fulfilled. The environmental impact analysis associated with the electrometallurgical process alternatives was based on actual data from the project. Section 1.6.3 of the EIS summarizes the status and the results of the project.

42-8: DOE has made material supporting the preparation of the EIS available in public reading rooms and through a series of public hearings which were advertised in the Federal Register, as well as local newspapers. In addition,

Commentor No. 42: Margaret Macdonald Stewart

Response to Commentor No. 42 (Cont'd):

completion of the Cost Study and Nonproliferation Impacts Assessment was expedited so that these would be available to the public during the comment period. These reports were mailed to interested parties on August 12, 1999, and were made available to attendees at all of the public hearings on the draft EIS. While the final National Research Council report on the Electrometallurgical Treatment Research and Demonstration Project at ANL-W was published in April 2000, interim status reports have been produced throughout the project and these are available in the public reading rooms. Considering the additional time provided by the extension of the comment period and the availability of the data used to prepare the EIS, DOE does not feel that a second draft is warranted.

42-9: The NEPA process provides a number of opportunities for the public to participate in the preparation of an EIS. For example, the public had the opportunity to attend scoping meetings and public hearings on the draft EIS, at which time they could make comments and speak directly to DOE and ANL personnel. These meetings were held in North Augusta, South Carolina; Boise, Idaho; Idaho Falls, Idaho; and Arlington, Virginia. The public also had the opportunity to comment on the EIS through the U.S. mail, e-mail, a toll-free FAX number, and a toll-free phone number. DOE takes this participation seriously. For example, DOE made a number of changes in the draft EIS in response to comments received during the scoping meetings, including dropping electrometallurgical treatment of sodium-bonded spent nuclear fuel at ANL-W as the Preferred Alternative from the beginning of the EIS process. In preparing the final EIS, DOE also carefully considered all comments received from the public. Thus, the public was not left out of the NEPA process for preparing this EIS.

Commentor No. 43: Willie R. Taylor

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D.C. 20240

SEP 7 1999

In Reply Refer To:
ER 99/637

Ms. Susan Lesica
Document Manager
Office of Nuclear Facilities Management (NE-40)
Office of Nuclear Energy, Science, and Technology
U. S. Department of Energy
19901 Germantown Road
Germantown, MD 20874-1290

Dear Ms. Lesica:

The United States Department of the Interior (Department) has reviewed the draft environmental impact statement (DEIS) for the treatment and management of sodium-bonded spent nuclear fuel and offers the following comments.

General Comments

From review of the DEIS it is unclear if the proposed treatment and storage of sodium-bonded spent nuclear fuel at the Savannah River Site will represent a substantial risk to Departmental trust resources. The analysis reveals that all alternatives will impact air quality and at least one of the alternatives will impact water resources. It has also accordingly been shown that ecological receptors occur within the affected environment. However, the document does not address potential impacts to these resources in the discussion of environmental consequences. We suggest that further revisions of the EIS reflect that appropriate consideration was given to both the human and ecological environments. **43-1**

Specific Comments

Section 2.10.2 -The second sentence of the second paragraph, states the radiological and nonradiological gaseous and liquid effluents, as well as the associated exposures to workers and the public, are well below regulatory standards and guidelines. However, these referenced standards and guidelines are not clearly represented in the document. It would be helpful if they were incorporated into *Table 2-4 Summary of Environmental Consequences for the Treatment and Management of Sodium-bonded Spent Nuclear Fuel* in the revised EIS. **43-2**

Section 4.4.4.1. - In the last paragraph of this section there is a typo which references a section of the text that does not exist, 3.2.12.2. We believe that the proper section identifier is 3.2.10.2. **43-3**

Response to Commentor No. 43:

43-1: As stated in Section 4.1.1, no radiological damage to plant and animal populations would be expected as the result of the proposed action because the estimated doses to the human population are well below threshold values for which effects to plants and animals would be expected. The EIS also identifies chemical releases to the air and water resources at SRS. These releases are essentially independent of the fuel being processed. They are generated from the operations of various facilities. The quantities of releases attributable to treatment of the fuel in this EIS are a very small fraction of the current releases at the site. Recent site environmental reports (years 1996-1998) did not identify any measurable impacts on plants and animals because the amounts emitted are very low or the chemicals have little potential for causing negative effects. Therefore, no chemical damage to plant and animal populations are expected to result from treatment of the fuel, as explained in this EIS.

43-2: Regulatory limits and guidelines for radiological and nonradiological effluent and associated exposures to workers and members of the public are presented in Section 4.1.3 and Appendix E of the EIS. Appropriate footnotes have been added to Table 2-4.

43-3: The commentor is correct. The section numbering cited by the commentor has been revised.

Commentor No. 43: Willie R. Taylor (Cont'd)

Section 4.10.2.1 - Assessment of impacts to air resources from nonradiological and radiological air pollutants is limited to concentrations at the site boundary. Many fish and wildlife resources, and possibly humans, will likely be exposed to air pollutants within the site boundary. Therefore, it is likely that impacts from air pollutants have been underestimated for wildlife populations occurring within the site boundary. **43-4**

The Department appreciates the opportunity to review the DEIS. We hope our comments will be useful in your evaluation of various alternatives for this project. We will be happy to provide any further assistance that you may need.

Sincerely,

Willie R. Taylor
Director
Office of Environmental Policy
and Compliance

Response to Commentor No. 43 (Cont'd):

43-4: Site annual environmental reports monitor conditions within the site boundaries at SRS and INEEL and have not identified any measurable impacts on fish and wildlife resources. Releases and emissions as a result of the proposed action are a small fraction of the current releases and emissions from each site. Therefore, no impacts to ecological resources are expected to occur from the incremental contribution to cumulative impacts at SRS or INEEL from the treatment and management of sodium-bonded spent nuclear fuel.

Commentor No. 44: Kathryn Graves

Kathryn Graves
Box 4185
Hailey, ID 83333

Ms Susan Lesica
US Dept Energy
Office of Nuclear Facilities Mgt., NE-40
19901 Germantown Rd.
German town, Maryland
20874-1290

September 7, 1999

To whom it may concern:

I would like to comment on the "Draft Environmental Impact statement for the Treatment and Management of Sodium-Bonded spent Nuclear fuel."

I think there are several things wrong with pyroprocessing

Firstly, it separates out bomb-grade uranium. Isn't that counterproductive to our nonproliferation goals? **44-1**

Secondly, this will create new forms of nuclear waste. We have thirty to forty years worth of nuclear waste here at INEEL That we don't know what to do with. **44-2**

Thirdly, There are great waste/storage/and Cleanup problems at INEEL that need to be dealt w/ first. **44-3**

Please note that I am against pyroprocessing. And I am also requesting a 60-day extension of the comment period. **44-4**

Sincerely,

Response to Commentor No. 44:

44-1: The assessment of nonproliferation impacts is not a part of the EIS process. None of the alternatives analyzed in this EIS would generate weapons-usable fissile materials at INEEL. Although highly enriched uranium would be an interim product, it would be down-blended to low enriched uranium during electrometallurgical treatment.

44-2: Electrometallurgical treatment (pyroprocessing) has been evaluated and successfully demonstrated in a three-year program at ANL-W that was continuously reviewed by a National Academy of Sciences' National Research Council Committee that concluded that electrometallurgical treatment is a feasible process for treating sodium-bonded spent nuclear fuel. All of the alternatives evaluated in this EIS would produce some forms of high-level radioactive waste. The electrometallurgical treatment alternative produces two new waste forms, both of which are more stable than nontreated sodium-bonded spent nuclear fuel. DOE is confident that these new waste forms will be acceptable for emplacement in a geologic repository. All waste, storage, and cleanup problems are being addressed in parallel with the SBSNF EIS. Other EISs that have been or are expected to be issued evaluate radioactive waste, and spent nuclear fuel at INEEL.

44-3: The commentor's objection to electrometallurgical treatment (pyroprocessing) of sodium-bonded spent nuclear fuel is noted.

44-4: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

Commentor No. 45: Marlise A. Teasley

Sept 2-99

Ms. Susan Stiles
US DOE
Office of Nuclear Facilities Mgt. NE40
19901 Germantown Road
Germantown, Maryland 20874-1290

Dear Ms. Stiles:

I am a native Idahoan who has followed as closely as I could the many problems at the INEEL for the past 15 years.

I have visited the site two times and thus, have some idea of the magnitude of the waste management problems created in the past which are compounded by the continuing use of this already overburdened facility as a "waste dump."

Because of the lack of visible information regarding the feasibility of pyroprocessing, the cost, the potential "fallout" regarding those

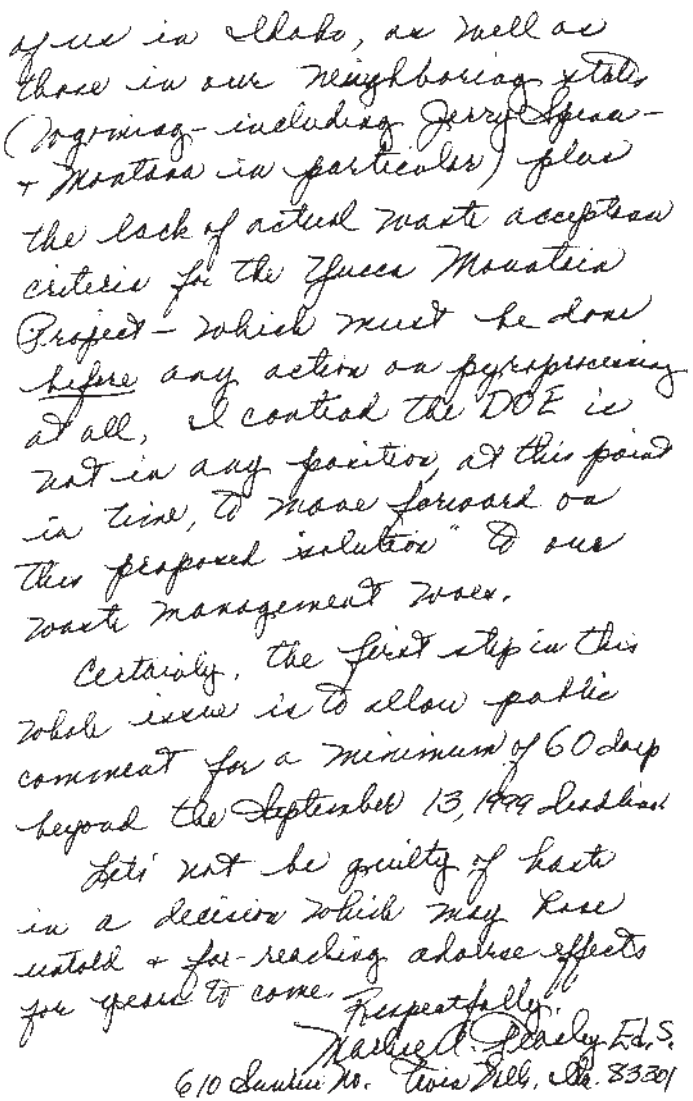
45-1

45-2

Response to Commentor No. 45:

45-1: DOE is committed to improving its environmental management practices, to operating its facilities in a manner that meets or exceeds all applicable environmental, safety, and health requirements, and to the cleanup of its environmental problems. DOE has a very aggressive cleanup program and has worked with the EPA, states, and stakeholders to develop long-range programs and commitments to clean up its facilities to acceptable levels. As stated in the introduction to this EIS, DOE proposes to treat the sodium-bonded spent nuclear fuel and facilitate its ultimate disposal in a geologic repository outside the State of Idaho. While the commentor's opinion about INEEL is noted, this comment is beyond the scope of the SBSNF EIS. The focus of the SBSNF EIS is to assess the potential environmental and health impacts associated with the treatment and management of sodium-bonded spent nuclear fuel.

45-2: As stated in the introduction to the SBSNF EIS, the programmatic risk in implementing any of the potential alternatives for the treatment and management of sodium-bonded spent nuclear fuel, or of not treating this fuel, is the uncertainty surrounding the acceptability of DOE spent nuclear fuel for emplacement in a potential geologic repository. Although not final, the latest guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999 (see Section 4.12.1 of the EIS), indicates it is highly probable that sodium-bonded spent nuclear fuel would not be acceptable in the repository without some stabilization and/or removal of the metallic sodium. The stabilization of the spent nuclear fuel and/or removal of the metallic sodium will provide greater protection of human health and the environment. Having completed the Electrometallurgical Treatment Research and Demonstration Project (see Section 1.6.3), and in planning the closure of its PUREX processing capabilities, DOE needs to decide whether these processes are suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the EIS could result in a loss of capability and of experienced, knowledgeable technical staff should DOE decide at a later date to use the electrometallurgical process to treat sodium-bonded spent nuclear fuel. Section 1.2 of the EIS has been revised for clarification.



your in Idaho, as well as those in our neighboring states (Wyoming - including Jerry Sprague + Montana in particular) plus the lack of actual waste acceptance criteria for the Yucca Mountain Project - which must be done before any action on preprocessing at all, I contend the DOE is not in any position, at this point in time, to move forward on this proposed solution to our waste management woes.

Certainly, the first step in this whole issue is to allow public comment for a minimum of 60 days beyond the September 13, 1999 deadline.

Let's not be guilty of haste in a decision which may have untold + far-reaching adverse effects for years to come.

Respectfully,
Marlise A. Teasley Ed.S.
610 Sunrise No. Twin Falls, Ida. 83301

45-2 (cont'd)

45-3

45-2

45-3: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13 to September 28, 1999 (64 FR 49169).

Commentor No. 46: H. Zerriffi & L. Ledwidge

Sept. 29, 1999

To: Susan Jessica, NE-40
Fr: Lisa Ledwidge
cc: Hisham Zerriffi

Attached please find an UPDATED VERSION of IEER's comments on
the Draft
Environmental Impact Statement for the Treatment and Management
of
Sodium-Bonded Spent Nuclear Fuel.

We noticed a slight grammatical error on the version that was
emailed to
you yesterday (from Hisham Zerriffi). Please replace that
version with the
one herein.

Thank you very much.

Lisa Ledwidge
Outreach Coordinator and Editor, Science for Democratic Action
Institute for Energy and Environmental Research (IEER)
6935 Laurel Ave., Suite 204
Takoma Park, MD 20912 USA
(301) 270-5500 fax: (301) 270-3029
http://www.ieer.org

SBSNFCOM.DOC

Response to Commentor No. 46:

Commentor No. 46: H. Zerriffi & L. Ledwidge (Cont'd)

INSTITUTE FOR ENERGY AND ENVIRONMENTAL RESEARCH

6935 Laurel Avenue, Suite 204
Takoma Park, MD 20912
Phone: (301) 270-5500
FAX: (301) 270-3029
e-mail: ieer@ieer.org
http://www.ieer.org

Comments of the Institute for Energy and Environmental Research (IEER) on the *Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE/EIS-0306D)

Hisham Zerriffi, Project Scientist
Lisa Ledwidge, Outreach Coordinator
9/28/1999

The Department of Energy (DOE) has once again released a Draft Environmental Impact Statement which demonstrates its willingness to sacrifice environmental protection and nonproliferation in order to pursue its programmatic goals. The *Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE/EIS-0306D, hereinafter referred to as DEIS) analyzes options for processing spent nuclear fuel which is contaminated with metallic sodium. With the exception of the "No Action Alternative" all six alternatives involve processing the spent fuel in such a way as to have serious repercussions on the proliferation of plutonium. **46-1**

What is worse is that this document makes it clear that the DOE wants to undertake a proliferation risky program under the guise of Environmental Management. And, to make matters even worse, one of the technologies being proposed is responsible for a significant portion of the Energy Department's environmental management problems. PUREX is a technology which for decades has separated plutonium for use in nuclear weapons and created extensive environmental problems and safety risks in both Washington and South Carolina. There are currently millions of gallons of liquid radioactive waste from PUREX operations threatening both the Columbia River and the Savannah River. **46-2**

The Energy Department proposes six alternatives for treating spent nuclear fuel contaminated with reactive metal sodium. The fuel is the result of the research program attempting to develop liquid metal fast breeder nuclear reactors. These used liquid metal sodium as a coolant.[1] The spent fuel consists mainly of two types: driver (used to maintain the chain reaction in the core) and blanket (used to breed plutonium-239). During irradiation, some of the metallic sodium enters and mixes with both the fuel and outer cladding (in the case of the driver fuel) or mixes with the outer cladding (in the case

[1] See Arjun Makhijani and Scott Saleska, *The Nuclear Power Deception: U.S. Nuclear Mythology From Electricity "Too Cheap to Meter" to "Inherently safe" Reactors*. (New York: Apex Press, 1999) for a description of fast breeder reactors and an explanation of why metallic sodium was used as a coolant.

Response to Commentor No. 46 (Cont'd):

46-1: Although the assessment of nonproliferation impacts is not part of the EIS process, DOE's Office of Arms Control and Nonproliferation assessed the potential nonproliferation impacts that may result from each of the proposed alternatives and technologies analyzed in this EIS. The report stated that, for this specific application, all of the alternatives except PUREX processing at SRS are fully consistent with U.S. policy on reprocessing and nonproliferation. Alternative 3, PUREX processing, is the only alternative that would generate weapons-usable fissile material, including plutonium. This plutonium would be managed along with other surplus plutonium, as described in the Surplus Plutonium Disposition EIS.

46-2: As described in Section 2.5.4 of the EIS, DOE is considering PUREX processing at F-Canyon as one of the alternatives for treatment and management of the sodium-bonded spent nuclear fuel. This process, as explained in Section 4.5.6, would produce liquid high-level and low-level radioactive waste. The liquid high-level radioactive waste would be vitrified at the Defense Waste Processing Facility and transformed to a borosilicate glass waste form in preparation for disposal in a geological repository. DOE has evaluated the impacts from current and future liquid waste storage and processing in the Defense Waste Processing Facility EIS and its Supplement (DOE/EIS-0082 and DOE/EIS-0082-S), as well as the Interim Management of Nuclear Material EIS (DOE/EIS-0220). Section 3.3.4.1 of this EIS and annual SRS environmental reports provide descriptions of current water quality conditions in the Savannah River at SRS. The liquid radiological effluent from PUREX treatment of declad and cleaned blanket spent nuclear fuel in F-Canyon would not exceed current operating parameters. The impacts of processing the liquid radioactive waste currently stored at the Hanford, Washington, site are beyond the scope of this EIS.

Commentor No. 46: H. Zerriffi & L. Ledwidge (Cont'd)

of blanket fuel). (p. 2-1 – 2-3) Of the 60 metric tons of sodium-bonded spent fuel, 57 metric tons is blanket fuel which can have the sodium removed through a method which does not process the fuel element itself (other than to remove the outer cladding).[2]

It is necessary to begin by noting the fact that this action is premature. The DEIS identifies no immediate environmental or health concerns for this action. Rather, the Purpose and Need for Action is because "[T]he presence of metallic sodium in the sodium-bonded spent nuclear fuel could complicate the disposal certification and licensing for the ultimate disposal of this spent nuclear fuel in a geologic repository." (p.1-3) This is because metallic sodium can react violently under certain conditions, including a possibility of spontaneous ignition. These reactions produce "heat, potentially explosive hydrogen gas, and sodium hydroxide, a corrosive substance." (p. 1-3) However, these concerns relate to the long-term management of this spent fuel. As is indicated in the "No Action Alternative" it is possible to undertake some stabilization activities to prevent immediate degradation while other alternatives are developed.

The DEIS goes on to state that pure plutonium metal and pure uranium metal are also reactive and the "waste acceptance criteria probably will exclude reactive materials unless their packaging minimizes the probability of rapid oxidation." (p. 1-3) Finally, the DEIS notes that some of the fuel contains HEU which "may require special criticality control measures." (p. 1-3) **46-3**

However, some very obvious facts concerning the purported "Need for Action" call into question both the need and timing of this action.

- There is no pressing need for this action in order to address immediate safety, environmental or health problems. This needs to be clearly stated in the "Purpose and Need for Action" section of the final Environmental Impact Statement. What is at issue is the "disposal certification and licensing for the ultimate disposal of this spent fuel in a geologic repository." (1-3) The spent fuel can be managed with better storage after some minimal preparation.
- There is no guarantee that Yucca Mountain will be selected as the high-level waste repository. Considerable technical controversy over its suitability still remains. **46-4**
- Even if Yucca Mountain is chosen, the final waste acceptance criteria have not yet been established and the DEIS itself states that there is a programmatic risk that the final waste forms will not meet the criteria. (1-1) The argument in the DEIS that potential waste forms should be developed in parallel with the repository is inconsistent with the fact that processing would start in the Year 2000. This is five years before the estimated time for receiving a construction permit from the Nuclear Regulatory Commission, a necessary step in developing final waste form criteria. The DOE is proposing to actually process this spent fuel, not develop "potential waste **46-5** **46-6**

[2] All six alternatives involve processing of at least a portion of the spent fuel. Five of the six alternatives would use a process called Electrometallurgical Treatment (EMT) at Argonne National Laboratory – West at the Idaho National Engineering and Environmental Laboratory in Idaho. This process, a subset of a reprocessing technology called pyro-processing, entails significant proliferation risks which are discussed below. Additionally, one of the options would use the traditional PUREX reprocessing technology at the Savannah River Site in South Carolina for a portion of the fuel.

Response to Commentor No. 46 (Cont'd):

46-3: The timing for this action is a programmatic issue rather than a safety issue. As stated in Section 1.2 of the SBSNF EIS, DOE considers that it is prudent to evaluate the alternative technologies now, while DOE is performing site characterization activities for the potential repository at Yucca Mountain. Although not final, the latest guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999 (see Section 4.12.1 of the EIS), indicates that there is a high probability that sodium-bonded spent nuclear fuel would not be acceptable in the repository without some stabilization and/or removal of the metallic sodium. The stabilization of the spent nuclear fuel and/or removal of the metallic sodium will provide for a greater protection of human health and the environment. Having completed the Electrometallurgical Treatment Research and Demonstration Project (see Section 1.6.3) and in planning the closure of the PUREX processing capabilities, DOE now needs to decide whether these processes are suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the EIS could result in the loss of capability and experienced, knowledgeable technical staff should DOE decide at a later date, to use the electrometallurgical process to treat sodium-bonded spent nuclear fuel. Section 1.2 of the EIS has been revised for clarification.

46-4: The commentor's support for continued storage is noted. The SBSNF EIS does not assume that Yucca Mountain will be selected as the high-level waste repository. It only assumes that, at some time in the future, a geologic waste repository will be licensed and operated by DOE which would receive spent nuclear fuel and high-level radioactive waste.

46-5: See response to comment 46-3.

46-6: DOE acknowledges the commentors' support of the No Action Alternative. As stated in the introduction to the EIS, the programmatic risk in implementing any of the potential alternatives for the treatment and management of sodium-bonded spent nuclear fuel, or of not treating this fuel, is the uncertainty surrounding the acceptability of DOE spent nuclear fuel for placement in a potential geologic repository. (See response to comment 46-3.) The development of waste forms in parallel with the development of the repository is one of many considerations discussed in Section 1.2 (Purpose and Need for Action) of the EIS. The primary

forms." Therefore, these are not parallel processes, but rather sequential processes undertaken in the wrong order. **46-6 (cont'd)**

- There are no immediate time constraints posed by the State of Idaho Settlement Agreement since it does not require spent fuel to be removed until 2035 and the longest processing time listed in the DEIS is 13 years. **46-7**
- Of the 60 MT of spent fuel, 57 MT can have the sodium removed without any of the processing listed in the DEIS through the high temperature cleaning process described in Section 2.4.9. This fact should be made much clearer in the DEIS. It should also note that the uranium in this 57 MT is not HEU. Therefore, if the final waste acceptance criteria require sodium removal, it would only apply to 3 MT of fuel. **46-8**
- The DEIS does not mention the fact that there is significantly more HEU in naval spent nuclear fuel slated to go to Yucca Mountain than is contained in the sodium bonded spent fuel.[3] As the DOE proposes to directly place naval fuel in Yucca Mountain, it is not clear why the HEU in the sodium fuel needs to be separated and isotopically diluted. **46-9**
- The DEIS does not mention the fact that the sodium bonded spent fuel is only a small portion of the metallic uranium fuel in the Energy Department's inventory.[4] The majority of the Uranium metal fuel (including fuels made of uranium alloys) is from the N-reactor. There is no indication that N-reactor fuel will be processed to change the form of the Uranium. As this fuel will also contain plutonium, it is not clear why the metal form of the U and Pu in the sodium bonded spent fuel is a problem that cannot be mitigated. The Environmental Impact Statement itself states that reactive metals may be allowed if packaged to minimize rapid oxidation. (1-3) The overwhelming emphasis placed on the sodium in the DEIS also indicates that the metal U and Pu are of secondary concern. If this is not the case, the DEIS should be clear under what circumstances the U or Pu can be expected to be reactive and what other mitigation measures are possible. **46-10**
- The DEIS should also be clear that some of the processing is specifically for the metallic uranium and plutonium. For example, PUREX processing of blanket fuel would occur *after* sodium removal in an argon hot-cell. Thus, PUREX is not a factor in making the fuel safe from the risks of metallic sodium. PUREX would be used to change the form of the uranium (the final form of the plutonium would still be metal, only it would be separated plutonium metal). **46-11**

In the "Background" section of the DEIS, it is noted that the research and demonstration project for Electrometallurgical Treatment (EMT) was coming to an end in August, 1999. EMT is one of the main technologies under consideration in this DEIS, and, in fact, the original scope of the DEIS was supposed to be only EMT. What the **46-12**

[3] The DOE anticipates 65 metric tons of heavy metal (MTHM) of naval spent nuclear fuel through 2035. U.S. Department of Energy, Office of Civilian Radioactive Waste Management, *Draft Environmental Impact Statement for a geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* DOE/EIS-0250D, July 1999. p. A-24

[4] ibid., p. A-24

consideration is the removal or conversion of metallic sodium to a nonreactive form.

46-7: The timing for the proposed action is not primarily dictated by constraints imposed by the State of Idaho Settlement Agreement and Consent Order. See response to comment 46-3.

46-8: The EIS, under Alternative 2 (Section 2.5.3), analyzes the environmental impacts of removing sodium from 57 metric tons of blanket sodium-bonded spent nuclear fuel and the subsequent packaging of this fuel in high-integrity cans. The environmental consequences of this action are presented in Section 4.4. As described in Appendix D, Section D.3.2.2, the uranium in the 57 metric tons of blanket fuel is depleted uranium and not highly-enriched uranium. Section 2.2 of the EIS was revised to be consistent with the information presented in Appendix D. If the finalized waste acceptance criteria for the repository require the removal of sodium from the spent nuclear fuel, this requirement would apply to all of the 60 metric tons of sodium-bonded spent nuclear fuel addressed in this EIS. As described in Sections 2.2 and 2.3.9 (Section 2.4.9 in the draft EIS), different treatment methods are required for the removal of sodium from driver fuel (3 metric tons) and blanket fuel (57 metric tons).

46-9: Disposal of HEU requires criticality control measures. Isotopic dilution of the HEU, while not necessary, would alleviate criticality concerns.

46-10: Section 2.2 of the EIS states that the 60 metric tons of heavy metal of sodium-bonded spent nuclear fuel constitutes approximately 2 percent of DOE's total current spent nuclear fuel inventory of nearly 2,500 metric tons of heavy metal. According to the latest guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999, DOE spent nuclear fuel "may be accepted as bare fuel. The specific acceptance criteria for this bare fuel will be developed on a case by case basis." Therefore, the decision whether or not to treat spent nuclear fuel, including N-Reactor fuel, before emplacement in a geologic repository has not been made. As discussed in Section 1.2 of the EIS, the presence of metallic sodium is the primary but not the only reason for the proposed action. The presence of metallic uranium, or the presence of highly enriched uranium, could also complicate the process of certifying the repository if it accepted sodium-bonded spent nuclear fuel for disposal. Qualification of the spent fuel for disposal in a geologic repository would require sufficient data and predictive analyses to demonstrate that emplacement of the spent nuclear fuel would not adversely

Commentor No. 46: H. Zerriffi & L. Ledwidge (Cont'd)

DOE has not stated is that without this Action there would be no more funds available for EMT and DOE needs to make a decision now on whether to proceed with this technology. The "Purpose and Need for Action" should clearly state that these programmatic considerations, maintaining an EMT program and possibly using the Savannah River canyons which are slated to be shutdown, are driving the timing of this project.

46-12 (Cont'd)

In addition to the manner in which the purpose and need for this action have been presented, there are also serious problems with DOE's presentation of the health effects of radiation. Surprisingly, the DEIS indicates that the dose to the general population near Argonne National Laboratory – West is ten times higher under the "No Action Alternative" (which would not involve any processing) than for Electrometallurgical Treatment of the spent fuel. (2-48) When asked at the public meeting held in Crystal City, VA on August 31, 1999, the representative from the EIS team stated that this was an artifact of an assumption used for the draft EIS. It seems that the inventory of spent fuel was based on a 1995 Programmatic EIS rather than the actual inventory at the Idaho National Engineering and Environmental Laboratory. The final EIS will be revised to reflect actual conditions.[5] However, the draft EIS is the only opportunity for the public to comment on the health effects of this action and potentially decide whether or not to support processing this fuel. Presenting the data in this manner on such a crucial issue is misleading.

46-13

Perhaps even more egregious, however, is the presentation in the DEIS of radiation risk and the use of the linear no-threshold theory for calculating risk. The EIS states that "[C]alculations of health impacts based on the linear no-threshold theory may overstate the actual impacts of low radiation doses and should be viewed as an upper bound on the potential health effects." (page 4-6) This statement is dubious at best. It is contradicted by works produced by scientific bodies including the National Academy of Sciences' Committee on the Biological Effects of Ionizing Radiation (BEIR), the International Commission on Radiological Protection (ICRP), and, notably, the National Council on Radiation Protection and Measurements (NCRP):

- "[I]t must be presumed that even small radiation doses may produce some deleterious health effect." (ICRP, 1991, *1990 Recommendations of the International Commission on Radiological Protection. ICRP Publication 60*, paragraph 100, page 25)
- "[T]he probability of a cancer resulting from radiation increases with increments of dose, probably with no threshold." (ICRP, 1991, Paragraph 58, page 69)
- "In spite of evidence that the molecular lesions which give rise to somatic and genetic damage can be repaired to a considerable degree, the new data do not contradict the hypothesis, at least with respect to cancer induction and hereditary genetic effects, that the frequency of such effects increases with low-level radiation as a linear, nonthreshold function of the dose." (BEIR V, 1990. *Health Effects of Exposure to Low Levels of Ionizing Radiation*, Committee on the Biological Effects of Ionizing Radiation, National Research Council, page 4)

46-14

[5] Our thanks go to Dr. Lyman of the Nuclear Control Institute for pointing out this fact and asking the question.

Response to Commentor No. 46 (Cont'd):

affect the repository's ability to protect the environment and worker and public health and safety. To ensure the requirements of the State of Idaho Settlement Agreement and Consent Order are met, and to facilitate disposal, DOE needs to reduce the uncertainties associated with qualifying sodium-bonded spent nuclear fuel for disposal. Appropriate treatment and management of the sodium-bonded spent nuclear fuel would significantly reduce complications related to disposal qualifications.

46-11: As described in Section 2.5.4 of the EIS, DOE evaluated PUREX processing as one of the alternatives for the treatment and management of sodium-bonded spent nuclear fuel. PUREX processing at SRS was included as a reasonable alternative in response to the National Research Council's recommendation that only PUREX processing would provide a viable alternative to the electrometallurgical treatment technology. However, since the sodium-bonded spent fuel contains metallic sodium, stainless steel, and zirconium, PUREX processing of this fuel would require the development and installation of a front-end process to ensure compatibility with the F-Canyon operation. Therefore, only the declad and cleaned blanket spent nuclear fuel, which is mainly depleted uranium metal and fission products, would be processed using PUREX at F-Canyon. In this process depleted uranium and plutonium metals would be separated from the fission products. The fission products would be vitrified as borosilicate glass in the Defense Waste Processing Facility, stored at the site, and transferred to a geologic repository. As explained in Section 4.1.2 of the EIS, the separated depleted uranium and plutonium would be stored at SRS pending a decision on their disposition.

46-12: DOE is committed to improving its environmental management practices; to operating its facilities in a manner that meets or exceeds all applicable environmental, safety, and health requirements; and to cleaning up its environmental problems. The focus of the EIS is to assess the potential environmental and health impacts associated with treatment and management of sodium-bonded spent nuclear fuel. Although not final, the latest guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999 (see Section 4.12.1 of the EIS) indicates it is highly probable that sodium-bonded spent nuclear fuel would not be acceptable in the geologic repository without some stabilization and/or removal of the metallic sodium. Stabilization of the spent nuclear fuel and/or removal of the metallic sodium will provide greater protection of human health and the environment. Having completed the Electrometallurgical Treatment Research and Demonstration Project (see

Commentor No. 46: H. Zerriffi & L. Ledwidge (Cont'd)

- "The dose-dependent excess of mortality from all cancer other than leukemia, shows no departure from linearity in the range below 4 sievert (Sv), whereas the mortality data for leukemia are compatible with a linear-quadratic dose response relationship." (BEIR V, 1990, Page 5)

More egregiously, the DOE misrepresents the 1995 NCRP report it quotes in the EIS by taking the quote out of context[6]. Here is what the EIS does *not* include:

"3.5 Summary

"Taken as a whole, the body of evidence from both laboratory animals and human studies allows a presumption of a linear no threshold response at low doses and low-dose rates, for both mutations and carcinogenesis." (NCRP, 1995. *Principles and Application of Collective Dose in Radiation Protection, NCRP Report No. 121*, page 45)"

As more has been learned about the health effects of radiation, radiation risk estimates have been revised upwards. This indicates that, over time, exposure to radiation has been found to be more harmful than previously believed. For instance, the 1990 BEIR V report noted that, upon reassessment of A-bomb dosimetry, "lifetime risk of cancer attributable to a given dose of gamma radiation now appears somewhat larger than formerly estimated," (page 5) and that, "[t]he dose-dependent increase in the frequency of mental retardation in prenatally irradiated A-bomb survivors implies the possibility of higher risks to the embryo from low-level irradiation than have been suspected heretofore" (page 8). **46-14 (Cont'd)**

The seventh BEIR committee (BEIR VII) has just convened to reassess the health effects to humans of exposure to low doses of ionizing radiation. There are many questions it faces before it can assess whether current risk estimates are too tight. As the attached September 3rd letter indicates, the BEIR VII committee has yet to consider the range of risks involved. It is very premature to claim that the linear no threshold hypothesis overstates the risks of low-level radiation, to say the least.

It is curious that this EIS, unlike some others, fails to include basic information about the health effects of radiation, and instead includes a weak dispute of the linear no threshold hypothesis. The DOE cannot credibly dismiss the linear no-threshold hypothesis, a long-held assumption in radiation and health circles, on the basis of one study and a misrepresentation of another, as it appears is the case in this EIS.

By failing to provide full and accurate information about what is and is not known about the health risks of radiation, the DOE, its EIS contractor SAIC, and the EIS itself lose credibility and public trust.

The section on health effects in this EIS should be rewritten to incorporate the aforementioned comments.

Not only is the DOE proposing an action which is clearly unnecessary at this time and entails programmatic risks since the final waste forms may not meet final repository **46-15**

[6] On page 4-6, the EIS quotes the NCRP report from page 45: "...essentially no human data can be said to prove or even to provide direct support for the concept of collective dose with its implicit uncertainties on nonthreshold, linearity and dose-rate independence with respect to risk."

Response to Commentor No. 46 (Cont'd):

Section 1.6.3) and in planning the closure of its PUREX processing capabilities, DOE now needs to decide whether these processes are suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the EIS could result in a loss of capability and of experienced, knowledgeable technical staff should DOE decide at a later date to use the electrometallurgical process to treat the sodium-bonded spent nuclear fuel. Section 1.2 of the EIS has been revised for clarification. DOE also has conducted four independent nonproliferation impacts assessments of the electrometallurgical treatment technology over the last 11 years. These assessments found the electrometallurgical treatment technology does not conflict with U.S. nuclear nonproliferation policy for this specific application, and have concluded that the electrometallurgical treatment technology is not capable of separating plutonium in a form that would be suitable for weapons production.

46-13: Air emissions under the No Action Alternative in the draft EIS were estimated using the adjusted values given in the No Action Alternative in the Programmatic Spent Nuclear Fuel EIS. The adjustment was based on the ratio of heavy mass inventory of the sodium-bonded spent nuclear fuel (60 metric tons) to the entire spent nuclear fuel inventory (274 metric tons) at INEEL. DOE assumed this estimate bounds any future degradation of the sodium-bonded spent nuclear fuel during storage at the INEEL site. The consequences resulting from this estimate were very small, and there was no intention to mislead the public. Since the issuance of the draft EIS, DOE has modified the activities under both options of the No Action Alternative as described in Section 4.2 of the final EIS, reevaluated the potential for sodium-bonded spent fuel degradation in wet and dry storage and revised the air emissions and associated health effects. The new results are provided in the final EIS.

46-14: As described in Section 4.1.3 of the EIS, the estimated health effects from radiation doses used in this EIS are based on the linear-no-threshold theory of radiation carcinogenesis. DOE would not consider any threshold in evaluating the potential cancer risk associated from radiation exposure, i.e., the limit of the range is extended to zero dose. As explained in Appendix E, Section E.2.2, of the EIS, there is a scientific uncertainty about cancer risk in the low-dose region below the range of epidemiologic observation, and the possibility of no risk cannot be excluded (from Committee on Interagency Radiation Research and Policy Coordination, Seiene Panel Report No. 9). DOE has revised the text in Section 4.1.3 of the EIS to remove the contentious

Commentor No. 46: H. Zerriffi & L. Ledwidge (Cont'd)

46-15 (Cont'd)

criteria, it is doing so in a way that poses significant nonproliferation problems. The Department should be commended for conducting a parallel Nonproliferation Assessment.[7] However, the resulting document seriously downplays some of the proliferation implications of the proposed actions, particularly Electrometallurgical Treatment (EMT).[8] The Nonproliferation Assessment does note many of the important proliferation risks posed by EMT:

46-16

- EMT can produce weapons-usable HEU
- EMT is a subset of a larger process which can separate plutonium and therefore has parallels with traditional reprocessing techniques such as PUREX

46-17

- EMT involves bulk processing which makes international safeguards harder to implement

46-18

- Safeguards have not been demonstrated since this a new technology.

However, the Assessment's system for grading the proliferation impacts, while a good start, was not sufficient. Each of the processing technologies was graded based on four policy factors[9] and three technical factors.[10] Each technology was graded on each factor. The grades were "fully meets nonproliferation objectives," "could raise nonproliferation concerns," and "raises nonproliferation concerns." Additionally, each of the DEIS alternatives (some of which involve using two different technologies for different portions of the fuel) were also graded on the same factors and with the same grading system. This system of grading poses a number of problems:

46-19

- There were no explicit criteria for choosing a particular grade for a particular technology or alternative.
- It was not made clear how mitigating factors were accounted for in the grading. There were a number of instances in which a proliferation concern was expressed, but a mitigating factor was also explained.

[7] United States Department of Energy, Office of Arms Control and Nonproliferation, *Nonproliferation Impacts Assessment for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*, July 1999, (hereinafter referred to as "Assessment")

[8] This discussion of the nonproliferation impacts of actions proposed in this DEIS will focus on electrometallurgical treatment for three reasons. First, the original intent was to undertake an EIS on EMT. The scope was only expanded after the scoping hearings on the original EIS. Second, EMT would be used for five of the six alternatives presented (not including the "No Action Alternative.") Third, EMT has the potential for widespread global use under the rubric of either waste management or advanced nuclear fuel cycles (both as a stand-alone technology and as part of a more comprehensive pyro-processing system for which EMT is a crucial component). However, all of the technology choices have serious nonproliferation implications with the possible exception of repackaging in high-integrity cans of blanket spent fuel.

[9] Consistency with Nonproliferation policy, Avoiding encouragement of plutonium reprocessing, Building confidence that the United States is not producing materials for weapons, Supporting negotiations for a Fissile Materials Cut-off Treaty.

[10] Assuring against theft or diversion, Facilitating cost-effective international monitoring, Difficult-to-retrieve final form.

Response to Commentor No. 46 (Cont'd):

statement by providing a reference to the discussion provided in Appendix E, Section E.2.2.

46-15: See response to comment 46-3.

46-16: The commentor's support for conducting the Nonproliferation Impacts Assessment is noted. Although the assessment of nonproliferation impacts is not a part of the EIS process, none of the alternatives analyzed in this EIS, with the exception of PUREX processing at SRS, would generate weapons-usable fissile materials. Although highly enriched uranium would be an interim product, it would be down-blended to low-enriched uranium during electrometallurgical treatment.

46-17: Although assessment of nonproliferation impacts is not a part of the EIS process, it should be noted that electrometallurgical treatment is not capable of producing plutonium for nuclear explosive purposes. As conceived for the cancelled Integral Fast Reactor project, the liquid cadmium cathode would have produced a metal alloy product containing up to 70 percent plutonium, which could only have been obtained after subsequent processing in a high-temperature vacuum furnace. The balance of materials would be those elements most difficult to separate from plutonium by any chemical means, such as uranium, americium, neptunium, curium, and the rare earth fission products. The plutonium metal alloy product would have a high fission product and transuranic content, a high heat source, a high neutron radiation source, and a high gamma radiation source, any one of which would make the design of a weapon extremely difficult. Neutron and gamma radiation would be three to four orders of magnitude higher than weapons-grade or reactor-grade material. These levels of radiation are lethal and would prohibit any handling of the material or weapon by other than remote means. Development of the cathode progressed only to the point of technical feasibility. No prototype or working model was ever commissioned for the Fuel Conditioning Facility. During electrometallurgical treatment, plutonium would stay mixed with the fission products and electrolyte salt. The plutonium and fission products then would be immobilized in the ceramic waste form. The ceramic waste form is more resistant to plutonium recovery than the metallic waste forms that result under the other alternatives that employ melt and dilute technologies and high-integrity cans.

46-18: There are several features of the electrometallurgical treatment process that make it adaptable to international safeguards. The process cell, made inaccessible to humans by high radiation, inert atmosphere, and thick concrete walls, has a minimal number of penetrations through which materials can be

Commentor No. 46: H. Zerriffi & L. Ledwidge (Cont'd)

- Chapter Six, evaluating the individual technologies, only considered the US context (as clearly indicated by the title chapter).[1] This is insufficient as proliferation is clearly a global issue.
- It is not made explicit how the combinations of individual grades for different technologies were combined to derive an overall grade for each alternative.
- While EMT in the global context was discussed in terms of the four policy and three technical factors (Assessment, Section 3.5) there were no formal grades assigned. If a grading system was to be used, it should have been used consistently whenever a technology or alternative was being discussed in terms of the technical and policy factors. The result is that EMT was only graded in the U.S. context in Chapter Six.

46-19 (Cont'd)

The Assessment also downplays some of the proliferation risks, resulting in grades which are lower than they would be if a more comprehensive evaluation had been conducted. For example, there is little justification for the conclusion that EMT "*could* raise nonproliferation concerns" for facilitating cost-effective monitoring. This is a bulk processing method with fissile materials separations and *no demonstrated system for safeguards*. (Assessment, p. 6-3)

More puzzling is the conclusion that EMT fully maintains consistency with US nonproliferation policy. The DOE apparently reached this conclusion because there would be no separation of plutonium. However, this is a very narrow definition of US nonproliferation policy and objectives given the connection of EMT with systems that could result in plutonium separation. The Assessment itself notes in its section on the global implications of EMT that "both domestic and export applications of EMT pose concerns with respect to U.S. Nonproliferation policy." (Assessment, p. 3-15) The fact that the HEU would be diluted or that export controls would be put in place do not adequately mitigate the proliferation implications.

46-20

The DOE also concludes that EMT only "*could* raise concerns" about avoiding encouragement of plutonium processing. This is despite the statement that:

> Extending the time that U.S. separations facilities operate and using a separations process to prepare spent nuclear fuel for geologic disposal (while at the same time acknowledging that the fuel does not pose near-term safety and health vulnerabilities and that such processing technically is not required) could serve to undermine U.S. credibility in expressing concern to other countries about the proliferation problems associated with conventional reprocessing in the nuclear fuel cycle. (Assessment, p. 6-4)

46-21

The justification for the mid-level grade (rather than concluding that this would raise proliferation concerns) is that the US can make it clear that this is being done to address specific chemical requirements of a small batch of fuel, that plutonium is not separated, and that it is being done for spent fuel disposal "rather than as part of a breeder reactor fuel cycle." (Assessment, p. 6-4) This ignores the earlier statement (in the same paragraph) that the processing is not required in the near term. More significantly, it ignores the possibility that others would use the justification of spent fuel management to

[1] "Evaluation of the Technologies in the U.S. Context as Scoped in the *Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*."

Response to Commentor No. 46 (Cont'd):

moved in and out. These openings are secured and can be readily monitored for material transfers. There are no liquid waste streams through which materials can be piped out of the facility. All by-products and waste from the process would be in solid form, and so would be accountable by unit inventory. Finally, all by-products and waste moving out of the facility could be subjected to nondestructive examination if additional assurances were required under international safeguards agreements.

46-19: The assessment of nonproliferation impacts is not part of the scope of the EIS. However, the Nonproliferation Impacts Assessment for the management of DOE's sodium-bonded spent nuclear fuel was conducted to be consistent with nonproliferation assessments for other proposed DOE activities. A group of independent experts reviewed all the reasonable alternatives included in the draft EIS for nonproliferation considerations based on both policy and technology. While their conclusions are necessarily somewhat subjective, DOE is satisfied that the report represents a fair, unbiased view of the nonproliferation impacts of the alternatives. The report was reviewed and approved by the DOE Office of Arms Control and Nonproliferation prior to its issuance. DOE believes that the U.S. context is appropriate for the technical evaluation. The types of spent fuel that would be managed under the alternatives considered in the draft EIS are unique to U.S. research reactors. All activities would be carried out under the DOE safeguards and security requirements implemented to prevent the theft and diversion of nuclear materials, including spent fuel. The global implications have been considered under policy factors. The potential impacts of the various alternatives on U.S. nonproliferation policy are described in Chapter 6 of the Nonproliferation Impacts Assessment and in the conclusions of the assessment.

46-20: The United States' policy on nonproliferation is contained in Presidential Decision Directive 13, a classified document. At the time the Presidential Directive was signed, an unclassified press release stated that, "The U.S. will seek to eliminate where possible the accumulation of stockpiles of highly-enriched uranium or plutonium." This would be done by down-blending the highly enriched uranium in the driver spent nuclear fuel and immobilizing the plutonium in the ceramic waste form. The press release also stated that the United States "does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes." Under the electrometallurgical treatment, the plutonium would be immobilized in the ceramic waste form.

Commentor No. 46: H. Zerriffi & L. Ledwidge (Cont'd)

implement a full pyroprocessing system with plutonium separation. Research into such systems is already on-going in a number of countries and the U.S. implementation of a subset of pyroprocessing will clearly undermine U.S. credibility. **46-21 (Cont'd)**

Electrometallurgical treatment should not be considered in isolation of its possible configuration for removal of plutonium nor without considering additional processing steps which could be implemented to further separate plutonium. While the current configuration does not result in separated plutonium, EMT should still be considered a reprocessing technology. Furthermore, EMT alone can result in separation of HEU and so should be considered a reprocessing technology on that basis. **46-20**

As noted by the Nonproliferation Assessment, EMT can be modified in order to separate Pu, either by adding in a cadmium cathode and other equipment developed for pyroprocessing of IFR fuel or by processing the residual waste from EMT. What is not made explicit is the difference in proliferation barrier between spent fuel and EMT waste. The addition of the cadmium cathode to separate plutonium and a cathode processor would result in a product which is as high as 70% plutonium, 30% actinides and <1% rare earth fission products.[12] Aqueous processing to further separate the plutonium would be on a much smaller scale than that necessary for PUREX processing of the entire amount of spent fuel. The total amount of material to be processed would be about 100 to 1000 times less for the same amount of plutonium separation. Conceivably this could be done on a glove-box scale, assuming lower concern about worker health. The process would result in significantly less detectable air emissions since the volatile fission products would have already gone through the pyroprocessing stage and been emitted. The Nonproliferation Assessment does not discuss the effect this would have on implementation of international safeguards. **46-17**

The Nonproliferation Assessment relies too heavily on the implementation of safeguards and on U.S. pronouncements as to the purpose of processing this particular spent fuel. These are inadequate mitigating factor. Safeguards do not have an absolute guarantee of success and are made more difficult by the types of processes discussed here. Generally, it would be best to avoid using these types of processing technologies, rather than rely on safeguards. **46-18**

The Assessment also does not seem to integrate its discussion in Chapter three concerning the "Potential use of Electrometallurgical Treatment in a Global Context" with its evaluation about the U.S. context. The evaluation of EMT for this EIS cannot and should not be done with only the US context in mind. Both the US and global contexts need to be considered and the future of Electrometallurgical processing technologies needs to be integrated into the discussion. By separating these considerations, the Assessment seriously downplays the implications of EMT and reaches conclusions which cannot be supported when one looks at the overall picture. **46-19**

In conclusion, there is no need for this action at this time. The spent fuel should be stored pending determination of Yucca Mountain's suitability as a repository and of **46-6 46-4**

[12] U.S. Congress, Office of Technology Assessment, *Technical Options for the Advanced Liquid Metal Reactor - Background Paper*, OTA-BP-ENV-126 (Washington, DC: U.S. Government Printing Office, May 1994): p. 21.

Response to Commentor No. 46 (Cont'd):

46-21: As stated in the Nonproliferation Impacts Assessment, the alternatives involving PUREX reprocessing and broad application of electrometallurgical treatment of both driver and blanket fuel have a greater potential to provide encouragement to other countries to engage in plutonium reprocessing. Given the small quantity and unique characteristics of the sodium-bonded spent nuclear fuel and the reason for the treatment, however, such encouragement, if any, would be limited. Sodium-bonded spent nuclear fuel represents approximately 2 percent of DOE's spent nuclear fuel inventory.

46-22: The commentor's opinion that development of technologies such as GMODS and Plasma Arc processing on the bases that they do not involve fissile material separation, is noted. As discussed in Section 1.5 of the EIS, one of the decisions that DOE could make in the Record of Decision is to take no action now and promote the development of a less mature technology (like GMODS and Plasma Arc) or some other new treatment technology (see also Section 4.2 of the EIS).

Commentor No. 46: H. Zerriffi & L. Ledwidge (Cont'd)

final waste acceptance criteria for whatever high-level waste management strategy is finally chosen. Avoiding the complete close-out of the EMT project is not a sufficient reason for undertaking this project, both from a health and environment and a non-proliferation perspective. In the meantime, there may be justification in proceeding with technology development of alternatives to the proposed processes, such as GMODS and Plasma Arc processing, which do not have fissile material separation or the possibility of being configured for fissile material separation. **46-5** **46-12** **46-22**

If the Department of Energy undertakes reprocessing of this spent fuel under the guise of environmental management it will set a dangerous precedent and significantly harm U.S. nonproliferation objectives. Electrometallurgical treatment, which appears to be the favored technology for at least part of the waste, poses particular concern because of its potential for clandestine plutonium separation, its potential use as a "waste management technique" in the context of "advanced" fuel cycles (with the explicit goal of plutonium separation) both in the United States and abroad and its use of a bulk process for which international safeguards have not yet been established. Pyroprocessing is an active area of inquiry in many nuclear countries, including the U.S., and continued U.S. interest in this technology and the application of a subset of pyroprocessing, would irreparably harm the U.S. government's credibility on nonproliferation. **46-15**

Response to Commentor No. 46 :

Commentor No. 47: Ted L. Carpenter

SENT BY: 9-28-98 ;11:11AM ;SHOBAN TRIBES-ATTY'S- 3014281973;# 1/ 1

The SHOSHONE-BANNOCK TRIBES

FORT HALL INDIAN RESERVATION
PROJECT DIRECTOR (208) 478-3782
ENVIRONMENTALIST (208) 478-3709
SECRETARY (208) 478-3708
FAX (208) 237-0797

TRIBAL/DOE PROJECT
PIMA DRIVE
P. O. BOX 306
FORT HALL, IDAHO 83203

Jeffrey J. Rikhoff, Senior Planner
Scientific Applications International Corporation
2021 Century Blvd., 3rd Floor
Germantown, Maryland 20874
FAX: 301-428-1973

Dear Jeffery

Thank-you for your assistance during the August 26 meeting in Idaho Falls. I appreciated the professional service provided by everyone involved in providing public information that evening.

I have studied all of the provided materials. My comments must not be considered "speaking for the Tribes." Only the Tribal Council officially does that. As the Tribal/DOE Project Environmentalist, I will comment.

Considering all of this material "60 metric tons of heavy metal of sodium-bonded . . . fuel" to be "waste" for "disposal" seems worse than killing a Bison, taking the tongue (or the tongue and the hide), then leaving every other part of the animal to rot! Molybdenum, ruthenium, rhodium, palladium, uranium, zirconium, niobium, chromium, nickel, etc. are valuable resources that are expensive to mine and refine by environmentally responsible methods. 47-1

The electrometallurgical process seems to have the most potential for wise, environmentally responsible use of the Earth's resources. Your own documents (p. S 13 in the Summary) state that "the electrometallurgical treatment process uses electrorefining, an industrial technology used to produce pure metals from impure feedstock. Electrorefining has been used to purify metals for more than 100 years."

Alternatives 3 and 6 would produce increased environmental impact because of the thousands of miles of transportation required between the INEEL and the Savanna River Site. Fossil fuels would be burned to fuel the engines that transport those materials. Additionally, the transportation route crosses the Fort Hall Reservation of the Shoshone-Bannock Tribes. I encourage you to consider sodium-bonded driver fuel and blanket fuel treatment and management systems that minimize shipments of these materials across the reservation. Personally, I do not imagine any radiation hazard to the Reservation community because of those shipments, but the fears of many here are real. Because of those fears, I consider transportation across these Tribal lands to be a serious issue. 47-2

I have only one sort-of technical comment. On page S-2 of the Summary, I read, "Metallic sodium reacts vigorously with water or moist air. . . ." Obviously, sodium reacts vigorously with moist air because moist air contains water in the form of water vapor. Thus the "or" is incorrect. Water in a liquid or vapor form will react vigorously with sodium resulting in spontaneous combustion of the hydrogen gas that is released by the reaction. 47-3

Please feel free to contact me if you have any questions.

Sincerely,

Ted L. Carpenter, Ph.D.

Response to Commentor No. 47:

47-1: Most of the noble metal fission products (e.g., niobium, technetium, ruthenium, rubidium, silver, cadmium, and zirconium) and fuel alloy (zirconium) in the electrorefiners would remain with the fuel cladding hull in the anode basket. In addition, some actinides would also remain with the noble fission products. The amount of material retained in the anode basket would strictly depend on the electrorefining operation conditions. If more actinides and the fuel matrix were dissolved in the molten salts, the retention of noble fission products would be lowered. The metal remains in the anode basket would be radioactive, and would be classified as high-level radioactive waste. It is true that electrometallurgical treatment has been used to produce metals from impure feedstock. However, that impure feedstock included metals with chemical contamination, not radioactive isotopes of the same metals. Noble metal recovery from the metallic waste would have limited uses because the metal would still be radioactive (i.e., it would contain radioactive isotopes of the metal elements), and would still be considered radioactive metallic waste. However, uranium would be separated and could be used for other purposes. The disposition of this uranium, along with DOE's inventory of surplus uranium, will be determined through another NEPA review.

47-2: DOE assumes that the commentor is referring to Alternative 3 and 5 (not 6), in which the declad and cleaned (metallic sodium removed) blanket spent nuclear fuel would be transported to SRS for treatment. As explained in the EIS, the risks associated with the fuel transport are very small. Regardless of the alternative, DOE would need to transport spent nuclear fuel and/or high-level waste out of INEEL. DOE will proceed in accordance with the DOE/Shoshone-Bannock Tribes Agreement-in-Principal, which covers notification and coordination of the transport of radioactive materials across the Fort Hall Reservation. All risks, including transportation, are included in the EIS and will be considered by DOE prior to making any decisions regarding the treatment and management of sodium-bonded spent nuclear fuel.

47-3: The commentor is correct, metallic sodium reacts with water and, consequently, moist air. The text has been revised accordingly.

Commentor No. 48: Debra Patla

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_____Forward Header_____
Subject:    INEEL pyro
Author: dpatla@tetonvalley.net_at_INTERNET
Date:       10/4/99 11:14 PM

Dear Ms. Lesica,
I strongly object to "pyroprocessing" at INEEL.  I was stunned to
hear that plans are again being advanced for reprocessing spent
nuclear fuel at the INEEL.  I thought this bad idea was put to bed
years ago when the Special Isotope Separator was finally rejected.

I am an Idaho resident and a "down-winder".  The DoE site at
INEEL is viewed very negatively in this area (near the Teton
Mountains), particularly since the plan was launched to incinerate
nuclear wastes at INEEL.  We don't trust the government to take care of
our health and welfare.  We fear that Idaho and Wyoming are a rural no-
place to headquarters  DoE, a throw-away zone because the population of
humans is low, making INEEL a great place for creating and storing
deadly elements.

I am protesting not only as an Idaho resident.  Weapons-grade
plutonium and uranium is the last thing the world needs.

The EIS should reveal estimates of how much weapon-grade
Plutonium and uranium exists, and how much may be in hands of elements
hostile to the U.S. or other governments.  It should estimate, given
past trends and possible future scenarios, what is the likelihood that
the products will be used to destroy life and/or induce global
instability.

The EIS should clearly document who initiated this project, and
why.  The trail of responsibility for this project should be made
clear so that in the event of future disasters, the American and global
public will know who is responsible.

The EIS should attempt to analyze how interrelationships of private
industry and government officials contributed to the initiation of this
project.  It should assess the 'revolving door' whereby DoE and
military personnel end up in related private industries after they
leave government service.

It should document what kinds of freedoms might end up being restricted
if DoE institutes stricter security measures.

The EIS should document how much waste will be generated by this
project and where it will be stored, both temporarily and permanently.

It should look at cumulative effects, and reveal how much waste exists
at INEEL.  It should analyze the costs of total clean-up, and reveal
how much this project will add to total clean-up costs.
```

48-1

48-2

48-3

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48-5

48-6

48-7

48-8

Response to Commentor No. 48:

48-1: The commentor's objection to electrometallurgical treatment (pyroprocessing) at INEEL is noted. This EIS evaluates several alternatives to electrometallurgical treatment including a No Action Alternative. The Special Isotope Separator referred to by the commentor was a weapons material production facility planned for INEEL back in the late 1980s. This facility was designed to use laser processing to produce weapons-grade plutonium from fuel-grade plutonium. The Special Isotope Separation Project EIS (DOE/EIS-0136) was published in November 1988. With the end of the Cold War, the need for plutonium production disappeared, and plans for the plutonium separation plant were halted. The special isotope separation laser process would not support the treatment and management and ultimate disposition of sodium-bonded spent nuclear fuel.

48-2: DOE has agreed to move all spent nuclear fuel out of the State of Idaho by 2035. To fulfill this commitment and prepare the fuel for ultimate disposal, DOE is proposing to treat and manage its sodium-bonded spent nuclear fuel at either INEEL or SRS.

48-3: Although the assessment of nonproliferation impacts is not a part of the EIS process, none of the alternatives analyzed in this EIS, with the exception of PUREX processing at SRS, would generate weapons-usable fissile materials. Although highly enriched uranium is an interim product, it is downblended to low-enriched uranium during electrometallurgical treatment. Alternative 3, PUREX processing, is the only alternative that would generate weapons-usable fissile material, including plutonium. This plutonium would be managed along with other surplus plutonium as described in the Surplus Plutonium Disposition EIS. The SBSNF EIS has been prepared in accordance with NEPA, Council on Environmental Quality regulations on implementing NEPA (40 CFR 1500-1508), and DOE's NEPA implementation procedures (10 CFR 1021). As discussed in the introduction, the basic objective of this EIS is to provide the public and DOE decision-makers with a description of the reasonable alternatives for the treatment and management of DOE's sodium-bonded spent nuclear fuel and their potential environmental impact. Estimating how much plutonium and uranium exists and the likelihood of these materials being used to destroy life and/or induce global instability are beyond the scope of the EIS.

Commentor No. 48: Debra Patla (Cont'd)

The EIS should attempt to measure how much risk to U.S. citizens this project poses, both in the present, 20 years from now, and long into the future. This analysis should be reviewed by impartial sources rather than DoE. Their commentary should be included within the EIS. **48-9** **48-10**

I urge DoE to start putting more money into environmental clean-up and protection rather than producing elements of potential mass murder. **48-11**

Sincerely,
Debra Patla
PO Box 230
Victor, ID 83455

Response to Commentor No. 48 (Cont'd):

48-4: The Electrometallurgical Treatment Research and Demonstration Project was initiated by DOE with Congressional funding to demonstrate electrometallurgical treatment technology, as directed by the 1995 Record of Decision for the Spent Nuclear Fuel Programmatic EIS (60 FR 28680). Near completion of the demonstration project, DOE developed this EIS to evaluate the potential environmental impacts of using electrometallurgical treatment or other technologies to treat the remaining sodium-bonded spent nuclear fuel and reduce the risk that the sodium-bonded spent nuclear fuel would not be accepted in a geologic repository. Chapter 1 of the EIS discusses the purpose and need for the proposed action. All preparers of the EIS, their organization, responsibilities, education, experience, and technical expertise are listed in Chapter 7 of the EIS. Council on Environmental Quality regulations 40 CFR 1506.5(c), which have been adopted by DOE (10 CFR 1021), require contractors preparing this EIS to execute a disclosure statement specifying they have no financial or other interest in the outcome of the project. This disclosure statement is provided in Appendix L of the EIS. Analyzing private industry and government interrelationships and the actions of DOE and military personnel after they leave government service are beyond the scope of this EIS.

48-5: The proposed action of the EIS does not require any changes in security.

48-6: The amount and form of the waste generated under each alternative are discussed in Chapter 4 of the EIS. The discussions in the chapter identify the final disposition of each waste form produced. For example, as described in Section 4.3.6, the ceramic and metallic high-level radioactive waste generated under Alternative 1 (electrometallurgically treat blanket and driver fuel at ANL-W) would be temporarily stored at the Radioactive Scrap and Waste Facility, and when a geologic repository is available the waste forms would be removed from storage and transferred to INEEL's Dry Transfer Facility for packaging and shipment to the repository.

48-7: Section 4.11.1.6 of the EIS summarizes cumulative waste generation at the INEEL site. This includes all waste currently present at the site, plus any new waste to be generated in the reasonably foreseeable future.

48-8: The SBSNF EIS has been prepared in accordance with NEPA, the Council on Environmental Quality regulations on implementing NEPA (40 CFR 1500-1508), and DOE's NEPA implementation procedures (10 CFR 1021). None of these require the inclusion of a cost analysis in an EIS. As discussed in the introduction, the basic objective of this EIS is to

the public and DOE decision-makers with a description of the reasonable alternatives for the treatment and management of DOE's sodium-bonded spent nuclear fuel and their potential environmental impact. However, DOE has issued a separate Cost Study that analyzes and compares the cost of the alternatives analyzed in the EIS. Cost will be considered during the decision-making process in preparing the Record of Decision.

48-9: DOE proposes to use the electrometallurgical treatment process to treat the sodium-bonded spent nuclear fuel and facilitate its ultimate disposal in a geologic repository. This process would transform about 60 metric tons of heavy metal sodium-bonded spent nuclear fuel into two inherently stable solid high-level waste forms. The process would take about 13 years to complete. Section 4.2 of the EIS discusses current risks to the public residing within 80 kilometers (50 miles) of the facilities where the sodium-bonded nuclear spent fuel is currently stored. The risks from operation of the electrometallurgical treatment process to the projected population (assumed to exist in the year 2010) residing within 80 kilometers (50 miles) of the facility are provided in Section 4.3 of the EIS. As explained in this section, the maximum annual dose to an individual from operation of this process is estimated to be less than 0.0004 millirem, or about 0.0001 percent of the background radiation dose. As explained in Section 4.3.6, the solid high-level waste would be packaged in special canisters and stored temporarily at the site. While in storage, this waste form would not pose any risks to any member of the public. This waste form is expected to be transferred to a geologic repository by 2035. The long-term impact from storage of this waste is evaluated in the Yucca Mountain EIS, which was issued in July 1999.

48-10: While the EIS has undergone internal DOE review, the NEPA public participation process provided an opportunity for all interested parties, including members of the public and Federal, state, local, and tribal officials, to independently review and comment on the draft EIS. All comments, along with DOE's responses, are included in the this final EIS.

48-11: Congress determines how funds are allocated. DOE spends monies consistent with Congressional direction. DOE is not in a position to make the difficult tradeoffs that may be required between alternative Federal programs and spending priorities. The issue of whether to fund the treatment and management of sodium-bonded spent nuclear fuel is beyond the scope of the SBSNF EIS. However, implementation of any of the sodium-bonded spent nuclear fuel treatment and management alternatives would not take

Commentor No. 48: Debra Patla

Response to Commentor No. 48 (Cont'd):

taxpayer dollars away from other environmental cleanup projects at INEEL. Each year Congress appropriates funds for environmental cleanup projects which are administered by the DOE Office of Environmental Management. The INEEL environmental cleanup efforts receive most of their money from these funds. Congress appropriates separate funds for spent nuclear fuel treatment, and these funds are administered by the DOE Office of Nuclear Energy, Science and Technology. The two sources of funds do not compete with each other.

Commentor No. 49: Kathleen E. Trever

Dirk Kempthorne, Governor
Kathleen E. Trever, Coordinator

INEEL Oversight
Idaho's eyes on the INEEL

900 North Skyline, Suite C • Idaho Falls, Idaho 83402
1410 North Hilton • Boise, Idaho 83706

September 28, 1999

Susan M. Lesica, EIS Document Manager
Office of Nuclear Facilities Management
Office of Nuclear Energy, Science and Technology
U.S. DOE, NE-40
19901 Germantown Road
Germantown, MD 20874-1290

Re: DEIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

Dear Ms. Lesica:

The State of Idaho INEEL Oversight Program submits the following comments on the Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel. Section and page references precede specific comments.

COMMENTS

Summary, page S-9, 1st paragraph, line 3; Volume 1, Section 1.6.1.7, pages 1-9 and 1-10
"The proposed Advanced Mixed Waste Treatment Facility would treat...." The Record of Decision for the AMWTP EIS was issued in March 1999. Therefore, "proposed" should be "planned", and "would" should be "will".

Summary, page S-9, 4th item in italics; Volume 1, Section 1.6.2.3, page 1-11
The correct name of the referenced EIS is *Idaho High-Level Waste and Facilities Disposition Environmental Impact Statement.* **49-1**

Summary, page S-10, last paragraph; Section S.8 Glossary; Volume 1, Section 2.2.1, page 2-3; Chapter 6 Glossary; Volume 2, Section D-2, page D-2
The only definition of fissium appears on page S-10; the term is used without definition in Volume 1, page 2-3 and in Volume 2, page D-2 (and perhaps elsewhere). "Fissium" should be added to the glossaries in Section S.8 and Chapter 6.

Summary, page S-13 to S-17; Volume 1, Sections 1.1 and 2.4
In each of these sections, the treatment methods that have been considered and eliminated should be identified as such and discussed in a separate section. It is confusing to read descriptions of GMODS, Chloride Volatility, etc. only to find out later that they have been eliminated from consideration. **49-2**

Response to Commentor No. 49:

49-1: The text cited by the commentor has been revised as appropriate. The name of the referenced EIS has been corrected. The term "fissium" has been added to the glossaries in Section S.10 and Chapter 6 of the EIS. The language used to explain or define "fissium" in Section S.2.1 of the Summary is also used in Section 2.2.1 of the draft EIS.

49-2: The purpose of Sections 1.1 and 2.4 of the draft EIS, as well as corresponding sections in the Summary, is to inform the reader of the pertinent characteristics of all potential technologies considered prior to selection of the reasonable alternatives presented in Section 2.6. Reasons why some of the technologies were dismissed from consideration as reasonable alternatives are found in Section 2.7. To avoid the confusion mentioned by the commentor, Section 2.3 of the final EIS has been revised to identify the dismissed technologies at an earlier point in the EIS.

49-3: Discharge waters to ANL-W's Industrial Waste Pond or Sanitary Sewage Lagoons are not waters of the U.S. and are exempted from compliance under the NPDES. However, these waters are designated as waters of the State of Idaho and, as such, require compliance with the state regulations that govern application of nonhazardous liquid waste (i.e., Land Application Permits). ANL-W applied to the State of Idaho for Land Application Permits for the Industrial Waste Pond and Ditches and the Sanitary Waste Treatment Pond Land Application Area on March 15, 1996, and July 17, 1998, respectively. ANL-W routinely monitors the effluent discharges to make sure they are within the limits identified in the Land Application Permits. The text of the various EIS sections of concern was revised to clarify that discharges are regulated in accordance with Idaho Land Application Permit requirements.

Commentor No. 49: Kathleen E. Trever (Cont'd)

Summary, Page S-31, 2nd paragraph; page S-37, 7th paragraph; Vol 1, Section 4.2.2, page 4-8, 3rd paragraph; Vol 1, Section 4.3.2, page 4-18, 3rd paragraph; Vol 1, Section 4.4.2, page 4-27, 2nd paragraph; Vol 1 Section 4.6.2 page 4-52, 5th paragraph; Vol 1, Section 4.8.2, page 4-76, 4th paragraph.

The statement "...discharges of nonhazardous liquid waste, which are monitored and subject to National Pollutant Discharge Elimination System (NPDES) permit requirements" implies that there is an NPDES permit for the industrial waste pond at ANL-W. However, the NPDES database does not include a permit for ANL-W. Further, the ANL-W Environmental Surveillance Report for 1997 did not refer to an NPDES permit. If there is an NPDES permit, its number should be included in section 3.2.4.1. References should also be identified to support the statement that the liquid waste is "nonhazardous" (e.g., results of TCLP analyses). **49-3**

Volume 1, Section 1.6.1.6, page 1-9; Section 3.2.11.9, pages 3-30 and 3-31

This section should note that DOE issued a Record of Decision on high-level waste from the Programmatic Waste Management EIS in August 1999. **49-4**

Volume 1, Section 1.6.2.2, page 1-11; Volume 1, Section 4.11.2, pages 4-103 to 4-105

These sections should reference the "Draft Environmental Impact Statement for a Geologic Repository..." issued in July 1999. **49-5**

Volume 1, Section 1.6.2.3, page 1-11, 1st paragraph under 1.6.2.3

"This EIS evaluates treatment alternatives for wastes that actions proposed in the SBSNF EIS could generate." The State of Idaho is familiar with the waste treatment alternatives in the forthcoming high-level waste EIS, but is unaware of the wastes referred to in this statement. The SBSNF EIS should identify what material and what quantities are or will be included. **49-6**

Volume 1, Section 2.4.1, Figure 2-2, page 2-7

The lower horizontal line between "Metal Casting" and "Cathode Processing" in the figure has arrowheads on both ends; it should have only one, probably on the left. **49-7**

Volume 1, Section 2.4.4, pages 2-10 and 2-11; Sections 2.6.4, 2.6.5, 2.6.6, and 2.6.7, pages 2-35 to 2-38; Sections 4.6, 4.7, and 4.8; Volume 2, Section C.4

What is the waste classification of the "metal waste form" or "melt and dilute product" that would be produced under the melt and dilute alternatives? Also, these alternatives only describe storage pending disposal; where would this material be disposed? Do these alternatives create a waste form whose ultimate disposal would be problematic? Would it be acceptable at the geologic repository? Is its isotopic content included in Appendix A of the draft EIS for the Geologic Repository? **49-8**

Volume 1, Section 2.6.4, pages 2-34 and 2-35; Section 4.1.2, page 4-3; Section 4.5.6, pages 4-47 to 4-51 **49-9**

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Response to Commentor No. 49 (Cont'd):

49-4: The text cited by the commentor has been revised to incorporate the latest Record of Decision for DOE's Waste Management Program: Storage of High-Level Radioactive Waste (64 FR 46661). In this third decision, DOE would store immobilized high-level radioactive waste in a final form at the site of generation (Hanford, INEEL, SRS, or the West Valley Demonstration Project in New York) until transfer to a geologic repository.

49-5: The text cited by the commentor has been revised to state that the Yucca Mountain Draft EIS was published in July 1999. The equivalent section in the Summary was also revised to reflect this change of status in the ongoing NEPA actions.

49-6: The sentence identified by the commentor in the SBSNF Draft EIS is no longer correct. At the time this sentence was written, it was unclear what role, if any, the Idaho High-Level Waste and Facilities Disposition EIS would play in the treatment of waste generated by the treatment of sodium-bonded spent nuclear fuel at ANL-W. Since that time, it has been determined that the high-level radioactive waste generated by the treatment and management of sodium-bonded spent nuclear fuel at ANL-W would not require any additional treatment at INEEL and are not within the scope of the Idaho High-Level Waste and Facilities Disposition EIS, which only evaluates the treatment of specific amounts of calcined high-level and sodium-bearing, radioactive waste material currently located at INEEL. Section 1.6.2.3 has been revised.

49-7: The commentor is correct. The figure has been revised.

49-8: For the purposes of this EIS, the "metallic waste form" or "melt and dilute product" from the melt and dilute alternatives are considered to be high-level radioactive waste that would be disposed of in a geologic repository. Disposal of the metallic waste form or melt and dilute product from the melt and dilute alternatives in the geologic repository is not expected to be problematic. The Yucca Mountain Draft EIS assumes that all sodium-bonded spent nuclear fuel will be treated using the electrometallurgical process (Alternative 1 of this EIS) and the Yucca Mountain Draft EIS presents isotopic contents in its Appendix A that are in accordance with the electrometallurgical treatment process.

49-9: The amount of plutonium in the various sodium-bonded spent nuclear fuel is given in Appendix D, Section D.2. Section 4.1.2 of the EIS has been modified to provide a perspective on the amount of plutonium that would be separated from the cleaned and declad blanket spent nuclear fuel during PUREX

Commentor No. 49: Kathleen E. Trever (Cont'd)

One or more of these sections (as well as the appendix) should include the amount of plutonium that would be produced and compare it to the total amount of plutonium that is expected to be produced and stored at SRS. A summary of quantities would be useful for reviewers. **49-9 (Cont'd)**

Volume 1, Section 3.2.4, Figure 3-3, page 3-11
The reference "LMITC 1977" at the bottom of the figure should probably be "LMITCo 1997." **49-10**

Volume 1, Section 3.2.4.1, page 3-9, 5th paragraph
The text states "No flood maps of the Big Lost River are available...." This statement is not entirely true as maps of the flood plain are presented in Berenbrock and Kjelstrom (1998). Further, the reference given for the statement regarding the lack of flood plain maps (i.e. Abbott, Crockett, and Moor, 1997) is a predecisional draft. This EIS should cite the *original scientific study*. **49-11**

Volume 1, Section 3.2.4.1, page 3-9, 5th paragraph
The text states that "Flood diversion facilities... secured the INEEL from the 300-year flood" and references an EIS (i.e. DOE, 1996c) as support for this statement. Instead of citing another EIS, this EIS should cite the *original scientific study* that reached that conclusion. **49-12**

Volume 1, Section 3.2.4.1, page 3-9, Last paragraph
Provide a reference for the statement that the liquid waste is "nonhazardous." **49-3**

Volume 1, Section 3.2.4.2, page 3-12, 2nd paragraph
Several of the statements in this paragraph should be referenced. For example, the text should cite the Federal Register for the sole source aquifer designation for the Snake River Plain aquifer. Scientific studies (not another EIS) should be cited for the amount of water in the aquifer and the source of recharge. **49-13**

Volume 1, Section 3.2.4.2, page 3-12, 3rd paragraph
Perched water bodies at the INEEL are present over relatively small areas of the site that are near surface water bodies or other sources of recharge. If perched water does not occur near ANL-W, then the last two sentences are irrelevant and should be deleted. The statement that "perched water tables tend to slow the migration of pollutants" should reference the original scientific study and not merely reference another EIS. **49-14**

Volume 1, Section 3.2.4.2, page 3-12, 4th paragraph
The EIS should provide a reference for the statement that the "tritium... concentration dropped 93 percent between 1961 and 1994." Also, the contaminant list provided is not all- inclusive. This section should also reference some of the more recent USGS **49-15**

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Response to Commentor No. 49 (Cont'd):

processing compared to the total amount of plutonium (considered surplus plutonium) currently stored at SRS.

49-10: The reference cited by the commentor has been revised. The reference is now DOE 1999a, "Idaho National Engineering and Environmental Laboratory Advanced Mixed Waste Treatment Project Final Environmental Impact Statement," DOE/EIS-290, Office of Environmental Management, Idaho Operations Office, Idaho Falls, Idaho.

49-11: The EIS text was revised to more clearly indicate the availability of the preliminary study of the 100-year peak flow of the Big Lost River. The sentence containing the Abbott, Crockett, and Moor (1997) reference has been deleted. The EIS cites the original scientific study written by Berenbrock and Kjelstrom (i.e., USGS 1998).

49-12: DOE based the affected environment discussions on the Surplus Plutonium Disposition EIS, except where otherwise noted. The discussion of flood diversion facilities is provided in that document, which is readily available to the public, so no additional reference is necessary. It is accepted practice for DOE to cite peer-reviewed, published, and approved DOE documents.

49-13: DOE based the affected environment discussions on the Surplus Plutonium Disposition EIS, except where otherwise noted. The discussion of the Snake River Plain aquifer is provided in that document, which is readily available to the public so no additional reference is necessary. It is an accepted practice for DOE to cite peer-reviewed, published, and approved DOE documents.

49-14: DOE based the affected environment discussions on the Surplus Plutonium Disposition EIS, except where otherwise noted. The discussion of the Snake River Plain aquifer is provided in that document, which is readily available to the public so no additional reference is necessary. It is accepted practice for DOE to cite peer-reviewed, published, and approved DOE documents.

49-15: DOE based the affected environment discussions on the Surplus Plutonium Disposition EIS, except where otherwise noted. A discussion of historical tritium concentrations is provided in that document, which is readily available to the public so no additional reference is necessary. Text in Section 3.2.4.2 was revised to address the migration of waste into the aquifer. The list of groundwater contaminants is intended to show examples of known contaminants and indicate those of primary concern. Text has been added to the this EIS to refer the reader to the annual environmental reports for more information on groundwater monitoring programs.

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hydrologic conditions reports for the INEEL (e.g., Bartholomay and others, 1997) for readers who would like more information.

The statement "Components of nonradioactive waste entered the aquifer as a result of past waste management practices" uses the past tense, and consequently is misleading. Nonradioactive wastes continue to migrate to the aquifer at the INEEL. For example, chloride discharged to the percolation ponds at the INTEC migrates rapidly enough that chloride concentrations in groundwater mirror the concentrations in the wastewater (see Bartholomay and others, 1997; p. 36). **49-15 (Cont'd)**

Volume 1, Section 3.2.5, page 3-13, 1st paragraph
References should be provided for the age of the rhyolitic rocks. Also, the last two sentences appear contradictory. Further discussion of sinkhole and lava tube issues is appropriate. **49-16**

Volume 1, Section 3.2.5, page 3-13, 3rd paragraph
The reference given for the statement regarding capable faults (i.e. Abbott, Crockett, and Moor, 1997) is a predecisional draft, which hardly seems appropriate. Reference the *original scientific study*. **49-17**

Volume 1, Section 3.2.5, page 3-13, 4th paragraph
The statement "No earthquakes have been recorded within 48 kilometers of the site" is false. In fact, several small earthquakes have been recorded beneath the INEEL (Jackson and others, 1993). **49-18**

Volume 1, Section 3.2.5, page 3-13, 4th paragraph
"An earthquake with a maximum horizontal acceleration of 0.15 g is calculated to have an annual probability of occurrence of 1 in 5,000 at a central INEEL location." The EIS should list the reference for this important value. **49-19**

Volume 1, Section 3.2.5, page 3-13, 5th paragraph
The statement "most of the basaltic volcanic activity occurred at the Craters of the Moon National Monument 20 kilometers southwest of INEEL between 4 million and 2,100 years ago" is inaccurate. While the most recent volcanism on the Snake River Plain occurred at the Craters of the Moon National Monument, researchers have mapped five volcanic zones on the INEEL. ANL-W lies within one of these, the axial volcanic zone (Hackett and Smith, 1994). Most or all of the basalt flows on the INEEL were derived from these or other local eruptive centers. The text should be revised to discuss the volcanic activity on the INEEL. **49-20**

The text states "The probability of volcanic activity affecting facilities at the INEEL is very low." "Very low" is not quantitative, and thus has no real meaning. A quantitative estimate for volcanism at ANL-W can and should be derived using the data presented

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Response to Commentor No. 49 (Cont'd):

49-16: The reference for the age of the rhyolitic rocks has been added to the EIS, and the two sentences referenced by the commentor have been modified for clarity.

49-17: Although Abbott, Crockett, and Moor (1997) is a predecisional draft, neither a draft or final version of the document will be issued. However, the document will be included in the Administrative Record for the EIS and will, therefore, be available to the public.

49-18: The statement that no earthquakes have been recorded within 48 kilometers (30 miles) of INEEL has been deleted from the EIS and reference to the occurrence of several "microearthquakes" at the site has been added (per Jackson et al. 1993).

49-19: The following reference has been added to the end of the sentence in question. Barghusen, J., and R. Feit, 1995, Technical Report on Affected Environment or the DOE Sites Considered in the DOE Waste Management Programmatic Environmental Impact Statement, META/Berger-SR-01, META/Berger, Gaithersburg, MD, July."

49-20: The referenced paragraph in Section 3.2.5 of the EIS has been revised using Hackett and Smith (1994). Also, reference to the volcanic zone within which ANL-W occurs has been added to the last paragraph of Section 3.2.5 of the EIS.

49-21: Although Abbott, Crockett, and Moor (1997) is a predecisional draft, neither a draft or final version of the document will be issued. However, the document will be included in the Administrative Record for the EIS and will, therefore, be available to the public.

49-22: Information presented in the second through fourth sentences of the referenced paragraph in Section 3.2.5 of the EIS is from ANL 1999a. This reference is provided at the end of the fourth sentence. The last sentence concerning disturbed soils has been retained.

49-23: The socioeconomic region of influence is not determined by proximity, but is defined by the areas where INEEL employees and their families reside, spend their income, and use their benefits, thereby affecting the economic conditions of the region. The region of economic influence was determined to be a four-county area in Idaho (Bonneville, Bingham, Bannock, and Jefferson Counties) in which large populations (94.4 percent) of all INEEL employees reside. The seven-county area used in other INEEL EISs was based solely on proximity and the 80-kilometer (50-mile) radius used to assess health impacts.

Commentor No. 49: Kathleen E. Trever (Cont'd)

in the Hackett and Smith study (1994). The text should present this information, not merely reference another EIS. The last sentence should be deleted and replaced with a detailed discussion in this document. **49-20 (Cont'd)**

Volume 1, Section 3.2.5, page 3-13, last paragraph
The reference given for the statement regarding capable faults (i.e., Abbott, Crockett, and Moor, 1997) is a predecisional draft. The EIS should reference the *original scientific study*. **49-21**

The EIS should provide a reference or topographic map to support the statement that ANL-W lies within a closed basin. **49-22**

The statement "Soils are highly disturbed within developed areas of the site" is intuitive and could be deleted.

Volume 1, Section 3.2.8, page 3-18
The region of influence should be expanded. A seven-county area has been used for other INEEL EISs. Butte County should at least be included, since most of the INEEL site is in Butte County. **49-23**

Volume 1, Section 3.2.11.1, Table 3-10, page 3-25
Because DOE considers the sodium-bearing waste in the INTEC Tank Farm mixed transuranic waste that may be processed in the future at the NWCF, the box opposite "INTEC NWCF" under "Mixed TRU" should contain an "x." Notably, the State of Idaho considers this material to be high-level waste. **49-24**

Volume 1, Section 3.2.11.2, page 3-27, lines 2-4
"Most aqueous solutions...were concentrated by evaporation and separated into low-level radioactive waste streams..." should be changed to say "...separated into low-level and high-level radioactive waste streams...." **49-25**

Volume 1, Section 3.2.11.2, page 3-7, lines 4-11
"This calcination was completed in February 1998." Calcination of non-sodium bearing HLW has been completed, but calcination of sodium-bearing waste has not.

The sentences at the end of this paragraph could be interpreted as indicating that storage tanks are empty. These sentences should be clarified, since about 1.4 million gallons of liquid mixed sodium-bearing waste remain in the INTEC Tank Farm. **49-26**

Volume 1, Section 4.1.2, page 4-3 (and various subsequent discussions of TRU waste)
"Transuranic waste....This waste could be disposed of in the Waste Isolation Pilot Plant." Would the TRU waste resulting from this process be acceptable for disposal **49-27**

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Response to Commentor No. 49 (Cont'd):

49-24: DOE concurs with the commentor, and this table has been revised in the EIS to reflect the change.

49-25: DOE has revised Section 3.2.11.2 of the EIS to be consistent with the information given in the Idaho High-Level Waste and Facilities Disposition Draft EIS.

49-26: See response to comment 49-25.

49-27: All of the transuranic waste generated by the treatment of sodium-bonded spent nuclear fuel would be acceptable for disposal at the Waste Isolation Pilot Plant under current regulations. If necessary, the Advanced Mixed Waste Treatment Facility will treat the waste to meet the Waste Isolation Pilot Plant Waste Acceptance Criteria and applicable requirements of the Toxic Substances Control Act and Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions.

49-28: For the purposes of evaluation, this EIS assumes that high-integrity can packaging could start as early as 2003. DOE would not begin packaging in high-integrity cans until it receives some indication that high-integrity can packaging would be acceptable under the waste acceptance criteria for the geologic repository and a high-integrity can specification is in place.

49-29: As described in the EIS, the adsorbent used in the off-gas system to collect volatile radionuclides released from spent nuclear fuel when it is heated is considered a high-level radioactive waste. This adsorbent material would be packaged and disposed of similar to other high-level radioactive waste generated under the proposed action. This high-level radioactive waste would be generated at ANL-W (and/or SRS), and would be stored and disposed of in a similar manner to the ceramic and/or metallic waste.

49-30: The text in Table 4-64 was revised to reflect this new information. The information presented in this table, as referenced, came from the Advanced Mixed Waste Treatment EIS released by DOE Idaho Operations in January 1999. DOE recognizes that there will always be other new commercial businesses that contribute to the cumulative impacts in the region. Since the potential incremental effects from the proposed action on the region would be small, it is not necessary to identify each of these new commercial businesses. As explained in Section 4.11.1 of the SBSNF EIS, DOE recognizes there are a number of existing and planned industrial and commercial facilities located in the counties surrounding INEEL, although the EIS does not identify them by name. Because of the distances between

Commentor No. 49: Kathleen E. Trever (Cont'd)

at WIPP under the WIPP Land Withdrawal Act and current regulations, or would legal changes be required for disposal at WIPP? **49-27 (Cont'd)**

Volume 1, Section 4.4, page 4-26
Will geologic repository waste acceptance criteria and specifications for high-integrity cans be established by 2003? This information will be necessary for placement in cans to begin. **49-28**

Volume 1, Section 4.4.6, page 4-33, under the header "Other Associated Process High-Level Radioactive Waste", 1st paragraph; Section 4.5.6, page 4-48; Section 4.6.6, page 4-59; Section 4.7.6, page 4-72; Section 4.8.6, pages 4-82 and 4-83
"...absorbant used in the off-gas system which has collected the volatile radionuclides...." How and where will this material be treated and disposed? **49-29**

Volume 1, Section 4.10.1, Table 4-62, page 4-88
The Target store listed in this table is not a "reasonably foreseeable offsite action." It has been completed and open for business for some time. It is unclear why this store was included in this table and other similar projects were not. For example, other commercial businesses of similar size recently have been or are being constructed in the Idaho Falls area. **49-30**

Volume 1, Section 4.11, page 4-102
"The programmatic considerations presented below is a programmative perspective of the alternatives vis-a-vis the current regulatory environment...." This sentence should be rewritten to be a clear statement. **49-31**

Volume 1, Section 5.1.3, Table 5-1, pages 5-6 and 5-7
DOE Order 435.1 and the associated manual and guidance document are now final. DOE Order 435.1 should be included in the table and its implications fully discussed in the text. Also, the entire SBSNF EIS should be reviewed for consistency with Order 435.1 requirements for radioactive waste management and waste type definitions and modified as necessary. **49-32**

Volume 2, Appendix A, Table A-3, page A-17, 1st item under "Transportation"
"It is DOE's intention to minimize transport of radioactive materials associated with its sodium-bonded spent nuclear fuel inventory wherever possible." This statement should be qualified in the text, since the SBSNF EIS considers alternatives that do <u>not</u> minimize transport. **49-33**

Volume 2, Appendix A, Table A-3, page A-21, 3rd item
Is the sale of low-enriched uranium as feedstock for commercial reactor fuel consistent with the U.S. policy on reprocessing? **49-34**

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Response to Commentor No. 49 (Cont'd):

INEEL and these facilities, there is no opportunity for interaction and no measurable contribution to the cumulative impacts.

49-31: The text cited by the commentor has been revised.

49-32: DOE Order 435.1 has been added to Table 5-1 of the EIS. This DOE Order replaces DOE Order 5820.2A, which was removed from the table. The definitions of radioactive waste materials identified in the EIS are consistent with the definitions used in DOE Order 435.1. The implications of DOE 435.1 are discussed, as appropriate, throughout the EIS.

49-33: DOE considered two alternative locations for the treatment and management of sodium-bonded spent nuclear fuel, INEEL and SRS. SRS was selected in response to the National Research Council's recommendation that only PUREX processing would provide a viable alternative to the electrometallurgical treatment technology. This is consistent with the statement made in Section A.1.3 of Appendix A that DOE would minimize transportation activities "wherever possible." As described in Section 4.9 of the EIS, the environmental impacts of transporting spent fuel to SRS are very small, and are essentially indistinguishable from those associated with local transport at the INEEL site.

49-34: Disposition of DOE's inventory of surplus uranium is not within the scope of this EIS. However, it will be the subject of a future NEPA action.

49-35: The definition of mixed waste in presented in Section B.5.1 of Appendix B has been expanded to indicate that mixed waste could be any radioactive waste that includes hazardous components, i.e., it could be either high-level radioactive, low-level radioactive, or transuranic waste.

49-36: The designation "Other Waste" has been removed from the list of waste types.

49-37: As part of the PUREX processing of spent nuclear fuel, the separated, impure plutonium would go through various cleaning cycles to reduce transuranic contamination. The separated plutonium from the blanket spent nuclear fuel would be considered surplus plutonium.

49-38: Qualifying statements were added to the table to clarify the radiation exposure units.

49-39: The text cited by the commentor has been revised.

49-40: DOE agrees with the commentor. The text has been revised for clarity and omissions. The unit for 0.03 is "g," or acceleration gravity, indicating the peak ground acceleration of the Borah Earthquake.

Commentor No. 49: Kathleen E. Trever (Cont'd)

Volume 2, Section B.5.1, page B-7
The definition of mixed waste (mid-page) should be changed to indicate that high-level and TRU waste can be mixed (as well as low-level waste). **49-35**

All wastes should fit into high-level, TRU, low-level, mixed, hazardous, or non-hazardous waste categories. Management and disposal of "other wastes" would be problematic. **49-36**

Volume 2, Section C.2, page C-6
Why would the plutonium be further purified in a "Second Plutonium Cycle" ? Is it considered to be surplus plutonium? **49-37**

Volume 2, Section E.2.2, Table E-2, page E-9
The table should include units; all impacts are per person-rem. **49-38**

Volume 2, Section E.4.1, page E-15, 1st paragraph, line 5
"Department of Environmental Quality" should be "Division of Environmental Quality." **49-39**

Volume 2, Section F.2.2.1.2, page F-11, 2nd paragraph
This paragraph is not clearly written and is hard to follow. Also, what are the 0.03 units referred to in "all major systems are known to have survived the 0.03 Borah earthquake..."? **49-40**

Volume 2, Section F.2.2.1.3, page F-24, 1st paragraph
"The location of the F-Canyon facility is far away from any airport...." A distance should be listed to quantify "far away." **49-41**

Volume 2, Section G.5.5, page G-16
"(ANL 1994)" A more recent reference for vehicle accident and fatality rates is Saricks, C. L. and M. M. Tompkins, 1999, State-Level Accident Rates of Surface Freight Transportation: A Re-Examination, ESD/TM-150, Argonne National Laboratory, Argonne, Illinois. **49-42**

Volume 2, Section G.5.6.2, 1st line
"The release fractions for were taken from...." The missing word between "for" and "were" should be provided. **49-43**

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Response to Commentor No. 49 (Cont'd):

49-41: DOE Standard 3014-96 discusses the distances from where a facility could be affected by takeoff and landing accidents. F-Canyon is located outside the farthest distance identified in the standard, more than 40 kilometers (25 miles) away from a major commercial airport. A clarification was added to the text.

49-42: The new transportation accident frequencies from this reference have been incorporated into the EIS.

49-43: The text in section G.5.6.2 of Appendix G has been revised for clarity.

Commentor No. 49: Kathleen E. Trever (Cont'd)

REFERENCES TO COMMENTS

Bartholomay, R.C., B.T. Tucker, D.J. Ackerman, and M.J. Liszewski, 1997. Hydrologic conditions and distribution of selected radiochemical and chemical constituents in water, Snake River Plain aquifer, Idaho National Engineering Laboratory, Idaho, 1992 through 1995: U.S. Geological Survey Water-Resources Investigations Report 97-4086 (DOE/ID-22137), 57 p.

Berenbrock, C., and L.C. Kjelstrom, 1998, Preliminary water-surface elevations and boundary of the 100-year peak flow in the Big Lost River at the INEEL, Idaho: U.S. Geological Survey Water-Resources Investigations Report 98-4065 (DOE/ID-22148), 13 p.

Hackett, W.R., and Smith, R.P, 1994, Volcanic hazards of the Idaho National Engineering Laboratory and adjacent areas: INEL-94/0276, 31 p.

Jackson, S.M., I.G. Wong, G.S. Carpenter, D.M. Anderson, and S.M. Martin, 1993, Contemporary seismicity in the eastern Snake River Plain, Idaho based on microearthquake monitoring: Bull. Seis. Soc. of Amer., v. 83, no. 3, pp. 680-695.

Should you have any questions regarding these comments, please contact Robert Guenzler at (208) 528-2600.

Sincerely,

Kathleen E. Trever

Kathleen E. Trever
Coordinator-Manager

KET/ds

Response to Commentor No. 49 :

Commentor No. 50: Bennett Ramberg

COMMITTEE TO BRIDGE THE GAP
1637 BUTLER AVENUE, SUITE 203
LOS ANGELES, CALIFORNIA 90025
(310) 478-0829

September 27, 1999

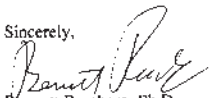
Susan Lesica
NE-40
U.S. Department of Energy
19901 Germantown Rd.
Germantown, MD 20874

Dear Ms. Lesica:

Enclosed please find comments on the Draft EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel.

Thank you for your consideration.

Sincerely,



Bennett Ramberg, Ph.D.
Director of Research

Response to Commentor No. 50:

Commentor No. 50: Bennett Ramberg (Cont'd)

Comments Submitted by
Bennett Ramberg, Ph.D.
Director of Research,
Committee to Bridge the Gap
1637 Butler St.
Los Angeles, CA 90025
310 478-0829

On the "Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel"

According to the dictionary, a "contortionist" is one who can twist his body into unnatural positions. Reading the "Nonproliferation Impacts Assessment for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel" (NIA)--an addendum to the "Draft Environmental Impact Statement for The Treatment and Management of Sodium-Bonded Spent Nuclear Fuel" (DEIS)--one comes away with the feeling that the Department of Energy (DOE) has adopted a contortionist's rationalization of reprocessing of spent nuclear fuel at the Argonne National Laboratory-West. (ANL-W). In so doing, the authors challenge a foundation of U.S. nuclear nonproliferation policy while laying the basis for implementation of more proliferation resistant actions.

In the commentary that follows, I intend to raise serious questions about the impact of EMT on the U.S. government's nuclear nonproliferation policy. In support of my concerns, I have enclosed the declarations of leading experts that appeared in litigation brought to halt the the Argonne National Laboratory-West's Electromeallurgical Treatment Research and Demonstration Project.

50-1

The following NIA "conclusion" provides a point of departure to illustrate the problem: "All but one alternative--the one involving PUREX reprocessing at SRS--are *fully consistent* with U.S. policy with respect to reprocessing and nonproliferation." (Page ES-7; emphasis added.) Note, however, that on page ES-6, DOE qualifies this affirmation declaring that the "consistent" alternatives "have the potential to raise limited concerns." In this Clintonesque word game, it is difficult to quantify how "limited" "limited concerns" are.

The report provides evidence that "concerns" are more than limited. On page ES-6 the authors note that EMT "could cause countries to question the U.S. commitment against reprocessing and *provide encouragement* for the expansion or initiation of reprocessing programs in other countries." (emphasis added) This is a curious consequence for a program that DOE purports to be "consistent "with Washington's nonproliferation policy. The body of the NIA supports this skepticism.

Response to Commentor No. 50:

50-1: The assessment of nonproliferation impacts is not part of the scope of the EIS. As stated in the Nonproliferation Impacts Assessment the alternatives involving PUREX reprocessing and broad application of electrometallurgical treatment of both driver and blanket fuel have a greater potential to provide encouragement to other countries to engage in plutonium reprocessing. Given the small quantity and unique characteristics of the sodium-bonded spent nuclear fuel and the reason for the treatment, however, such encouragement, if any, would be limited. Sodium-bonded spent nuclear fuel represents approximately 2 percent of the DOE's spent nuclear fuel inventory.

Commentor No. 50: Bennett Ramberg (Cont'd)

The contortions manifest early in the defense of EMT when the NIA cites ANL-W's contention, namely that IFR pyroprocessing "was designed to be 'proliferation resistant.'" (Page 3-4.) The NIA itself subsequently casts doubt citing no less and authority than the National Academy of Sciences: "Although the developers of the electrometallurgical technique argue that the technology is proliferation resistant, any [spent nuclear fuel] processing approach that is capable of separating fissionable materials from associated fission products and transuranic elements could be redirected to produce materials with nuclear detonation capability." (Page 3-5)

The contortions continue in another direction when the NIA concludes on page 3-8 that EMT in its "current equipment configuration" is incapable of producing weapons useable plutonium. At the same time DOE--echoing the National Academy of Sciences--concedes that "additional steps" could be taken to permit the procurement of weapons useable plutonium. In this regard the NIA notes that the compact EMI process allows for a "more concealed plutonium purification process." (Page 3-14.) It acknowledges that EMT will extract weapons-useable HEU. On page 3-14 the authors note diversion scenarios for both nuclear weapons useable materials.

Before proceeding into a comparative evaluation of spent fuel treatment alternatives, the NIA strains to distinguish EMT from reprocessing. Civil reprocessing has been contrary to public policy since the Ford Administration. The Clinton Administration has drawn an artificial line declaring that reprocessing refers solely to the extraction of plutonium. This is contrary to the common definition of reprocessing which is the separation of spent fuel into its constituent parts. (See the critical reviews of how reprocessing has been represented at ANL-W in Attachments 1 and 2 by Thomas Cochran, Ph.D. and Professor Albert Wohlstetter, Ph.D., respectively.)

Recognizing the dilemma, the authors engage in remarkable contortions attempting to suggest that EMT is not reprocessing. In this view, "Because EMT is not capable of separating plutonium from fission products, it cannot be considered plutonium reprocessing." In the same paragraph, however, the NIA concedes that "separation of weapons-usable plutonium is possible using a modified EMT electrorefiner in a hybrid system." With regard to HEU, the authors concede that extraction from spent fuel is "reprocessing": "EMT does recover HEU from HEU-containing spent nuclear fuel, similar to other DOE reprocessing facilities such as the Idaho Chemical Processing Plant and the

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Response to Commentor No. 50:

Commentor No. 50: Bennett Ramberg (Cont'd)

H-Canyon facility at the Savannah River Site (SRS), and for that reason, EMT could be recognized as a reprocessing technology." (Page 3-15.)

As a result of this the NIA concludes, "Because of the similarities between EMT and conventional reprocessing, in particular the ability of EMT to recover HEU and the role of the EMT electrorefiner in a potential hybrid plutonium recovery process, both domestic and export applications of EMT pose concerns with respect to U.S. nonproliferation policy." (Page 3-15.) The authors punctuate this point on page E-16 noting, "*Except in cases where EMT exhibits a decisive advantage (e.g., in security, cost, environmental, or health and safety) over other alternatives, the use, export, development, or promotion of this technology could cause countries to question the U.S. commitment against reprocessing. Closely scrutinizing proposals for applying EMT (and similar fissile material separations technologies) will help mitigate this issue.*" (italics included) This is a peculiar conclusion for a technology that DOE contends is "consistent" with nonproliferation. Furthermore the authors fail to define what "scrutiny" is required to address their concerns.

All this is prolog to a curious comparative evaluation of the proliferation resistance of various sodium bonded spent fuel disposal alternatives. The Department of Energy argues that save for PUREX, all remaining alternatives are "acceptable in terms of nonproliferation risk." (Page ES-6.) However, Chapter 6's assessment demonstrates quite the contrary: some alternatives are clearly less risky than others and, it is not at all clear, as the report concludes, that the benefits of some are simply "marginal." (Page ES-6.)

50-1

Table 6-1 provides a point of departure. The authors indicate that in four categories EMT "could raise proliferation concerns." The text provides elaboration repeating concerns raised elsewhere. DOE concedes that it is difficult to assure application of international safeguards to EMT because bulk processing of nuclear material and separation of fissile material. Furthermore,

> "The similarities between EMT and conventional reprocessing would have somewhat greater potential to encourage reprocessing in other countries than would the high-integrity cans or melt and dilute options. This potential stems primarily from its ability to produce weapons-useable HEU and the historical origins of EMT as part of the IFR breeder fuel-cycle technology, which can be perceived as having several parallels to the PUREX technology used worldwide to process spent nuclear fuel. Extending the time that U.S. separations facilities operate and using a separations process to prepare spent nuclear fuel for geological disposal (while at

Response to Commentor No. 50:

Commentor No. 50: Bennett Ramberg (Cont'd)

the same time acknowledging that the fuel does not pose near-term safety and health vulnerabilities and that such processing technically is not required) could serve to undermine U.S. credibility in expressing concern to other countries about the proliferation problems associated with conventional reprocessing in the nuclear fuel cycle." (Page 6-4.)

The authors then proceed to rationalize EMT through a serious of contortions as the paragraph continues. They argue the technology is not intended to extract plutonium. Note however that the paragraph concedes that EMT has parallels to PUREX which is a plutonium reprocessing technology. The report then argues that EMT is necessary to address the "unique chemical reactivity requirements of the highly unusual type of spent fuel." However, the authors grant that other technologies which do not require reprocessing can cope with the challenge. A third defense of EMT argues that the technology intends to prepare the fuel for disposal rather than breeding. This is a *non sequitur*; with the conclusion of operations at EBR II, there is no breeder program in the United States. Finally, the authors acknowledge that that EMT would challenge verification under the Fissile Material Cutoof Treaty.

Were EMT the only alternative apart from PUREX, perhaps a case could be made for its application. However the NIA reports alternatives. High Integrity Cans for blanket assemblies and Melt and Dilute both reduce the proliferation challenge. The No Action alternative, defers the problem for an interim period. (In Attachment 3, Professor Frank von Hippel, Ph.D. argues that there is no urgency to treat the spent fuel at ANL-W.) Indeed, No Action allows time for development of "less mature" proliferation resistant technologies mentioned in the NIA and the DOE/EIS, e.g. GMODS and plasma arc methods. (Pages 6-9 of the NIA and S-23 and 2-31 of the DEIS. See also Professor James Warf, Ph.D., Attachment 4, on alternatives to extract sodium from the spent fuel without reprocessing.)

The NIA's demonstration that practical alternatives exist that do not bear the proliferation onus of EMT, coupled to others in development, begs the following questions: Why is EMT being promoted? Why has DOE engaged in the noted contortions? Why can't DOE await the maturation of promising technologies under development which do not raise the proliferation specter?

In conclusion, the foregoing analysis demonstrates that EMT is contrary to the "major principals" laid out in the September 27, 1993 White House "Nonproliferation and

50-1

Response to Commentor No. 50:

Commentor No. 50: Bennett Ramberg (Cont'd)

Export Control Policy Statement" which declares "Our national security requires us to accord higher priority to nuclear nonproliferation." The application of EMT, which DOE acknowledges is reprocessing and could "provide encouragement" for reprocessing in other countries, is clearly inconsistent with the "Statement." Accordingly, DOE should halt the application of EMT without delay.

50-1

Attachments

Attachment 1: Declaration of Thomas B. Cochran, Ph.D.

Attachment 2: Declaration of Albert Wohlstetter, Ph.D.

Attachment 3: Declaration of Frank Von Hippel, Ph.D.

Attachment 4: Declaration of James C. Warf, Ph.D.

Response to Commentor No. 50:

Commentor No. 51: Charles Rice

Citizens Advisory Board

Idaho National Engineering and Environmental Laboratory

99-CAB-099

September 28, 1999

Susan Lesica
NEPA Document Manager
U.S. Department of Energy
Office of Nuclear Facilities Management
Office of Nuclear Energy Science, and Technology, NE-40
19901 Germantown Road, Germantown, Maryland 20874-1290,

Attention: DOE/EIS-0306

Dear Ms. Lesica:

> Note: The Site-Specific Advisory Board (SSAB) for the Idaho National Engineering and Environmental Laboratory (INEEL), also known as the INEEL Citizens Advisory Board (CAB), is a local advisory committee chartered under the Department of Energy's (DOE) Environmental Management SSAB Federal Advisory Committee Act Charter.

The Idaho National Engineering and Environmental Laboratory Citizens Advisory Board (INEEL CAB) reviewed the *Draft Environmental Impact Statement (EIS) for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* and two companion documents, the *Cost Study of Alternatives Presented in the Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* and the *Nonproliferation Impacts Assessment for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*.

The enclosed recommendation, INEEL CAB Recommendation #64, conveys the INEEL CAB's comments on the three documents. The recommendation was reached through consensus at our September 1999 meeting. I might add that we appreciated your willingness to extend the public comment period to allow our participation.

We await your response to this recommendation.

Sincerely,

Charles M. Rice
Chair, INEEL CAB

Jason Associates Corporation • 477 Shoup Avenue, Suite 201 • Idaho Falls, Idaho 83402
Phone • (208) 522-1662 Fax • (208) 522-2531
http://www.ida.net/users/cab

Response to Commentor No. 51:

Commentor No. 51: Charles Rice (Cont'd)

cc: Dieter Knecht, INEEL CAB Spent Nuclear Fuel Committee Chair
Beverly Cook, DOE-ID
Greg Bass, DOE-Chicago
Carolyn Huntoon, DOE-HQ
Bill Magwood, DOE-HQ
Martha Crosland, DOE-HQ
Fred Butterfield, DOE-HQ
Larry Craig, U.S. Senate
Mike Crapo, U.S. Senate
Mike Simpson, U.S. House of Representatives
Helen Chenowith, U.S. House of Representatives
Laird Noh, Chair, Idaho Senate Resources and Environment Committee
Golden C. Linford, Chair, Idaho House of Representatives Resources and Conservation Committee
Jack Barraclough, Chair, Idaho House of Representatives Environmental Affairs Committee
Gerald Bowman, DOE-ID
Kathleen Trever, State of Idaho INEEL Oversight
Wayne Pierre, U.S. Environmental Protection Agency Region X

Jason Associates Corporation ▪ 477 Shoup Avenue, Suite 201 • Idaho Falls, Idaho 83402
Phone • (208) 522-1662 Fax • (208) 522-2531
http://www.ida.net/users/cab

Response to Commentor No. 51 (Cont'd):

Commentor No. 51: Charles Rice (Cont'd)

Citizens Advisory Board
Idaho National Engineering and Environmental Laboratory

Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

The Idaho National Engineering and Environmental Laboratory Citizens Advisory Board (INEEL CAB) has reviewed the *Draft Environmental Impact Statement (EIS) for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* and two companion documents, the *Cost Study of Alternatives Presented in the Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* and the *Nonproliferation Impacts Assessment for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*. This recommendation, reached through consensus, presents our comments on the three documents.

During the scoping period for this EIS, the INEEL CAB recommended that DOE consider the possibility of using different treatment processes for the driver fuel and the blanket fuel. **We commend DOE for taking that recommendation to heart.** We also feel that DOE was responsive to other recommendations we made during the scoping period, including requests for (1) a listing of all assumptions and (2) bounding estimates of shipments in and out of Idaho and estimates of storage duration(s). The following recommendations address our prior recommendations that were less well addressed and other concerns that arose during review of the draft EIS.

51-1

During the scoping period for this EIS, the INEEL CAB recommended that DOE evaluate the impacts of additional alternatives. We appreciate that DOE accepted that recommendation. **The INEEL CAB recommends that DOE give more consideration to the Glass Material Oxidation and Dissolution System and the Direct Plasma Arc-Vitreous Ceramic Treatment process in the Final EIS.**

51-2

The INEEL CAB recommends that DOE construct one more alternative and evaluate the impacts of that alternative in the Final EIS. The additional alternative should entail taking no action for the driver fuel. The components of this additional alternative are presented in other alternatives considered. Presentation of the impacts of these components separately (in different configurations) does not allow the public to evaluate this particular combination. This alternative would allow DOE more time to develop other non-separation technologies for possible treatment of the driver fuel and to allow further development work to determine the feasibility of removing sodium from the driver fuel (which would thereby allow disposal in High Integrity Cans). The INEEL CAB is not recommending selection of this additional alternative at this time, but would like to evaluate the impacts of such an alternative in comparison with those presented in the EIS.

51-3

During the scoping period for this EIS, the INEEL CAB recommended that relevant documents be made available during this comment period to support an informed public review of the Draft EIS. We were pleased to receive the *Cost Study of Alternatives Presented in the Draft*

51-4

RECOMMENDATION # 64 September 28, 1999
Page 1

Response to Commentor No. 51 (Cont'd):

51-1: DOE appreciates the commentor's commendation. DOE revised the scope of the EIS based on comments provided during the public scoping period.

51-2: The reasons why DOE dismissed the GMODS and direct plasma arc-vitreous ceramic treatment processes from its list of reasonable alternatives are provided in Section 2.6 of the EIS. There has been no new information since issuance of the draft EIS to change this position. Should DOE decide to take no action and wait for the development of a technology such as GMODS or the plasma arc process in its Record of Decision, additional NEPA documentation would be required to assess the impacts from the use of such technologies.

51-3: The environmental assessment of Alternatives 2, 3, 4, and 5 in Chapter 4 of the EIS presents the impacts from treatment of the driver and blanket sodium-bonded spent nuclear fuel separately. Conclusions on the environmental impacts of the alternative suggested by the commentor can be easily drawn, especially since the environmental impacts for all alternatives, including no action, are small and have been shown to not be a discriminator between alternatives. As discussed in Section 2.5 of the EIS, DOE will consider combinations of technologies, options, and fuel types, including combinations not included among the specific combinations considered in the EIS, in reaching its decision.

51-4: The National Academy of Sciences' National Research Council prepared nine reports on the electrometallurgical treatment technology that have been reviewed by DOE. These reports are located in the public reading rooms. The National Research Council completed its review of the electrometallurgical treatment technology in September 1999, and the final summary report on the Electrometallurgical Treatment Research and Demonstration Project was published in April 2000. DOE will consider the findings in this final report in determining the technical risk associated with the electrometallurgical technology alternatives in the EIS. Technical risk will be a factor in preparing the Record of Decision, which is scheduled for completion no sooner than 30 days after publication of the final EIS. Data generated during the demonstration project were used in preparing this EIS. Although NEPA does not provide for public hearings and a formal comment period following the issuance of a final EIS, the public is free to comment on the final document prior to publication of the Record of Decision.

51-5: Actual costs for treating and managing sodium-bonded spent nuclear fuel are not part of the EIS process. However, the Cost Study states that

Commentor No. 51: Charles Rice (Cont'd)

Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel and the *Nonproliferation Impacts Assessment for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*. Two other important and relevant studies still underway should have bearing on the decisions that this EIS will support. Inasmuch as the Draft EIS places primary emphasis on electrometallurgical treatment technology, the not-yet-reported electrometallurgical treatment demonstration project and the pending National Research Council's review of the electrometallurgical treatment process appear relevant. We regret that our review of the Draft EIS is less well informed than desired because the results of those two studies are not yet available. **The INEEL CAB recommends that DOE enhance public participation in this environmental review by allowing subsequent public comment period(s) once the other studies are available for public review.**

51-4 (Cont'd)

The *Cost Study of Alternatives Presented in the Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* presented relevant data on the alternatives considered in the Draft EIS. We noted, however, numerous apparent discrepancies and possible inaccuracies in the cost data presented. Such discrepancies and inaccuracies confuse the reader.

For example, Section 2.2 2 (pages 2-3 through 2-5) and Table 2-3 (on page 2-5) summarize costs associated with Alternative 1 by various cost elements. The text in Section 2.2.3 (on page 2-4) and the table both state that the net present value (in millions of Year-2000 dollars) for one cost element—waste form qualification at Argonne National Laboratory - West—would be $52 million. The cost estimate presented on Table 2-3 for another cost element—disposal fees for high-level radioactive waste—differs from the dollar value presented in the text, however. According to the table, disposal of high-level radioactive waste would cost $47 million; the text in Section 2.2.4 reports that the "repository fee" for 135 high-level radioactive waste disposal canisters would be "about $64 million" in 2015. There is no explanation for the difference between the two numbers. **The INEEL CAB recommends that DOE revise the cost study and that all cost estimates be presented in a readable and understandable form to support informed public review of environmental documentation.**

51-5

The INEEL CAB supports U.S. goals regarding nonproliferation. We recommend that DOE base decisions related to the management of sodium bonded spent nuclear fuel on a sound analysis of the potential nonproliferation impacts.

The members of the INEEL CAB differ significantly with regard to their opinions and perspectives on the current U.S. policy regarding reprocessing. As a result, we were unable to reach consensus on a recommendation regarding any particular alternative at this time. Those who support the current U.S. policy against reprocessing may not be able to support any alternative involving separations. Those who do not support the current policy may support alternatives involving separation technologies. Because we believe we represent the range of public opinions on this topic, the INEEL CAB appreciates DOE's current dilemma.

51-6

Response to Commentor No. 51 (Cont'd):

$47 million is the net present value of the disposal fee in 2000, i.e., the year 2000 value of the $64 million paid in the year 2015. In Section 1.4 of the Cost Study, the nominal escalation rate is defined to be 2.8 percent and the official discount rate provided by the Office of Management and Budget is 4.9 percent. The numbers are, therefore, consistent as stated. On page 1-7, the Cost Study explains the methodology used. Annual operating costs are provided in nominal, current year estimates except where life-cycle costs are noted.

51-6: The assessment of nonproliferation impacts is not part of the scope of the EIS. However, DOE's Office of Arms Control and Nonproliferation assessed the potential nonproliferation impacts that may result from each of the alternatives and technologies analyzed in this EIS. This analysis is presented in the Nonproliferation Impacts Assessment, which states that, for this specific application, all alternatives except PUREX processing at SRS are fully consistent with U.S. policy on reprocessing and nonproliferation. DOE welcomes public comments on nonproliferation issues and has received and responded to many comments on these issues during the public comment period on the draft EIS.

51-7: The SBSNF EIS was prepared in accordance with Council on Environmental Quality regulations (40 CFR 1500-1508) and DOE's NEPA-related regulations (10 CFR 1021) and procedures. As explained in the introduction to the EIS, the purpose of the EIS is to assess reasonable alternatives for the treatment and management of sodium-bonded spent nuclear fuel. As part of this assessment, as noted by the commentor, the EIS lists and describes the assumptions and methodologies used to evaluate environmental impacts. These assumptions and methodologies are consistent with the assumptions used in other related DOE EISs. The "related EISs" alluded to by the commentor, which are interdependent parts of a larger action as outlined in the Record of Decision for the Programmatic Spent Nuclear Fuel EIS (60 FR 28680), have been incorporated by reference and used, as appropriate, in the SBSNF EIS (see 40 CFR 1508.25(a)1(iii)). As a result of their publication, discussions on data and assumptions presented in the Yucca Mountain Draft EIS and the Idaho High-Level Waste and Facilities Disposition Draft EIS in particular have been expanded in the SBSNF EIS. The contributory effects of these other ongoing related NEPA actions at INEEL and SRS are evaluated as part of the cumulative impacts analysis for those sites (see Section 4.11 in the EIS). DOE acknowledges the commentor's opinion that the public deserves an assessment of data and assumptions to ensure consistency

Commentor No. 51: Charles Rice (Cont'd)

The INEEL CAB recommends that DOE support vigorous debate regarding the environmental impacts of reprocessing, as well as the potential for terrorist or rogue military use of nuclear materials.

51-6

During the scoping period for this EIS, the INEEL CAB recommended that DOE include a list of all assumptions that provide the basis for the assessment of impacts associated with the various alternatives. While the Draft EIS provided a list of all assumptions, the INEEL CAB recommends that more information be provided on common data and planning assumptions used in related EISs and other environmental documentation. Our recommendation was not adequately addressed by simply providing the title and contents of other ongoing analyses. The public deserves an assessment of the data and assumptions to assure consistency and compatibility with other proposed actions.

51-7

During the scoping period for this EIS, the INEEL CAB recommended that the EIS describe how each alternative would address the waste acceptance criteria for resulting waste products destined for disposal at current and planned disposal facilities. In response to that recommendation, the Draft EIS states that existing preliminary criteria for spent fuel and high-level waste have been developed by DOE's Office of Civilian Waste Management and that the final criteria will be established by the Nuclear Regulatory Commission (NRC). The reference document cited in the draft EIS was the "Civilian Radioactive Waste Management System - Waste Acceptance System Requirements Document (WASRD), DOE/RW-0351, 1998." We note that the WASRD was revised in April 1999 to add criteria for high-level waste glass and for plutonium ceramic glass composite in addition to criteria for spent nuclear fuel and high-level waste. **The INEEL CAB recommends that the Final EIS be revised to incorporate the revised WASRD.**

51-8

The INEEL CAB further recommends that DOE begin to address the requirements that will be imposed by the waste acceptance criteria before the NRC licensing process begins. We understand that the criteria for the high-level waste glass and the plutonium ceramic glass composite (as incorporated in the current revised WASRD under Section 4.2.3.1 "Specific Acceptance Criteria for HLW") were developed in response to input regarding the likely characteristics of those waste forms. **The INEEL CAB recommends that DOE work to develop preliminary waste acceptance requirements for the wastes that will result from the treatment selected in the Record of Decision (ROD) for this EIS as soon as the ROD is issued.** In that manner, the characteristics of the likely wastes will be incorporated into future revisions of the WASRD before NRC develops the final waste acceptance criteria.

51-9

The INEEL CAB concluded that the Summary to the Draft EIS was overly brief and did not provide adequate explanations for the various alternatives evaluated nor for the impacts of those alternatives. We noted that the handout materials (provided at the public comment meetings on the Draft EIS) summarizing the alternatives and the impacts of those alternatives were reader-friendly and easily understood. **The INEEL CAB recommends greater reliance on reader-friendly formats in the Final EIS to help the public understand the information being presented.**

51-10

Response to Commentor No. 51 (Cont'd):

and compatibility with other proposed actions; however, a separate assessment beyond that already presented in the EIS is beyond the scope of this EIS.

51-8: As noted in both versions of the "Civilian Radioactive Waste Management System - Waste Acceptance System Requirements Document (WASRD), DOE/RW-0351, April 1999," the DOE spent nuclear fuel addressed by the Waste Acceptance System Requirements Document does not include the metallic sodium-bonded fuel addressed in the SBSNF EIS "which are candidates for treatment or processing prior to disposal." The EIS has been revised to identify the April 1999 version of the Waste Acceptance System Requirements Document. The analyses and results presented in the SBSNF EIS are not affected by the criteria identified by the commentor for high-level radioactive waste glass, plutonium ceramic glass composite, spent nuclear fuel, and other forms of high-level radioactive waste. DOE will determine the final waste acceptance criteria after the U.S. Nuclear Regulatory Commission issues its construction authorization, based on the successful demonstration of the safe, long-term performance of the repository in accordance with the U.S. Nuclear Regulatory Commission regulations.

51-9: The commentor's recommendation is noted. As stated in Section 2.7 of the EIS, DOE is actively working to develop final waste acceptance requirements for the waste discussed in this EIS. DOE expects the waste that would result from the alternatives analyzed in the EIS would be acceptable in a geologic repository.

51-10: DOE acknowledges the commentor's recognition of the usefulness of reader-friendly formats. The Summary to the EIS has been revised to incorporate a more reader-friendly format in illustrating the types of sodium-bonded spent nuclear fuel, the proposed action and alternatives, and the overall conclusions of potential environmental impacts presented in the handout materials.

Commentor No. 52: Edwin Lyman

NUCLEAR CONTROL INSTITUTE

1000 CONNECTICUT AVE. NW, SUITE 401 WASHINGTON DC 20036 202•822•8444 FAX 202•452•0892

Email: nci@clinic.net Website: www.clinic.org

Comments on the Department of Energy's
Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

Nuclear Control Institute
September 28, 1999

The Nuclear Control Institute (NCI) appreciates the fact that the approach of the *Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (SBDEIS) differs from that described in the Notice of Intent (NOI), and appears to reflect some of the comments made by NCI and others on the NOI.

In particular, the overall structure and title were changed so that electrometallurgical treatment (EMT) of the sodium-bonded spent nuclear fuel (SBSNF) could be evaluated on a more equal footing with the other treatment alternatives, including high-integrity canisters (HIC) and melt-and-dilute. **52-1**

Also, the physical differences between the blanket and driver SBSNF assemblies were explicitly acknowledged, permitting the development of alternatives which utilize different approaches for the two types of fuel. (In this regard, we commend DOE for locating the documentation associated with the mechanical decladding and sodium removal of 7000 EBR-II blanket fuel in the 1980s that was reported to be missing at the NOI scoping hearing.) The wisdom of the approach has been confirmed by DOE's acknowledgment that "alternative technologies may have certain advantages (e.g. cost) for some or all fuel" (SBDEIS, Vol. I, pg. 2-41), and the fact that EMT of the entire SBSNF inventory has not been designated as the preferred alternative, as the NOI had envisioned. **52-2** **52-1**

Nonetheless, the SBDEIS, as well as the supporting cost and non-proliferation assessment documents, contain fundamental deficiencies and are utterly inadequate to the task of helping to determine a management approach for SBSNF which minimizes damage to the environment and to U.S. non-proliferation credentials. These deficiencies can be attributed in part to the relatively short time taken to produce these documents. We are greatly concerned by reports that the EIS process for SBSNF is being rushed so that funding can continue to flow to EMT development at Argonne National Laboratory (ANL)-West and the research team can be kept together. There **52-3**

Response to Commentor No. 52:

52-1: The commentor's appreciation is noted. DOE revised the scope of the EIS based on comments provided during the public scoping period.

52-2: DOE appreciates the commentor's commendation.

52-3: The timing for this action is a programmatic issue rather than a safety issue. The SBSNF EIS was prepared in accordance with Council on Environmental Quality regulations (40 CFR 1500-1508) and DOE's NEPA-related regulations (10 CFR 1021) and procedures. Every effort was made to prepare an EIS that is complete and understandable. Further supporting documentation, such as the Cost Study and the Nonproliferation Impacts Assessment, is referenced and is available in DOE's public reading rooms. DOE is committed to improving its environmental management practices, to operating its facilities in a manner that meets or exceeds all applicable environmental, safety, and health requirements, and to cleaning up its environmental problems. The focus of the SBSNF EIS is to assess the potential environmental and health impacts associated with the treatment and management of sodium-bonded spent nuclear fuel. Although not final, the latest guidance provided by DOE's Office of Civilian Waste Management in their "Waste Acceptance System Requirements Document," Revision 3, April 1999 (see Section 4.12.1 of the EIS), indicates that it is highly probable that sodium-bonded spent nuclear fuel would not be acceptable in the repository without some stabilization and/or removal of the metallic sodium. The stabilization of the spent nuclear fuel and/or removal of the metallic sodium will provide greater protection of human health and the environment. Having completed the Electrometallurgical Treatment Research and Demonstration Project (see Section 1.6.3) and in planning the closure of its PUREX processing capabilities, DOE now needs to decide whether these processes are suitable for treating the remaining sodium-bonded spent nuclear fuel, or whether there is sufficient reason to delay a decision and wait for the development of other treatment technologies. Delaying the EIS could result in a loss of capability and of experienced, knowledgeable technical staff should DOE decide at a later date to use the electrometallurgical process to treat sodium-bonded spent nuclear fuel. Section 1.2 of the EIS has been revised for clarification. It is also worth noting that DOE has conducted four independent nonproliferation assessments of the electrometallurgical treatment technology over the last 11 years. These assessments have found the electrometallurgical treatment technology to be in accordance with U.S. nuclear nonproliferation policy for this specific application, and have concluded that electrometallurgical treatment is not capable of separating plutonium in a form that would be

is no safety justification for making a hasty decision on such an important issue. 52-3 (Cont'd)

Comments on the *Draft EIS*

1. The need for EMT of the driver fuel has not been demonstrated.

The main problem with the SBDEIS is that it does not provide sufficient evidence that the SBSNF inventory will pose unacceptably high environmental risks if directly disposed of in a geologic repository. Without convincing evidence of this nature, it is not possible to conclude that the costs and risks of going forward with EMT are justified. At a minimum, to make a convincing case, DOE would have to show all three of the following:

1. Long-term chemical durability tests of SBSNF elements under repository-like conditions indicate that (a) the release rates of radionuclides are significantly greater than those of the proposed EMT waste forms or those of the much larger quantities of commercial SNF, vitrified high-level wastes and metallic uranium fuel (i.e. N-Reactor fuel) that will be placed in the repository; and/or (b) the presence of metallic sodium and uranium in the fuel results in chemical reactions of sufficient violence to cause significant structural damage to the repository, prolonged excessive heating or other undesirable changes. 52-4

2. The enhanced release of radionuclides, either directly from the SBSNF or indirectly as a result of damage to other waste forms in the repository, as well as other deleterious effects resulting from energetic chemical reactions, have significant impacts on the ability of the geologic repository to meet the regulatory performance criteria.

3. There are no technical remedies that could be applied to direct disposal of the SBSNF (i.e. local addition of a chemical buffer or special backfill) that could mitigate the risks associated with the presence of metallic sodium or uranium.

The SBDEIS contains no evidence along these lines, but merely asserts that the SBSNF might pose problems or "could complicate the process of certification of the SNF for disposal." This certification may well be complicated, but the cost and difficulty associated with certification must be compared to that which would be incurred by electrometallurgical treatment of this fuel.

Therefore, a variant of Alternative 2 should be considered in which the blanket fuel elements are mechanically declad and placed in high-integrity cans and the driver fuels are disposed of in high-integrity cans without any processing. The incremental impact of this option on repository performance compared to Alternative 2 should be evaluated. 52-5

2. Inconsistencies in the data must be corrected. 52-6

There are numerous inconsistencies in the technical data presented in the SBDEIS.

2

suitable for weapons production. DOE, in the Record of Decision, will take into account many factors besides this EIS and its supporting documents, including ongoing DOE programs, missions, and related, relevant NEPA actions. The commentor's opinion that the EIS and supporting documents may be deficient in supporting a decision is noted. DOE is confident that a sufficient amount of time was devoted to the preparation of this EIS and its associated documents.

52-4: As stated in the introduction to the EIS, the programmatic risk associated with implementing any of the potential alternatives for the treatment and management of sodium-bonded spent nuclear fuel, or with not treating this fuel, is the uncertainty surrounding the acceptability of DOE spent nuclear fuel for placement in a potential geologic repository. Although not final, the latest guidance provided by DOE's Office of Civilian Waste Management in its "Waste Acceptance System Requirements Document," Revision 3, April 1999 (see Section 4.12.1 of the EIS), indicates it is highly probable that sodium-bonded spent nuclear fuel would not be acceptable in a geologic repository without some stabilization and/or removal of the metallic sodium. The points raised by the commentor are the major reasons for uncertainties about the acceptability of this fuel. Performance of sodium-bonded spent nuclear fuel in a geologic repository depends on many factors (e.g., long-term fuel integrity, repository environment fuel/waste package survivability) and the presence of metallic sodium would complicate the modeling even further. Stabilization of the spent nuclear fuel and/or removal of the metallic sodium would provide greater protection for human health and the environment.

52-5: The alternative suggested by the commentor is similar, if not identical, to the direct disposal option of the No Action Alternative, which is evaluated in Section 4.2 of the EIS. It is not clear whether the commentor suggests the sodium is or is not removed before the blanket fuel elements are placed in high integrity cans. In either case, it is not the intent of this EIS to analyze the performance of a repository that would store spent nuclear fuel containing metallic sodium. This EIS assumes that the presence of metallic sodium in the sodium-bonded spent nuclear fuel may raise issues of acceptability in a repository and proposes technologies to either remove it or convert it into a nonreactive form to facilitate its disposal.

52-6: Since spent fuel degradation in storage cannot be ruled out, as described in Section 4.2.1 of the SBSNF EIS, air emissions under the No Action Alternative in the draft EIS were estimated using the adjusted values given

Commentor No. 52: Edwin Lyman (Cont'd)

Perhaps the most obvious one is the result (Table S-4) that the radiation dose to the public associated with the No Action alternative (SBSNF storage for 35 years) is nearly a factor of ten greater than that associated with Alternative 1 (EMT of the entire SBSNF inventory), although common sense dictates that the radioactive emissions resulting from processing SBSNF will exceed those resulting from storage. This curious result is a consequence of using an inconsistent set of assumptions for the two cases. At the public hearing in Arlington in August, DOE representatives assured the audience that this error would be remedied in the final EIS.

52-6 (Cont'd)

Another inconsistency is related to the categorization of the uranium recovered from the EMT process. The DEIS refuses to treat this material as a "waste," which is reflected in the tables listing the waste volumes resulting from the different alternatives. However, in the associated cost study, no credit is assigned to the recovered uranium. This is consistent with the expectation that this material will be "off-spec" and, moreover, that DOE has committed to tight restrictions on the sale of its surplus uranium for at least ten years in order to support the price of uranium originating from downblending of Russian HEU. However, a material without any value can properly be considered a waste and should be treated as such consistently through the documentation.

52-7

Comments on the *Nonproliferation Impacts Assessment for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*

We are disappointed that DOE did not grant our request that the nonproliferation assessment for SBSNF treatment be provided to the public in draft form for comment as part of the EIS process. This is unfortunate, because the *Nonproliferation Impacts Assessment for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (NIA) provides only the most cursory and superficial examination of the important security issues associated with this action. As a result, the document in its current form sheds no new light on the situation and merely serves as a non-proliferation rubber-stamp.

52-8

1. The proliferation implications of other proposed applications of EMT must be considered.

Perhaps the most fundamental problem with the NIA is its refusal to look beyond the narrow constraints of the proposed program and consider the larger nonproliferation consequences of a decision by DOE to continue to pour resources into EMT development. While the NIA insists that "the Department has no current plan to use [EMT] ... beyond the potential treatment of the sodium-bonded spent nuclear fuel inventory," the authors are either dissembling or badly misinformed. One need go no further than the ANL-West World-Wide Web site page on EMT (http://www.era.anl.gov/spentfuel/emt.html) to discover that "the [EMT] process is being developed for application **to all constituents** of the DOE-owned spent nuclear fuel inventory" (emphasis ours).

52-9

Even worse, the NIA does not acknowledge the critical role played by EMT in DOE's

3

Response to Commentor No. 52 (Cont'd):

in the No Action Alternative for the Programmatic Spent Nuclear Fuel EIS. The adjustment was based on the ratio of the heavy mass inventory of the sodium-bonded spent nuclear fuel (60 metric tons) to the entire spent nuclear fuel inventory (274 metric tons) at INEEL. DOE assumed this estimate bounds any future degradation of the sodium-bonded spent nuclear fuel during storage at the INEEL site. The consequences resulting from this estimate were very small, and there was no intention to mislead the public. Since issuance of the SBSNF Draft EIS, DOE has modified the activities under both options of the No Action Alternative, as described in Section 4.2 of the final EIS; reevaluated the potential for sodium-bonded spent fuel degradation in wet and dry storage; and revised the estimates of air emissions and associated health effects. These new results are provided in the final EIS.

52-7: The uranium recovered from the electrometallurgical treatment process contains radioactive isotopes which render it unusable as surplus uranium without further processing to remove these impurities. DOE has not yet determined the final disposition of this uranium. For the purpose of the EIS, it is assumed that metal uranium ingots from the electrometallurgical treatment process would be stored in the Materials Building within the Zero Power Physics Reactor at ANL-W. The uranium recovered from the electrometallurgical treatment process has not been treated as a waste because of its potential value if it is further processed.

52-8: The SBSNF EIS has been prepared in accordance with NEPA, the Council on Environmental Quality regulations on implementing NEPA (40 FR 1500-1508), and DOE's NEPA implementation procedures (10 FR 1021). None of these require the preparation of a nonproliferation impacts assessment as part of the EIS process. As discussed in the introduction, the basic objective of this EIS is to provide the public and DOE decision-makers with a description of the reasonable alternatives for the treatment and management of DOE's sodium-bonded spent nuclear fuel and their potential environmental impact. DOE's Office of Arms Control and Nonproliferation separately assessed the potential nonproliferation impacts that may result from each of the alternatives and technologies analyzed in this EIS. The report stated that for this specific application all alternatives, except PUREX processing at SRS, are fully consistent with U.S. policy with respect to reprocessing and nonproliferation. DOE feels that this assessment provides the public with a reasonable comprehensive evaluation of the proliferation risks associated with each alternative. The information contained in the EIS, public

Commentor No. 52: Edwin Lyman (Cont'd)

"Roadmap for Accelerator Transmutation of Waste (ATW). ATW is a profoundly misguided and dangerous effort, spearheaded by Senator Pete Domenici of New Mexico, to jump-start commercial spent fuel reprocessing in the United States with massive government subsidies. Although this program is clearly in violation of U.S. government policy on reprocessing, "it appears likely an ATW program will be established within the DOE in the near future, most probably under the auspices of the Office of Nuclear Energy," according to the ATW program manager, Greg Van Tuyle.[1]

According to Van Tuyle, "ATW separations are based on variations on the pyrometallurgical processing developed in support of the Integral Fast Reactor program," i.e. on EMT. Therefore, any meaningful assessment of the nonproliferation impacts of EMT development must contain an analysis of its function within the ATW plan, as well as the ramifications of ATW in an international policy context.

Specifically, the NIA should examine whether DOE's attempt to sanitize EMT from a non-proliferation perspective has led to the current confusion that has allowed ATW to go forward. Supporters of ATW only need to invoke DOE's numerous statements that EMT is a proliferation-resistant technology to defend their plan and argue that it does not violate the U.S. non-reprocessing policy. Meanwhile, there has been no analysis to show that a credible and cost-effective safeguards regime could be implemented on an ATW system based on EMT, or that EMT's purported proliferation-resistance would be meaningful in such a context.

It also should be noted that the current ATW strategy involves use of an aqueous process known as "UREX" to separate uranium from commercial oxide spent fuel prior to EMT processing.[2] Therefore, EMT process lines would be co-located with aqueous process lines. Since the NIA insists that EMT does not pose proliferation risks unless there is an aqueous separations capability nearby that could be used for further plutonium purification, the ATW strategy should raise serious concerns even according to the NIA's logic.

The refusal of DOE to produce a realistic and honest assessment of the proliferation concerns associated with EMT will have clear ramifications. A quixotic campaign to develop a massive ATW infrastructure in the U.S. will breath new life into faltering reprocessing industries all over the world. The alleged proliferation resistance of EMT will provide a fig leaf for countries like Japan, who are repeatedly faced with suspicions by their neighbors concerning their accumulation of plutonium in civil programs.

52-9 (Cont'd)

[1] Greg Van Tuyle, "The Roadmap for Accelerator Transmutation of Waste," *Nuclear Weapons and Materials Monitor* 3 (22), September 27, 1999, p.10.

[2] Greg van Tuyle, *op cit.*

4

Response to Commentor No. 52 (Cont'd):

comments in response to the draft EIS, and the Nonproliferation Impacts Assessment will be among the factors considered during the decision-making process in preparing the Record of Decision.

52-9: This Nonproliferation Impacts Assessment analyzes the potential proliferation risks of all the alternatives presented in this EIS. Prepared by DOE's Office of Arms Control and Nonproliferation, the assessment concluded that for this specific application the electrometallurgical treatment process is fully consistent with U.S. policy with respect to reprocessing and nonproliferation. In the assessment, DOE acknowledges that future actions associated with the treatment and management of the sodium-bonded spent nuclear fuel should be closely scrutinized to evaluate their consistency with their individual and cumulative impact on U.S. policy concerning reprocessing and nonproliferation. While the commentor's concern about the proliferation implications of other proposed applications of electrometallurgical treatment is noted, these issues are beyond the scope of the SBSNF EIS.

52-10: There are several features of the electrometallurgical treatment process that make it adaptable to international safeguards. The process cell, made inaccessible to humans by high radiation, inert atmosphere, and thick concrete walls, has a minimal number of penetrations through which materials can be moved in and out. These openings are secured and can be readily monitored for material transfers. There are no liquid waste streams through which materials can be piped out of the facility. All by-products and waste from the process are in solid form, and thus are accountable by unit inventory. Finally, all materials moving out of the facility could be subjected to nondestructive examination if additional assurances were required under international safeguards agreements.

52-11: Although the assessment of nonproliferation impacts is not a part of the scope of the EIS, it should be noted that the residual highly enriched uranium in the cladding hulls can be determined accurately by several independent techniques. As much as 4 percent of the high enriched uranium in the EBR-II driver fuel may be left in the hulls to be disposed of as waste. Less than 1 percent of the depleted uranium would be left in the blanket fuel hulls because of different process conditions. Because the plutonium is preferentially dissolved from the blanket elements, no significant quantity of fissile material would remain in the blanket hulls. The blanket and driver hulls would be blended to reduce the enrichment of the residual uranium. Whether it would be desirable to blend a small amount of additional depleted

Commentor No. 52: Edwin Lyman (Cont'd)

2. A more detailed technical analysis of safeguard issues is essential.

The NIA glosses over many significant details. One crucial issue is the ability to apply accurate material accountancy techniques, both for domestic and international safeguards purposes. A highly inhomogeneous process such as EMT, with several different hard-to-characterize waste streams, will present significant challenges for material accountancy. While the NIA acknowledges that safeguards concepts for the complex bulk processing steps involved in EMT have not been demonstrated in detail, it asserts that effective international monitoring should be possible for a reasonable cost. However, it provides little justification for this assertion. **52-10**

On the other hand, the NIA states that after EMT of SBSNF, "less than five percent of the uranium [remains] undissolved in the cladding hulls" (according to the National Academy of Sciences, material balances are about 95% for blanket assemblies and about 98% for driver assemblies). This is actually quite poor performance from a material accountancy perspective. For instance, over 3 MTHM of HEU is contained in the EBR-II driver fuel. Two percent left in the hulls equals over 60 kilograms of HEU (about two significant quantities). It is unclear how accurately the residual HEU content in the cladding can or will be measured. In addition, five percent of the 250 kilograms of "super-grade" plutonium in the blanket fuel left in the hulls exceeds 12 kilograms. The NIA does not explore the implications of these results for material accountancy. **52-11**

The NIA also repeats without question the assertion that "pyroprocessing technology as envisioned in the IFR flowsheet is not capable of separating weapons-usable plutonium" because of the presence of uranium, radioactive fission products and minor actinides. This statement needs to be reevaluated in the current context for a number of reasons. First of all, as the current EMT demonstration project shows, over 95% of the uranium can be extracted on a steel cathode before extraction of the plutonium on a liquid cadmium cathode is attempted. Second, this author has shown that the residual fission products that remain with the plutonium after extraction provide a minimal radiation barrier, especially if the spent fuel has been out of the reactor for several months.[3] Third, the recently declassified statement by DOE that there are proliferation concerns associated with minor actinides, including Np-237 and Am-241, suggests that the cathode product may in fact have a greater utility for weapons than has previously been acknowledged, even without further purification. **52-12** **52-13**

The NIA also gives too much credit to the proliferation resistance of the EMT ceramic waste forms in concluding that there is a higher level of difficulty in recovering plutonium from them than from the original spent fuel elements. It is unclear why this is the case, since its analysis indicates that the radiation barrier provided by the waste forms will be no stronger than **52-14**

[3] Lyman, E.S., "Interim Storage Matrices for Excess Plutonium: Approaching the 'Spent Fuel Standard' Without the Use of Reactors," PU/CEES Report No. 286, Center for Energy and Environmental Studies, Princeton, NJ, August 1994.

Response to Commentor No. 52 (Cont'd):

uranium in the metal waste in order to meet safeguards and waste disposal goals is still under evaluation as a part of Argonne's continuing waste form development program.

52-12: The commentor makes reference to the Integral Fast Reactor program. The purpose for the Integral Fast Reactor program was to develop an efficient, safe process for recycling nuclear fuel by using a liquid metal-cooled reactor in combination with an integral fuel reprocessing facility. As part of this program, the EBR-II was used for fuel-design and fuel irradiation testing. Congress cancelled funding for the Integral Fast Reactor program in 1994. The previously envisioned Integral Fast Reactor process is outside the scope of the EIS. The Nonproliferation Impacts Analysis states that the pyroprocessing technology as envisioned in the Integral Fast Reactor program is not capable of separating weapons-usable plutonium was based both on previous evaluations and the more recent results obtained from the electrometallurgical treatment demonstration project. The current demonstration has actually shown that greater than 99 percent of the uranium is dissolved from the blanket elements and an equal amount is deposited on the cathode prior to being scraped into a product collection container. However, in order for this process to work, the uranium concentration in the electrolyte must be maintained within a specified range. Uranium chloride is added in order to maintain the concentration of uranium in the electrolyte at a constant level through the fuel treatment campaign. There is no cadmium cathode nor is there a state of operations in which 95 percent of the uranium would be removed from the electrolyte. The unsuitability of the plutonium product from the modified Integral Fast Reactor program for weapons use is based on several physical characteristics in addition to its high radiation barrier.

52-13: The evaluation performed considered the entire mix of materials in the hypothetical cathode, including neptunium and americium. The quantities of neptunium 237 and americium 241 in the EBR-II blanket elements are quite small, and could not change the conclusions even if their consideration had been omitted from the evaluation.

52-14: Given sufficient time and resources, any chemical element can be separated from another. Alternative 3, PUREX processing at SRS, for example, is a fully developed process that has equipment and facilities that are capable

Commentor No. 52: Edwin Lyman (Cont'd):

that provided by the original spent fuel (in fact, according to the NIA the radiation barriers are exactly the same before and after processing the EBR-II fuel). No evidence is presented to support the assertion that recovery of plutonium from the ceramic waste form would be decisively more difficult than from the spent fuel elements.

52-14 (Cont'd)

In summary, the NIA's conclusion that EMT of SBSNF is consistent with U.S. policy on plutonium reprocessing is short-sighted and ignores the vastly expanded uses of EMT that are being considered by DOE. The worldwide ramifications of continued EMT development are far more serious and damaging to U.S. nonproliferation efforts worldwide than the NIA acknowledges.

Sincerely,

Edwin S. Lyman, PhD
Scientific Director

Response to Commentor No. 52 (Cont'd):

of separating plutonium from the blanket fuel elements. The recovered plutonium from this process, however, is addressed by the Surplus Plutonium Disposition EIS. For the complex chemistry of the electrometallurgical treatment ceramic waste form, processes, equipment and facilities would have to be developed to recover plutonium. Therefore, it is reasonable to conclude that plutonium recovery from this ceramic waste form would be more difficult than recovering plutonium from the sodium-bonded spent nuclear fuel and melt and dilute product.

Commentor No. 53: Richard Parkin

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

September 28, 1999

Reply To
Attn Of: ECO-088 Ref: 99-010-DOE

Sue Lesica
Office of Nuclear Facilities Management (NE-40)
Office of Nuclear Energy, Science, and Technology
U.S. Department of Energy
19901 Germantown Road
Germantown, MD 20874

Dear Ms. Lesica:

The Environmental Protection Agency has received and reviewed the draft Environmental Impact Statement (EIS) for the *Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* consistent with our responsibilities under the National Environmental Policy Act and §309 of the Clean Air Act. The draft EIS examines six action alternatives to treat, contain, or treat and contain sodium-bonded spent nuclear fuel to facilitate its disposal in a geologic repository. The draft EIS does not identify a preferred alternative.

Based on our review, we have rated the draft EIS EC-2 (Environmental Concerns - Insufficient Information). This rating and a summary of our comments will be published in the *Federal Register*. We have enclosed a summary of the rating system used in our review for your reference.

It appears that the current drivers for this project are potential NRC regulations and the possibly inadequate current storage of spent nuclear fuels in high-integrity cans. However, the regulations remain unpromulgated and the viability of current storage of the spent fuels is not discussed in the EIS. Thus, the EIS fails to make a compelling argument that the proposed project is needed at this time. Moreover, the EIS was issued before final test results on the electrometallurgical process became available. This process is included in five of the six action alternatives. The absence of this information in the EIS prevents reviewers from fully assessing the efficacy of the the project.

Enclosed please find our detailed comments. We are interested in working closely with the Department of Energy in the resolution of these issues and I encourage you to contact Chris Gebhardt at (206) 553-0253 to discuss our comments and how they might best be addressed. Thank you for the opportunity to review this draft EIS.

Sincerely,

Richard B. Parkin

Richard B. Parkin, Manager
Geographic Implementation Unit

Printed on Recycled Paper

Response to Commentor No. 53:

Environmental Protection Agency Comments on the Draft Environmental Impact Statement (EIS) for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

Introduction

The Environmental Protection Agency (EPA) has completed its review of the draft EIS for the *Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*. We are primarily concerned about the lack of information in the following areas. The EIS does not explain why immediate treatment is necessary. It would appear that treatment at this time might be premature since the NRC (Nuclear Regulatory Commission) has not yet promulgated regulations and a disposal site has not been chosen. Moreover, the need to replace the high-integrity cans has not been demonstrated. Finally, results of final testing of the electrometallurgical process that demonstrates the cost-and treatment-effectiveness of this method are not available in the EIS.

Purpose and Need

The EIS fails to make a compelling argument that the proposed project is needed. The EIS should describe in more concrete terms the conditions creating a need to treat sodium-bonded spent nuclear fuels. Disclosure of this nature would better meet NEPA's requirement of presenting accurate, high-quality information for public scrutiny (40 CFR 1500.1(b)).

Lack of Critical Information Establishing and Defining a Need

The EIS has identified a need to treat sodium-bonded spent nuclear fuels before sufficient information exists to demonstrate this. The EIS states that storage regulations could require treatment of these spent fuels and examines options to treat the fuels before the regulatory parameters defining the existence and the nature of this need have been established:

- the site decision as to whether to store the spent fuels over the long term, and if so, where (e.g., Yucca Mountain) has not yet been made;
- the Nuclear Regulatory Commission (NRC) has not yet promulgated regulations for the safe storage of spent fuels, nor authorized construction, for the still undecided site;
- it is unknown whether blanket fuels (which comprise 95% of the total spent fuels by weight) would be in compliance with the requirements of RCRA (Resource Conservation and Recovery Act) and NRC if stored in high-integrity cans after sodium removal; and
- DOE has not tested whether high-integrity cans can viably and safely store metallic uranium for the projected 100,000 years needed.

Presumably, site characteristics, general and site-specific regulations and the capabilities of waste storage equipment dictate acceptable waste standards and appropriate treatments to meet standards. This critical information should be developed before a decision on whether and how to treat spent nuclear fuels is made.

1

53-1

53-1: DOE's examination of options for the management and treatment of sodium-bonded spent nuclear fuel is based on the existing regulatory environment concerning long-term disposal of spent nuclear fuel and high-level radioactive waste. It is also based on the assumption that sodium-bonded spent nuclear fuel, as well as other DOE-owned spent nuclear fuel, would eventually be disposed of in a geologic repository, whether at Yucca Mountain or some other site. As stated in Section 1.2 of the EIS, DOE needs to reduce the uncertainties associated with qualifying sodium-bonded spent nuclear fuel for disposal so that the requirements of the State of Idaho Settlement Agreement and Consent Order are met, and disposal in a geologic repository is facilitated.

The Settlement Agreement calls for removal of all spent nuclear fuel from the State of Idaho by the year 2035. It would be environmentally prudent for the fuel at the time of removal to be in a form that is suitable for repository disposal, even if it is transported for continued storage to another site outside the State of Idaho.

The uncertainties associated with qualifying sodium-bonded spent nuclear fuel for repository disposal are based on the existing regulatory environment. As discussed in Section 4.12.1 of the EIS, one of the key U.S. Nuclear Regulatory Commission requirements for acceptance of spent nuclear fuel or high-level radioactive waste is that it cannot contain or generate materials that are explosive, pyrophoric, or chemically reactive (in a repository environment) in a form or amount that could compromise the repository's ability to perform its waste isolation function or to satisfy its performance objective (10 CFR 135(b)(1)). In addition, in accordance with the current version of the "Waste Acceptance Systems Requirements Document," issued in April 1999 by the DOE Office of Civilian Radioactive Waste Management, only spent nuclear fuel and high-level radioactive waste that is not subject to regulation under RCRA, Subtitle C, and meets all other acceptance criteria (e.g., packaging, uranium content), will be accepted for disposal. Although this determination for sodium-bonded spent nuclear fuel has not been made, it is a possible outcome. Based on the current regulatory environment, it is highly probable that sodium-bonded spent nuclear fuel will not be qualified for repository disposal without the removal or conversion of the metallic sodium to a nonreactive form.

The timing for this action is a programmatic issue rather than a safety issue. That is, the driver for the project is not "inadequate storage of spent nuclear fuel in high integrity cans," as the commentor appears to have concluded from the EIS. The EIS does not make this statement.

Commentor No. 53: Richard Parkin (Cont'd)

No Need for Immediate Action

The information in the EIS does not demonstrate an urgent need to treat the spent nuclear fuels. The consent agreement between the State of Idaho and Department of Energy (DOE)/Navy specifies a time frame ending in the Year 2035 for removing the sodium-bonded spent nuclear fuels from Idaho. Presently, DOE is safely storing these spent fuels in high-integrity cans. Continuing to do so in Idaho for the short-term and other locations (e.g., Yucca Mountain) over the long-term does not appear problematic from the information presented in the EIS.

Insufficient Information about Electrometallurgical Treatment

The EIS calls for using electrometallurgical treatment in five of the six action alternatives. Nevertheless, the draft EIS was issued before final testing of the treatment- and cost-effectiveness of the electrometallurgical process were conducted. The results of these tests are absent from the draft EIS, and thus largely from public review and scrutiny.

Conclusion

We believe it critical that the draft EIS include the final tests results for the electrometallurgical process as well as information indicating the need for the project to achieve the dual purposes of NEPA: public disclosure and involvement and better decisions. Therefore, we suggest that you consider including the following information.

- the location of the geologic repository for the sodium-bonded, spent nuclear fuels,
- an explanation of the RCRA, AEA (Atomic Energy Act) and NRC standards that must be met for safe storage at the designated geologic repository,
- a description of the viability of high-integrity cans for the long-term storage of metallic uranium, and
- the test results of the cost- and treatment-effectiveness of the electrometallurgical process.

More Detailed Comments

Page S-3
Sidebars on this and other pages present background information in an appealing, useful way.

Page S-34:
In the last paragraph, the risk estimates should be "0.0088" vs. "0.0088 x 10-4".

Section 4.4.4.1:
It should be noted somewhere in the evaluation that with regard to the EPA requirements for radioactive air emissions under 40 CFR 61, levels below the 10 mrem/year standard are acceptable and that lower levels are not necessarily "more acceptable".

53-1 (Cont'd)

53-2

53-3

53-4

2

Response to Commentor No. 53 (Cont'd):

Furthermore, the EIS does not assume that the sodium-bonded spent nuclear fuel is currently stored in high integrity cans. As stated in Section 1.2 of the EIS, DOE considers it prudent to evaluate the alternative technologies now, while DOE is performing site characterization activities for the potential repository at Yucca Mountain. Potential waste forms resulting from treatment or packaging of sodium-bonded spent nuclear fuel should be developed as much as possible in parallel with any repository development to promote consistency between the two efforts and to minimize the programmatic risks associated with waste qualification and acceptance for ultimate disposal. In addition, as discussed in Section 1.6.3 of the EIS, the Electrometallurgical Treatment Research and Demonstration Project was recently completed, successfully fulfilling all the criteria established at the outset of the project. In view of the results, DOE needs to decide whether electrometallurgical treatment is a viable technology for processing the rest of the sodium-bonded spent nuclear fuel, or whether some other process could offer environmental, cost, or nonproliferation advantages. Should DOE decide that electrometallurgical treatment is the appropriate treatment technology, the decision needs to be made while the facilities, skills, and personnel involved in the demonstration project are still available to carry out the treatment in an expedient and cost-effective manner. Section 1.2 of the EIS has been revised for clarification.

Final test results were made available in August 1999 and were used in preparing the EIS. The success criteria established at the outset of the project have been fulfilled. The environmental impact analysis associated with the electrometallurgical treatment process alternatives was based on actual data from the project. Section 1.6.3 of the EIS summarizes the current status and the results of the project.

DOE expects that spent nuclear fuel eventually will be disposed of in a geologic repository and this is a fundamental assumption made in the EIS. The site-specific characteristics of the potential repository are not expected to alter the uncertainties associated with qualifying sodium-bonded spent nuclear fuel for disposal. But even if one assumes that spent nuclear fuel will not be stored for the long term in a geologic repository, the treatment and management of this small quantity of spent nuclear fuel (2 percent of the total spent nuclear fuel inventory owned by DOE) to convert it to a stable, nonreactive form would be beneficial in any long-term storage environment. The high-integrity cans identified in the EIS protect the spent nuclear fuel while it is stored at the site until placement in standardized canisters for transportation to the repository. They would also provide

Commentor No. 53: Richard Parkin (Cont'd)

Section 4.4.4.2:
If accidents are screened based on frequency (i.e., less than 1E-7), consideration should also be given to screening based on consequence (i.e., dose level). **53-5**

Page 4-30:
The justification for excluding analysis of criticality accidents does not address the fact that although the frequency may be low, the dose consequences are likely greater than any other accident. This coupled with the understanding that a number of criticality accidents have occurred (including at INEEL), and the highly enriched nature of some of the uranium, would indicate the need for further evaluation. In addition, the issue of criticality is specifically mentioned in section S.1.1 with regard to geologic repository concerns so it seems inconsistent to exclude it from evaluation. **53-6**

Page E-6, Radiation Protection Guides:
This section should include the EPA Radiation Protection Guidance to Federal Agencies for both occupational radiation exposure and exposure to the general public. **53-7**

Page E-6, Limits of Radiation Exposure:
This section is misleading about the process and basis for radiation standards set by Federal agencies. ICRP and NCRP make recommendations. EPA takes those recommendations into account when issuing guidance (Radiation Protection Guidance for Federal Agencies). Federal agencies (including DOE) follow EPA Guidance in setting radiation standards under their own specific authority.

This section should include discussion of the EPA Radiation Protection Guidance to Federal Agencies for both occupational radiation exposure and exposure to the general public. These Guidance documents provide the basis for the implementation of radiation protection levels by other federal agencies (including DOE) under their own specific authorities. **53-8**

This section should also include NCRP as a source of recommendations in addition to the ICRP.

Table E-1:

The proper "guidance criterion" associated with 4 mrem/year (drinking water) is the EPA drinking water standards referred to at 40 CFR 141.

This table should make it clear where exposure standards include an "ALARA" requirement and where they do not. For instance, the 5000 mrem/year and 2000 mrem/year worker exposure limits also require that exposures be maintained "as low as reasonably achievable". By contrast, the 40 CFR 190 and 40 CFR 61 standards are compliance criteria that do not require any additional effort to reduce exposures. **53-9**

3

Response to Commentor No. 53 (Cont'd):

another barrier for protection in a repository environment; however, the barrier relied on to provide the isolation function at the repository is the waste package that would contain the standardized canisters which, in turn, would contain the high-integrity cans. In the environmental impact analysis, the Yucca Mountain Draft EIS takes no credit for the long-term integrity of either the standardized canisters or the cans (e.g., the high-integrity cans mentioned in this SBSNF EIS). Section 2.3.3 of the EIS has been revised to clarify the function of the high-integrity cans.

In the absence of metallic sodium, the other constituent of sodium-bonded spent nuclear fuel that is described as reactive and, in some cases, pyrophoric is metallic uranium. As discussed in Section 4.12.1, metallic uranium is defined under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2001 et seq.), as a source, special nuclear, or by-product material and, therefore, is excluded from RCRA under 40 CFR 261.4(a)4. Furthermore, the purpose of the proposed action is to reduce the uncertainties associated with qualifying sodium-bonded spent nuclear fuel for repository disposal.

53-2: DOE acknowledges the commentor's recognition of the usefulness of the information presented in the sidebar format.

53-3: The commentor is correct; the risk estimate in the draft EIS should have been 0.0088.

53-4: DOE agrees with the commentor, and a clarifying statement has been added to Section E.2.1 of Appendix E, Limits on Radiation Exposure, in the EIS. This information had been addressed in Section 4.1.3.

53-5: To meet the Council of Environmental Quality's regulations, DOE's Office of NEPA Oversight has issued recommendations for the preparation of environmental assessments and environmental impact statements. In accordance with this guidance the analysis should identify a spectrum of the potential accident scenarios that could occur. The accident frequency should be "reasonably foreseeable." The primary purpose of accident analysis would be twofold: (1) to determine whether a proposed action has a potential for significant impact, and (2) to inform an agency (and the public) in making reasonable choices among alternatives. The accidents would have a likelihood of occurrence of greater than 10^{-7} per year. The guidance indicates that events with a probability of less than 10^{-7} will rarely need to be evaluated. Therefore, screening based on the frequency eliminates the need to evaluate the consequences.

Commentor No. 53: Richard Parkin

Response to Commentor No. 53 (Cont'd):

53-6: The potential for criticality could only exist if sufficient fissile material (enriched uranium fuel) existed in a favorable critical geometry. Operation of the hot cell facilities at ANL-W limits any moderator within the hot cell. The analysis of criticality accidents described in Section F.2.2.1.2 of Appendix F evaluated the potential for a criticality accident after a beyond design-basis earthquake, considering equipment operation at capacity and nuclear fuel staged for treatment, and concluded the likelihood of such an accident to be less than 10^{-7} per year. DOE evaluated an accidental criticality for melt and dilute processing of driver spent nuclear fuel. The consequences of such an accident are described in Appendix F and are summarized in Chapter 4 of the EIS. As indicated, the consequences to both the public and workers from a criticality accident in operations performed in the hot cells are very small. Once the fuel is put in a geologic repository, water could be available to potentially create a critical condition; therefore, criticality safety considerations would need to be implemented.

53-7: This section has been revised and clarifying statements have been added.

53-8: Clarifying statements have been added to Section E.2.1, of this EIS.

53-9: Clarifying statements have been added to Section E.2.1, of this EIS.

Commentor No. 54: Barbara Mathison

1335 Sew Creek Way
Meridian, Idaho,
83642
Sept. 9, 1999

Dear Ms. Susan Lewis,

I am commenting on the "Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel"

I object to the Proposed Project at INEEL to Cyropro-cessing spent nuclear waste. 54-1

This procedure separates out bomb-grade uranium from spent fuel and therefore runs counter to U.S. Nonproliferation goals. In addition, the technology can be modified to separate out bomb-grade plutonium. 54-2

The project creates new forms of nuclear waste. It 54-3

54-4

Response to Commentor No. 54:

54-1: The commentor's objection to electrometallurgical treatment (pyroprocessing) of the sodium-bonded spent nuclear fuel at INEEL is noted.

54-2: The assessment of nonproliferation impacts is not a part of the scope of the EIS. However, none of the alternatives analyzed in this EIS would generate weapons-usable fissile materials at INEEL. Although highly enriched uranium is an interim product, it is downblended to low enriched uranium during electrometallurgical treatment (pyroprocessing). Within the current equipment configuration and design, it is not possible to produce weapons-usable plutonium by adjusting operating parameters. Traditional aqueous processing would have to be used after electrometallurgical treatment. However, traditional aqueous processing could also be used to produce weapons-usable plutonium directly from the spent nuclear fuel, without pyroprocessing.

54-3: All of the alternatives evaluated in this EIS would produce some forms of high-level radioactive waste. Electrometallurgical treatment (pyroprocessing) would produce two new waste forms, both of which are more stable than untreated sodium-bonded spent nuclear fuel. DOE expects these waste forms would be suitable for disposal in a geologic repository.

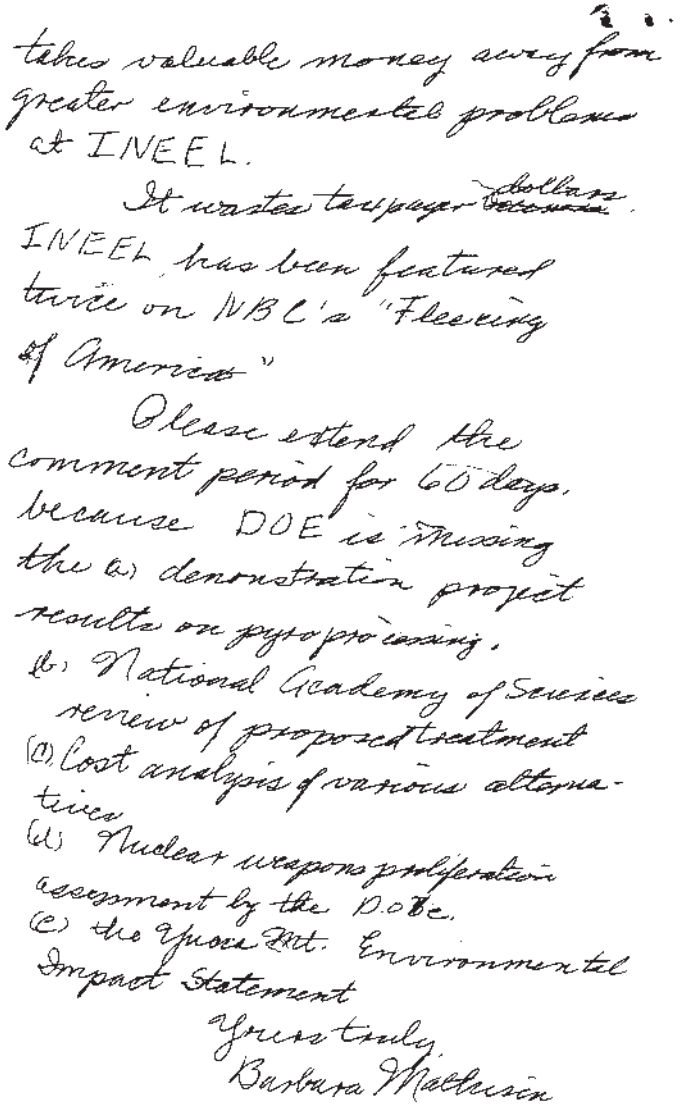
54-4: Congress determines how funds are allocated. DOE spends monies consistent with congressional direction. DOE is not in a position to make the difficult tradeoffs that may be required between alternative Federal programs and spending priorities. The issue of funding for the treatment and management of sodium-bonded spent nuclear fuel is beyond the scope of the SBSNF EIS.

54-5: In an effort to ensure that all interested parties had time to comment on the draft EIS, the deadline for transmittal of comments was extended from September 13, 1999, to September 28, 1999 (64 FR 49169).

54-6: Final test results were made available in August 1999 and were used in the EIS. The success criteria established at the outset of the project were fulfilled. The environmental impact analysis associated with the electrometallurgical process alternatives was based on actual data from the project. Section 1.6.3 of the EIS summarizes the status and the results of the project.

54-7: The National Academy of Sciences' National Research Council Committee prepared interim status reports on the results of the Electrometallurgical Treatment Research and Demonstration Project that have been reviewed

Commentor No. 54: Barbara Mathison (Cont'd)



takes valuable money away from greater environmental problems at INEEL.

It wastes taxpayer dollars because.

INEEL has been featured twice on NBC's "Fleecing of America"

Please extend the comment period for 60 days. because DOE is missing the (a) demonstration project results on pyroprocessing.

(b) National Academy of Sciences review of proposed treatment

(c) Cost analysis of various alternatives

(d) Nuclear weapons proliferation assessment by the D.o.E.

(e) the Yucca Mt. Environmental Impact Statement

Yours truly,
Barbara Mathison

54-4 (Cont'd)

54-5

54-6

54-7

54-8

54-9

54-10

Response to Commentor No. 54 (Cont'd):

by DOE. The National Research Council completed their evaluation of the electrometallurgical treatment demonstration project in September 1999 and published their final summary report in April 2000. The final report findings will be considered during the decision-making process leading to the Record of Decision.

54-8: Environmental impact statements do not normally include a cost comparison between alternatives as costs are not environmental consequences. At the request of several members of the public during the Scoping Process for this draft EIS, DOE made a separate Cost Study available to the public during the comment period for the draft EIS. Copies of the Cost Study were mailed to individuals requesting the study, and copies were available during the four public hearings on the draft EIS.

54-9: Although the assessment of nonproliferation impacts is not a part of the EIS process, DOE's Nonproliferation Impacts Assessment was mailed out to interested members of the public on August 12, 1999 and is available by request. The assessment was also placed in DOE public reading rooms and distributed at public hearings during the public comment period on the draft EIS. Information from the assessment, along with other factors such as cost, schedule, environmental consequences, and technical risk will be considered during the decision-making process in preparing the Record of Decision.

54-10: The EIS has not specified a site for ultimate geologic disposal of waste, and thus is not affected by site-specific information that may be contained in the Yucca Mountain Draft EIS. As discussed in the revised Section 1.6.2.2 of this EIS, the Draft Yucca Mountain EIS was released by DOE in July 1999. Nothing contained in the Yucca Mountain Draft EIS changes the assumptions and the environmental impact analysis presented in the SBSNF EIS.

Commentor No. 55: Robert Bobo

The SHOSHONE-BANNOCK TRIBES

FORT HALL INDIAN RESERVATION
PROJECT DIRECTOR (208) 478-3792
ENVIRONMENTALIST (208) 478-3709
SECRETARY (208) 478-3708
FAX (208) 237-0797

TRIBAL/DOE PROJECT
PIMA DRIVE
P. O. BOX 306
FORT HALL, IDAHO 83203

September 17, 1999

Ms. Sue Lesica
US Department of Energy, NE-40
19901 Germantown Rd.
Germantown, MD 20874

Dear Ms. Lesica:

RE: *DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE TREATMENT AND MANAGEMENT OF SODIUM -BONDED SPENT NUCLEAR FUEL*

Attached are comments compiled by the technical departments of the Shoshone-Bannock Tribes. Thank you for the opportunity to review and comment on this document.

Sincerely,

Robert Bobo, Project Director

cc: Robert Fence, DOE-ID American Indian Program Manager
file

Response to Commentor No. 55:

Commentor No. 55: Robert Bobo (Cont'd)

COMMENTS TO THE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE TREATMENT AND MANAGEMENT OF SODIUM-BONDED FUEL

(all comments refer to the summary document)

Pg. iii - Instead of just saying there is a 45-day comment period, give the exact dates and deadlines. Also clearly indicate who should be the recipient of the comments. — **55-1**

Pg. S-2- Inasmuch as 98% of DOE's sodium bonded fuel is located at INEEL, it would seem prudent to perform any treatment at INEEL rather than ship the fuel to SRS or other facility. Transportation of SNF should be kept to a minimum. — **55-2** **55-3**

Pg. S-2, sect S.1.1- One of the primary reasons given for treating sodium fuel is that "sodium reacts vigorously with water or moist air…" Why, then, is the sodium bonded fuel stored in water basins at INEEL and SRS? — **55-4**

Pg. S-13, sect S.3.1, 4th para. – What process is used to treat the uranium, and how will the uranium ingots be disposed? As waste or as a usable resource? — **55-5**

Pg. S-14, sect S.3.3, 1st para. - Please define "long-term". — **55-6**

Pg. S-14, sect S.3.3, last para. - Please expound further on "…designed to promote containment under repository conditions." What exactly would those containment criteria be? And what are the repository conditions? — **55-7**

Pg. S-14, sect S.3.4, 1st para. – It is this commentor's understanding that the only reason for treating sodium-bonded fuel is to remove the sodium; for disposal of SNF without sodium, no treatment will be necessary. If that is in fact the case, the first option of the Melt and Dilute Process seems unnecessary inasmuch as the sodium has already been removed (how?) before the remaining constituents are melted. If the sodium has already been removed, the mission has been accomplished, has it not? Dispose of the remaining constituents as non-sodium SNF that requires no treatment. Likewise, option two calls for treatment *after* the sodium has been removed. Again, if the sodium has already been removed, the goal set out in this EIS has been met. Why is it necessary to treat the remaining constituents? — **55-8**

Pg. S-15, sects S.3.5 and S.36, 1st para – Mention is made to research and development demonstration projects. What is the status of those projects? Have they demonstrated the feasibility of these two alternatives? — **55-9**

Pg. S-16, sect S.3.9, 1st para. – At the risk of belaboring the point, may I express perplexity in the statement, "For those methods that do not require the removal of metallic sodium prior to treatment…" Also, in the next paragraph, the statement "To remove the cladding after sodium has been extracted…" It seems totally superfluous to entertain any process for treatment *after* the sodium has been removed inasmuch as the removal of sodium is the sole reason given for treating the fuel to begin with. — **55-8**

Response to Commentor No. 55 (Cont'd):

55-1: The text cited by the commentor has been revised in the final EIS. In notices to the public published in the Federal Register, mailings to interested stakeholders, and in statements made by DOE at public meetings during the public scoping and comment periods members of the public were directed to submit comments to the DOE Document Manager, Ms. Susan Lesica.

55-2: The commentor's support for treating sodium-bonded spent nuclear fuel at INEEL, since most of it is located there, is noted. The environmental impacts from the transportation of blanket spent nuclear fuel from Idaho to SRS, discussed in Sections 4.9.4 and 4.9.6 of the EIS, are very small.

55-3: DOE assumes the commentor is referring to Alternatives 3 and 5, where the declad and cleaned (metallic sodium removed) blanket spent nuclear fuel would be transported to SRS for treatment. As explained in the EIS, the risks associated with fuel transport are very small. Regardless of the alternative, DOE would need to transport spent nuclear fuel and/or high-level waste out of INEEL. DOE will proceed in accordance with the DOE/Shoshone-Bannock Tribes Agreement-in-Principal, which covers notification and coordination of the transport of radioactive materials across the Fort Hall Reservation.

55-4: As discussed in Section E.4.6, the EBR-II fuel at INTEC's Basins 666 and 66 are stored inside sealed stainless steel cans that prevent the contact of basin water with the fuel cladding. During the average 17 years of storage in Basin 666, 10 of the 2,148 cans were confirmed to have water in-leakage. With water inside these cans, a fuel-water reaction produced hydrogen gas, which created bubbles that allowed detection of the water in-leakage. These observations are consistent with the fact that sodium and metallic uranium react with water to produce hydrogen and this is the reason that all the sodium-bonded spent nuclear fuel is stored in dry storage or sealed containers that prevent the exposure of the fuel cladding to water. The fuel at SRS is a single sodium-bonded spent nuclear fuel element encapsulated in an aluminum can, with no observed failure.

55-5: Two uranium stream products are produced by the electrometallurgical process. The uranium separated from the processed driver spent nuclear fuel would be diluted to about 19 percent uranium-235 (a low-enriched uranium fuel) before being cast into uranium ingots. Processing of the blanket spent nuclear fuel would produce depleted uranium ingots. As explained in Section 4.1.2 of the EIS, these products are not considered waste products. However, the uranium ingots would have fission product

and actinide contamination (in trace quantities) that would require additional purification before they could be used commercially. Disposition of this surplus uranium will be the subject of a future NEPA review.

55-6: DOE interprets "long-term" to mean 1000 or more years after the repository's closure and no institutional control. The text in Section S.3.3 has been revised for clarification.

55-7: Containment criteria and repository conditions are provided in the Yucca Mountain Draft EIS and 10 CFR Part 60. Section S.3.3 of the Summary to this EIS has been revised for clarification.

55-8: As stated in the introduction to the EIS, the programmatic risk associated with implementing any of the potential alternatives for the treatment and management of sodium-bonded spent nuclear fuel, or with not treating this fuel, is the uncertainty surrounding the acceptability of DOE spent nuclear fuel for placement in a potential geologic repository. While DOE has drafted preliminary waste acceptance criteria for a geologic repository, the final acceptance criteria will be more refined. If the repository is developed, final acceptance criteria will not be available until after the U.S. Nuclear Regulatory Commission issues its construction authorization, based on the successful demonstration of the safe, long-term performance of the repository in accordance with the U.S. Nuclear Regulatory Commission regulations. As discussed in Section 1.2, the presence of metallic sodium is the primary, but not sole, reason for the proposed action. The presence of metallic uranium or the presence of highly enriched uranium could also complicate the process of qualifying the spent nuclear fuel for disposal. Such qualification would require sufficient data and predictive analyses to demonstrate that emplacement of the spent nuclear fuel would not adversely affect a repository's ability to protect the environment and worker and public health and safety. To ensure that the requirements of the State of Idaho Settlement Agreement and Consent Order are met, and to facilitate disposal, DOE needs to reduce the uncertainties associated with qualifying sodium-bonded spent nuclear fuel for disposal. Appropriate treatment and management of the sodium-bonded spent nuclear fuel (e.g., PUREX processing) would significantly reduce complications related to disposal qualification . The borosilicate glass waste form resulting from PUREX processing has been extensively tested and analyzed under conditions relevant to a geologic repository. It is expected that other waste forms (e.g., ceramic and metallic) would be suitable for repository disposal.

Commentor No. 55: Robert Bobo

Response to Commentor No. 55: (Cont'd)

55-9: The text in the draft EIS, as written, could imply that demonstration projects for the GMODS and plasma arc-vitreous ceramic processes are ongoing. This is not the case. The text has been revised to indicate that these technologies have the potential for treating both blanket and driver sodium-bonded spent nuclear fuel if it is demonstrated that they can deal with sodium and other factors.

Commentor No. 56: John Commander and Lowell Jobe

COALITION21 Supporting Tomorrow's Technologies With Facts ✦ Not Fears!
P.O. Box 51232✦Idaho Falls, Idaho 83405✦208-528-2161✦FAX: 528-2199

COMMENTS FROM COALITION 21 RE DOE/EIS-0306D DRAFT EIS for
SODIUM-BONDED SPENT NUCLEAR FUEL

It was nearly impossible for the public to evaluate the alternatives prior to having the independent cost and non-proliferation reports. With these finally available August 26th.we now submit the following comments: **56-1**

1. Coalition 21 strongly supports the treatment of the sodium-bonded spent nuclear fuel (SBSNF) by the electrometallurgical process. The process should be used for both driver and blanket fuels. as described in Alternative 1 for the following reasons:

a. Since over 98% of the SBSNF is located at INEEL. it seems only reasonable that all of it be treated at ANL-W unless there was an overriding cost saving by using an alternative method.

b. ANL-W is the location of most of the experience and expertise in handling SBSNF materials.

c. The National Research Council in its most recent report expressed the opinion that. with the exception of the Purex process. all other alternatives to the electrometallurgical process were at an early stage of development. (Vol.1, p2-41). **56-2**

d. Since the amount of SBSNF appears to be a fixed amount with no planned future additions, there is no further justification for funding the development of any other alternatives to handle the current amount of SBSNF.

e. Alternative 1, properly done, will demonstrate to the government and the public that the remnants of the Integral Fast Reactor program have been made ready for final disposal. It will have been accomplished in a timely manner with a technology compatible with the IFR concept. This position is consistent with the objectives of our lawsuit against DOE, which asks the court to require DOE to do a complete EIS on the disposal of the rest of the EBR-II reactor.

f. This alternative will also dispose of the sodium-bonded fuel, so that it cannot be used as an example of a failed technology by anti-nuclear groups.

2. We recommend that the cost report be redone and reissued to assure consistency in reporting, especially units of data tables. For example, in the separate cost report, Tables S-1 and 2 give cost summaries in 'millions of year 2000 dollars', while Table S-3 uses 'thousands of 2000 dollars (tabulated in tens of thousands) instead of using consistent 'millions of dollars'. To further confuse comparison of figures, Tables F-2 and F-3 thru F-9 list values as 'current dollars' (again tabulated in tens of thousands); this required searching for a clue to the discrepancy, found only in the bullet 2 under the F-2 Summary re Alternative 3's cost figure: 'at more than $130 million in 2009'. **56-3**

Visit our internet site! www.coalition21.org Printed on Recycled Paper Send us E-mail! facts@coalition21.org

Response to Commentor No. 56 (Cont'd):

56-1: The preparation of the Cost Study and Nonproliferation Impacts Assessment was expedited so that they could be mailed to interested parties on August 12, 1999, and be available to attendees at all of the public hearings on the draft EIS. Although these reports are not required for the EIS, they will be considered during the decision-making process in the preparation of the Record of Decision.

56-2: The commentor's support for using the electrometallurgical process to treat both driver and blanket fuel at ANL-W is noted. DOE acknowledges that the reasons provided by the commentor concerning the current location of the sodium-bonded spent nuclear fuel and the maturity of the electrometallurgical process are valid and have been the subject of discussion in the EIS. Issues such as funding or public relations are not within the scope of the EIS.

56-3: DOE believes the Cost Study provides the public with a reasonable comprehensive estimate of the cost of each alternative. There is no need to revise the Cost Study, because costs for treating and managing sodium-bonded spent nuclear fuel are not part of the EIS process. However, cost will be one of the factors considered in preparing the Record of Decision for the treatment and management of sodium-bonded spent nuclear fuel.

56-4: The costs presented in Table F-2 were discounted by the official discount rate provided by the Office of Management and Budget (4.9 percent) in accordance with the methodology described in Section 1.4 of the Cost Study. The ANL-W costs in Tables F-3 through F-9 are larger because they were not discounted, as stated on the last line of each table. The purpose of Tables F-3 through F-9 is to show the nominal costs in the year that those costs would be incurred.

56-5: The commentors' acknowledgment of the ranking of the estimated cost of alternatives as presented in the Cost Study is noted. Factors such as cost, schedule, environmental consequences, and technical risk will factor into the Record of Decision for the treatment and management of sodium-bonded spent nuclear fuel.

56-6: Tables S-3 and F-2 of the Cost Study are not numerically identical because the data in Table S-3 are discounted to year 2000 dollars, whereas the data in Table F-2 are in nominal dollars in the year in which the costs are incurred. From 2001 through 2006, Alternative 1 has lower annual costs than the other alternatives. The higher costs projected for Alternatives 4, 5 and 6 are partially explained by higher contingency factors that have been added to reflect their lesser degree of technological maturity.

Commentor No. 56: John Commander and Lowell Jobe

Next, how can annual costs for 10 year summaries of data from Table F-2 be greater than the 35 year summaries of Table S-3 and the life cycle costs of alternatives 2,3 &4 of Table S-2?. Also, how can the annual ANL-W cost summaries from Tables F-3 thru F-9 be larger than ANL-W life cycle costs of Table S-2 except for the no-action and alternative 1? These inconsistencies need answering or correction. Any corrections might affect the other following comments. **56-4**

3. If cost were the only consideration, Alternative 2 for treating Driver-SNF and sodium removal plus packaging the blanket SNF in High-integrity cans at ANL-W would produces the lowest cost both by site and total cost, including waste disposal charges (Table S-2 of the cost report). Alternatives 1 and 3 were in second and third place, with Alternatives 4, 5 and 6 being substantially higher (Table S-2). **56-5**

4. The annualized cost tables S-3 and F-2, although not numerically identical, result in the same conclusions that would place Alternatives 4, 5, and 6 out of consideration, in line with their less mature status. Table F-2 also shows our recommended Alternative 1 for the electrometallurgical treatment of all SBSNF as the lowest 10 year annualized cost. **56-6**

5. Although the Purex treatment part of Alternative 3 produces the least amount of high level waste (HLW), it produces several times as much Transuranic (TRU) and low level waste (LLW) as any other alternative. **56-7**

6. The No-Action alternative produces more HLW than any of the other alternatives. With an attendant cost of 73-86% of those for Alternatives 1 through 3 for no measureable solution to the problem, any consideration of this would be unwarranted. **56-8**

7. Since only the blanket-SBSNF can be handled at SRS and it must be first decladded and cleaned of sodium at ANL-W, the only advantage of Alternative 3 would be the transferal of that part of the SNF out of Idaho. There is no net time saving except for the Purex processing. **56-9**

8. All alternatives still require ANL-W to treat the driver SNF. Alternative 5 would still requires ANL-W to declad and clean the blanket-SBSNF of sodium prior to packaging it for shipment to SRS. In order to meet the 1995 Nuclear Waste Agreement with the state of Idaho, SRS would have to guarantee they could receive the material as it was readied, regardless of their prior commitments for handling other materials until 2035. **56-10**

9. We agree with the conclusions of the separate nonproliferation report that "Of the seven alternatives proposed in the Draft EIS, only one-that involving Purex reprocessing at the Savannah River Site raises significant nonproliferation issues....The alternative involving Purex reprocessing at SRS involves operation of a former weapons production facility and production of weapons-usable material." We see no non-proliferation problem with the electrometallurgical process. **56-11**

10. We recommend that the final EIS not be delayed to allow public comments on the final report of the electrometallurgical project by the Nat.Research Council of the NAS, a nationally recognized non-partisan organization; public comment is not required for this. Its report will be factored into the final EIS and ROD. **56-12**

Lowell A. Jobe

John C. Commander

Response to Commentor No. 56 (Cont'd):

56-7: The estimated waste generated by each of the alternatives is given in Table 2-4 of the EIS.

56-8: As indicated in the waste management sections of Chapter 4 of the EIS and summarized in Table 2-4, the direct disposal option of the No Action Alternative results in the highest volume of material (spent nuclear fuel or high-level radioactive waste) that would be disposed of in a repository. The commentor's opinion that the No Action Alternative should not be considered because it does not reduce waste volumes and the cost is nearly that of Alternatives 1 through 3 is noted.

56-9: Time-saving is one of the programmatic issues; however, the programmatic risk in implementing any of the potential alternatives for the treatment and management of sodium-bonded spent nuclear fuel, or of not treating this fuel, is the uncertainty surrounding the acceptability of DOE's spent nuclear fuel for emplacement in a potential geologic repository. While DOE has drafted preliminary waste acceptance criteria for a geologic repository, the final acceptance criteria will be more refined. If the repository is developed, final acceptance criteria will not be available until after the U.S. Nuclear Regulatory Commission issues its construction authorization based on successful demonstration of the safe, long-term performance of the repository in accordance with the U.S. Nuclear Regulatory Commission regulations. As discussed in Section 1.2, the presence of metallic sodium is the primary but not the only reason for the proposed action. The presence of metallic uranium, or the presence of highly enriched uranium could also complicate the process of certifying the repository. Such certification would require sufficient data and predictive analyses to demonstrate that placement of the spent nuclear fuel would not adversely affect a repository's ability to protect the environment and worker and public health and safety. To ensure that requirements of the State of Idaho Settlement Agreement and Consent Order are met and to facilitate disposal, DOE needs to reduce the uncertainties associated with qualifying sodium-bonded spent nuclear fuel for disposal. Appropriate treatment and management of the sodium-bonded spent nuclear fuel (e.g., PUREX processing) would significantly reduce the complications related to disposal qualification. The borosilicate glass waste form resulting from PUREX processing has been extensively tested and anlyzed under conditions relevant to a geologic repository. It is expected that other waste forms (e.g., ceramic and metallic) would be suitable for repository disposal.

Commentor No. 56: John Commander and Lowell Jobe

Response to Commentor No. 56 (Cont'd):

56-10: DOE agrees with the commentor that SRS should be able to receive declad and cleaned blanket fuel on or before 2035 for melt and dilute processing as soon as current missions are completed (around 2035). However, as indicated in Section 4.12.2, treatment at SRS could start as early as 2020 if additional treatment capacity becomes available, which is a programmatic rather than environmental issue.

56-11: The commentors' agreement with the Nonproliferation Impacts Assessment is noted.

56-12: The public comment period was extended from September 13 to September 28, 1999 (64 FR 49169) so that all interested parties would have additional time to comment on the draft EIS. While the results of the demonstration project were used to prepare the EIS, DOE agrees with the commentor that public comments on the final National Research Council report on the Electrometallurgical Treatment Research and Demonstration Project at ANL-W are not required by NEPA. It should be noted that the National Academy of Sciences' National Research Council Committee's interim status reports on the demonstration project were made available to the public in the public reading rooms.

APPENDIX B
IMPACT ASSESSMENT METHODS

B.1 INTRODUCTION

This appendix briefly describes the methods used to assess the potential direct, indirect, and cumulative effects of the treatment and management of sodium-bonded spent nuclear fuel. Included are impact assessment methods for air quality; water resources; socioeconomics; waste management; and cumulative impacts. Each section is organized so that the affected resource is described first, and then the impact assessment method is presented. Methodologies were not developed for land resources; site infrastructure; noise; geology and soils; ecological resources; and cultural and paleontological resources, since impacts to these resources either would not occur or would be very small. This is because new construction would not be required, airborne and aqueous effluent would be controlled and permitted, and infrastructure requirements would not change for any of the treatment and management alternatives. Descriptions of the methods for the evaluation of human health effects from normal operations; facility accidents; transportation; and environmental justice are presented in Appendices E, F, G, and H, respectively.

Impact analysis varied with the resource area. For air quality, for example, estimated pollutant concentrations from the proposed facilities were compared with the appropriate regulatory standards or guidelines. Comparison with regulatory standards is a commonly used method for benchmarking environmental impacts and was done here to provide perspective on the magnitude of the identified impacts. The analysis of waste management impacts compared waste generated by the management of sodium-bonded spent nuclear fuel to the capacities of waste management facilities. Impacts in all resource areas were analyzed consistently; that is, the impact values were estimated using a consistent set of input variables. Also, similar presentations were developed to facilitate the comparison of alternatives.

B.2 AIR QUALITY

B.2.1 Description of Affected Resources

Air pollution refers to any substance in the air that could harm human or animal populations, vegetation, or structures, or that unreasonably interferes with the comfortable enjoyment of life and property. For purposes of this environmental impact statement (EIS), only outdoor air pollutants were addressed. These may be in the form of solid particles, liquid droplets, gases, or a combination of these forms. Generally, they can be categorized as primary pollutants (those emitted directly from identifiable sources) and secondary pollutants (those produced in the air by interaction between two or more primary pollutants, or by reaction with normal atmospheric constituents that may be influenced by sunlight). Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Thus, air pollutant emission characteristics, meteorology, and topography affect air quality.

Ambient air quality in a given location can be described by comparing the concentrations of various pollutants in the atmosphere with the appropriate standards. Ambient air quality standards have been established by Federal and state agencies to allow an adequate margin of safety for protection of public health and welfare from the adverse effects of pollutants in the ambient air. Pollutant concentrations higher than the corresponding standards are considered unhealthy; those below such standards are considered acceptable.

The pollutants of concern are primarily those for which Federal and state ambient air quality standards have been established, including criteria air pollutants, hazardous air pollutants, and other toxic air compounds. Criteria air pollutants are those listed in 40 CFR 50. Hazardous air pollutants and other toxic compounds are those listed in Title I of the 1990 Clean Air Act, as amended; those regulated by the National Emissions Standards for Hazardous Air Pollutants; and those that have been proposed or adopted for regulation by the respective state or are listed in state guidelines. Also of concern are air pollutant emissions that may contribute to the depletion of stratospheric ozone or global warming.

Areas with air quality better than the National Ambient Air Quality Standards (NAAQS) for criteria air pollutants are designated as being in attainment, while areas with air quality worse than the NAAQS for such pollutants are designated as being in nonattainment. Areas may be designated as unclassified when sufficient data for assigning attainment status are lacking. Attainment status designations are assigned by county, metropolitan statistical area, consolidated metropolitan statistical area, or portions thereof. Air Quality Control Regions designated by the U.S. Environmental Protection Agency (EPA) are listed in 40 CFR 81.

For locations that are in an attainment area for criteria air pollutants, Prevention of Significant Deterioration regulations limit pollutant emissions from new sources and establish allowable increments of pollutant concentrations. Three Prevention of Significant Deterioration classifications are specified with the criteria established in the Clean Air Act amendments. Class I areas include national wilderness areas; memorial parks larger than 2,020 hectares (5,000 acres); national parks larger than 2,430 hectares (6,000 acres); and areas that have been redesignated as Class I. Class II areas are all areas not designated as Class I. No Class III areas have been designated. Idaho National Engineering and Environmental Laboratory (INEEL) and the Savannah River Site (SRS) are within attainment areas (Class II) for the criteria air pollutants. INEEL is located about 50 kilometers (33 miles) from the Craters of the Moon Wilderness Area Class I area. There are no Class I areas within 100 kilometers (62 miles) of SRS.

Baseline air quality is typically described in terms of the pollutant concentrations modeled for existing sources at each site and the background air pollutant concentrations measured near the sites. For criteria pollutants at Argonne National Laboratory-West (ANL-W), baseline concentrations are based on 1) dispersion modeling at the site boundary centered at the INTEC facility, performed for the *Idaho High-Level Waste and Facilities Disposition Draft Environmental Impact Statement* (DOE 1999), using 1997 actual emissions and excluding ANL-W; and 2) dispersion modeling at the site boundary centered on ANL-W, using 1997 actual emissions. The modeling performed for the High-Level Waste and Facilities Disposition EIS used EPA's ISCST3 model with hourly meteorological data. The ANL-W modeling used EPA's SCREEN3 model, which is very conservative compared to ISCST3, and uses a set of worst-case meteorological conditions to predict a maximum one-hour concentration. This one-hour concentration was converted to other averaging times using regulatory scaling factors (SCDHEC 1993). For these reasons, the ANL-W concentrations are extremely conservative. For SRS, concentrations for existing sources were obtained from the *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement* (DOE 2000). These concentrations were compared with Federal and state regulations or limits (**Table B–1**). To determine human health risk, modeled chemical concentrations in air were weighed against chemical-specific toxicity values.

B.2.2 Description of Impact Assessment

Potential air quality impacts of pollutant emissions were evaluated for each alternative. This assessment included a comparison of emissions from each alternative with applicable Federal and state ambient air quality standards. If both Federal and state standards exist for a given pollutant and averaging period, compliance was evaluated using the more stringent standard.

Table B–1 Impact Assessment Protocol for Air Quality

Resources	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Criteria air pollutants and other regulated pollutants [a]	Modeled ambient concentrations (micrograms per cubic meter) of air pollutants from existing sources at site	Emission rate (kilograms per year) of air pollutants from facility and concentrations of air pollutants	Contribution of proposed alternative and total concentration of each pollutant at or beyond site boundary compared to applicable standard
Toxic/hazardous air pollutants [b]		Emission rate (kilograms per year) of toxic air pollutants from facility (micrograms per cubic meter)	

[a] Carbon monoxide; hydrogen fluoride; lead; nitrogen oxides; ozone; particulate matter with an aerodynamic diameter less than or equal to 10 microns; particulate matter with an aerodynamic diameter less than or equal to 2.5 microns; sulfur dioxide; total suspended particulates.

[b] Clean Air Act Title III pollutants, pollutants regulated under the National Emission Standards for Hazardous Air Pollutants, and other state-regulated pollutants.

Air pollutant emissions and concentrations data for each alternative, including the No Action Alternative, were based on information obtained in response to data requests to INEEL (ANL 1999) and on the SRS Spent Nuclear Fuel Final EIS (DOE 2000). For INEEL, a dispersion modeling analysis using the EPA SCREEN3 Model (Version 96043) (EPA 1995) was performed to estimate air quality impacts associated with the various alternatives. Emissions from ANL-W emergency diesel generators were modeled, in addition to cadmium emissions from the Fuel Conditioning Facility stack. The generators were modeled as ground-level volume sources; the cadmium emissions were modeled as an elevated point source release. Note that the emissions from the emergency generators are not specific to any given alternative, but are representative of the current operation of ANL-W. The cadmium emissions are specific to the current electrometallurgical treatment process. However, neither cadmium emissions nor emergency generator emissions are expected to increase as a result of any of the alternatives. Concentrations were predicted at 16 INEEL site boundary receptors and were compared to the ambient air quality standards.

For SRS, concentrations were obtained by scaling the concentrations in the SRS Spent Nuclear Fuel Final EIS (DOE 2000) based on the mass of sodium-bonded spent nuclear fuel to be processed under this EIS compared to the mass of spent nuclear fuel to be processed under the SRS Spent Nuclear Fuel Final EIS. The resulting concentrations were compared to the ambient air quality standards.

Ozone is typically formed as a secondary pollutant in the ambient air (troposphere). It is formed from primary pollutants such as nitrogen oxides and volatile organic compounds which emanate from vehicular (mobile), natural, and other stationary sources and mix in the presence of sunlight. Ozone is not emitted directly as a pollutant from the sites. Although ozone may be regarded as a regional issue, specific ozone precursors, notably nitrogen dioxide and volatile organic compounds, were analyzed as applicable to the alternatives under consideration.

Emissions of potential stratospheric ozone-depleting compounds such as chlorofluorocarbons were not evaluated, as no emissions of these pollutants were identified.

B.3 WATER RESOURCES

B.3.1 Description of Affected Resources

Water resources are the surface and subsurface waters that are suitable for human consumption; agricultural purposes; irrigation; or industrial/commercial purposes, and that could be impacted by the treatment of sodium-bonded spent nuclear fuel. This analysis involves the review of engineering estimates of expected water use and effluent discharges associated with the alternatives addressed in this EIS and the impacts of these alternatives on local water quality (including surface water and groundwater).

Surface water flow and quality data were obtained from existing reports. Groundwater users, information on water use rights, and groundwater quality data also were obtained from existing reports.

B.3.2 Description of Impact Assessment

B.3.2.1 Water Use

The assessment of alternatives analyzed how the volumes of current water usage and effluent discharges would change as a result of each alternative addressed in this EIS. A determination of the impacts of the alternatives on water usage and effluent discharge is summarized in **Table B–2**.

Table B–2 Impact Assessment Protocol for Water Use and Effluent Discharge

	Required Data		
Resources	***Affected Environment***	***Alternative***	***Measure of Impact***
Surface water availability	Surface waters near the facilities, including average flow and numbers of downstream users	Volumes of withdrawals from and discharges to surface waters	Changes in availability to downstream users of water for human consumption, irrigation, or animal feeding [a]
Groundwater availability	Groundwater near the facilities, including existing water rights for major water users and contractual agreements for water supply use within impacted area	Volumes of withdrawals from groundwater	Changes in availability of groundwater for human consumption, irrigation, or animal feeding

[a] For surface water availability, an impact is assumed if withdrawals exceed 10 percent of the 7-day, 10-year low-flow of the stream.

If the determination reflected an increase in water use or effluent discharge, then an evaluation of the design capacity of the water and effluent treatment facilities was made to determine whether the design capacity would be exceeded by the additional flow. If the combined flow (i.e., the existing flow plus that of the proposed activities) were less than the design capacity of the water and effluent treatment plants, then it was assumed there would be no impact on water availability for local users, nor on the receiving stream from effluent discharges. Since flows from the facilities proposed to treat sodium-bonded spent nuclear fuel were found not to exceed the design capacity of the existing water or effluent treatment facilities, no additional analysis of water availability was performed.

B.3.2.2 Water Quality

The water quality impact assessment for this EIS analyzed how effluent discharges to surface water and groundwater resulting from the alternatives would affect current water quality. The determination of the impacts of the alternatives is summarized in **Table B–3**, and consisted of a comparison of the projected water quality with relevant regulatory standards such as the Clean Water Act, Safe Drinking Water Act, state regulations, and existing permit conditions. Separate analyses were conducted for surface water and groundwater impacts, as described below.

Surface Water Quality

The evaluation of surface water quality impacts focused on the quality and quantity of the effluent to be discharged and the quality of the receiving stream upstream and downstream from the discharge. The evaluation of effluent quality involved a review of the expected parameters, such as design average flows, as well as the effluent parameters reflected in the existing or expected National Pollutant Discharge Elimination System (NPDES) permit. Those parameters include metals; organic and inorganic chemicals; radionuclides; and any other parameters that affect the local environment. Water quality management practices were reviewed to ensure that NPDES permit limitations would be met. Factors that currently degrade water quality also were identified.

Table B–3 Impact Assessment Protocol for Water Quality

	Required Data		
Resources	***Affected Environment***	***Alternative***	***Measure of Impact***
Surface water quality	Surface waters near the facilities in terms of stream classifications and changes in water quality	Expected contaminants and contaminant concentrations in discharges to surface water	Compliance of discharges to surface water with relevant standards of Clean Water Act or with state regulations and existing NPDES permits
Groundwater quality	Groundwater near the facilities in terms of classification, presence of designated sole–source aquifers, and changes in quality of groundwater	Expected contaminants and contaminant concentrations in discharges that could reach groundwater	Concentrations of contaminants in groundwater exceeding standards established in accordance with Safe Drinking Water Act or state regulations

Groundwater Quality

No effluent discharges to groundwater are anticipated from any of the alternatives. Therefore, an analysis of impacts to groundwater quality was not performed.

B.4 SOCIOECONOMICS

B.4.1 Description of Affected Resources

Socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics of a region. The number of jobs created by treatment of sodium-bonded spent nuclear fuel could affect regional employment, income, and expenditures. Job creation is characterized by two types: (1) construction jobs related to modification of existing facilities, which may be transient in nature and short in duration and thus less likely to impact public services; and (2) jobs related to plant operations that are required for a decade or more and possibly could create additional service requirements in the region of influence.

The socioeconomic environment is made up of two geographic regions, the regional economic area and the region of influence. Regional economic areas are made up of regional economies and include industrial and

service sector characteristics and their linkages to the communities within a region. These linkages determine the nature and magnitude of any effect associated with a change in regional economic activity. For example, as work expands within a region, the money spent on accomplishing this work flows into the local economy, where it is spent on additional jobs, goods, and services within the regional economic area.

Similarly, potential demographic impacts were assessed for the region of influence. The region of influence could represent a smaller geographic area—one in which only the housing market and local community services would be significantly affected by a given alternative. Site-specific regions of influence were identified as those counties in which approximately 90 percent of the site's work force reside. This distribution reflects an existing residential preference for people currently employed at the sites, and was used to estimate the distribution of new workers supporting the alternatives.

B.4.2 Description of Impact Assessment

The socioeconomic impact assessment analyzes both the potential positive and negative impacts of each alternative, including the No Action Alternative. For each regional economic area, data were compiled on the current socioeconomic conditions, including unemployment rates, economic industrial and service sector activities, and the civilian labor force. Work force and cost requirements for each alternative were determined to measure their possible effect on these socioeconomic conditions. For each region of influence, census statistics were compiled on population, housing demand, and community services. U.S. Census Bureau population forecasts for the regions of influence were combined with overall projected work force requirements for each of the alternatives being considered at each of the sites to determine the extent of impacts to housing demand and levels of community services (**Table B–4**).

B.5 WASTE MANAGEMENT

B.5.1 Description of Affected Resources

The operation of support facilities for treating sodium-bonded spent nuclear fuel would generate several types of waste, depending on the alternative. Such waste includes the following:

- **High-level radioactive:** The highly radioactive waste material that results from the processing of spent nuclear fuel, including liquid waste produced directly in processing and any solid waste derived from the liquid. High-level radioactive waste contains transuranic waste and fission products requiring permanent isolation.

- **Transuranic:** Waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste with half-lives greater than 20 years, except for: (1) high-level radioactive waste; (2) waste that has been determined by DOE and the EPA not to need the degree of isolation required by 40 CFR 191; and (3) waste that the U.S. Nuclear Regulatory Commission has approved for disposal, case by case, in accordance with 10 CFR 61. Mixed transuranic waste contains hazardous components regulated under the Resource Conservation and Recovery Act (RCRA).

- **Low-level radioactive:** Waste that contains radioactivity and is not classified as high-level radioactive waste; transuranic waste; spent nuclear fuel; or the tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level radioactive waste, provided the transuranic concentration is less than 100 nanocuries per gram of waste.

Table B–4 Impact Assessment Protocol for Socioeconomics

Resources	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Regional Economic Characteristics			
Work force requirements	Site work force projections from DOE sites	Estimated construction and operating staff requirements and schedule	Work force requirements added to site work force projections
Regional economic area civilian labor force	Labor force projections based on state population projections		Change in work force requirements as a percentage of the civilian labor force
Unemployment rate	1996 unemployment rates in counties surrounding sites and in host states		Projected change in unemployment rates
Population and Housing			
Population	Latest available population projection estimates from the U.S. Census Bureau	Estimated contribution to projected population	Projected change in population projection
Housing (percentage of occupied housing units)	Latest available rates from the U.S. Census Bureau	Assessment of potential need for housing units to meet work force requirements	Impacts are not expected since work force requirements would be small
Community Services			
Education Percentage of operating capacity for school districts in region of influence	Latest available rates from the U.S. Census Bureau	Assessment of potential need for new schools	Impacts are not expected since work force requirements would be small
Teacher-to-student ratio		Assessment of potential need for additional teachers	
Public safety Ratio of police and firefighters to 100,000 residents		Assessment of potential need for new officers and firefighters	
Health care Number of hospital beds and physicians per 100,000 residents		Assessment of potential need for hospitals and physicians	

- **Mixed:** Radioactive waste that also contains hazardous components regulated under RCRA.

- **Hazardous:** Under RCRA, waste that, because of its characteristics, may (1) cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous waste appears on special EPA lists or possesses at least one of the following characteristics: ignitability, corrosivity, reactivity, or toxicity. This category does not include source, special nuclear, or by-product material as defined by the Atomic Energy Act.

- **Nonhazardous:** Discarded material including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities.

This category does not include source, special nuclear, or by-product material as defined by the Atomic Energy Act.

Waste associated with the alternatives for treating the sodium-bonded spent nuclear fuel would be managed in existing or already-planned-for treatment, storage, and disposal facilities. The management of this waste could have an impact on existing site facilities. Waste generated during modifications to existing facilities could produce additional hazardous debris.

Waste management activities in support of treating sodium-bonded spent nuclear fuel would be contingent on Records of Decision issued for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a). Depending on future waste type-specific Records of Decision, in accordance with that EIS, waste could be treated and disposed of on site or at regionally or centrally located waste management centers. According to the Transuranic Waste Record of Decision issued January 20, 1998, transuranic and transuranic mixed waste would be treated on site according to current planning-basis Waste Isolation Pilot Plant waste acceptance criteria and shipped to the Waste Isolation Pilot Plant for disposal. The impacts of disposing of transuranic waste at the Waste Isolation Pilot Plant are described in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b). Per the Hazardous Waste Record of Decision issued August 5, 1998, nonwastewater hazardous waste would continue to be treated and disposed of at offsite commercial facilities, with SRS continuing to treat some of its own hazardous waste on site in existing facilities, where this is economically favorable.

B.5.2 Description of Impact Assessment

As shown in **Table B–5**, impacts were assessed by comparing the projected waste stream volumes generated from the alternatives at each site with current site waste generation rates and storage volumes. For sodium-bonded spent nuclear fuel treatment, only the impacts related to the capacities of waste management facilities were considered. Environmental impacts of waste management facility operation are evaluated in other facility-specific or site-wide National Environmental Policy Act (NEPA) documents. Projected waste generation rates for the alternatives were compared with the processing rates and capacities of those existing treatment, storage, and disposal facilities likely to be involved in managing the additional waste. Another factor considered is the reduction in volume of spent nuclear fuel and high-level radioactive waste destined for geologic disposal under each alternative.

The waste generation rates associated with sodium-bonded spent nuclear fuel treatment either were provided by the sites' technical personnel or were estimated based on evaluating similar processes, with adjustments made to account for differences in the amounts of materials processed.

B.6 CUMULATIVE IMPACTS

Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time (40 CFR 1508.7). The cumulative impact analysis for this EIS involved combining the impacts of the sodium-bonded spent nuclear fuel treatment alternatives (including No Action) with the impacts of other present and reasonably foreseeable activities in a region of influence.

The regions of influence for different resources can vary widely in extent. For example, the region of influence for waste management generally would be confined to the site itself; whereas the region of influence for human health would include areas extending out to 80 kilometers (50 miles) from each site.

Table B–5 Impact Assessment Protocol for Waste Management

Resources	*Required Data*		*Measure of Impact*
	Affected Environment	*Alternative*	
Waste management capacity related to: - High-level radioactive waste - Transuranic waste - Low-level radioactive waste - Mixed waste - Hazardous waste - Nonhazardous waste	Site generation rates (cubic meters per year) for each waste type Site management capacities (cubic meters) or rates (cubic meters per year) for potentially affected treatment, storage, and disposal facilities for each waste type	Generation rates (cubic meters per year) of each waste type from modification and operation of existing facilities used to treat the sodium-bonded spent nuclear fuel	Combination of waste generation volumes from: (1) facilities that treat sodium-bonded spent nuclear fuel, and (2) current site and additional future generation volumes, in comparison to the capacities of applicable waste management facilities
Disposal capacity for transuranic waste (including mixed transuranic waste) [a]	Transuranic waste volume (cubic meters) expected to be disposed of at the Waste Isolation Pilot Plant Capacity at the Waste Isolation Pilot Plant (cubic meters)	Total transuranic waste generated (cubic meters) by spent nuclear fuel treatment facilities	Combination of transuranic waste generation volumes from: (1) facilities that treat sodium-bonded spent nuclear fuel, and (2) current site transuranic waste generation volume, in comparison to the capacity of the Waste Isolation Pilot Plant

[a] This additional entry is made for transuranic waste disposal because of its comparison with Waste Isolation Pilot Plant capacity.

In general, cumulative impacts were calculated by adding other planned and reasonably foreseeable future actions to the values for the baseline affected environment (i.e., conditions attributable to past and present actions by DOE and other public and private entities). This cumulative value was weighed against the appropriate impact indicators to determine the potential for impact. For this cumulative impact assessment, it was conservatively assumed that all facilities would operate concurrently at the DOE sites. Only selected indicators of cumulative impacts (**Table B–6**) were evaluated.

Table B–6 Selected Indicators of Cumulative Impacts

Category	*Indicator*
Resource use	Electricity use Water use Workers required
Air quality	Percent of NAAQS for criteria pollutants
Human health	Maximally exposed offsite individual, population, workers - dose - latent cancer fatalities
Waste	Site waste total and generation rate: - High-level radioactive waste - Transuranic waste - Low-level radioactive waste - Hazardous mixed waste

The analysis focused on the potential for cumulative impacts at each candidate site from DOE actions under detailed consideration at the time of this EIS (**Table B–7**). Non-DOE actions also were considered where information was readily available. Public documents prepared by agencies of Federal, state, and local governments were the primary sources of information for non-DOE actions.

Table B–7 Other Past, Present, and Reasonably Foreseeable Actions Included in the Cumulative Impact Assessments

Activities	*INEEL*	*SRS*
Surplus highly enriched uranium disposition		X
Surplus plutonium disposition		X
Interim management of nuclear materials at SRS		X
Management of waste	X	X
Radioactive releases from the Vogtle Nuclear Power Plant		X
Management of plutonium residues and scrub alloy at Rocky Flats		X
Construction and operation of a tritium extraction facility at SRS		X
Advanced mixed waste treatment project	X	
Defense waste processing facility		X
High-level waste and facility disposition	X	

It was assumed that construction impacts related to internal modification of existing facilities would not be cumulative, because construction typically is short in duration and construction impacts generally are temporary. Deactivation of the facilities utilized for the treatment of sodium-bonded spent nuclear fuel was not addressed in the cumulative impact estimates. Given the uncertainty regarding the timing of the deactivation and the fact that facilities could be used for other projects, any impact estimate at this time would be premature. The evaluation of decontamination and decommissioning impacts will be provided in NEPA documentation closer to the actual time of those actions.

Recent site-wide NEPA documents (**Table B–8**) provide the latest comprehensive evaluation of cumulative impacts for the sites.

Table B–8 Recent Comprehensive NEPA Documents for DOE Sites Assessed in This EIS

Site	*Document*	*Year*	*Record of Decision First Issued*
INEEL	*Idaho High-Level Waste and Facilities Disposition Draft Environmental Impact Statement* (DOE 1999)	1999	—
SRS	*Savannah River Site Waste Management Final Environmental Impact Statement* (DOE 1995)	1995	October 1995

B.7 REFERENCES

ANL (Argonne National Laboratory), 1999, *Response to Data Call from SAIC for Sodium-Bonded Spent Nuclear Fuel Treatment Technologies*, Idaho National Engineering and Environmental Laboratory, Idaho Falls, June.

DOE (U.S. Department of Energy), 1995, *Savannah River Site Waste Management Final Environmental Impact Statement*, DOE/EIS-0217, Savannah River Operations Office, Aiken, South Carolina, July.

DOE (U.S. Department of Energy), 1997a, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-F, Office of Environmental Management, Washington, DC, May.

DOE (U.S. Department of Energy), 1997b, *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2, Carlsbad Area Office, Carlsbad, New Mexico, September.

DOE (U.S. Department of Energy), 1999, *Idaho High-Level Waste and Facilities Disposition Draft Environmental Impact Statement*, DOE/EIS-0287D, Idaho Operations Office, Idaho Falls, Idaho, December.

DOE (U.S. Department of Energy), 2000, *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement*, DOE/EIS-0279, Savannah River Operations Office, Aiken, South Carolina, March.

EPA (U.S. Environmental Protection Agency), 1995, *SCREEN3 Model User's Guide*, EPA-454/B-95-004, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September.

SCDHEC (South Carolina Department of Health and Environmental Control), 1993, *Air Quality Modeling Guidelines*, Bureau of Air Quality, Columbia, South Carolina, August.

APPENDIX C
TECHNOLOGY DESCRIPTIONS

The technology options that the U.S. Department of Energy (DOE) has considered for the treatment of sodium-bonded spent nuclear fuel are described in this appendix. Each technology is described in the context of treating sodium-bonded spent nuclear fuel driver and/or blanket assemblies. A brief discussion of the technical maturity of each treatment technology is included at the end of each technology description. The technical maturity of the technologies range from mature technologies that have been previously demonstrated by DOE for spent nuclear fuel or in an industrial setting to immature technologies that have only been demonstrated on a laboratory scale or for which only a conceptual design has been developed.

C.1 ELECTROMETALLURGICAL TREATMENT

The electrometallurgical treatment process for sodium-bonded spent nuclear fuel was developed at Argonne National Laboratory for processing Experimental Breeder Reactor-II (EBR-II) driver and blanket spent nuclear fuel assemblies. The process has been demonstrated for the stainless steel-clad uranium alloy fuel used in that reactor. The electrometallurgical treatment process uses electrorefining, an industrial technology used to produce pure metals from impure metal feedstock (DOE 1996). Although most of the sodium-bonded spent nuclear fuel driver and blanket elements are composed of uranium metal alloys, there also are small quantities (about 0.1 metric tons of heavy metal) of sodium-bonded uranium oxide, uranium nitride, and uranium carbide fuel. The oxide fuel would be prepared for treatment using the electrometallurgical treatment process by reducing the uranium oxide to uranium metal with lithium metal dissolved in small batches of lithium chloride-potassium chloride molten salt solution. The resulting uranium-bearing solution would be added to the molten salt solution used in the electrometallurgical treatment process for other sodium-bonded fuel and blanket elements and processed with those materials. The carbide fuel would be prepared for electrometallurgical treatment by cleaning the fuel of sodium to the extent possible and then converting the fuel to uranium oxide with water or dilute acid. This oxide then would be converted to uranium metal by lithium metal in a molten salt solution and processed by the electrometallurgical treatment process with other sodium-bonded spent nuclear fuel and blankets. The nitride fuel also would be prepared for electrometallurigcal treatment by converting it to uranium metal.

The description of electrometallurgical treatment in this environmental impact statement (EIS) is based on the assumption that the electrorefiner waste salts would be disposed of without salt recycling. This process differs from the original process described in the environmental assessment of the electrometallurgical treatment for the demonstration project (DOE 1996). In that assessment, the electrorefiner salts were to be treated in a series of zeolite columns. In these columns, the zeolite would absorb the fission products and transuranics from the salt and would release potassium as potassium chloride, which is one of the basic constituents of the electrorefiner salt. The bulk fluid handling system and zeolite columns were to be installed in the Hot Fuel Examination Facility argon cell. The potassium chloride salt and the recovered electrorefiner salts were to be reused in the electrorefiners. The fission products and transuranics that were absorbed in the zeolite then were to be removed from the columns in preparation for waste form production. Use of zeolite columns could potentially reduce the final ceramic waste volume.

Electrorefiner salt needs to be replaced if either the sodium concentration or the plutonium concentration limit is reached. The zeolite column would be a preferred option if the plutonium concentration in the salt became more limiting than the sodium concentration. In the latter case, which is the most likely scenario for the driver and Fermi-1 blanket spent nuclear fuel, the waste volume would be similar to the batch processing (i.e. without

salt recycling). During the demonstration project, due to lack of an available large-scale zeolite column, limited resources, and the fact that the batch processing produced acceptable waste forms and volumes, work focused primarily on batch processing. Additional research and development is needed to extend zeolite column use beyond the laboratory scale.

The individual steps in the electrometallurgical treatment process are described below. A diagram of the electrometallurgical process is shown in **Figure C–1**.

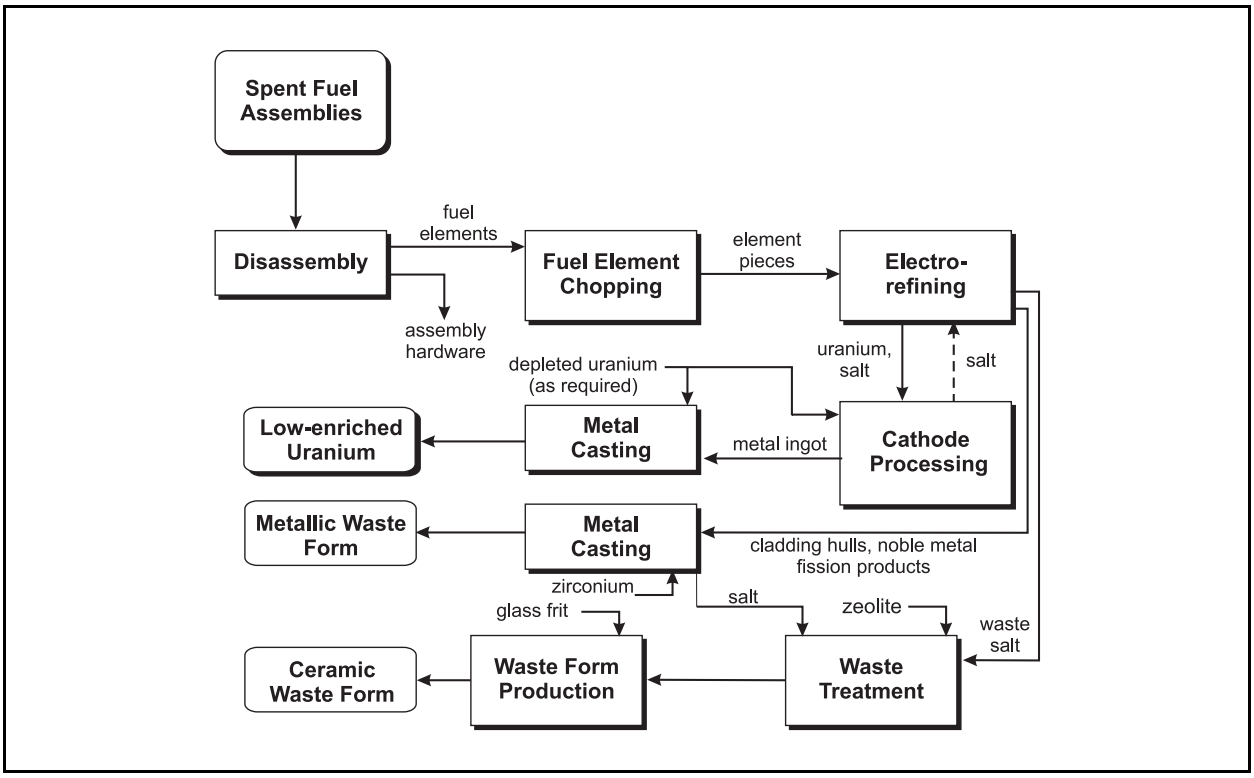


Figure C–1 Electrometallurgical Treatment Process Flow Diagram

Disassembly: Although the fuel and blanket assemblies mostly have been disassembled, some assemblies may need to be removed. The assembly hardware would be separated from the fuel elements that contain uranium and fission products by cutting the assemblies and physically separating the fuel elements. The fuel elements would be placed into a container for transfer to a hot cell containing an inert (argon) atmosphere for the remaining treatment steps. The assembly hardware would be stored at the Radioactive Scrap and Waste Facility at Argonne National Laboratory-West (ANL-W). This is a normal waste stream for ANL-W operations, and the separated hardware would be handled in accordance with normal site waste management practices.

Fuel Element Chopping: The sodium-bonded driver fuel or the blanket fuel elements would be placed in a machine for cutting into small pieces. The section of the element containing the fuel and sodium would be sheared into short segments. The section of the element containing the gas space (plenum) would be left intact. This section of the fuel pin cladding and the spacer wire would go into the metallic waste stream. The sheared fuel segments would be placed in perforated, stainless steel baskets to form an anode (positive electrode where oxidation would occur) for the electrorefiner.

During shearing of the hollow end (plenum) of the fuel pin, some fission product gases (primarily tritium and krypton) would be released to the argon cell atmosphere. These gases eventually would pass through high efficiency particulate air filters and be released up the emissions stack to the environment. All air emissions would be monitored and recorded.

Electrorefining: The electrorefiner is a machine in which the main electrometallurgical processes would occur. The electrorefiner vessel is made of steel. At its operating temperature of about 500 °C (930 °F), the vessel would contain a molten mixture of two salts, lithium chloride and potassium chloride. The electrorefiner also would have two or more electrodes: one or more anodes and one or more cathodes (negative electrodes where reduction would occur). Each anode would have baskets to hold the spent nuclear fuel pieces, and each cathode would consist of a bare steel rod where uranium metal would be collected.

The chopped fuel elements would be loaded into anode baskets and then lowered into the molten process salt. Upon application of an electric current between the anodes and cathodes, uranium, plutonium, and other transuranic elements, most of the fission products, and the sodium would be oxidized and dissolved into the salt. Uranium ions would be deposited at the cathode. Crystalline deposits of uranium would grow for 24 to 72 hours until almost all of the uranium in the anode baskets has been dissolved. The uranium-bearing cathodes would be raised into the gas space in the electrorefiner to allow some of the molten salt to drain away, although salt would adhere to each cathode. Each cathode then would be removed from the electrorefiner. The uranium deposit would be mechanically harvested and stored in the argon cell in a canister until it could be processed in the cathode processor.

The stainless steel cladding hulls and noble metal fission products would remain undissolved in the anode baskets. They would be removed from the electrorefiner and temporarily stored, prior to melting, into metallic waste-form ingots. The reactive fission products and transuranic elements would remain in the electrorefiner salt. The plutonium would be in a chloride compound in a liquid state and would be homogeneously mixed with other salts. The concentration of plutonium in the salt would be monitored through repeated sampling. The maximum plutonium concentration (about 8 weight percent) in the salt would not pose criticality safety concerns (Goff et al. 1999). In addition, abnormal localized concentrations of plutonium within the electrorefiner have been analyzed for a number of scenarios. These analyses have confirmed that an adequate margin of criticality safety would exist even under these conditions. The sodium would be in the form of sodium chloride (chemical form of table salt) as a part of the molten salt mixture.

The electrometallurgical process would use two electrorefining designs: Mark IV (for driver spent nuclear fuel) and Mark V (for blanket spent nuclear fuel). The Mark IV electrorefiner design would use a layer of cadmium to allow recovery of uranium that falls off the cathode during treatment. The Mark V design would use a collection basket instead of a cadmium layer.

Cathode Processing: The uranium deposits would be removed from the electrorefiner and treated to remove any adhering salt in the cathode processor, which is a furnace equipped with a vacuum system. The cathode product (along with depleted uranium to lower the enrichment of the resulting metallic ingot to less than 50 percent uranium-235, in the case of driver spent nuclear fuel) would be heated to about 1,200 °C (2,200 °F), melting both the uranium and the salt. Under vacuum conditions, the salt would distill away from the uranium and condense in a receiver crucible. The uranium would be melted in the cathode processor crucible and then solidified into an interim product ingot, which would be stored before final treatment in a casting furnace.

Uranium Metal Casting: The enriched uranium from driver spent nuclear fuel elements recovered in the electrorefiner would be melted together in a casting furnace with a separate stream of depleted uranium, electromagnetically stirred, and allowed to solidify. In this manner, enriched uranium from the treatment of driver spent nuclear fuel assemblies would be blended with depleted uranium in the casting furnace to form

low-enriched, metal ingots. The ingots then would be transferred to the Materials Storage Building within the Zero Power Physics Reactor complex, a controlled storage facility, until a decision is made by DOE regarding final disposition. Similarly, depleted uranium from treatment of blanket spent nuclear assemblies would be melted in a casting furnace and placed into storage until DOE makes a decision on final disposition.

Metallic Waste Form: The metallic waste form is one of the two high-level radioactive waste forms generated from electrometallurgical treatment of sodium-bonded spent nuclear fuel. This waste form would consist of metallic ingots used to stabilize the stainless-steel cladding material, residual fuel matrix materials, and noble metal fission products. Actinides that remain in the cladding hulls after dissolution also would be present in the metallic waste form. These metals would be melted together in a separate casting furnace from the one used for uranium metal casting. Any salt remaining with the metals would be distilled away under vacuum at about 1,200 °C (2,200 °F). Upon heating to about 1,500 °C (2,730 °F), the metals would melt and form an alloy. A small amount of zirconium metal also would be added to improve performance properties and to produce a lower melting point alloy. After cooling, the metal would solidify into a metallic waste ingot. The typical composition of these ingots would be stainless steel, 15 weight percent zirconium, and about 1 weight percent noble metal fission products (Goff et al. 1999). These ingots would be packaged and stored in interim dry storage at the Radioactive Scrap and Waste Facility until shipment to a geologic repository in canisters for disposal.

Treatment of Electrorefiner Waste: At the end of a processing campaign, fission products and actinides would remain dissolved in the molten salt. The waste salt would be removed from the electrorefiner and allowed to solidify. It then would be crushed and milled to obtain the desired particle size for ceramic waste form production. The liquid cadmium layer at the bottom of the electrorefiner also would be removed periodically, filtered, and returned to the electrorefiner. Filters from this bulk fluid handling system would become part of the metallic waste stream.

Ceramic Waste Form Production: The ceramic waste form is the second waste form generated from electrometallurgical treatment of sodium-bonded spent nuclear fuel. The crushed and milled waste salt and dried zeolite would be added to a heated V-mixer. (Zeolites are crystalline aluminosilicates of group I (alkali) and group II (alkaline earth) elements. Their framework is a network of aluminum oxide and silicon oxide tetrahedra linked by the sharing of oxygen atoms. The networks of tetrahedra in the zeolite form cages in which molecules can be occluded.) The waste salt containing fission products and actinides would be absorbed into the crystal lattice of the zeolite, forming a dry particulate solid. Glass frit (sand-like glass) then would be mixed with the waste-bearing zeolite and placed in a special metal canister designed to be compressed to a desired and predictable shape. The mixture of material going into the process would be about 75 weight-percent waste-bearing zeolite and 25 weight-percent glass (Goff et al. 1999). This canister would be put into a type of furnace called a hot isostatic press, where it would be subjected to a temperature of 850 °C (1,560 °F) and a pressure of 1,057 kilograms per square centimeter (15,000 pounds per square inch). This would compress the canister and transform the material inside into a single cylinder of glass-bonded zeolite, which is referred to as the ceramic waste form. During compression, the zeolite would be converted to sodalite, a naturally occurring, salt-bearing material. Fission product chlorides largely would remain in the sodalite phase, while actinides (and most of the rare earth elements) would react with residual water in the zeolite to form oxide phases in the waste form. A conservative criticality assessment of the ceramic waste form indicated that the plutonium concentration in the waste form would pose no criticality safety concern (ANL 1999). These waste-form cylinders would be packaged and stored in interim dry storage at the Radioactive Scrap and Waste Facility until shipment to a geologic repository in canisters for disposal.

Technology Maturity: The electrometallurgical treatment process is considered to be a mature technology. DOE demonstrated the electrometallurgical process for stainless steel-clad uranium alloy fuel used in the EBR-II reactor. Furthermore, it is an industrial technology used to produce pure metals from impure metal feedstock.

C.2 DECLAD AND CLEAN PROCESS

Cleaning (removing metallic sodium) and/or decladding are necessary steps in the treatment of sodium-bonded spent nuclear fuel using the plutonium-uranium extraction (PUREX) process at the Savannah River Site (SRS), the melt and dilute process at either SRS or ANL-W, and high-integrity can packaging. The fuel would need only to be cleaned of metallic sodium (i.e., it would not have to be declad) for melt and dilute processing at ANL-W and high-integrity can packaging. Decladding and sodium removal could be done using either a mechanical process (the melt, drain, evaporate, and calcine [MEDEC] process) or a laser declad and alcohol wash process. In the MEDEC process, the metallic sodium would be removed first; then, if necessary, the fuel would be declad. The MEDEC process has been performed for unirradiated blanket elements. The laser declad and clean process performs these functions in the reverse order—the fuel is declad using the laser and then the sodium is removed using an alcohol wash. Laser cutting is accompanied by partial volatilization of cladding, sodium, and materials dissolved or suspended in sodium, most notably cesium. This process was performed at the Rockwell International Hot Laboratory to declad and remove metallic sodium from approximately 7,000 EBR-II irradiated (low burnup) blanket spent nuclear fuel elements (Frazier and Campbell 1987). The process used a yttrium-aluminum-garnet (YAG) laser system. An automated fuel cutting sequence was developed, and the cladding was cut into strips. The cutting sequence included four circumferential cuts and three longitudinal cuts (at 120° circumferential segments) to allow mechanical removal of the cladding pieces. The bare fuel pins and the cladding pieces were washed in alcohol (ethanol) and water mixtures to remove the metallic sodium. The bare fuel pins were packaged and sent to SRS for processing. The contaminated alcohol mixture then was evaporated to reduce the volume, solidified with a grouting agent, and disposed of as low-level radioactive waste.

MEDEC Sodium Removal and Processing: This process would be performed at the Hot Fuel Examination Facility. Fuel elements would be brought into an argon-atmosphere hot cell where the ends of the elements would be cut off to expose the sodium within the cladding. The elements then would be cut into segments less than 61 centimeters (24 inches) in length. The fuel elements would be placed into a crucible and loaded into a closed induction furnace with an off-gas control system. The temperature in the furnace would be raised above the melting point of sodium (about 200°C [390°F]) and the molten sodium would be drained into a collection tank. With most of the sodium removed, the temperature would be raised to about 500°C (930°F) and a 10^{-4} torr vacuum would be applied to the chamber. This vacuum would volatilize the residual sodium, allowing the sodium vapor to be drawn away from the fuel. The vapor-phase sodium would be condensed in a trap and combined with the drained sodium in the collection tank pending further processing. Operating conditions necessary for complete sodium removal would be determined through testing. Verification of sodium removal would be obtained through analytical laboratory inspection and analysis. If the MEDEC process is applied for production, further verification would be performed. If necessary, the fuel pins would be mechanically pushed out of the stainless steel cladding after all the metallic sodium is eliminated.

Sodium recovered during the cleaning process would contain some fission products, most notably cesium-137. This cesium would be recovered by vacuum distillation of the sodium, taking advantage of the large difference in the boiling points of the two elements. The boiling point of cesium is 690°C (1,274°F), while the boiling point of sodium is 892°C (1,638°F). A vapor trap would be placed between the distillation column and pump to collect volatile species emitted from the condenser. The purified sodium would be processed by injection into a chamber where it would react rapidly with oxygen and water to form an aqueous sodium hydroxide. Carbon dioxide gas then would be bubbled through the hydroxide solution, converting the sodium hydroxide to a sodium carbonate. The aqueous sodium carbonate would be solidified with a binder and packaged for disposal as low-level radioactive waste. The cesium collected as distillate from the separation process would be added to the ceramic waste form described in Section C.1.

Laser Declad and Wash: As stated above, this process was performed at Rockwell International. The process would use a modified laser system for remote operations and a machine to hold and index the fuel elements

during cutting operations. The fuel elements would be brought into a hot cell. The fuel would be cut both circumferentially and longitudinally in a predefined cutting sequence. The fumes generated during the cutting process would be filtered and exhausted through an off-gas system. The fuel pins along with the cladding strips would be washed in an alcohol and water mixture to neutralize the metallic sodium and fission product (i.e., cesium) contamination. The fuel pins would be packaged and stored at ANL-W for further treatment, or sent to SRS for treatment. The alcohol and water solution would be evaporated partially, and the sodium/cesium alcoholates and hydroxides would be neutralized, then solidified in a grouting agent and disposed of as a low- or high-level radioactive waste, depending on the cesium content.

Compatibility with argon cell operation: The MEDEC procedure has been demonstrated using sealed vessels in an ANL-W facility. The laser process was demonstrated at Rockwell International. The laser process operation required personnel to enter the hot cell on a biweekly basis for laser maintenance and purging of the cell atmosphere to maintain a low oxygen level (less than 4 percent) and to vent alcohol-water vapors and hydrogen gas from the cell. Neither of these practices would be acceptable for argon cell operations. These concerns could be ameliorated by use of a hot cell with a different type of inert atmosphere, such as nitrogen, which could be purged and replaced with air. Nevertheless, personnel entry into the hot cell would still be restricted due to current radiation exposure controls and the higher level of fission products in the present inventory of sodium-bonded spent nuclear fuel. The use of alcohol and water in a multipurpose hot cell could raise a criticality concern if fissile materials were present in the cell. However, there would be no criticality issue with the blanket fuel itself, so a dedicated hot cell would eliminate this concern.

Finally, sodium collected during previous laser decladding operations was disposed of as low- level radioactive waste. The sodium collected from the processing of the fuel addressed by this EIS would be contaminated with cesium. If sufficient quantities of cesium were present in the sodium, this waste could not be treated as low-level radioactive waste. For the sodium to be managed as low-level radioactive waste, the sodium would have to be processed (as is done with the sodium removed from the fuel in the MEDEC process) to remove the cesium from the alcohol mixture using a currently undefined process. Because of the compatibility concerns associated with laser operation in the argon cell, the MEDEC process has been used to evaluate the various alternatives that require cleaning and/or decladding of the sodium-bonded spent nuclear fuel.

Technology Maturity: Argonne National Laboratory has used the MEDEC process to recover the uranium from 1,700 unirradiated sodium-bonded fuel rods. Laser decladding and cleaning were demonstrated on 17 metric tons of heavy metal (6,780 rods) of very low burnup EBR-II blanket fuel. Both processes are considered mature technologies.

C.3 PUREX PROCESS

The PUREX process is a counter-current solvent extraction method used to separate and purify uranium and plutonium from fission product-containing spent nuclear fuel and irradiated uranium targets. DOE has two facilities at the SRS, F-Canyon and H-Canyon, that use the PUREX process for the treatment of aluminum-clad fuel and targets. In this EIS, the PUREX process at F-Canyon is being considered for treating declad and cleaned EBR-II and Fermi-1 blanket spent nuclear fuel. The stainless steel cladding and sodium would be removed from these blanket spent nuclear fuel elements at ANL-W. The cleaned blanket spent nuclear fuel pins would be packaged in aluminum cans and shipped to SRS. The decladding and cleaning activities would be conducted in argon cells at ANL-W facilities. A diagram of the PUREX process is shown in **Figure C–2**.

Disassembly: The first step in the process would be similar to the disassembly process previously described in Section C.1. The assembly hardware would be stored at the Radioactive Scrap and Waste Facility at ANL-W and handled in accordance with normal site waste management practices.

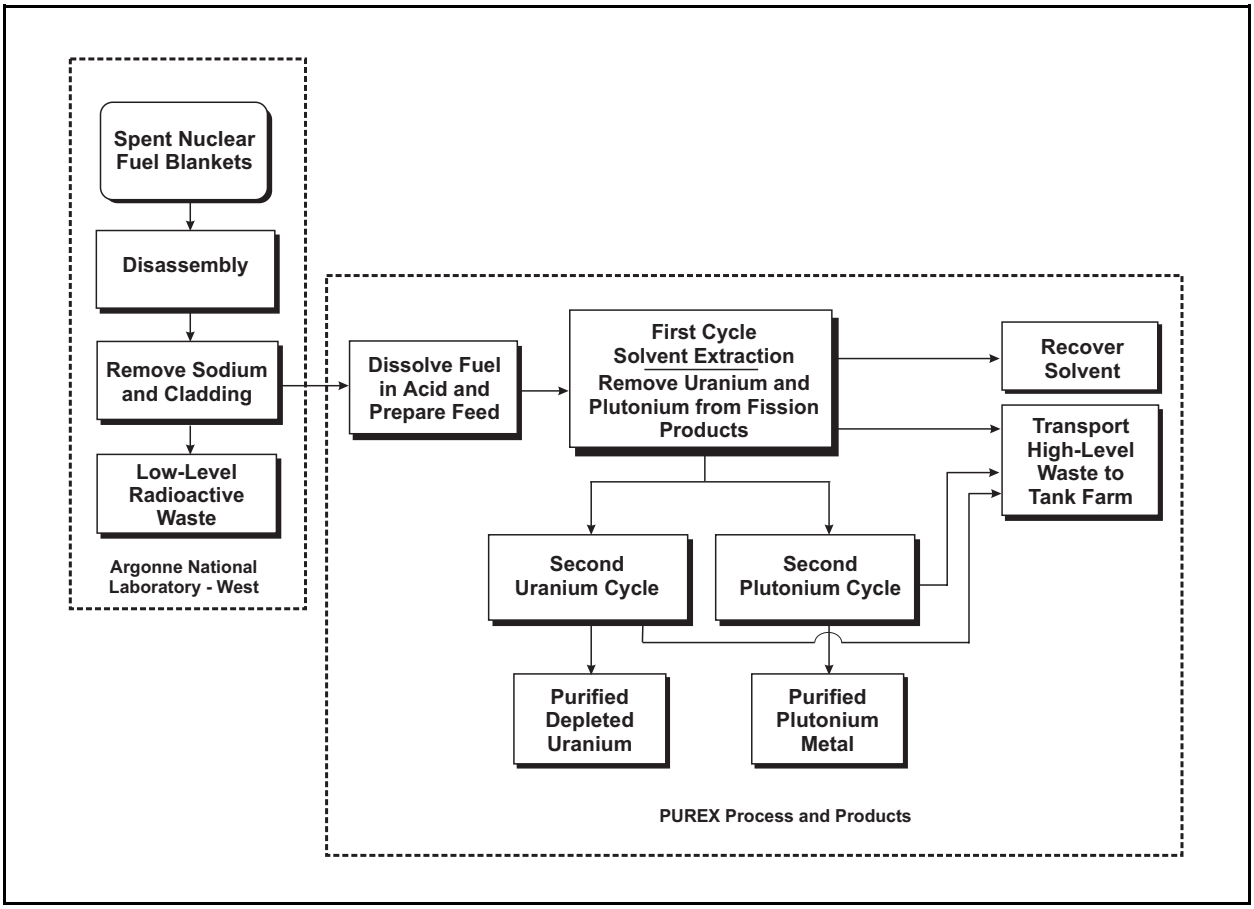


Figure C–2 PUREX Process Flow Diagram at SRS

Decladding and Sodium Removal: Blanket spent nuclear fuel elements would be cleaned and declad using the MEDEC process described in Section C.2. The uranium pins would be mechanically pushed out of the stainless steel cladding after all the metallic sodium has been eliminated. The bare uranium pins then would be packed into aluminum canisters in the Hot Fuel Examination Facility. The canisters, approximately 10 centimeters (4 inches) in diameter and 61 centimeters (24 inches) in length, would be backfilled with an inert gas and sealed. Each canister would contain about 60 kilograms (130 pounds) of depleted uranium fuel pins. The canisters would be placed in a NAC-LWT cask for shipment to SRS.

Receiving and Storage at SRS: The packages of blanket spent nuclear fuel pins from ANL-W would be received at the L-Reactor Disassembly Basin for storage until transfer to the F-Canyon for stabilization using the PUREX process.

PUREX Unit Operations: The EBR-II and Fermi-1 blanket spent nuclear fuel pins would be processed using the traditional PUREX process. This process consists of several major operations referred to as "unit operations," which yield two products, uranium and plutonium (in solution form). The unit operations are dissolution, head end, first cycle, second uranium cycle, and second plutonium cycle. Unit operations that support the product recovery process are high-activity waste, low-activity waste, and solvent recovery.

Dissolution and Head End: The blanket fuel would be transferred to the canyon in casks and loaded into a large tank called a dissolver. Heated nitric acid in the tank would dissolve the blanket fuel, resulting in a solution containing depleted uranium, plutonium, and fission products. Gelatin would be added to the solution, if necessary, to precipitate fuel impurities. Then the solution would be transferred to a centrifuge

where impurities would be removed as waste. The clarified product solution from this process would be adjusted with nitric acid and water in preparation for the first cycle unit operation in the PUREX process. The waste stream generated from the process would be chemically neutralized and sent to the SRS high-level radioactive waste tanks pending further processing at the Defense Waste Processing Facility.

First-Cycle Operation: The first-cycle operation has two functions: (1) to remove fission products and other chemical impurities, and (2) to separate the solution into two product streams (i.e., uranium and plutonium) for further processing. This separation process occurs as the product solution passes through a series of equipment consisting of a centrifugal contactor and mixer-settler banks. Before the introduction of the product solution, flows of solvent and acid solution would be started through the equipment. After an equilibrium condition has been established, the product solution would be introduced. The chemical properties of the acid/solvent/product solutions in contact with each other would cause the fission products to separate from the uranium and plutonium. Later in the first cycle process, the plutonium would be separated from the uranium in a similar manner. The first cycle would produce four process streams: (1) a plutonium-containing solution (with some residual fission products), which would be sent to the second plutonium cycle; (2) a uranium-containing solution (with some residual fission products), which would be sent to the second uranium cycle; (3) a solvent stream, which would be sent to a solvent recovery cycle; and (4) an aqueous acid stream, which would contain most of the fission products and would be sent to the SRS high-level radioactive waste tanks pending further processing at the Defense Waste Processing Facility.

Second Uranium Cycle: In the second uranium cycle, the uranium-containing solution coming from the first cycle would be purified further in a manner similar to that described for the first cycle. The purified solution would be transferred to storage tanks. Eventually, the uranium would be converted to uranium oxide and stored in 208-liter (55-gallon) drums. The uranium oxide would be stored for future use. The solution containing the residual fission products would be sent to SRS high-level radioactive waste tanks pending further processing at the Defense Waste Processing Facility.

Second Plutonium Cycle: In the second plutonium cycle, the plutonium-containing solution coming from the first cycle would be further purified in a manner similar to that described for the first cycle. The purified solution would be converted to plutonium metal in the FB-Line. The plutonium would be disposed of in accordance with the Record of Decision (75 FR 1608), for the *Surplus Plutonium Disposition Final Environmental Impact Statement* (DOE 1999). The solution containing the residual fission products would be sent to the SRS high-level radioactive waste tanks pending further processing at the Defense Waste Processing Facility.

Other Unit Operations: The unit operations for high- and low-activity waste would reduce the volume of the aqueous streams containing fission products. The streams originate with primary separation process unit operations such as the first cycle. The fission products would be separated and sent to the high-level radioactive waste tanks. The volume reduction process would be accomplished using a series of evaporators in the canyons. The solvent recovery unit operation would recover and recycle the solvent used in the first cycle by removing impurities from the solvent. The purified solvent would be returned to the first cycle for reuse, and the impurities would be transferred to low-activity waste for processing (DOE 1994).

Technology Maturity: The PUREX process is considered to be a mature technology. It has been used throughout the world since 1954 to separate and purify uranium and plutonium from fission product-containing spent nuclear fuel and irradiated uranium targets.

C.4 HIGH-INTEGRITY CAN PACKAGING

The high-integrity can packaging option is being considered for EBR-II and Fermi-1 blanket spent nuclear fuel elements. The high-integrity can is made from Hastelloy Alloy C-22 metal alloy pipe having a 13.7-centimeter (5-inch) diameter, variable length, and a pipe wall thickness of 0.655 centimeters (0.258 inches) (Shaber 1998). Hastelloy Alloy C-22 is an alloy of nickel, chromium, and molybdenum that is highly corrosion-resistant due to its high chrominium (22 percent) and molybdenum (13 percent) content. The high-integrity cans are designed for dry hot cell loading with a lid adaptable to wet loading and vacuum drying. The lid on each can has a threaded design to accommodate the partial loading of the spent nuclear fuel into the can at different times. The threaded lid prevents spillage of can contents during interim storage (DOE 1998). After packaging the fuel, the cans would be placed in standardized canisters of about 46 to 61 centimeters (18 to 24 inches) in diameter and up to 3 meters (118 inches) in length and would be codisposed with high-level radioactive waste in a repository. A diagram of the high-integrity can packaging is shown in **Figure C–3**.

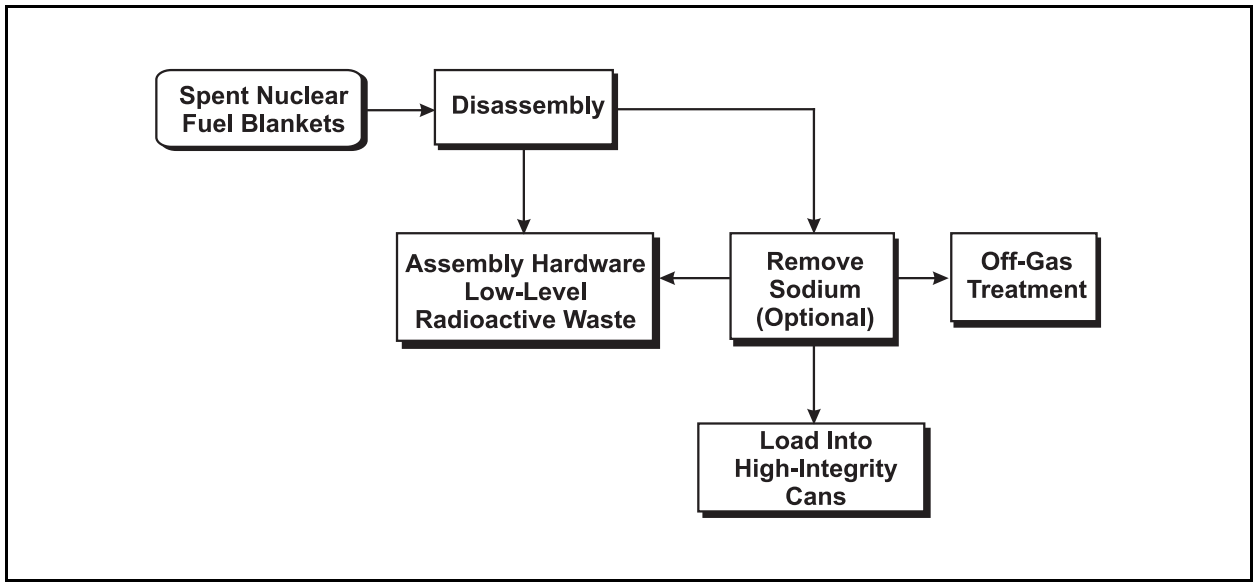


Figure C–3 High-Integrity Can Packaging Flow Diagram

Disassembly: Although the blanket assemblies have been mostly disassembled, there may be some assembly hardware that needs to be removed. The assembly hardware would be separated from the blanket fuel pins by cutting the assemblies and physically separating the fuel elements. The fuel elements would be placed into a container for transfer to an argon-atmosphere hot cell for the remaining process steps. The assembly hardware would be stored at the Radioactive Scrap and Waste Facility at ANL-W. This is a normal waste stream for ANL-W operations, and the separated hardware would be handled in accordance with normal site waste management practices.

Sodium Removal: If needed, the blanket spent nuclear fuel elements would be cleaned using the MEDEC process described in Section C.2.

Loading into High-Integrity Cans: The blanket spent nuclear fuel elements would be packaged in a standard-sized can fabricated from Hastelloy Alloy C-22, or possibly some other highly corrosion-resistant materials such as titanium Grade-12.

The high-integrity can would be placed in dry storage at an appropriate location. If transportation is required, the cans would be packaged into shipping casks. Prior to shipment to a geologic repository, the high-integrity

can containing spent nuclear fuel would be placed into a standardized canister, an overpack designed to provide additional containment within the waste package under repository conditions.

Direct Disposal of Sodium-Bonded Spent Nuclear Fuel: Direct disposal of sodium-bonded spent nuclear fuel is currently precluded by DOE policy concerning acceptance of Resource Conservation and Recovery Act-designated mixed waste (which contains both hazardous and radioactive waste). In the absence of such a policy, sodium-bonded spent nuclear fuel (driver and blanket) could be cleaned of surface sodium, packaged in high-integrity cans without removal of metallic sodium from the interior of the fuel elements, and directly disposed of in a geologic repository. The high-integrity cans would be placed into a standardized canister designed to promote containment under repository conditions.

Technology Maturity: Packaging materials in a high-integrity can is considered to be a mature technology. These cans would be made from highly corrosion-resistant materials and would be designed to provide exceptional protection from external environments.

C.5 MELT AND DILUTE PROCESS

The melt and dilute process is being considered for driver and blanket spent nuclear fuel elements. Three process options are being considered: (1) melting bare uranium blanket spent nuclear fuel pins with aluminum, (2) melting blanket spent nuclear fuel elements with cladding and additional stainless steel, and (3) using a modified melt and dilute process capable of handling the sodium in a volatilized form and processing chopped driver spent nuclear fuel elements that could not be completely cleaned of sodium. Processing activities would be conducted in the Hot Fuel Examination Facility at ANL-W or in Building 105-L at SRS. A diagram of the melt and dilute process flow for the first two options is shown in **Figure C–4**. A process flow diagram for the third option is shown in **Figure C–5**.

Disassembly of Blanket Spent Nuclear Fuel Elements at ANL-W: Although the blanket spent nuclear fuel assemblies mostly have been disassembled, there may be some assembly hardware that needs to be removed. The assembly hardware would be separated from the blanket spent nuclear fuel elements by cutting the assemblies and physically separating the fuel elements. The spent nuclear fuel elements would be placed into a container for transfer to an argon-atmosphere hot cell for the remaining process steps. The assembly hardware would be stored at the Radioactive Scrap and Waste Facility at ANL-W. This is a normal waste stream for ANL-W operations, and the separated hardware would be handled in accordance with normal site waste management practices.

Sodium Removal and Processing at ANL-W: Blanket spent nuclear fuel elements would be cleaned using the MEDEC process described in Section C.2.

Decladding and Packaging Blanket Spent Nuclear Fuel Pins for Shipment to SRS: In the first melt and dilute processing option, blanket spent nuclear fuel pins that would be sent to SRS would be mechanically pushed out of the stainless steel cladding after all the sodium has been removed. These blanket spent nuclear fuel pins would be packed into aluminum cans in the Hot Fuel Examination Facility. The cans, approximately 10 centimeters (4 inches) in diameter and 61 centimeters (24 inches) in length, would be backfilled with an inert gas and sealed. Each can would contain about 60 kilograms (130 pounds) of depleted uranium spent nuclear fuel pins. The cans would be packaged and placed in a NAC-LWT cask for shipment to SRS.

Receiving and Storage at SRS: The cleaned and declad blanket spent nuclear fuel cans from ANL-W would be received at the L-Reactor Disassembly Basin for storage until transfer to the processing facility in Building 105-L.

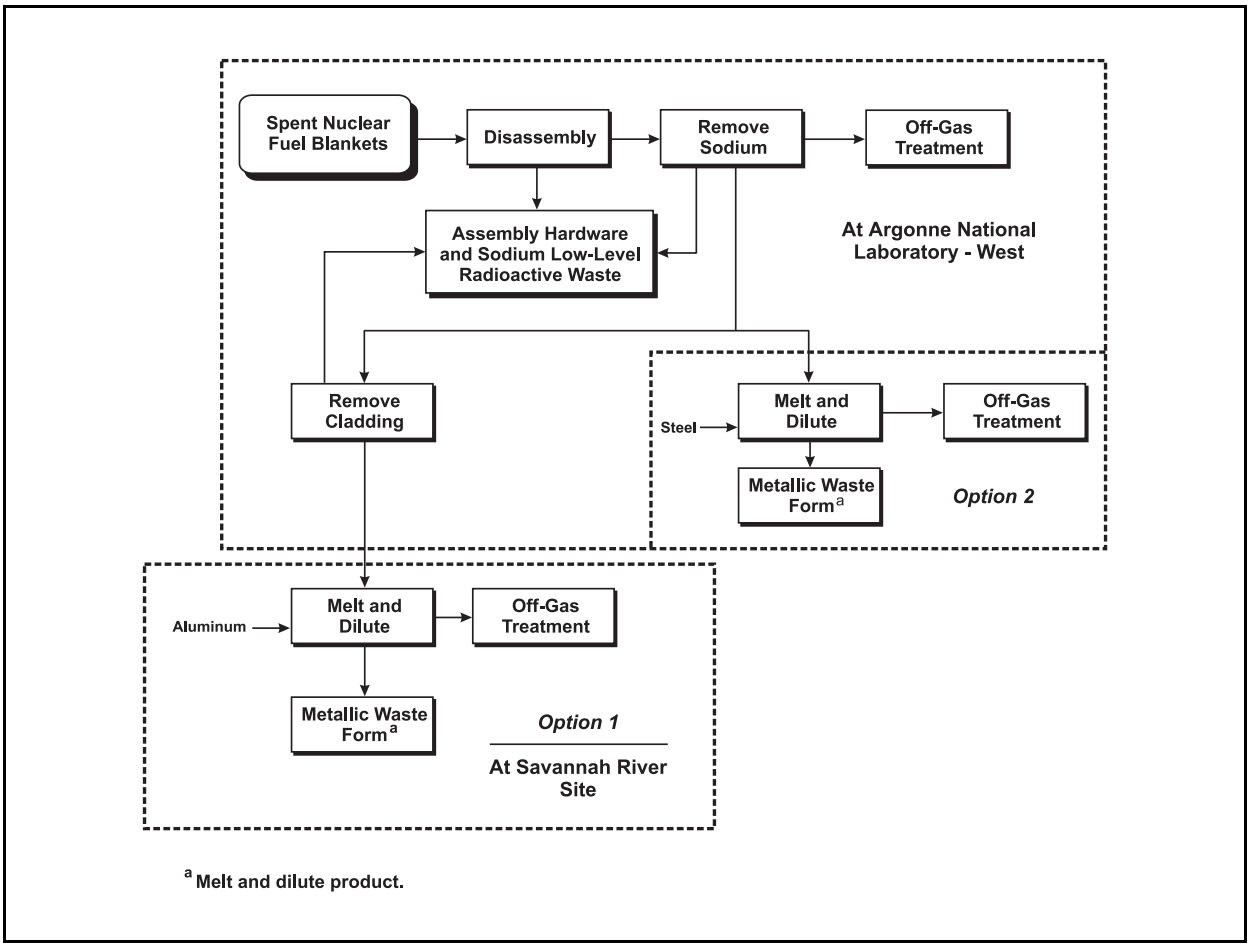


Figure C–4 Melt and Dilute Process Flow Diagram (Options 1 and 2)

Melt and Dilute Process for Blanket Fuel at SRS: Blanket spent nuclear fuel cans would be transferred to the treatment facility in Building 105-L for processing. The spent fuel cans would be loaded into an induction furnace where they would be heated to approximately 1,000 °C (1,830 °F). This temperature significantly exceeds the aluminum-uranium eutectic temperature required to initiate the melting, so it would proceed within a reasonable time. Sufficient aluminum would be added to make an aluminum-uranium alloy with a composition of about 70 percent aluminum and 30 percent uranium. The metal alloy would be cast into an ingot, sampled, and packaged into canisters. The canisters would be evacuated, filled with inert gas, sealed by welding, and transferred to storage pending disposition in a geologic repository. Volatile fission products would be captured by a series of filter banks before releasing the off-gas. The filters would be disposed of as low-level or high-level radioactive waste, as appropriate.

Melt and Dilute Process for Blanket Fuel at ANL-W: In the second melt and dilute processing option, blanket spent nuclear fuel elements recovered from the sodium removal process would be placed in an induction furnace crucible with additional radioactive waste steel. Sufficient steel would be added to make an alloy with a composition of about 50 percent each of uranium and steel. The furnace would be heated to approximately 1,400 ° C (2,550 ° F) to melt the uranium, after which the steel would be slowly dissolved into the uranium pool. The mixture would be electromagnetically stirred to a uniform composition. The metal alloy would be cast into an ingot, sampled, and packaged for interim storage at the Radioactive Scrap and Waste Facility. An off-gas system would capture the volatile and semi-volatile fission products for stabilization and processing into waste forms suitable for disposal. The filters would be disposed of as low-level or high-level radioactive waste, as appropriate.

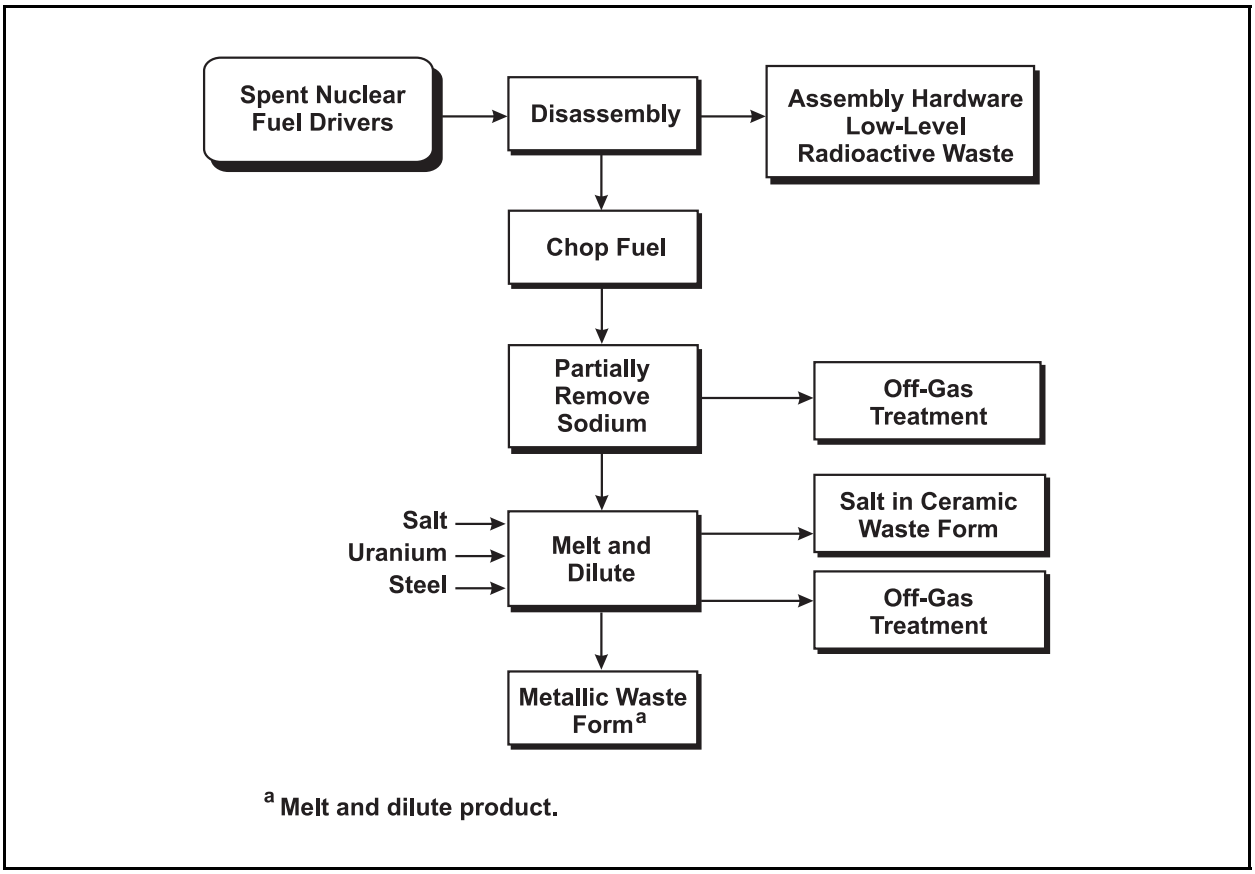


Figure C–5 Melt and Dilute Process Flow Diagram (Option 3)

Melt and Dilute Process for Driver Fuel at ANL-W: The third melt and dilute option would be for sodium-bonded driver spent nuclear fuel. Most of the metallic sodium in the driver spent nuclear fuel elements would be removed in a manner similar to the way sodium would be removed from the blanket spent nuclear fuel elements, i.e., the fuel would be cut into a few segments and heated to allow some sodium to drain away and then the fuel pieces would be heated under a vacuum to volatilize additional sodium. However, as explained below, not all the sodium could be removed by these processes. During the irradiation of the fuel in the reactor, after approximately a 1 to 3 percent burnup, the gap between the fuel pin and the cladding would be closed by the swelling of the fuel pin and interdiffusion between the cladding and the fuel pin. During the swelling process, the fuel pin would become porous and metallic sodium would enter the fuel. At discharge from the reactor, 15 to 20 percent of the fuel's pores would contain trapped sodium with dissolved fission products. The trapped sodium within the fuel pins and the areas of interdiffused fuel and cladding could not be removed.

Since not all the sodium could be removed from the driver spent nuclear fuel by the heating and vacuum process, a modified melt and dilute process would be needed. In this process, the driver fuel elements would be covered with a layer of low melting-temperature salt containing uranium chloride to oxidize the molten sodium. Depleted uranium would be added in a ratio of about 2.5 to 1 to reduce the enrichment to less than 20 percent uranium-235. Radioactive waste steel would be added in equal weight to the uranium to complete the mix. The furnace then would be heated to a temperature of about 1,400 °C (2,550 °F). The molten salt would capture sodium vapors escaping from the fuel elements as they melt, protecting the downstream components from the sodium. After volatilization of the sodium and reaction with the molten salt, a vacuum would be applied to the furnace to volatilize the salt, which would be condensed and partially reused. The

salt would be stabilized in the ceramic waste form described in Section C.1. The molten metal would be stirred to achieve a uniform composition, and then would be cast into an ingot, placed into a container, and stored. An off-gas system would capture the volatile and semi-volatile fission products for stabilization and processing into waste forms suitable for disposal. The filters would be disposed of as low-level or high-level radioactive waste, as appropriate.

Technical Maturity: The melt and dilute process was developed for treating aluminum-based spent nuclear fuel at SRS and is DOE's preferred technology for treating most (almost 97 percent by volume) of that type of spent nuclear fuel (DOE 2000). The melt and dilute process for stainless steel-clad spent nuclear fuel would require operating temperatures of approximately 1,400 °C (2,550 °F), compared with about 1,000 °C (1,830 °F) for aluminum-based spent nuclear fuel. Induction-heated melters that can achieve the higher temperatures required for stainless steel have been demonstrated at ANL-W. Technology development would be required to demonstrate capturing the quantities of sodium present in the driver spent nuclear fuel assemblies in a molten salt.

The melt and dilute process can be used for most of the driver spent nuclear fuel. However, there are small quantities (about 0.1 metric tons of heavy metal) of driver spent nuclear fuel that are composed of uranium oxide, uranium carbide or uranium/plutonium carbide, and uranium nitride, which have high melting points and cannot be treated using the melt dilute process.

C.6 Direct Plasma Arc-Vitreous Ceramic Treatment Process

The plasma arc treatment technology (DOE 2000) would use a plasma torch to melt and oxidize the spent nuclear fuel in conjunction with depleted uranium oxide and other ceramic-forming materials, as necessary. The fuel would be fed into the process with minimal sizing or pretreatment. The plasma arc would cut the fuel assemblies into small pieces and heat the fuel to temperatures at least as high as 1,600 °C (2,910 °F) to melt and oxidize it in a rotating furnace. Ceramic material would be added, as necessary, while the mixture was being homogenized by the torch. When melting and oxidation were complete, the rotating furnace would slow and the melt would fall into molds prepared to receive it. A diagram of the plasma arc treatment process flow is shown in **Figure C–6**.

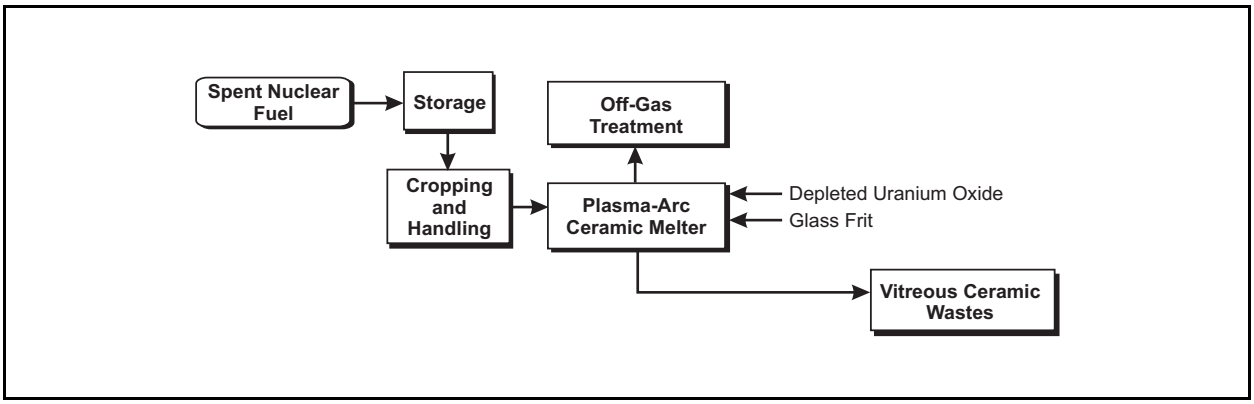


Figure C–6 Direct Plasma Arc-Vitreous Ceramic Treatment Process Flow Diagram

Metallic fuel such as EBR-II fuel would require the addition of some ceramic material. Depleted uranium could be added to the process in almost any form to reduce the uranium-235 enrichment. Criticality issues would be addressed by limiting the process to batch runs of preselected quantities of fissile material by the addition of the depleted uranium and by the addition of neutron poisons, if necessary.

As with all processes that dissolve or melt spent nuclear fuel, the plasma arc treatment would produce radioactive off-gases. These gases would be filtered and treated by appropriate means, with the filter and treatment media recycled into the plasma arc furnace for incorporation into the ceramic product.

Technology Maturity: The plasma arc process is a developmental technology that has not been demonstrated for stabilization of spent nuclear fuel.

C.7 GLASS MATERIAL OXIDATION AND DISSOLUTION SYSTEM

The Glass Material Oxidation and Dissolution System (GMODS) uses lead oxide to convert unprocessed spent nuclear fuel directly to borosilicate glass using a batch process. A diagram of the GMODS process flow is shown in **Figure C–7.**

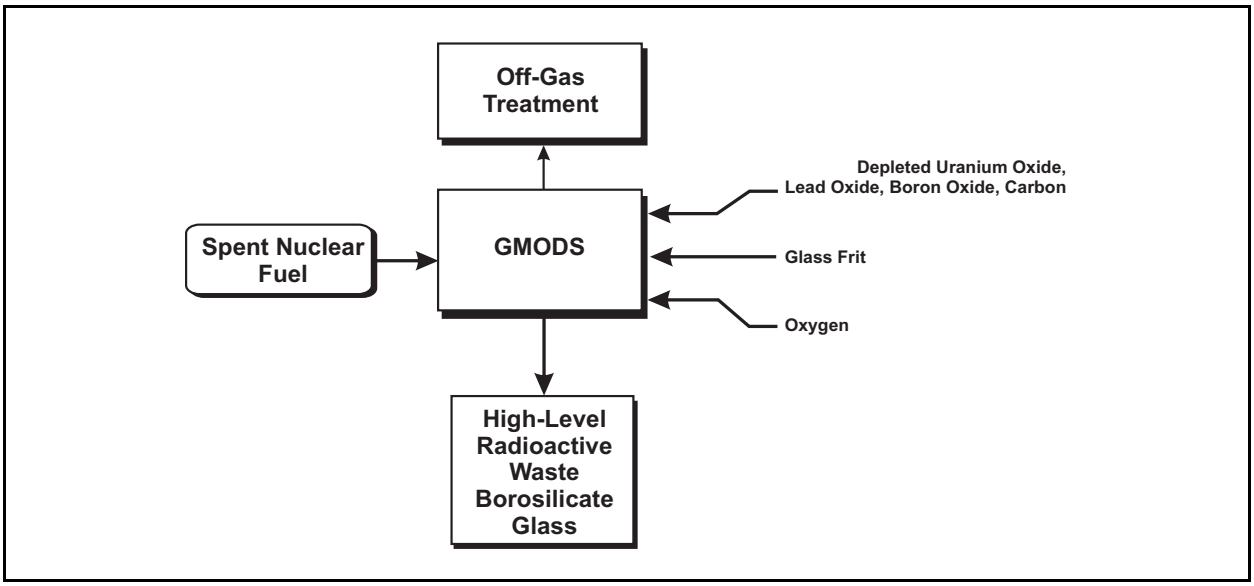


Figure C–7 GMODS Process Flow Diagram

Metal Oxidation: The principal piece of equipment for GMODS would be an induction-heated, cold-wall melter, which is used commercially to convert corrosive or high-melting metals to ultrapure materials. The melter, operating at 1,000 to 1,200 °C (1,830 to 2,200 °F), would be charged with a molten glass consisting of lead oxide and boron oxide. Oxides and amorphous components of the spent nuclear fuel would directly dissolve into the glass. Metals, which normally do not dissolve in glass, would be converted to oxides by the lead oxide. Boron oxide, a neutron poison, is a common agent for dissolving oxides into glass. Criticality concerns would be addressed by diluting the uranium-235 enrichment with depleted uranium and using boron oxide as a dissolving agent (DOE 2000).

On feeding the spent nuclear fuel into the melter, the uranium, plutonium, and other metals would be oxidized and dissolved in the molten glass. The oxidation of the metals would convert the lead oxide to metallic lead, which would sink to the bottom of the melter. Radioactive off-gases produced during this process would be filtered. The filters would be managed as high-level radioactive, low-level radioactive, or mixed waste, as appropriate.

Conversion of Lead to Lead Oxide: After decanting the glass, the melter would be recharged with boron oxide and, if necessary, lead oxide. Oxygen would be piped into the system to convert the metallic lead at

the bottom of the melter back to lead oxide. Therefore, lead would be an oxygen carrier that would not leave the system.

Glass Waste Form: The resulting glass mixture would not have qualities necessary for long-term durability, so silicon oxide (glass frit) would need to be added to increase the durability of the high-level radioactive waste borosilicate glass. The silicon oxide would not be part of the initial melter charge because its properties are not conducive to rapid oxidation-dissolution of spent nuclear fuel. Unreduced lead oxide could limit the durability of the glass and increase volume, so carbon would be added to the melt to reduce the excess lead oxide (DOE 2000).

Technology Maturity: The GMODS process was developed by DOE for stabilization of radioactive waste. At this time, it has only been tested in small-scale laboratory experiments.

C.8 CHLORIDE VOLATILITY PROCESS

Chloride volatility is an advanced treatment technology that was investigated at the Idaho National Engineering and Environmental Laboratory (NAS 1998). The process (1) uses the differences in the volatilities of chloride compounds to segregate major nonradiological constituents from spent nuclear fuel for the purpose of volume reduction, and (2) isolates the fissile material to produce a glass or ceramic waste form. A diagram of the chloride volatility process flow is shown in **Figure C–8**.

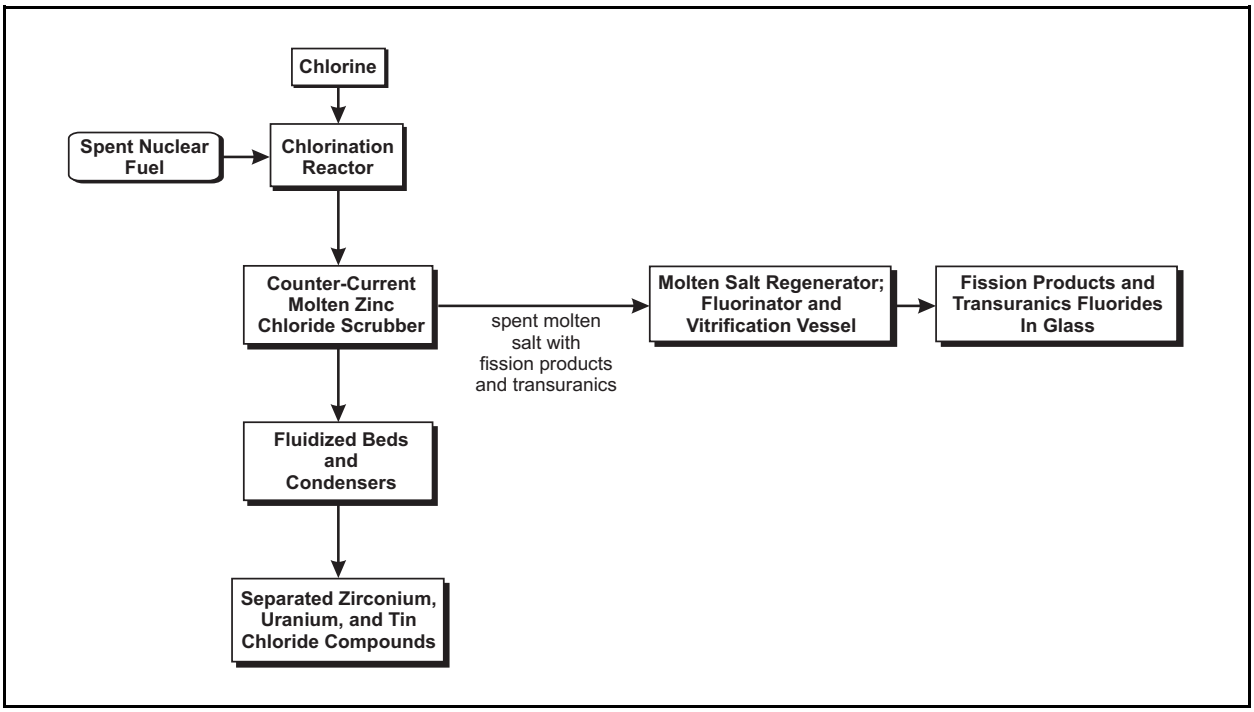


Figure C–8 Chloride Volatility Process Flow Diagram

The chloride volatility process would consist of four operations:

(1) A high-temperature chlorination step that would operate at approximately 1,500 °C (2,730 °F) and would convert fuel and cladding materials to gaseous chloride compounds

(2) A molten zinc chloride bed that would remove the transuranic chlorides and most of the fission products and would operate at approximately 400 °C (750 °F)

(3) A series of fluidized beds and condensers that would operate at successively lower temperatures to condense zirconium tetrachloride, uranium hexachloride, and stannous tetrachloride

(4) A zinc chloride regeneration/recycle process

The transuranic and fission product chlorides would be converted to either fluorides or oxides for final disposal. Argon carrier gas and unreacted chlorine gas would be recycled, the chlorine content adjusted, and the stream split and passed through the unit operations in a continuous closed loop. Periodic shutdowns of the coupled unit operations would occur for batch removal of fission product xenon and krypton gases from the carrier gas (such as by cryogenic distillation), batch transfer of the molten salt to the molten salt regenerator, and batch removal of nonradioactive constituents and uranium from the condensers.

The small quantity of fission-product/transuranic-product high-level radioactive waste would be converted into a waste form for repository disposal. The conversion steps to a glass or glass-ceramic form could involve fluorination and melting with glass frit additives, or conversion to oxides by heating at about 1,000 °C (1,830 °F) with boric acid.

In the chlorination step, the rate of reaction would be controlled by the feed rate of chlorine, and the temperature would be controlled by appropriate blending of argon gas with chlorine. An oxygen scavenger, such as carbon monoxide, would be added as needed to prevent formation of oxychlorides when oxides are present. A carbon dioxide absorption bed in the off-gas system would collect the carbon dioxide that would be formed. Zinc chloride would be used for the scrubber medium because its low melting point and favorable vapor pressure would permit its use to scrub the chlorinator off-gas at a low temperature, while its volatility at 725 °C (1,337 °F) would allow evaporative separation from the radioactive waste chlorides for subsequent recycle.

Theoretical chloride volatilities have been used to postulate the equipment sizing and operating parameters. Because of the lack of any experimental basis, significant concerns exist about the distribution of chloride compounds for multivalent elements such as uranium and plutonium. These concerns, in turn, lead to potential uncertainties in separation capabilities and overall flowsheet performance. The use of halides, either fluorides or chlorides, for the transuranic and fission product elements raises questions about the use of a glass or vitrified waste form. A proposal to use boric acid at about 1,000 °C (1,830 °F) allays some of those concerns (LITCO 1996).

Technology Maturity: The chloride volatility process has not progressed beyond the conceptual design stage. No laboratory experiments have been conducted.

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APPENDIX D
SODIUM-BONDED FUEL CHARACTERISTICS

D.1 BACKGROUND

D.1.1 General Characteristics

The sodium-bonded spent nuclear fuel addressed in this environmental impact statement (EIS) is primarily from the operation of the Experimental Breeder Reactor-II (EBR-II) and Fermi-1 breeder reactors (a small percentage of the spent nuclear fuel is derived from other sources). Breeder reactors use two types of fuel: driver fuel, which is placed in the center of the reactor core, and blanket fuel, which is placed at the perimeter of the core. Driver fuel consists of highly enriched uranium alloy (alloy of uranium in zirconium or fissium[1]) fuel. (Natural uranium consists of mostly uranium-238, containing approximately 0.7 weight percent uranium-235; low-enriched uranium contains less than 20 weight percent uranium-235; highly enriched uranium contains greater than or equal to 20 weight percent uranium-235.) As a fissile material, uranium-235 is capable of undergoing fission (splitting into two major fragments called fission products) releasing energy and additional neutrons when struck by a neutron. This enriched uranium core produces the majority of the neutrons that power (drive) the reactor and breeding in the blanket, hence the name driver fuel. In the blanket region, uranium-238 from either natural uranium or depleted uranium, which has less than 0.3 weight percent uranium-235, capture neutrons to produce fissile materials, such as plutonium-239. In this manner, breeder reactors can produce (or breed) more fissile material than they consume.

The uranium in nuclear fuel is clad with a metal to protect it from chemical reactions with the coolant and to prevent the release of fission products to the coolant. Zirconium, stainless steel, and aluminum are common cladding materials. Most of the spent nuclear fuel analyzed in this EIS is clad with stainless steel.

Inside the cladding, the fuel is often in the form of a ceramic, an alloy that combines uranium with other metals such as zirconium, metallic uranium, or an oxide, carbide, nitride, or other form. The fuel can be fabricated as parallel plates, concentric tubes, bundles of rods or pins, or other designs. Each individual fuel item is referred to as a fuel element. Multiple fuel elements are typically combined into an assembly. Each assembly has mounting and lifting hardware, structures to direct coolant, and in some cases the capability to install neutron absorbing material and instrumentation. Most of the fuel elements addressed by this EIS are uranium alloy rods or pins. In order to improve the transfer of heat from the uranium matrix where the heat is generated to the cladding, the gap between the fuel and the cladding has been filled with a small amount of metallic sodium.

Usually a number of fuel assemblies make up a reactor core. Blanket assemblies placed around the reactor driver core for breeding or shielding are similar in design to driver fuel. An axial blanket may be placed above and below the reactor core and a radial blanket may be placed at the perimeter of the reactor core.

D.1.2 Recent Spent Nuclear Fuel Management Actions

In 1992, the Department of Energy (DOE) decided to phase out defense-related spent nuclear fuel reprocessing. Subsequently, the Department began to establish programs to manage DOE spent nuclear fuel

[1] *Fissium is a mixture of noble metals (molybdenum, ruthenium, rhodium, palladium, zirconium, and niobium).*

that were no longer based on the production of strategic nuclear material. DOE identified the initial components of this plan in the *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Environmental Impact Statement* (DOE 1995) (hereafter referred to as the Programmatic Spent Nuclear Fuel EIS). The Record of Decision for this EIS (60 FR 28680) stated, in part, that DOE would consolidate the management of its aluminum-clad spent nuclear fuel at the Savannah River Site (SRS), leave the Hanford production spent nuclear fuel at Hanford, and would consolidate nonaluminum-clad fuel at the Idaho National Engineering and Environmental Laboratory (INEEL). This Record of Decision was amended in March 1996 (61 FR 9441). The amended Record of Decision leaves all Fort St. Vrain spent nuclear fuel at the storage site in Colorado, all but sodium-bonded spent nuclear fuel at Hanford, and places restrictions on shipment schedules.

However, in the Programmatic Spent Nuclear Fuel EIS Record of Decision, DOE made no decisions on the technologies it would apply to the management of spent nuclear fuel at the designated storage sites. The Record of Decision stated that the selection of spent nuclear fuel stabilization technologies and the preparation of spent nuclear fuel for ultimate disposition would be the subject of site-specific and fuel-type-specific evaluations prepared in accordance with the National Environmental Policy Act (NEPA) and tiered from the Programmatic Spent Nuclear Fuel EIS (DOE 1995).

D.2 INVENTORY OVERVIEW

This EIS addresses a variety of spent nuclear fuel types that have one common characteristic, the presence of metallic sodium (or sodium and potassium). As a result of research, development, and demonstration activities associated with liquid metal fast breeder reactors, DOE has approximately 60 metric tons of heavy metal of spent nuclear fuel that contains metallic sodium. This EIS addresses a range of technologies that may be used to treat and manage this spent nuclear fuel for disposal. Based on composition, there are five broad categories of spent nuclear fuel to be considered: EBR-II driver spent nuclear fuel, EBR-II blanket, Fermi-1 blanket, Fast Flux Test Facility fuel, and miscellaneous spent nuclear fuel. While there are variations within each category, they may generally be described as follows:

EBR-II driver – This spent nuclear fuel is stainless steel clad highly enriched uranium in a uranium alloy, typically either fissium or zirconium. There are some variations in the specific cladding alloys, the enrichments, fuel compound alloy, dimensions, and burnup within this category. Also, there are small amounts of fuel experiments that use a different uranium compound, for example uranium carbide. This uranium carbide fuel type was added to the miscellaneous group.

EBR-II blanket – This spent nuclear fuel consists of stainless steel clad depleted uranium in a uranium metal form. There are various blanket designs: upper and lower axial, and inner and outer radial blankets. The primary difference between these blankets is dimension and burnup.

Fermi-1 blanket – This spent nuclear fuel consists of stainless steel clad depleted uranium in a uranium-molybdenum alloy. There are various blanket designs: upper and lower axial, and inner and outer radial blankets. The primary difference between these blankets is dimension, elements per assembly, and burnup. Fermi-1 blankets are similar to EBR-II blankets in enrichment, but differ in dimension (Fermi-1 elements are larger), burnup, and form (uranium metal versus uranium-molybdenum alloy).

Fast Flux Test Facility – This group of fuel includes both irradiated and fresh driver fuel. The fuel is either uranium zirconium or plutonium/uranium zirconium, with some containing plutonium/uranium carbide and nitride. This fuel is stainless steel-clad with various levels of enrichment.

Miscellaneous – This group includes experimental spent nuclear fuel from experiments irradiated in the Engineering Test Reactor and the Annular Core Research Reactor at Sandia National Laboratories/New Mexico, Oak Ridge National Laboratory fast reactor spent nuclear fuel, sodium research experiment spent nuclear fuel at SRS, and Westinghouse Atomic Power Division test reactor experiment at INEEL. There are small quantities of experimental fuel that have metallic sodium or potassium. This type of fuel is highly diverse and differs in cladding, uranium compound, enrichment, and burnup.

Table D–1 provides a summary of all DOE sodium-bonded spent nuclear fuel. It should be noted that the inventories reported in Table D–1 include 0.4 metric tons of heavy metal of EBR-II driver fuel and the 1.2 metric tons of EBR-II blanket fuel that are being treated as part of the electrometallurgical treatment demonstration program.

Table D–1 Overview of Sodium-Bonded Spent Nuclear Fuel Categories

Fuel Type	*Storage Volume (cubic meters)* [a]	*Total End of Life Fissile Mass (kilograms)*	*End of Life Mass Metric Tons of Heavy Metal*
EBR-II Driver	58 [b]	2,030	3.1
EBR-II Blanket	13	285	22.4
Fermi-1 Blanket	19	130	34.2
Fast Flux Test Facility	8 [b]	175	0.3
Miscellaneous	3 [b]	60	0.1
Total	**101**	**2,680**	**60**

[a] Volume refers to canister storage volume.
[b] A larger volume per unit mass for the driver fuel is required for the criticality control.
Source: ANL 1999.

By any measure, the majority of the spent nuclear fuel consists of EBR-II driver, EBR-II blanket, and Fermi-1 blanket fuel. **Table D–2** provides a summary of the fraction of spent nuclear fuel in each category by a variety of different measures. As shown, the percentages vary considerably depending upon the measure used for comparison.

Table D–2 Comparison of Sodium-Bonded Spent Nuclear Fuel by Different Measures

Fuel Type	*Storage Volume (percent)*	*Total End of Life Fissile Mass (percent)*	*End of Life Mass Metric Tons of Heavy Metal (percent)*
EBR-II Driver	58	75	5
EBR-II Blanket	13	11	37
Fermi-1 Blanket	19	5	57
Fast Flux Test Facility	8	7	0.5
Miscellaneous	3	2	less than 0.1
Total [a]	**100**	**100**	**100**

[a] Values may not add to exactly 100 percent due to rounding.

The radionuclide inventory of the spent nuclear fuel varies widely due to differences in the construction, function and operational history of the spent nuclear fuel. Therefore, radionuclide inventory estimates were developed for EBR-II driver fuel (including a separate estimate for the experimental driver fuel), EBR-II blanket, Fermi blanket, and Fast Flux Test Facility experimental fuel (SAIC 1999). **Table D–3** provides a summary of plutonium and sodium content for each fuel type.

Table D–3 Plutonium and Sodium Content in Sodium-Bonded Fuel

Spent Nuclear Fuel Type	*Plutonium Mass (kilograms)*	*Sodium Mass (kilograms)*
EBR-II Driver	19	83
EBR-II Blanket	250	176
Fermi-1 Blanket	7	365
Fast Flux Test Facility	3	7
Miscellaneous	0.10	31
Total	**279.10**	**662**

Table D–4 provides a list of principal radionuclide isotopes for each of the fuel types.

For each fuel type, principal radionuclide inventories were determined by considering all isotopes that, as a whole, contribute greater than 99.99 percent of the total dose in a case of accidental release. The dose estimates associated with each isotope intake were based on the effective committed dose equivalent factors provided in Federal Regulatory Guidance Report No. 11 (EPA 1988). Next, the list of isotopes was adjusted to include those isotopes with a boiling point less than 1,400° C (2,550° F), which is the maximum melt and dilute process temperature, and then isotopes of interest like hydrogen-3 (tritium), krypton-85, iodine-129, and uranium isotopes were added. The values in Table D–4 reflect the inventory of each isotope as of January 2000 (Liaw 1998).

The following sections provide a more detailed description of each category of spent nuclear fuel.

D.3 EBR-II Spent Nuclear Fuel

D.3.1 Reactor Background

EBR-II was a research and test reactor at Argonne National Laboratory-West (ANL-W) used to demonstrate the engineering feasibility of a sodium-cooled, liquid metal fast breeder reactor with a steam electric power plant and integral fuel cycle. It achieved initial criticality in September 1961 and continued to operate until September 1994. During its operation, numerous fuel designs were tested in EBR-II. The reactor operating power level was 62.5 megawatts-thermal.

D.3.2 Description of EBR-II Spent Nuclear Fuel

The EBR-II reactor consisted of an enriched driver core surround by depleted blanket assemblies. The reactor originally had an upper and lower axial blanket above and below the driver core, as well as a radial blanket around the perimeter of the driver core. It later operated with a radial blanket only. In addition, various experimental assemblies where placed into the core for testing. The following sections describe the driver fuel (including experiments) and blanket assemblies.

Table D–4 Principal Radionuclide Activities per Kilogram of Heavy Metal [a]

Elements	*Isotope*	*EBR-II Driver* [b]	*EBR-II Radial Blanket* [c]	*EBR-II Exp. Driver Fuel*	*Fermi-1 Blanket*	*FFTF Driver*
Tritium	H-3	1.23	0.00712	1.16	0.0000756	1.90
Carbon	C-14	0.000199	0.0000597	0.000954	1.05×10^{-8}	0.000674
Iron	Fe-55	4.87	0.0901	5.11	0.0000269	9.89
Cobalt	Co-60	0.481	0.0159	2.09	0.0000888	0.586
Nickel	Ni-63	0.229	0.00306	0.152	0.0000482	0.0491
Krypton	Kr-85	18.9	0.0520	16.5	0.000663	23.9
Strontium	Sr-90	197	0.807	171	0.0163	241
Yttrium	Y-90	197	0.807	171	0.0163	241
Ruthenium	Ru-106	1.51	0.135	2.67	7.02×10^{-10}	3.95
Rhodium	Rh-106	1.51	0.135	2.67	7.02×10^{-10}	3.95
Cadmium	Cd-113M	0.0464	0.000712	0.0511	2.86×10^{-6}	0.0659
Antimony	Sb-125	2.96	0.0231	2.98	2.92×10^{-6}	4.72
Tellurium	Te-125M	1.23	0.00951	1.23	1.20×10^{-6}	1.89
Iodine	I-129	0.0000735	1.44×10^{-6}	0.0000685	1.26×10^{-8}	0.0000898
Cesium	Cs-134	1.76	0.0134	1.93	6.66×10^{-9}	4.19
	Cs-137	221	1.73	199	0.0243	272
Barium	Ba-137M	209	1.64	188	0.0230	257
Cerium	Ce-144	2.96	0.0627	5.55	6.60×10^{-12}	9.88
Praseodymium	Pr-144	2.96	0.0627	5.55	6.60×10^{-12}	9.88
Promethium	Pm-147	82.6	0.407	80.2	0.0000810	128
Samarium	Sm-151	5.34	0.100	5.00	0.00131	6.49
Europium	Eu-154	0.567	0.00734	0.628	7.70×10^{-7}	0.969
	Eu-155	3.81	0.0481	3.97	0.0000671	5.28
Thorium	Th-228	0.0000514	1.55×10^{-7}	0.0000561	1.32×10^{-10}	0.0000739
Uranium	U-234	0.0404	1.33×10^{-6}	0.0371	3.20×10^{-8}	0.0407
	U-235	0.00131	3.77×10^{-6}	0.00120	7.48×10^{-6}	0.00123
	U-236	0.00121	4.24×10^{-6}	0.00104	1.09×10^{-7}	0.00141
	U-238	0.000111	0.000327	0.000120	0.000331	0.000117
Neptunium	Np-237	0.000289	8.37×10^{-6}	0.000287	2.28×10^{-7}	0.000401
Plutonium	Pu-238	0.166	0.00939	0.233	3.34×10^{-6}	0.304
	Pu-239	0.269	0.753	1.61	0.0134	0.739
	Pu-240	0.00911	0.0518	0.754	0.0000112	0.123
	Pu-241	0.00222	0.210	14.4	3.54×10^{-7}	1.60
Americium	Am-241	0.000391	0.0163	0.359	3.46×10^{-8}	0.0516
Americium	Am-242M	3.313×10^{-7}	0.000169	0.00218	7.84×10^{-14}	0.000140
Total	**Ci/kg** [d]	**957**	**7.18**	**884.1**	**0.0959**	**1,240**
Total heavy metal mass	metric tons	3.1	22.4	0.2 [e]	34.2	0.25

[a] Activities are in curies per kilogram of heavy metal, as of January 1, 2000.
[b] Inventory of Mark III driver fuel is bounding fuel for all EBR-II driver fuel type.
[c] Representative for all EBR-II blanket fuel.
[d] Curie per kilogram of heavy metal.
[e] EBR-II experimental driver fuel mass is a subset of EBR-II driver fuel.

D.3.2.1 Driver Fuel

Standard Driver Fuel

The driver fuel contains highly enriched uranium (enrichment of up to 78 weight percent). When the fuel is "spent," the enrichment (ratio of uranium-235 to total uranium) ranges between 55 percent and 76 percent.

Each driver fuel element has a metal rod (also called a fuel pin) about 36 centimeters (14 inches) long and less than 0.5 centimeters (0.2 inches) in diameter. A typical EBR-II driver fuel pin is a metal alloy of 90 percent uranium and 10 percent zirconium. This fuel pin and a small amount of metallic sodium were loaded into a 73.7-centimeter (29-inch) long stainless-steel tube (cladding) and welded shut, as shown in **Figure D–1**. This unit of fuel is called an "element." Sixty-one (in some 91) fuel elements were put together in a stainless-steel hexagonal "can" to make a fuel assembly approximately 2.3 meters (92 inches) long and 5.8 centimeters (2.3 inches) across. A typical fresh (unirradiated) driver fuel assembly contains 4.5 kilograms (9.9 pounds) of uranium and a typical irradiated fuel assembly contains 4.1 kilograms (9.0 pounds).

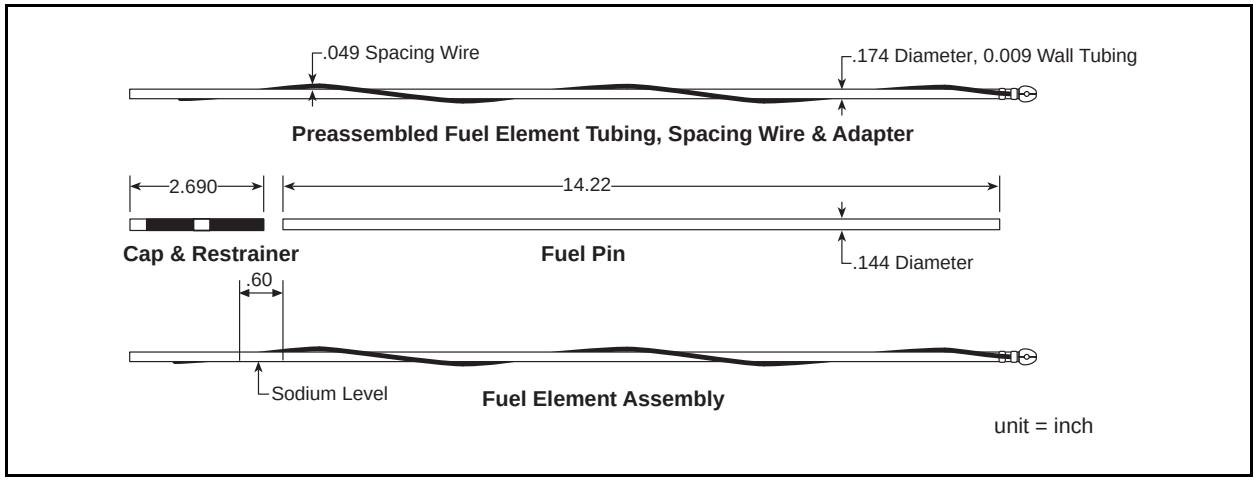


Figure D–1 Typical EBR-II Driver Element

The sodium inside driver and blanket elements improves the heat transfer from the fuel to the reactor coolant through stainless steel cladding. When the driver fuel is irradiated in the reactor for some period of time, the metallic pin swells until it reaches the cladding wall. Pores form throughout the fuel pin as it swells under pressure from the gaseous fission products. As these pores expand and connect to one another, the fission gases escape to a plenum in the fuel element just above the metallic fuel pin. As the gas escapes, the liquid sodium flows into these tiny pores, much like a sponge. As more pores form and grow, others are closed off from the fuel pin surface, including those containing sodium. Between 20 and 40 percent of the available sodium flows into the fuel pores and is inseparable from the uranium except by dissolving or melting the fuel. Further, during reactor operations, cesium-137 (an abundant radioactive fission product) dissolves in the sodium. Cesium, a reactive metal with chemical properties similar to sodium, remains with the sodium until the spent nuclear fuel is treated.

There have been numerous different fuel assemblies used in the EBR-II reactor, including a variety of experimental fuel. The types of standard spent nuclear fuel include Mark-I/IA, Mark-II/IIA, Mark-IIC/IICS, and Mark-III/IIIA. These different fuel types are quite similar, but differ in terms of dimensions, enrichment, fuel alloy, and cladding material. **Table D–5** shows the range of properties for EBR-II fuel, experimental fuel, and blanket elements.

Argonne National Laboratory has performed radionuclide projections individually for all of its spent nuclear fuel elements with the ORIGEN-RA depletion code and created a database containing inventory projections for all sodium-bonded spent nuclear fuel at ANL-W (Liaw 1998). The radionuclide inventory for a typical standard driver and experimental driver fuel element is presented in Table D–4. The driver fuel inventory is based on an average of the Mark-III elements, which are expected to have the highest inventory of the driver fuel. The EBR-II experimental driver inventory is based on the average of the experimental fuel elements that have not been processed. There may be individual elements with inventories that exceed this basis, but these inventories are well above the average for all driver assemblies.

Table D–5 Description of Unirradiated Typical EBR-II Driver and Blanket Fuel Elements

Property	*Standard Driver Fuel*	*Experimental Driver Fuel*	*Axial Blanket*	*Radial Blanket*
Element Description:				
Cladding material	SS-304L, SS-D-9, SS-316, SS-HT-9	SS-316, SS-HT-9, and SS-D-9	SS-304	SS-304
Clad outside diameter (inches)	0.179 – 0.23	0.17 - 0.29	0.38	0.49
Clad thickness (inches)	0.009 – 0.015	0.012 - 0.022	0.022	0.018
Element length (inches)	18 – 30	24 - 30	22	62
Fuel elements (or rods) per assembly	61 – 91	61	19	19
General Composition:				
Uranium alloy composition	U–5F [a] U–10Zr [b]	U–10Pu–10Zr [c] Pu/U-Carbide	Uranium metal	Uranium metal
Uranium-235 enrichment (percent)	67-78	Up to 93	0.2	0.2
Burnup (atom percent)	Up to 10	Up to 18	0.014	0.2
Sodium (g/element)	1.0 – 2.0	1.0 – 2.0	~ 3	~ 20

SS = Stainless steel.

[a] An alloy of 95 weight percent uranium and 5 weight percent fissium. Fissium consists of molybdenum, ruthenium, rhodium, palladium, zirconium, and niobium.

[b] An alloy of 90 weight percent uranium and 10 weight percent zirconium.

[c] An alloy of 80 weight percent uranium, 10 weight percent plutonium, and 10 weight percent zirconium.

Experimental Fuel

EBR-II has irradiated various types of different experimental driver fuel in support of its own and other liquid metal fast breeder reactor fuel development programs. Over 3,000 of these fuel elements still exist. Some of these experiments investigated the use of different fuel compositions including uranium-plutonium-zirconium alloy, plutonium-carbide, uranium-carbide and uranium-oxide. Table D–5 provides the range of data applicable for experiments. While the quantity of experimental spent nuclear fuel is relatively small, it is significant because of the associated potential unique requirements. Before this fuel can be treated, the carbide and oxide forms of the fuel may have to be reprocessed and converted to metallic forms.

D.3.2.2 Axial and Radial Blanket

The blanket assemblies were made from depleted uranium, a type of uranium in which most of the fissile uranium-235 has been removed, leaving 99.7 percent uranium-238. This type of uranium will fission, but not readily, and cannot be used alone to power a nuclear reactor. Early in EBR-II's history, the blanket assemblies surrounded or "blanketed" the reactor core to demonstrate the breeding of plutonium-239, another fissile material. However, in 1967 the breeding experiment was completed and the job of reconfiguring the reactor for its role as an irradiation test facility began. By 1972, the final blanket assemblies had been moved

well away from the core and replaced by a thick ring of stainless-steel reflector assemblies. In this configuration, the blanket assemblies provided shielding to protect structural materials from radiation emanating from the core.

Blanket assemblies are similar to the driver assemblies except that the individual blanket pins are larger. The blanket pins, made entirely from depleted uranium, are 1.1 centimeters (0.4 inches) in diameter, with three to five pins placed end-to-end to make a sodium-bonded blanket element 140 centimeters (55 inches) long. Since the blanket pins are a larger diameter and longer length, 19 blanket elements comprise a blanket assembly containing approximately 47 kilograms (103 pounds) of uranium. On average, about 99 percent of the uranium remains in the spent blanket assemblies with the remaining 1 percent having been converted to fission products and transuranic elements. The principal isotopes contributing to the activity of the axial and radial blanket assemblies are given in Table D–4.

Some of the EBR-II blanket assemblies have been in the reactor since it began operation more than 30 years ago. With the shutdown of EBR-II, these assemblies were unloaded from the reactor. In preparation for interim storage in the Radioactive Scrap and Waste Facility, they were cleaned to remove the few grams of sodium coolant that had adhered to the external surface as they were pulled out of the reactor.

D.3.2.3 Storage

Most of the fuel from the last seven years of EBR-II operation is presently stored in three different facilities at ANL-W: the Fuel Conditioning Facility, Hot Fuel Examination Facility, and Radioactive Scrap and Waste Facility. Previously, the spent nuclear fuel was shipped to the Idaho Nuclear Technology and Engineering Center (INTEC) (formerly Idaho Chemical Processing Plant) for reprocessing. However, INTEC ceased accepting the fuel in 1991 when a new uranium-zirconium alloy fuel, which could not be dissolved with INTEC's existing Chemical Processing Plant, went into full use at EBR-II. More than 6 metric tons (6.6 tons) of EBR-II fuel were processed at INTEC. When DOE stopped processing at INTEC in 1992, elements from some 500 EBR-II spent driver fuel assemblies of earlier design were left in storage pools located at INTEC. The spent nuclear fuel generated after shipments to INTEC ceased was stored at ANL-W in several facilities (Fuel Conditioning Facility, Hot Fuel Examination Facility, and Radioactive Scrap and Waste Facility).

D.4 FERMI-1 BLANKET

D.4.1 Reactor Background

The Enrico Fermi Atomic Power Plant[2] was designed and built at Monroe Beach, Michigan (30 miles southwest of Detroit) to demonstrate the feasibility of the fast breeder reactor for electric power production. Fermi-1 was a sodium cooled, fast reactor. Information was provided by Argonne National Laboratory, based upon EBR-I and EBR-II, to assist in the design of the Fermi-1 reactor. The reactor achieved initial criticality in 1963 and operated until September 1972. Fermi-1 was licensed for operation at a power level of 200 megawatts-thermal.

On October 5, 1966, Fermi-1 experienced a coolant blockage caused by a detached piece of zirconium liner. As a result, melting occurred in two subassemblies and the reactor was shutdown for three years and nine months. On July 18, 1970, the second Fermi-1 reactor core achieved criticality. New fuel and some of the

[2]*The original name of the plant was the Enrico Fermi Atomic Power Plant. The numeral "1" was added to the name in 1969 after Detroit Edison Company began construction of Fermi-2. The plant is also known as Fermi, Fermi-1 or Enrico Fermi-1 (EF-1).*

original fuel was used for the second core. Termination of reactor operations in 1972 was not due to mechanical or technical problems, but rather due to lack of adequate financial support.

D.4.2 Blanket Description

The reactor had two different blanket designs: axial blanket assemblies above and below the core, and radial blanket assemblies surrounding the core. The core assemblies (25.69 percent enriched fuel) were not bonded with sodium and are not part of the scope of this EIS. All blanket assemblies contain depleted uranium and contain a sodium bond between the uranium and the cladding. **Figure D–2** shows the radial blanket assembly. The inner and outer radial blanket assemblies had the same design and only differed in their placement in the reactor. The axial assemblies are similar, except they are shorter and have fewer, larger diameter pins. **Table D–6** provides data on both the axial and radial assemblies.

Table D–6 Description of Fermi-1 Blanket Elements and Assemblies

Property	*Axial Blanket*	*Radial Blanket*
Element Description:		
Cladding material	Stainless steel 304	Stainless steel 304
Clad outside diameter (inches)	0.443	0.443
Clad thickness (inches)	0.010	0.010
Uranium length (inches)	14	65
Fuel elements (pins or rods) per assembly	16 in upper blanket 16 in lower blanket	25
Assembly Description:		
Cross-section shape	Square	Square
Outside dimension (inches)	2.646	2.646
Wall thickness (inches)	0.096	0.096
Number of assemblies	403 [a]	559
General Composition:		
Uranium alloy composition	U–2.75 Mo [b]	U–2.75 Mo [b]
Uranium-235 enrichment (percent)	0.35	0.35
Sodium (grams/element)	5.5	20.7

[a] Includes both upper and lower axial blankets.
[b] An alloy of 97.25 percent depleted uranium and 2.75 percent molybdenum.

D.4.3 Storage

After the Fermi-1 reactor was permanently shutdown, the blanket assemblies were placed into 14 canisters and transported to INTEC in 1974 and 1975 in 14 shipments. The 14 canisters are made of stainless steel with a carbon steel basket inside. The canisters are 3.4 meters (11 feet, 2.5 inches) long and 65 centimeters (25.5 inches) in diameter. The canisters were filled with helium and seal welded. Twelve of the canisters contain the radial blanket assemblies and two of the canisters contain the shorter axial blanket assemblies.

D.5 Fast Flux Test Facility and Other Miscellaneous Fuel

As shown in Table D–2, the majority of the spent nuclear fuel addressed by this EIS is EBR-II driver, EBR-II blanket, or Fermi-1 blanket. However, there are small quantities of other spent nuclear fuel that also contain metallic sodium that are included in the scope of this EIS. These miscellaneous materials are described below.

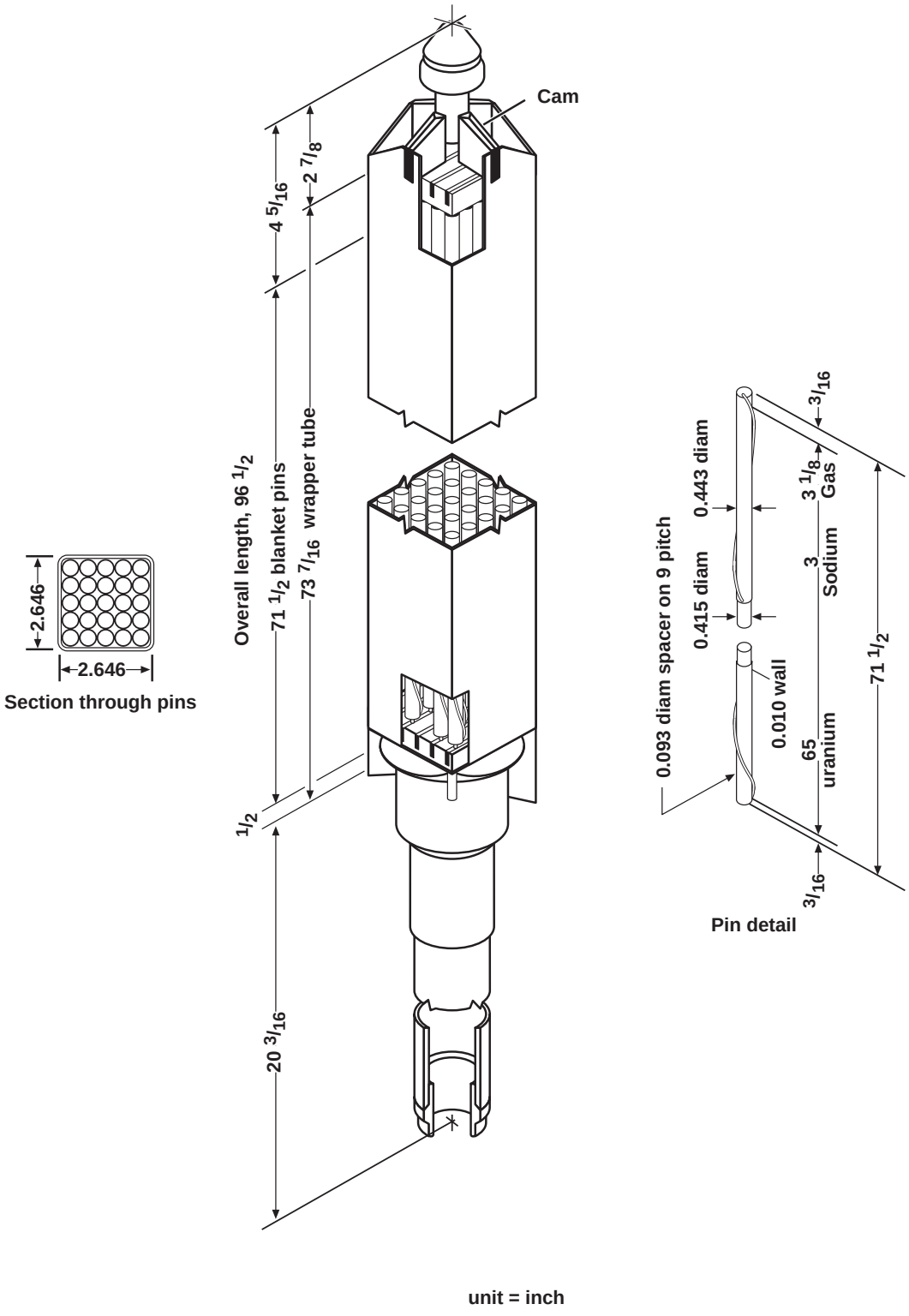


Figure D–2 Fermi-1 Radial Blanket Assembly

D.5.1 Fast Flux Test Facility

Background – The Fast Flux Test Facility, located on the Hanford Site near Richland, in southeastern Washington State, is a 400-megawatt thermal nuclear test reactor cooled by liquid sodium. It was built in 1978
and achieved initial criticality in 1980. The Fast Flux Test Facility was built to test plant equipment and fuel for the U.S. Government's liquid metal reactor development program. Although the facility is not a breeder reactor, this program demonstrated the technology of commercial breeder reactors. It was constructed to verify the safety and optimal performance of the key reactor systems and components. It was also intended to ensure the safety and best design of mixed oxide fuel, a mixture of uranium oxide and plutonium oxide.

The Fast Flux Test Facility successfully tested advanced nuclear fuel, materials, and safety designs. It also produced a large number of different medical isotopes, and made tritium for the U.S. fusion research program. Its operation also demonstrated the reactor's inherent safety features—most notably its ability during an emergency to remove reactor decay (residual) heat without pumps or any other mechanical system, simply based on its design. By contrast, current conventional water reactors require complex safety cooling and backup systems to remove their decay heat.

Description – Under normal operating conditions of the Fast Flux Test Facility, mixed oxide fuel with an enrichment of 20 to 30 percent plutonium was fabricated and inserted in the reactor core. However, the Fast Flux Test Facility also tested a number of experimental fuel types. The material included in the scope of this EIS is the sodium-bonded experimental fuel that was irradiated. **Table D–7** provides data on the sodium-bonded Fast Flux Test Facility spent nuclear fuel addressed by this EIS.

Storage – The Fast Flux Test Facility sodium-bonded spent nuclear fuel is currently in dry storage at the facility. The facility has no major vulnerabilities.

Inventory – There are just over 1,600 Fast Flux Text Facility rods (approximately 300 individual rods or elements and six assemblies consisting of 217 rods each) which are sodium-bonded totaling 0.32 metric tons of heavy metal. (Of this fuel, 0.07 metric tons of heavy metal, consisting of approximately 100 rods or elements and one assembly, are unirradiated fuel.) The radionuclide inventory of this spent nuclear fuel is presented in Table D–4.

D.5.2 Miscellaneous Fuel

Sandia National Laboratory Experiments

Background – A series of debris bed experiments were conducted at the Sandia National Laboratory's Annular Core Research Reactor from 1977 to 1985. These experiments were part of a program to study the "coolability" of debris beds that might be formed during reactor accidents. In the event of a severe accident in a sodium-cooled fast reactor, molten core materials may interact with liquid sodium and thus result in rapid quenching, freezing, and fragmentation. This fragmented debris may settle on horizontal surfaces within the reactor vessel to form debris beds. If the beds are subcritical, the debris will be heated by the radioactive decay of retained fission products. The possibility of damage to the pressure vessel and the containment, which prevent or mitigate the release of fission products as a consequence of the accident, depends on the extent to which natural cooling of the debris can be relied to remove decay heat from the bed. The debris bed experiments were the first "coolability" experiments to be conducted in-pile, using internally heated uranium dioxide and sodium.

Table D–7 Description of the Fast Flux Test Facility Sodium-Bonded Spent Nuclear Fuel

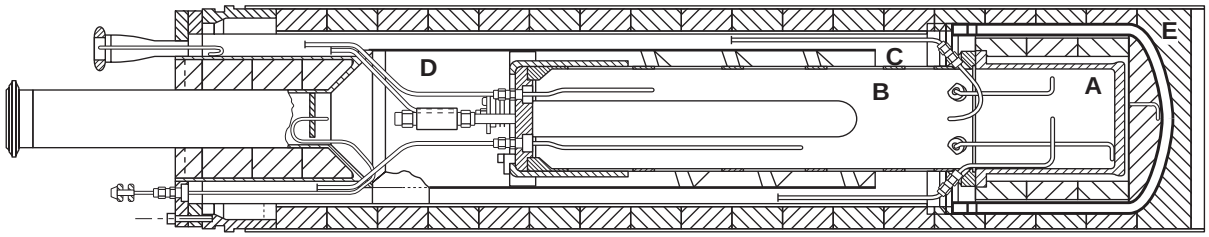
Property	*Fast Flux Test Facility Spent Nuclear Fuel*
Element Description:	
Shape	Round rod
Cladding material	Stainless steel 316 Stainless steel D9 Stainless steel HT9
Clad outside diameter (inches)	0.23 to 0.38
Clad thickness (inches)	0.022
Element length (inches)	93 to 120
Fuel pins or rods per assembly	217
Sodium (grams/element)	9 to 40
General Composition:	
Uranium alloy composition	Uranium-10 Zirconium [a] Uranium-10 Plutonium-10 Zirconium Plutonium/Uranium Carbide
Uranium-235 enrichment (percent)	0.2 to 24
Typical burnup (megawatt days/metric ton uranium)	68,000 to 140,000
Assembly Description:	
Rods per assembly	217
Assembly shape	Hexagon
Assembly width (inches)	4.567 flat to flat
Assembly height (inches)	144

[a] An alloy of 90 weight percent uranium and 10 weight percent zirconium.

Description – Each experiment consists of either a single or double containment within a helium chamber in the experiment section. Older experiments had a single containment, while newer ones were doubly contained. The uranium dioxide fuel, sodium, thermocouples, and in newer experiments, the insulated crucible are within the inner containment vessel. The uranium dioxide used in the experiments was produced by Los Alamos National Laboratory. The fuel was not irradiated prior to use in these experiments, nor was it melted during the experiments.

Figure D–3 provides a cut-away view of a typical debris bed experiment. As shown, these experiments are considerably different than the arrangement of sodium-bonded spent nuclear fuel. The fuel is just a small portion of the overall experiment structure. The fuel bed is held in a tantalum-tungsten alloy crucible with zirconia insulation. Each of the experiments is 10 centimeters (4 inches) in diameter and 50 centimeters (20 inches) long.

Storage – The seven debris bed experiments are stored dry at Sandia National Laboratories/New Mexico in Tech Area 5. The experiments are presently stored in seven "Dense Packs," a set of underground storage holes in Tech Area 5. There are no known vulnerabilities with this storage.



A bed in containment vessel
B sodium
C entrance for helium coolant to helical upflow heat exchanger
D exit plenum for hot helium
E typical solid insulation

Figure D–3 Typical Debris Bed Experiment

Inventory – The seven debris bed experiments have a total mass of 650 kilograms (1,433 pounds), of which only 34 kilograms (75 pounds) is highly-enriched uranium (93 percent uranium-235) and 20 kilograms (44 pounds) is metallic sodium. The sodium is interdispersed within the fuel debris. The burnup on this spent nuclear fuel is minor since the fuel had not been irradiated prior to these experiments.

The radionuclide inventory for these experiments was modeled as the EBR-II driver spent nuclear fuel on a heavy metal basis (see Table D–4). This is considered conservative because of the very low fuel burnup and the long cooling time (1977 to 1985, depending upon the experiment).

Westinghouse Atomic Power Division

Background – When the Engineering Test Reactor at INEEL was being taken to power, the activity of the primary reactor water rose abruptly. Within a few minutes after the rise began, the reactor received a slow setback which reduced power. Water chemistry analysis indicated a rupture in an experiment capsule. A small crack was found in one of the Westinghouse Atomic Power Division experiments (WAPD-49-AQ). There were 15 other similar experiment capsules in the reactor at the time. All of these capsules were removed from the reactor.

Description – The capsules have an overall length of 94.6 centimeters (37.25 inches) and are about 12.7 centimeters (5 inches) in diameter. Thirty centimeters (12 inches) of each capsule holds the fuel sample assembly. Each fuel sample assembly holds four fuel pins, each having a length of 14 centimeters (5.5 inches) and diameter of 0.9 centimeters (0.34 inches). The fuel pins contain uranium dioxide pellets (18 percent enriched). The oxide pellets have either one or two sheaths. The sheaths are made of either 304 stainless steel or zircaloy. The fuel pins that have two sheaths have a mixture of sodium and potassium between them. **Figure D–4** show the typical Westinghouse Atomic Power Division capsule arrangement.

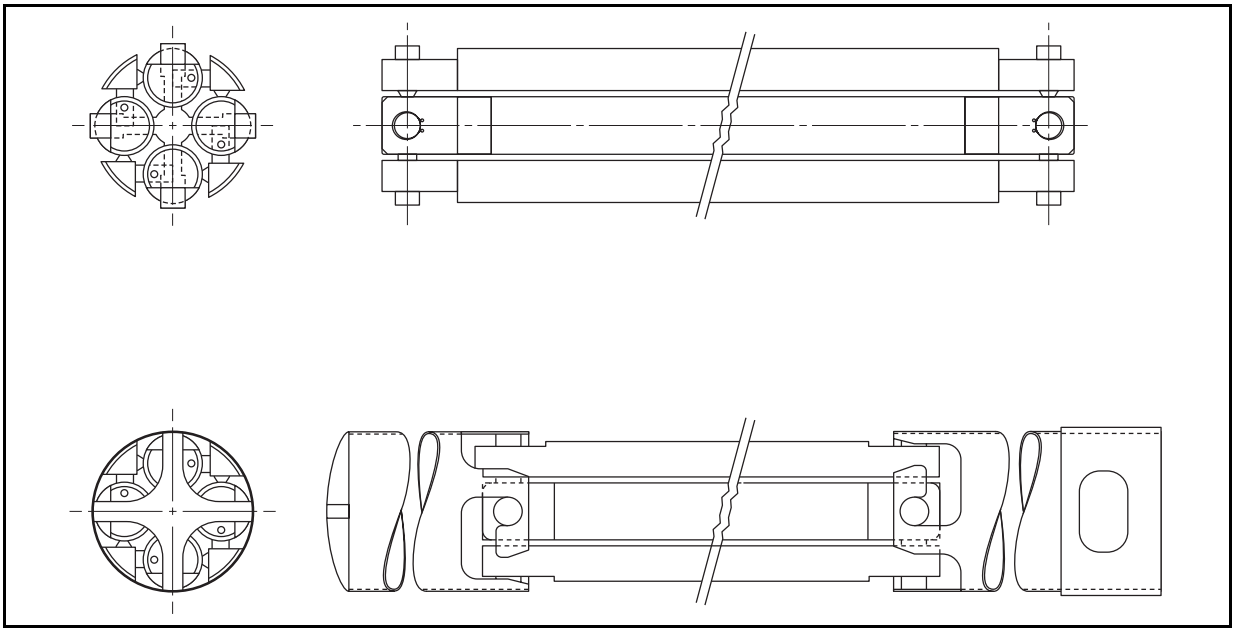


Figure D–4 Diagram of the Westinghouse Atomic Power Division Capsule

Storage – The Westinghouse Atomic Power Division spent nuclear fuel is currently stored in INTEC-603. There are a total of 22 experiments (i.e., pins). There are 4 experiments stored each in five aluminum cans and two capsules in the final can.

Inventory – The total inventory of the Westinghouse Atomic Power Division spent nuclear fuel is 6.6 kilograms (14.5 pounds) of uranium, at 18 percent enrichment. A radionuclide inventory of the Westinghouse Atomic Power Division spent nuclear fuel will be scaled conservatively from the EBR-II driver fuel inventory (see Table D–4) based upon heavy metal. This scaling approach is conservative because the experiments are fabricated with plutonium and uranium, have a lower enrichment, and have a lower burnup.

Oak Ridge National Laboratory Fast Reactor Spent Nuclear Fuel

Background – On August 12, 1998, the fuel elements were being sheared in half when a "sparkler-like reaction" was observed, lasting less than 30 seconds. This observed reaction was suspected of being an indication of sodium bonding on the spent nuclear fuel. This has not yet been confirmed. This spent nuclear fuel is included in this listing of sodium-bonded spent nuclear fuel in the event that it does prove to be sodium-bonded.

Description – The spent nuclear fuel is considered to be experimental EBR-II spent nuclear fuel elements. They are reported to be a uranium-carbide composition with stainless steel cladding. Figure D–1 shows the general configuration of EBR-II fuel, including experimental fuel. Table D–5 provides data on experimental EBR-II spent nuclear fuel.

Storage – This spent nuclear fuel is currently stored at the Oak Ridge National Laboratory in Building 3525, the Irradiated Fuel Examination Laboratory. The Irradiated Fuel Examination Laboratory is a two-story brick structure which contains hot cells. Disassembly and examination of fuel and components continue to be the mission of the facility. There are no identified vulnerabilities associated with this facility.

This spent nuclear fuel is stored in 4 containers in Building 3525. The containers are about 1.3 centimeters (0.5 inches) in diameter by 107 centimeters (42 inches) long.

Inventory – This spent nuclear fuel contains a total of 0.38 kilograms (0.84 pounds) of uranium, 0.35 kilograms (0.77 pounds) of which is uranium-235. Therefore, the enrichment is over 90 percent. This spent nuclear fuel also contains a total of 0.091 kilograms (0.20 pounds) of plutonium, 0.084 kilograms (0.18 pounds) of which is plutonium-239 or plutonium-241.

The radionuclide inventory for this small amount of material can be approximated by scaling the experimental spent nuclear fuel inventory (see Table D–4) based on heavy metal. This scaling approach is appropriate since this is an EBR-II experimental fuel.

Sodium Research Experiment at SRS

Background – The Sodium Research Experiment was a sodium-cooled, graphite-moderated reactor owned by the Atomic Energy Commission and Southern California Edison, Co. The Sodium Research Experiment achieved initial criticality in 1957 and was last operated in 1964. The Sodium Research Experiment operated at 20 megawatts-thermal until it was shut down in February 1964 for modification to permit an increase in power level to 30 megawatts-thermal. In December 1966, deactivation was announced.

Description – The Core I Sodium Research Experiment fuel was an unalloyed, uranium metal matrix, with a 2.8 percent uranium-235 enrichment stainless steel type 304 cladding, and sodium-potassium bonding. The Core I fuel contained seven rods per assembly. Core I was removed in 1959 after an incident resulted in the overheating and failure of one or more fuel in a number of fuel assemblies. The 26 undamaged fuel assemblies were shipped to Oak Ridge National Laboratory and were reprocessed. The assemblies that had damaged rods, along with miscellaneous fuel pieces retrieved from the reactor, were packaged into stainless steel canisters.

Core II assemblies were a thorium – 7.6 percent uranium alloy with a 92.3 percent uranium-235 enrichment, stainless steel type 304 cladding and sodium-potassium bonding. Core II fuel contained only five rods per assembly. Each rod contained 12 fuel slugs. Each fuel slug was 1.9 centimeters (0.75 inches) in diameter and 15.2 centimeters (6 inches) long. **Figure D-5** shows the typical assembly. The Core II fuel assemblies were removed from the reactor and placed into storage in 1964. This fuel was declad by Atomics International and shipped to SRS for reprocessing in 1976 and 1977.

In addition to the typical fuel, the Sodium Research Experiment also contained several types of experimental fuel. The experimental fuel addressed by this EIS is a uranium carbide fuel with a 9.8 percent uranium-235 enrichment, and stainless steel type 304 cladding.

Storage – The uranium carbide spent nuclear fuel addressed by this EIS is currently stored in the Receiving Basin for Offsite Fuel at the SRS. The Sodium Research Experiment spent nuclear fuel is stored in a can 8.9 centimeters (3.5 inches) in outer diameter and 366 centimeters (12 feet) long.

Inventory – This spent nuclear fuel contains a total of 43 kilograms (95 pounds) of uranium, 4.2 kilograms (9 pounds) of which is uranium-235. Therefore, the enrichment is 9.8 percent. This spent nuclear fuel also contains a total of 0.016 kilograms (0.035 pounds) of plutonium.

The radionuclide inventory for this small amount of material can be approximated by scaling the experimental spent nuclear fuel inventory (see Table D–4) based on heavy metal. This scaling approach is appropriate since this is a very small quantity of spent nuclear fuel with a burnup lower than the EBR-II spent nuclear fuel.

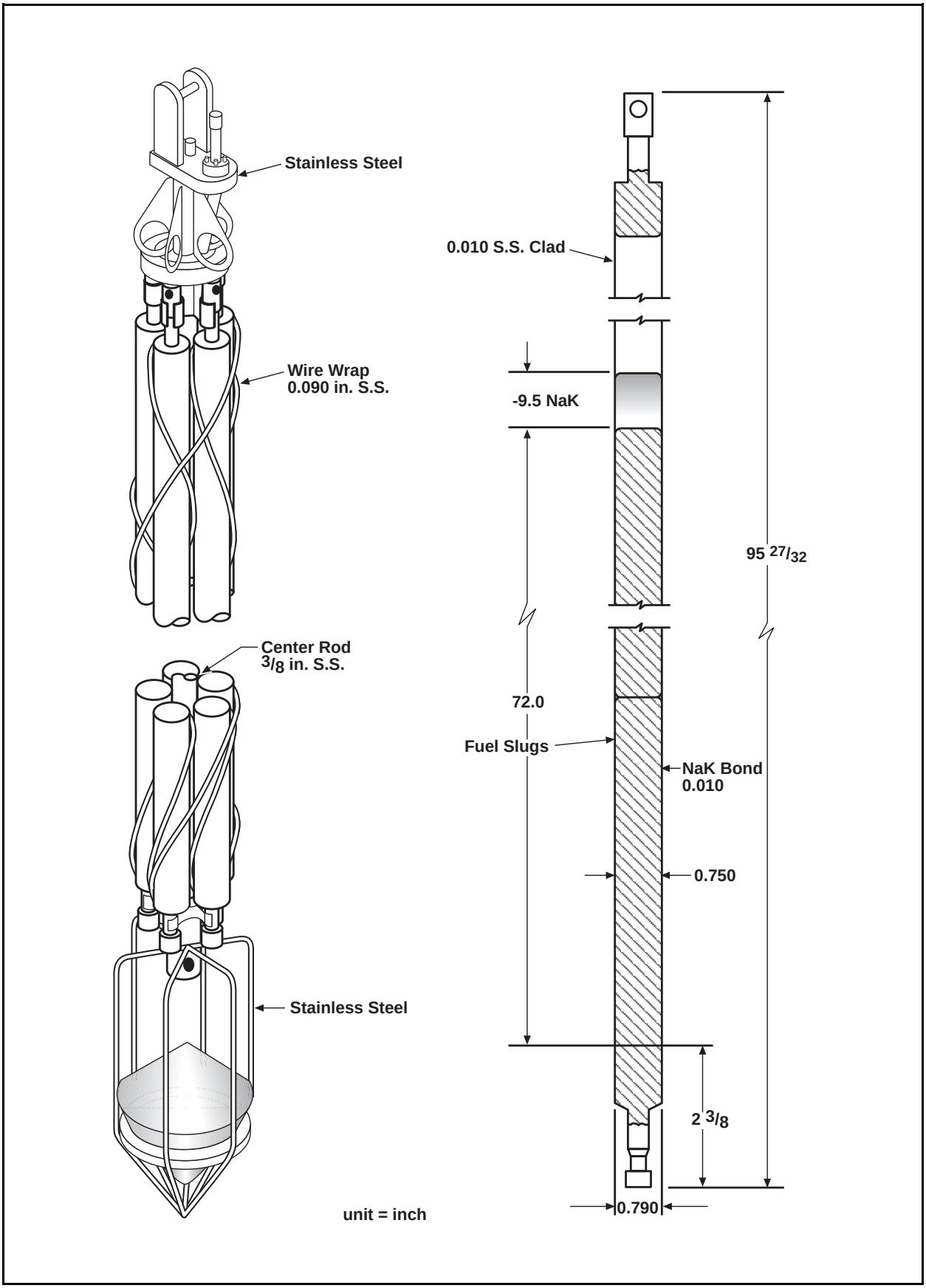


Figure D–5 Sodium Research Experiment Fuel Rod and Assembly Configuration

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APPENDIX E
EVALUATION OF HUMAN HEALTH EFFECTS FROM NORMAL OPERATIONS

E.1 INTRODUCTION

This appendix provides a brief general discussion on radiation and its associated health effects and describes the method and assumptions used for estimating the potential impacts and risks to individuals and the general public from exposure to the releases of radioactivity and hazardous chemicals during normal operations at the proposed facilities. Information regarding potential radiological impacts resulting from facility accidents is provided in Appendix F of this environmental impact statement (EIS).

This appendix presents numerical information using engineering and/or scientific notation. For example, the number 100,000 also can be expressed as 1×10^5. The fraction 0.00001 also can be expressed as 1×10^{-5}. The following chart defines the equivalent numerical notations that may be used in this appendix.

FRACTIONS AND MULTIPLES OF UNITS

Multiple	*Decimal Equivalent*	*Prefix*	*Symbol*
1×10^6	1,000,000	mega-	M
1×10^3	1,000	kilo-	k
1×10^2	100	hecto-	h
1×10	10	deka-	da
1×10^{-1}	0.1	deci-	d
1×10^{-2}	0.01	centi-	c
1×10^{-3}	0.001	milli-	m
1×10^{-6}	0.000001	micro-	μ
1×10^{-9}	0.000000001	nano-	n
1×10^{-12}	0.000000000001	pico-	p
1×10^{-15}	0.000000000000001	femto-	f
1×10^{-18}	0.000000000000000001	atto-	a

E.2 RADIOLOGICAL IMPACTS ON HUMAN HEALTH

Radiation exposure and its consequences are topics of interest to the general public. For this reason, this EIS places much emphasis on the consequences of exposure to radiation, provides the reader with background information on the nature of radiation, and explains the basic concepts used in the evaluation of radiation health effects.

E.2.1 Nature of Radiation and Its Effects on Humans

What Is Radiation?

Radiation is energy transferred in the form of particles or waves. Globally, human beings are exposed constantly to radiation from the solar system and the earth's rocks and soil. This radiation contributes to the natural background radiation that always surrounds us. Manmade sources of radiation also exist, including medical and dental x-rays, household smoke detectors, and materials released from nuclear and coal-fired power plants.

All matter in the universe is composed of atoms. Radiation comes from the activity of tiny particles within an atom. An atom consists of a positively charged nucleus (central part of an atom) with a number of negatively charged electron particles in various orbits around the nucleus. There are two types of particles in the nucleus: neutrons that are electrically neutral and protons that are positively charged. Atoms of different types are known as elements. There are more than 100 natural and manmade elements. An element has equal numbers of electrons and protons. When atoms of an element differ in their number of neutrons, they are called isotopes of that element. All elements have three or more isotopes, some or all of which could be unstable (i.e., decay with time).

Unstable isotopes undergo spontaneous change, known as radioactive disintegration or radioactive decay. The process of continuously undergoing spontaneous disintegration is called radioactivity. The radioactivity of a material decreases with time. The time it takes a material to lose half of its original radioactivity is its half-life. An isotope's half-life is a measure of its decay rate. For example, an isotope with a half-life of eight days will lose one-half of its radioactivity in that amount of time. In eight more days, one-half of the remaining radioactivity will be lost, and so on. Each radioactive element has a characteristic half-life. The half-lives of various radioactive elements may vary from millionths of a second to millions of years.

As unstable isotopes change into more stable forms, they emit electrically charged particles. These particles may be either an alpha particle (a helium nucleus) or a beta particle (an electron), with various levels of kinetic energy. Sometimes these particles are emitted in conjunction with gamma rays. The alpha and beta particles are frequently referred to as ionizing radiation. Ionizing radiation refers to the fact that the charged particle energy force can ionize, or electrically charge, an atom by stripping off one of its electrons. Gamma rays, even though they do not carry an electric charge as they pass through an element, can ionize its atoms by ejecting electrons. Thus, they cause ionization indirectly. Ionizing radiation can cause a change in the chemical composition of many things, including living tissue (organs), which can affect the way they function.

When a radioactive isotope of an element emits a particle, it changes to an entirely different element, one that may or may not be radioactive. Eventually a stable element is formed. This transformation, which may take several steps, is known as a decay chain. For example, radium, which is a member of the radioactive decay chain of uranium, has a half-life of 1,622 years. It emits an alpha particle and becomes radon, a radioactive gas with a half-life of only 3.8 days. Radon decays first to polonium, then through a series of further decay steps to bismuth, and ultimately to lead, which is a stable element. Meanwhile, the decay products will build up and eventually die away as time progresses.

The characteristics of various forms of ionizing radiation are briefly described below and in the box at right (see Chapter 6 for further definition):

Radiation Type	Typical Travel Distance in Air	Barrier
α	Couple of centimeters	Sheet of paper or skin's surface
β	Few meters	Thin sheet of aluminum foil or glass
γ	Very large [a]	Thick wall of concrete, lead, or steel
n	Very large	Water, paraffin, graphite

[a] *Would be infinite in a vacuum*

Alpha (α)

Alpha particles are the heaviest type of ionizing radiation. They can travel only a couple of centimeters in air. Alpha particles lose their energy almost as soon as they collide with anything. They can be stopped easily by a sheet of paper or by the skin's surface.

Beta (β)

Beta particles are much (7,330 times) lighter than alpha particles. They can travel a longer distance than alpha particles in the air. A high-energy beta particle can travel a few meters in the air. Beta particles can pass through a sheet of paper, but may be stopped by a thin sheet of aluminum foil or glass.

Gamma (γ)

Gamma rays (and x-rays), unlike alpha or beta particles, are waves of pure energy. Gamma rays travel at the speed of light. Gamma radiation is very penetrating and requires a thick wall of concrete, lead, or steel to stop it.

Neutrons (n)

Neutrons are particles that contribute to radiation exposure both directly and indirectly. The most prolific source of neutrons is a nuclear reactor. Indirect radiation exposure occurs when gamma rays and alpha particles are emitted following neutron capture in matter. A neutron has about one-quarter the weight of an alpha particle. It will travel in the air until it is absorbed in another element.

Units of Radiation Measure

During the early days of radiological experience, there was no precise unit of radiation measure. Therefore, a variety of units were used to measure radiation. These units were used to determine the amount, type, and intensity of radiation. Just as heat can be measured in terms of its intensity or effects using units of calories or degrees, amounts of radiation or its effects can be measured in units of curies, radiation absorbed dose (rad), or dose equivalent (roentgen equivalent man, or rem). The following summarizes those units (see also the definitions in the Glossary [Chapter 6]).

Curie

The curie, named after the French scientists Marie and Pierre Curie, describes the "intensity" of a sample of radioactive material. The rate of decay of 1 gram of radium is the basis of this unit of measure. It is equal to 3.7×10^{10} disintegrations (decays) per second.

Rad

The rad is the unit of measurement for the physical absorption of radiation. The total energy absorbed per unit quantity of tissue is referred to as absorbed dose (or simply dose). As sunlight heats pavement by giving up an amount of energy to it, radiation similarly gives up rads of energy to objects in its path. One rad is equal to the amount of radiation that leads to the deposition of 0.01 joule of energy per kilogram of absorbing material.

Radiation Units and Conversions to International System of Units

1 curie = 3.7×10^{10} becquerel
1 rad = 0.01 gray
1 rem = 0.01 sievert
1 gray = 1 joule per kilogram
1 becquerel = 1 disintegration per second

Rem

A rem is a measurement of the dose equivalent from radiation based on its biological effects. The rem is used in measuring the effects of radiation on the body as degrees centigrade are used in measuring the effects of sunlight heating pavement. Thus, 1 rem of one type of radiation is presumed to have the same biological effects as 1 rem of any other kind of radiation. This allows comparison of the biological effects of radionuclides that emit different types of radiation.

The units of radiation measure in the International System of Units are: becquerel (a measure of source intensity [activity]), gray (a measure of absorbed dose), and sievert (a measure of dose equivalent).

An individual may be exposed to ionizing radiation externally (from a radioactive source outside the body) or internally (from ingesting or inhaling radioactive material). The external dose is different from the internal dose because an external dose is delivered only during the actual time of exposure to the external radiation source, but an internal dose continues to be delivered as long as the radioactive source is in the body. The dose from internal exposure is calculated over 50 years following the initial exposure. Both radioactive decay and elimination of the radionuclide by ordinary metabolic processes decrease the dose rate with the passage of time.

Sources of Radiation

The average American receives a total of approximately 360 millirem per year from all sources of radiation, both natural and manmade, of which approximately 300 millirem per year are from natural sources. The sources of radiation can be divided into six different categories: (1) cosmic radiation, (2) terrestrial radiation, (3) internal radiation, (4) consumer products, (5) medical diagnosis and therapy, and (6) other sources (NCRP 1987). These categories are discussed in the following paragraphs.

Cosmic Radiation

Cosmic radiation is ionizing radiation resulting from energetic charged particles from space continuously hitting the earth's atmosphere. These particles and the secondary particles and photons they create comprise cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with the altitude above sea level. The average dose to people in the United States from this source is approximately 27 millirem per year.

External Terrestrial Radiation

External terrestrial radiation is the radiation emitted from the radioactive materials in the Earth's rocks and soils. The average dose from external terrestrial radiation is approximately 28 millirem per year.

Internal Radiation

Internal radiation results from the human body metabolizing natural radioactive material that has entered the body by inhalation or ingestion. Natural radionuclides in the body include isotopes of uranium, thorium, radium, radon, polonium, bismuth, potassium, rubidium, and carbon. The major contributor to the annual dose equivalent for internal radioactivity is the short-lived decay products of radon, which contribute approximately 200 millirem per year. The average dose from other internal radionuclides is approximately 39 millirem per year.

Consumer Products

Consumer products also contain sources of ionizing radiation. In some products, such as smoke detectors and airport x-ray machines, the radiation source is essential to the product's operation. In other products, such as televisions and tobacco, the radiation occurs as the product's function. The average dose from consumer products is approximately 10 millirem per year.

Medical Diagnosis and Therapy

Radiation is an important diagnostic medical tool and cancer treatment. Diagnostic x-rays result in an average exposure of 39 millirem per year. Nuclear medical procedures result in an average exposure of 14 millirem per year.

Other Sources

There are a few additional sources of radiation that contribute minor doses to individuals in the United States. The dose from nuclear fuel cycle facilities (e.g., uranium mines, mills, and fuel processing plants), nuclear power plants, and transportation routes has been estimated to be less than 1 millirem per year. Radioactive fallout from atmospheric atomic bomb tests, emissions of radioactive material from nuclear facilities, emissions from certain mineral extraction facilities, and transportation of radioactive materials contribute less than 1 millirem per year to the average dose to an individual. Air travel contributes approximately 1 millirem per year to the average dose.

Exposure Pathways

As stated earlier, an individual may be exposed to ionizing radiation both externally and internally. The different ways that could result in radiation exposure to an individual are called exposure pathways. Each type of exposure is discussed separately in the following paragraphs.

External Exposure

External exposure can result from several different pathways, all having in common the fact that the radiation causing the exposure is external to the body. These pathways include exposure to a cloud of radiation passing over the receptor (i.e., an individual member of the public), standing on ground that is contaminated with radioactivity, and swimming or boating in contaminated water. If the receptor departs from the source of radiation exposure, the dose rate will be reduced. It is assumed that external exposure occurs uniformly during the year. The appropriate dose measure is called the effective dose equivalent.

Internal Exposure

Internal exposure results from a radiation source entering the human body through either inhalation of contaminated air or ingestion of contaminated food or water. In contrast to external exposure, once a

radiation source enters the body, it remains there for a period of time that varies depending on decay and biological half-life. The absorbed dose to each organ of the body is calculated for a period of 50 years following the intake. The calculated absorbed dose is called the committed dose equivalent. Various organs have different susceptibilities to harm from radiation. The quantity that takes these different susceptibilities into account is called the committed effective dose equivalent, and it provides a broad indicator of the risk to the health of an individual from radiation. The committed effective dose equivalent is a weighted sum of the committed dose equivalent in each major organ or tissue. The concept of committed effective dose equivalent applies only to internal pathways.

Radiation Protection Guides

Various organizations have issued radiation protection guides. The responsibilities of the main radiation safety organizations, particularly those that affect policies in the United States, are summarized below.

International Commission on Radiological Protection

This Commission has the responsibility for providing guidance in matters of radiation safety. The operating policy of this organization is to prepare recommendations to deal with basic principles of radiation protection and to leave to the various national protection committees the responsibility of introducing the detailed technical regulations, recommendations, or codes of practice best suited to the needs of their countries.

National Council on Radiation Protection and Measurements

In the United States, this Council is the national organization that has the responsibility for adapting and providing detailed technical guidelines for implementing the International Commission on Radiological Protection recommendations. The Council consists of technical experts who are specialists in radiation protection and scientists who are experts in disciplines that form the basis for radiation protection.

National Research Council/National Academy of Sciences

The National Research Council is an organization within the National Academy of Sciences that associates the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the Federal Government.

Environmental Protection Agency

The Environmental Protection Agency (EPA) has published a series of documents, *Radiation Protection Guidance to Federal Agencies*. This guidance is used as a regulatory benchmark by a number of Federal agencies, including the U.S. Department of Energy (DOE), in the realm of limiting public and occupational work force exposures to the greatest extent possible.

Limits of Radiation Exposure

Limits of exposure to members of the public and radiation workers are derived from International Commission on Radiological Protection recommendations. The EPA utilizes the National Commission on Radiological Protection and the International Commission on Radiological Protection recommendations and sets specific annual exposure limits (usually less than those specified by the Commission) in Radiation Protection Guidance to Federal Agency documents. Each regulatory organization then establishes its own set of radiation standards. DOE has established a set of limits for radiation workers in 10 CFR 835. **Table E–1** provides the various exposure limits set by DOE and the EPA for radiation workers and members of the public.

Table E–1 Exposure Limits for Members of the Public and Radiation Workers

Guidance Criteria (Organization)	*Public Exposure Limits at the Site Boundary*	*Worker Exposure Limits*
40 CFR 190 (EPA)	25 millirem per year (all pathways)	—
10 CFR 835 (DOE)	—	5,000 millirem per year [a]
DOE Order N441.1 (DOE)	—	2,000 millirem per year [a]
DOE Order 5400.5 (DOE) [b]	10 millirem per year (all air pathways) 4 millirem per year (drinking water pathway) 100 millirem per year (all pathways)	—
40 CFR 61 (EPA)	10 millirem per year (all air pathways)	—
40 CFR 141 (EPA)	4 millirem per year (drinking water pathways)	—

[a] Although these are limits (or levels) which are enforced by DOE, worker doses must still adhere to as low as reasonably achievable principles.

[b] Derived from 40 CFR 61, 40 CFR 141, and 10 CFR 20.

E.2.2 Health Effects

Radiation exposure and its consequences are topics of interest to the general public. To provide the background for discussions of impacts, this section explains the basic concepts used in the evaluation of radiation effects.

Radiation can cause a variety of damaging health effects in people. The most significant effects are induced cancer fatalities. These effects are referred to as "latent" cancer fatalities because the cancer may take many years to develop. In the discussions that follow, all fatal cancers are considered latent; therefore, the term "latent" is not used.

The National Research Council's Committee on the Biological Effects of Ionizing Radiation (BEIR) has prepared a series of reports to advise the U.S. Government on the health consequences of radiation exposures. *Health Effects of Exposure to Low Levels of Ionizing Radiation*, BEIR V (National Research Council 1990), provides the most current estimates for excess mortality from leukemia and other cancers that are expected to result from exposure to ionizing radiation. BEIR V provides estimates that are consistently higher than those in its predecessor, BEIR III. This increase is attributed to several factors, including the use of a linear dose response model for cancers other than leukemia, revised dosimetry for the Japanese atomic bomb survivors, and additional follow-up studies of the atomic bomb survivors and associated others. BEIR III employs constant, relative, and absolute risk models, with separate coefficients for each of several sex and age-at-exposure groups. BEIR V develops models in which the excess relative risk is expressed as a function of age at exposure, time after exposure, and sex for each of several cancer categories. The BEIR III models were based on the assumption that absolute risks are comparable between the atomic bomb survivors and the U.S. population. BEIR V models were based on the assumption that the relative risks are comparable. For a disease such as lung cancer, where baseline risks in the United States are much larger than those in Japan, the BEIR V approach leads to larger risk estimates than the BEIR III approach.

The models and risk coefficients in BEIR V were derived through analyses of relevant epidemiologic data that included the Japanese atomic bomb survivors, ankylosis spondylitis patients, Canadian and Massachusetts fluoroscopy (breast cancer) patients, New York postpartum mastitis (breast cancer) patients, Israeli tinea capitis (thyroid cancer) patients, and Rochester thymus (thyroid cancer) patients. Models for leukemia, respiratory cancer, digestive cancer, and other cancers used only the atomic bomb survivor data, although results of analyses of the ankylosis spondylitis patients were considered. Atomic bomb survivor analyses were based on revised dosimetry, with an assumed relative biological effectiveness of 20 for neutrons, and were restricted to doses less than 400 rads. Estimates of risks of fatal cancers, other than leukemia, were obtained by totaling the estimates for breast cancer, respiratory cancer, digestive cancer, and other cancers.

The National Council on Radiation Protection and Measurements (NCRP 1993), based on the radiation risk estimates provided in BEIR V and the International Commission on Radiological Protection Publication 60 recommendations (ICRP 1991), has estimated the total detriment resulting from low dose[1] or low dose rate exposure to ionizing radiation to be 0.00073 per rem for the general population and 0.00056 per rem for the working population. The total detriment includes fatal and nonfatal cancer and severe hereditary (genetic) effects. The major contribution to the total detriment is from fatal cancer and is estimated to be 0.0004 and 0.0005 per rem for the radiation workers and the general population, respectively. **Table E–2** provides the breakdown of the risk factors for both workers and the general population. Nonfatal cancers and genetic effects are less probable consequences of radiation exposure. To simplify the presentation of the impacts, estimated effects of radiation are calculated only in terms of latent cancer fatalities.

Table E–2 Nominal Health Effects Coefficients (Risk Factors) From Exposure to 1 Rem of Ionizing Radiation

Exposed Individual	*Fatal Cancer* [a, c]	*Nonfatal Cancer* [b]	*Genetic Disorders* [b]	*Total*
Worker	0.0004	0.00008	0.00008	0.00056
Public	0.0005	0.0001	0.00013	0.00073

[a] For fatal cancer, the health effect coefficient is the same as the probability coefficient. When applied to an individual, the units are the lifetime probability of a latent cancer fatality per rem of radiation dose. When applied to a population of individuals, the units are the excess number of cancers per person-rem of radiation dose.

[b] In determining a means of assessing health effects from radiation exposure, the International Commission on Radiological Protection has developed a weighting method for nonfatal cancers and genetic effects. Genetic effects can be applied only to a population, not individuals.

[c] For high individual exposures (greater than or equal to 20 rem), the health factors are multiplied by a factor of 2.

Source: NCRP 1993.

The numerical estimates of fatal cancers presented in this EIS were obtained using a linear extrapolation from the nominal risk estimated for lifetime total cancer mortality, which is 0.1 gray (10 rad). Other methods of extrapolation to the low-dose region could yield higher or lower numerical estimates of fatal cancers. Studies of human populations exposed to low doses are inadequate to demonstrate the actual level of risk. There is scientific uncertainty about cancer risk in the low-dose region below the range of epidemiologic observation, and the possibility of no risk cannot be excluded (CIRRPC 1992).

Health Effect Risk Factors Used in This EIS

Health impacts from radiation exposure, whether from external or internal sources, generally are identified as "somatic" (i.e., affecting the exposed individual) or "genetic" (i.e., affecting descendants of the exposed individual). Radiation is more likely to produce somatic effects than genetic effects. The somatic risks of most importance are induced cancers. Except for leukemia, which can have an induction period (time between exposure to carcinogen and cancer diagnosis) of as little as 2 to 7 years, most cancers have an induction period of more than 20 years.

For a uniform irradiation of the body, the incidence of cancer varies among organs and tissues; the thyroid and skin demonstrate a greater sensitivity than other organs. Such cancers, however, also produce relatively low mortality rates because they are relatively amenable to medical treatment. Because fatal cancer is the

[1] *Low dose is defined as the dose level where DNA repair can occur in a few hours after irradiation-induced damage. Currently, a dose level of about 0.2 grays (20 rad), or a dose rate of 0.1 milligrays (0.01 rad) per minute is considered to allow the DNA to repair itself in a short period (EPA 1994).*

most probable serious effect of environmental and occupational radiation exposures, estimates of cancer fatalities rather than cancer incidence are presented in this EIS. The numbers of fatal cancers can be used to compare the risks among the various alternatives.

Based on the preceding discussion and the values presented in Table E–2, the fatal cancers to the general public during normal operations and for accidents in which individual doses are less than 20 rem are calculated using a health risk factor of 0.0005 per person-rem. For workers, a risk factor of 0.0004 excess fatal cancers per person-rem is used. (The risk factors are lifetime probabilities that an individual would develop a latent fatal cancer per rem of radiation.) This lower value reflects the absence of children (who are more radiosensitive than adults) in the work force. Nonfatal cancer and genetic disorders among the public are 20 and 26 percent, respectively, of the fatal cancer risk factor. For workers, the health risk estimators are both 20 percent of the fatal cancer risk factor. The nonfatal cancer risk factors are not used in this EIS.

The fatal cancer factors are used to calculate the statistical expectation of the effects of exposing a population to radiation. For example, if 100,000 people were each exposed to one time radiation dose of 100 millirem (0.1 rem), the collective dose would be 10,000 person-rem. The exposed population would then be expected to experience 5 additional latent cancer fatalities from the radiation (10,000 person-rem × 0.0005 lifetime probability of latent cancer fatalities per person-rem = 5 latent cancer fatalities).

Calculations of the number of excess fatal cancers associated with radiation exposure do not always yield whole numbers; calculations may yield numbers less than 1.0, especially in environmental impact applications. For example, if a population of 100,000 were exposed to a total dose of only 0.001 rem per person, the collective dose would be 100 person-rem, and the corresponding estimated number of latent cancer fatalities would be 0.05 (100,000 persons × 0.001 rem × 0.0005 latent cancer fatalities per person-rem = 0.05 latent cancer fatalities). The 0.05 means that there is one chance in 20 that the exposed population would experience one latent fatal cancer. In other words, the 0.05 latent cancer fatalities is the *expected* number of deaths that would result if the same exposure situation were applied to many different groups of 100,000 people. In most groups, no person (0 people) would incur a latent fatal cancer from the 0.001 rem dose each member would have received. In a small fraction of the groups, 1 latent cancer fatality would result; in exceptionally few groups, 2 or more latent cancer fatalities would occur. The *average* expected number of deaths over all the groups would be 0.05 latent cancer fatalities (just as the average of 0, 0, 0, and 1 is 1/4, or 0.25). The most likely outcome is 0 latent cancer fatalities.

The same concept is applied to estimate the effects of radiation exposure on an individual member of the public. Consider the effects of individual's exposure to a 360 millirem (0.36 rem) annual dose from all radiation sources. The probability that the individual will develop a latent fatal cancer from continuous exposure to this radiation over an average life of 72 years (presumed) is 0.013 (1 person × 0.36 rem per year × 72 years × 0.0005 latent cancer fatality risk per person rem = 0.013). This correlates to one chance in 77 that the individual would develop a fatal cancer.

E.3 METHODOLOGY FOR ESTIMATING RADIOLOGICAL IMPACTS

The radiological impacts from releases during normal operation of the facilities used to treat and manage sodium-bonded spent nuclear fuel were calculated using Version 1.485 of the GENII computer code (PNL 1988). Site-specific input data were used including location, meteorology, population, and source terms. Section E.3.1 briefly describes GENII and outlines the approach used for normal operations.

E.3.1 GENII Computer Code

The GENII computer model, developed by Pacific Northwest National Laboratory, is an integrated system of various computer modules that analyze environmental contamination resulting from acute or chronic

releases to, or initial contamination in, air, water, or soil. The model calculates radiation doses to individuals and populations. The GENII computer model is well documented for assumptions, technical approach, method, and quality assurance issues. The GENII computer model has gone through extensive quality assurance and quality control steps, including comparing results from model computations with those from hand calculations and performing internal and external peer reviews (PNL 1988).

GENII code consists of several modules for various applications, see the code manual (PNL 1988) for details. For this EIS, only the ENVIN, ENV, and DOSE computer modules were used. The output of one module is stored in a file that can be used by the next module in the system. The functions of the three GENII computer modules used in this EIS are discussed below.

ENVIN

The ENVIN module of the GENII code controls the reading of input files and organizes the input for optimal use in the environmental transport and exposure module, ENV. The ENVIN code interprets the basic input, reads the basic GENII data libraries and other optional input files, and organizes the input into sequential segments based on radionuclide decay chains.

A standardized file that contains scenario, control, and inventory parameters is used as input to ENVIN. Radionuclide inventories can be entered as functions of releases to air or water, concentrations in basic environmental media (air, soil, or water), or concentrations in foods. If certain atmospheric dispersion options have been selected, this module would generate tables of atmospheric dispersion parameters that are used in later calculations. If the finite plume air submersion option is selected in addition to the atmospheric dispersion calculations, preliminary energy-dependent finite plume dose factors can be prepared as well. The ENVIN module prepares the data transfer files that are used as input by the ENV module; ENVIN generates the first portion of the calculation documentation—the run input parameters report.

ENV

The ENV module calculates the environmental transfer, uptake, and human exposure to radionuclides that result from the chosen scenario for the user-specified source term. The code reads the input files from ENVIN and then, for each radionuclide chain, sequentially performs the precalculations to establish the conditions at the start of the exposure scenario. Environmental concentrations of radionuclides are established at the beginning of the scenario by assuming decay of pre-existing sources, considering biotic transport of existing subsurface contamination, and defining soil contamination from continuing atmospheric or irrigation depositions. For each year of postulated exposure, the code then estimates the air, surface soil, deep soil, groundwater, and surface water concentrations of each radionuclide in the chain. Human exposures and intakes of each radionuclide are calculated for: (1) pathways of external exposure from finite atmospheric plumes; (2) inhalation; (3) external exposure from contaminated soil, sediments, and water; (4) external exposure from special geometries; and (5) internal exposures from consumption of terrestrial foods, aquatic foods, drinking water, animal products, and inadvertent intake of soil. The intermediate information on annual media concentrations and intake rates are written to data transfer files. Although these may be accessed directly, they are usually used as input to the DOSE module of GENII.

DOSE

The DOSE module reads the intake and exposure rates defined by the ENV module and converts the data to radiation dose.

E.3.2 Data and General Assumptions

To perform the dose assessments for this EIS, different types of data were collected and generated. This section discusses the various data, along with the assumptions made for performing the dose assessments in this EIS.

Dose assessments were performed for both members of the general public and workers around and at Argonne National Laboratory-West (ANL-W) and the Savannah River Site (SRS). These assessments were made to determine the incremental doses that would be associated with the alternatives addressed in this EIS. Incremental doses for members of the public were calculated (via GENII) for two different types of receptors:

- Maximally Exposed Offsite Individual—The maximally exposed offsite individual was assumed to be an individual member of the public located at a position on the site boundary that would yield the highest impacts during normal operations.

- Population—The general population living within 80 kilometers (50 miles) of the facility.

Meteorological Data

The meteorological data used for all normal operational scenarios discussed in this EIS were in the form of joint frequency data files. A joint frequency data file is a table listing the fractions of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The joint frequency data files were based on measurements taken over a period of several years at both the ANL-W and SRS sites.

Population Data

Population distributions were based on the 1990 Census of Population and Housing data (DOC 1992). Projections were determined for the year 2010 (representative year for operations) for areas within 80 kilometers (50 miles) of the release locations at ANL-W and SRS. The projected site-specific population in 2010, assumed to be representative of the population over the operational period evaluated, was used in the impact assessments. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances up to 80 kilometers (50 miles). The grid was centered at the location from which the radionuclides were assumed to be released.

Source Term Data

The site- and process-specific source terms used to calculate the impacts of normal operations are provided in Section E.4.

Food Production and Consumption Data

Generic food consumption rates are established in the U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.109 (NRC 1977). This regulatory guide provides guidance for evaluating ingestion doses from consuming contaminated terrestrial and animal food products using a standard set of assumptions for crop and livestock growth and harvesting characteristics. In this EIS, food consumption rates were based on site-specific agricultural production rates and local diets.

Basic Assumptions

To estimate annual radiological impacts from normal operations, the following additional assumptions and factors were considered in using GENII:

- Radiological airborne gaseous and particulate emissions were assumed to be released to the atmosphere through the plant stacks. See Section E.4 for the specifics at each management facility.

- Ground contamination was based on dry deposition of radionuclides from normal operation releases, assuming no previously deposited radionuclides. Doses resulting from previously deposited radionuclides are accounted for in the baseline dose analysis, as presented in Chapter 3, and are not attributable to the processing of sodium-bonded spent nuclear fuel.

- Unless limited by the process duration, the inhalation exposure time to the plume was assumed to be per year for the maximally exposed offsite individual and the general population. Plume exposure parameters used in the GENII model for normal operations are provided in **Table E–3**.

- The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of an adult human.

- A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, and ingestion of food crops and animal products contaminated by deposition of radioactivity from the air.

- Resuspension of particulates was not considered because calculations of dust loading in the atmosphere show that this pathway is negligible compared to the other pathways.

- Reported release heights were used for atmospheric releases and were assumed to be the effective stack heights. The resultant doses were conservative, as use of the actual stack heights negates plume rise.

- The calculated doses were 50-year committed doses from 1 year of intake.

- Unless otherwise noted, radionuclide materials were considered to be released in the chemical form resulting in the largest radiological impact, thus maximizing the potential dose effect.

Table E–3 GENII Exposure Parameters to Plumes and Soil Contamination (Normal Operations)

Maximally Exposed Offsite Individual				*General Population*			
External Exposure		*Inhalation of Plume*		*External Exposure*		*Inhalation of Plume*	
Plume (hours)	*Soil Contamination (hours)*	*Exposure Time (hours)*	*Breathing Rate (cubic centimeters per second)*	*Plume (hours)*	*Soil Contamination (hours)*	*Exposure Time (hours)*	*Breathing Rate (cubic centimeters per second)*
6,136	6,136	8,766	270	4,383	4,383	8,766	270

Sources: PNL 1988, NRC 1977.

Worker doses associated with the processing alternatives were determined from historical data associated with similar operations. See Section E.4 for details.

E.3.3 Uncertainties

The sequence of analyses performed to generate the radiological impact estimates from normal operation include: (1) selection of normal operational modes, (2) estimation of source terms, (3) estimation of environmental transport and uptake of radionuclides, (4) calculation of radiation doses to exposed individuals, and (5) estimation of health effects. There are uncertainties associated with each of these steps. Uncertainties exist in the way the physical systems being analyzed are represented by the computational models and in the data required to exercise the models (due to measurement, sampling, or natural variability).

In principle, one can estimate the uncertainty associated with each source and predict the remaining uncertainty in the results of each set of calculations. Thus, one can propagate the uncertainties from one set of calculations to the next and estimate the uncertainty in the final results. However, conducting such a full-scale quantitative uncertainty analysis is neither practical nor a standard practice for a study of this type. Instead, the analysis is designed to ensure—through judicious selection of release scenarios, models, and parameters—that the results represent the potential risks. This is accomplished by making conservative assumptions in the calculations at each step. The models, parameters, and release scenarios used in the calculations are selected in such a way that most intermediate results and, consequently, the final estimates of impacts are greater than would be expected. As a result, even though the range of uncertainty in a quantity might be large, the value calculated for the quantity would be close to one of the extremes in the range of possible values, so the chance of the actual quantity being greater than the calculated value would be low (or the chance of the quantity being less than the calculated value if the criteria are such that the quantity has to be maximized). The goal of the radiological assessment for normal operation in this study is to produce results that are conservative.

The degree of conservatism in the calculated results is related closely to the range of possible values the quantity can have. This range is determined by what can be expected to occur realistically. Limitations on the processing of material (e.g., design capacity/processing rate, system availability, operational duration) provide upper limits to the quantity of spent nuclear fuel that can be processed in a given time, (e.g., annually). In many cases these restrictions were used to represent normal operating capacity, thus maximizing the amount of spent nuclear fuel that can be processed annually. Using these upper limits on processing rates provides a conservative estimate of the annual release of radionuclides during normal operation for each of the treatment techniques. These conservative release estimates were used to calculate the annual impacts presented for each alternative.

Details of some of the proposed treatment processes (e.g., melt and dilute) have not been finalized, yet the evaluation of worker doses can be performed using data associated with existing operations, where appropriate. While this introduces additional uncertainties in the estimation of worker exposures, many similarities between existing and proposed operations justify the use of this data. Among the features that justify use of existing data are the following: ANL-W and SRS are both committed to adhering to as low as reasonably achievable radiation protection practices; both sites have treated spent nuclear fuel under similar operating conditions; existing facilities (although modified in some cases) and existing protective features will be used; and any operational controls generated for new processes will be similar to existing operational (procedural) controls. These similarities between existing and proposed process controls mitigate some of the uncertainties inherent in estimating the impacts of processes yet to be finalized.

The radionuclide composition of source terms has been estimated conservatively. There are uncertainties in the radionuclide inventory which are proportional to the quantities of source terms that ultimately are released. For evaluation purposes, the inventory used is based on the spent nuclear fuel with the highest representative radionuclide content with no credit taken for further decay beyond that which occurred prior to the year 2000.

E.4 RADIOLOGICAL RELEASES TO THE ENVIRONMENT AND ASSOCIATED IMPACTS

This section summarizes the estimated radiological releases to the environment as well as resulting impacts associated with the various alternatives assessed in this EIS. Impacts to workers from these alternatives also are discussed. The methodology for estimating radiological impacts, associated input data, and analytical assumptions is provided in Section E.3.

E.4.1 Electrometallurgically Treat Blanket and Driver Fuel at ANL-W (Alternative 1)

Under this alternative, releases of radioactive material would occur during normal operational processing of the sodium-bonded fuel rods in the argon cell at the Fuel Conditioning Facility. Fuel assemblies would be disassembled in the Fuel Conditioning Facility air cell, and individual fuel elements then would be transferred to the argon cell for chopping and treatment in one of the electrorefiners. The entire inventory of gaseous fission products, mainly tritium and krypton-85, is assumed to be released during processing in the Fuel Conditioning Facility. The likelihood of release of radionuclides other than the gaseous fission products is very small. No radionuclides would be released from the packaged salt and packaged metallic waste material transferred from the Fuel Conditioning Facility to the Hot Fuel Examination Facility.

Estimated radioactive releases during normal operations at ANL-W were calculated using a conservative methodology. First, assumptions were made to estimate a maximum annual throughput of material to be processed at the Fuel Conditioning Facility. There would be two electrorefiners in the Fuel Conditioning Facility argon cell; blanket material would be treated in one of the two electrorefiners and driver material would be treated in the other. Both driver and blanket material could be processed each year. Based on an annual operational processing limit of 5,000 kilograms (11,023 pounds) of total heavy metal fuel material consisting of more than 600 kilograms (1,320 pounds) of heavy metal driver material, it was assumed that driver fuel would be processed at the maximum rate until all driver fuel was processed. In addition, it was assumed that the Experimental Breeder Reactor-II (EBR-II) fuel (driver and blanket) currently at ANL-W would be processed first. Using these assumptions, annual mass processing throughputs were developed for the purposes of estimating releases of radioactive material during normal operations, and are presented in **Table E–4**.

Radioactive releases from the Fuel Conditioning Facility argon cell during fuel treatment were estimated next. Radioactivity associated with the fuel to be processed was determined using the fuel radioactivity inventory values discussed in Appendix D. Estimated releases were based on a methodology developed in support of ANL-W's State of Idaho and National Emission Standards for Hazardous Air Pollutants air permitting activities, and agreed upon by the State of Idaho's Department of Environmental Quality (Bauer 1992). From this methodology, equilibrium concentrations in the argon cell (curies per cubic meter per curie processed) were calculated and applied to the inventory associated with the assumed annual throughputs shown in Table E–4. Annual radioactive releases to the atmosphere were calculated as the product of the radionuclide equilibrium concentrations in the argon cell, the annual argon cell atmosphere exhaust (74,400 cubic meters per year), and a conservative adjustment (0.00001) to account for the combined filtration of the two banks of high-efficiency particulate air filters that the cell exhaust must pass through before entering the environment. This filtration adjustment was not applied to tritium or krypton-85, as 100 percent of these radionuclides were assumed to be released.

The Fuel Conditioning Facility stack was modeled with an effective stack height of 60.96 meters (200 feet). This is the actual stack height, and for conservatism, no plume rise was included in the atmospheric dispersion modeling.

Table E–4 Annual Processing Assumptions for Estimation of Radiological Releases During Normal Operations Under Alternative 1 at ANL-W

Year of Processing	Driver Fuel (kilograms per year)		Blanket Fuel (kilograms per year)		Total Fuel (kilograms per year)		
	EBR-II [a]	Fast Flux Test Facility [b]	EBR-II [c]	Fermi-1	Driver	Blanket	Driver + Blanket
1	600	0	4,400	0	600	4,400	5,000
2	600	0	4,400	0	600	4,400	5,000
3	600	0	4,400	0	600	4,400	5,000
4	600	0	4,400	0	600	4,400	5,000
5	600	0	4,400	0	600	4,400	5,000
6	100	400	400	4,200	500	4,600	5,100
7	0	0	0	5,000	0	5,000	5,000
8	0	0	0	5,000	0	5,000	5,000
9	0	0	0	5,000	0	5,000	5,000
10	0	0	0	5,000	0	5,000	5,000
11	0	0	0	5,000	0	5,000	5,000
12	0	0	0	5,000	0	5,000	5,000
Totals (kilograms)	3,100	400	22,400	34,200	3,500	56,600	60,100

[a] EBR-II driver spent nuclear fuel consists of 1,100 kilograms of EBR-II driver spent nuclear fuel at ANL-W and 2,000 kilograms at INTEC.

[b] The Fast Flux Test Facility driver spent nuclear fuel consists of 250 kilograms of sodium-bonded Fast Flux Test Facility driver spent nuclear fuel at Hanford, 70 kilograms of unirradiated sodium-bonded Fast Flux Test Facility fuel, and 80 kilograms of miscellaneous spent nuclear fuel at INTEC, Sandia National Laboratory, SRS, and the Oak Ridge Reservation.

[c] EBR-II blanket spent nuclear fuel consists of EBR-II blanket spent nuclear fuel at ANL-W.

The dose resulting from the release of tritium (H-3) depends heavily on its chemical form. The inhalation dose from oxidized tritium is 25,000 times higher than for tritium in elemental form (ICRP 1982). The dose conversion factors used in the GENII code assume that tritium released to the environment is in the oxidized form and therefore are very conservative for releases that involve elemental tritium. Because of the argon atmosphere in the Fuel Conditioning Facility argon cell, releases of tritium to the cell atmosphere would not become oxidized, and stack releases of tritium most likely would be in the elemental form. The oxidation of elemental tritium to oxidized tritium has been shown to occur slowly in the environment, and for this EIS, the long-term dose from elemental tritium releases is conservatively estimated to be 1 percent of that for the oxidized form (DOE 1997). Therefore, the inventory of tritium for each year of electrometallurgical treatment processing at the Fuel Conditioning Facility was multiplied by a factor of 0.01 to convert them to an equivalent release of tritium oxide for use as input to the GENII code.

Radiological Gaseous Emissions

The estimated annual and total atmospheric releases are tabulated in **Table E–5**. This table lists only those radionuclides that resulted from a screening procedure to indicate potential significant dose contributions. The source term listed in Table E–5 for each of the first five years of processing (years 1 through 5) represents the source term that results in the highest annual offsite dose, and is therefore used for the maximum annual dose calculations. The project lifetime total values in Table E–5 represent the total estimated releases over the 12 years of processing at ANL-W.

Table E–5 Annual and Total Radiological Releases During Normal Operations Under Alternative 1 at ANL-W

Isotope [a]	Annual Releases (curies per year)			Project Lifetime Total (curies)
	Years 1 through 5	Year 6	Years 7 through 12	
H-3	770	680	0.38	4,530
C-14	1.7×10^{-12}	1.0×10^{-12}	2.3×10^{-16}	9.4×10^{-12}
Fe-55	1.4×10^{-8}	1.5×10^{-8}	5.8×10^{-13}	8.7×10^{-8}
Co-60	1.6×10^{-9}	9.7×10^{-10}	1.9×10^{-12}	8.8×10^{-9}
Ni-63	6.5×10^{-10}	1.7×10^{-10}	1.0×10^{-12}	3.4×10^{-9}
Kr-85	11,570	8,800	3.3	66,670
Sr-90	7.0×10^{-8}	5.2×10^{-8}	4.7×10^{-11}	4.0×10^{-7}
Y-90	7.0×10^{-8}	5.2×10^{-8}	4.7×10^{-11}	4.0×10^{-7}
Ru-106	3.2×10^{-8}	2.9×10^{-8}	7.6×10^{-17}	1.9×10^{-7}
Rh-106	3.2×10^{-8}	2.9×10^{-8}	7.6×10^{-17}	1.9×10^{-7}
Cd-113m	6.7×10^{-10}	5.2×10^{-10}	3.1×10^{-13}	3.9×10^{-9}
Sb-125	4.1×10^{-8}	3.6×10^{-8}	3.2×10^{-13}	2.4×10^{-7}
Te-125m	4.5×10^{-10}	3.9×10^{-10}	3.4×10^{-15}	2.6×10^{-9}
I-129	1.4×10^{-12}	9.7×10^{-13}	1.8×10^{-15}	8.2×10^{-12}
Cs-134	3.2×10^{-8}	4.0×10^{-8}	9.5×10^{-16}	2.0×10^{-7}
Cs-137	4.0×10^{-6}	2.9×10^{-6}	3.5×10^{-9}	0.000023
Ba-137m	3.8×10^{-6}	2.8×10^{-6}	3.3×10^{-9}	0.000022
Ce-144	1.2×10^{-9}	1.8×10^{-9}	1.9×10^{-20}	7.7×10^{-9}
Pr-144	1.2×10^{-9}	1.8×10^{-9}	1.9×10^{-20}	7.7×10^{-9}
Pm-147	2.9×10^{-8}	2.6×10^{-8}	2.3×10^{-13}	1.7×10^{-7}
Sm-151	2.1×10^{-9}	1.4×10^{-9}	3.7×10^{-12}	1.2×10^{-8}
Eu-154	2.1×10^{-10}	2.0×10^{-10}	2.2×10^{-15}	1.3×10^{-9}
Eu-155	1.4×10^{-9}	1.1×10^{-9}	1.9×10^{-13}	8.3×10^{-9}
Th-228	1.6×10^{-14}	1.3×10^{-14}	3.2×10^{-19}	9.1×10^{-14}
U-234	1.2×10^{-11}	7.8×10^{-12}	7.8×10^{-17}	6.7×10^{-11}
U-235	3.9×10^{-13}	2.6×10^{-13}	1.8×10^{-14}	2.3×10^{-12}
U-236	3.7×10^{-13}	2.6×10^{-13}	2.7×10^{-16}	2.1×10^{-12}
U-238	7.4×10^{-13}	7.7×10^{-13}	8.1×10^{-13}	9.4×10^{-12}
Np-237	3.9×10^{-13}	2.8×10^{-13}	2.1×10^{-15}	2.2×10^{-12}
Pu-238	2.9×10^{-10}	2.2×10^{-10}	3.4×10^{-14}	1.6×10^{-9}
Pu-239	7.1×10^{-9}	1.2×10^{-9}	1.4×10^{-10}	3.7×10^{-8}
Pu-240	4.7×10^{-10}	1.2×10^{-10}	1.1×10^{-13}	2.5×10^{-9}
Pu-241	1.9×10^{-9}	1.1×10^{-9}	3.6×10^{-15}	1.1×10^{-8}
Am-241	6.2×10^{-12}	1.8×10^{-12}	1.5×10^{-17}	3.3×10^{-11}
Am-242m	6.4×10^{-14}	9.3×10^{-15}	3.4×10^{-23}	3.3×10^{-13}
Totals	12,310	9,500	3.7	71,200

[a] The listed isotopes are present within the argon cell at the Fuel Conditioning Facility. Due to lack (scarcity) of oxygen in the argon cell, the tritium (H-3) released to the cell would be in molecular (elemental) form.

Population Impacts

The estimated annual radiological impacts due to the source term for the maximally exposed offsite individual and the general public residing within the 80 kilometer (50 mile) radius surrounding ANL-W are tabulated in **Table E–6**. Calculated impacts are shown for each year of processing as well as for each of the fuel types to be processed. Impacts are listed resulting from releases during processing EBR-II driver and blanket spent nuclear fuel during each of the first five years (years 1 through 5), processing some of all four fuel types during the sixth year (year 6), and processing Fermi-1 blanket spent nuclear fuel during each of the final six years (years 7 through 12). The impacts to the maximally exposed offsite individual and the surrounding population would result primarily from estimated releases of tritium (H-3) and krypton-85. Together, these two radionuclides would account for greater than 99.9 percent of the estimated impacts.

Table E–6 Annual Radiological Impacts to the Public From Operational Activities Under Alternative 1 at ANL-W

		Population		*Maximally Exposed Offsite Individual*	
Year(s) of Processing	***Spent Nuclear Fuel Type***	***Collective Dose (person-rem per year)***	***Latent Cancer Fatalities (number of cancers)***	***Dose (millirem per year)***	***Latent Cancer Fatality Risk***
1 - 5	EBR-II driver	0.0027	1.4×10^{-6}	0.00033	1.6×10^{-10}
	Fast Flux Test Facility driver	0	0	0	0
	EBR-II blanket	0.000083	4.2×10^{-8}	0.000010	5.0×10^{-12}
	Fermi-1 blanket	0	0	0	0
	All fuel, years 1 through 5	0.0028	1.4×10^{-6}	0.00034	1.7×10^{-10}
6	EBR-II driver	0.00046	2.3×10^{-7}	0.000054	2.7×10^{-11}
	Fast Flux Test Facility driver	0.0018	9.2×10^{-7}	0.00022	1.1×10^{-10}
	EBR-II blanket	7.6×10^{-6}	3.8×10^{-9}	9.1×10^{-7}	4.6×10^{-13}
	Fermi-1 blanket	9.1×10^{-7}	4.5×10^{-10}	1.1×10^{-7}	5.5×10^{-14}
	All fuel, year 6	0.0023	1.2×10^{-6}	0.00028	1.4×10^{-10}
7 - 12	EBR-II driver	0	0	0	0
	Fast Flux Test Facility driver	0	0	0	0
	EBR-II blanket	0	0	0	0
	Fermi-1 blanket	1.1×10^{-6}	5.4×10^{-10}	1.3×10^{-7}	6.5×10^{-14}
	All fuel, years 7 through 12	1.1×10^{-6}	5.4×10^{-10}	1.3×10^{-7}	6.5×10^{-14}

Total cumulative radiological impacts over the projected 13 years of operations under this alternative are tabulated in **Table E–7**. This table shows the sum of the calculated impacts to the maximally exposed offsite individual and the surrounding population over 12 years of fuel treatment.

Table E–7 Cumulative Maximum Radiological Impacts to the Public From Normal Operational Releases Under Alternative 1 at ANL-W

	Population		*Maximally Exposed Offsite Individual*	
	Collective Dose (person-rem)	*Latent Cancer Fatalities (number of cancers)*	*Dose (millirem)*	*Latent Cancer Fatality Risk*
Project total impacts [a]	0.0163	8.2×10^{-6}	0.00198	9.9×10^{-10}

[a] Total impacts are estimated for the 12-year duration of fuel treatment; there are no releases in the 13th year, i.e., only salt stabilization is performed.

Worker Impacts

Workers involved with electrometallurgical treatment activities at ANL-W could receive radiation doses during handling activities, such as receiving and unloading fuel casks, and transferring in-process waste material from the Fuel Conditioning Facility to the Hot Fuel Examination Facility. Doses received during in-cell activities likely would be very small. A maximally exposed worker dose estimate for this EIS is based on the regulatory limit of 5,000 millirem per year for radiation workers at DOE sites. If an individual worker received this dose each year of the 13 years of the electrometallurgical treatment project, the total worker dose would be 65,000 millirem with an associated risk of developing fatal cancer of 0.026.

However, actual worker doses are likely to be much lower than this maximum estimate. The ANL-W radiation control program incorporates the DOE Administrative Control Level of 2,000 millirem per year per person established for all DOE activities in DOE Order N441.1. In addition, ANL-W has established an administrative goal of 1,500 millirem per year to any individual. The general design goals at the Fuel Conditioning Facility, for example, were to maintain radiation fields below 0.5 millirem per hour at all workstations. This means that for an individual working at the Fuel Conditioning Facility for a full-time occupational work year of 2,000 hours, the annual dose would be 1,000 millirem.

Worker population doses were estimated by examining the type and duration of various operations performed by workers involved with the electrometallurgical treatment project. Doses can be estimated based on previous doses from similar activities at ANL-W. Based on information from ANL-W, the total worker population dose estimate is 22 person-rem per year, averaging out to an individual dose of 60 millirem per year for each of the 346 involved workers. If these estimates are extended out over the 13 years of operational activities (12 years of fuel treatment and a year of high-level radioactive waste conversion activities), the collective worker dose is 286 person-rem and the associated risk is 0.11 latent cancer fatalities. The estimated impacts to the worker population associated with this alternative are summarized in **Table E–8**.

Table E–8 Annual and Total Impacts to Workers From Operational Activities Under Alternative 1 at ANL-W

	Worker Population	
	Collective Dose (person-rem)	*Latent Cancer Fatalities*
Annual impacts	22	0.0088
Project total impacts [a]	319	0.13

[a] Total impacts are estimated for the 13-year processing duration, plus a year for deactivation activities at 33 person-rem.

E.4.2 Prepare Blanket Fuel and Electrometallurgically Treat Driver Fuel at ANL-W (Alternatives 2 Through 5)

In Alternatives 2 through 5, the blanket spent nuclear fuel assemblies would need to be prepared at the ANL-W facilities prior to packaging in high-integrity cans or processing in either the plutonium-uranium extraction (PUREX) process at SRS or the melt and dilute process at SRS or ANL-W. When the blanket spent nuclear fuel is to be processed at SRS, Alternative 3 (PUREX processing) and 5 (melt and dilute processing), the blanket spent nuclear fuel would be declad and cleaned at ANL-W in the argon cell of the Hot Fuel Examination Facility. Processing of the blanket spent nuclear fuel assemblies at ANL-W (Alternative 2, placing the blanket spent nuclear fuel in high-integrity cans, and Alternatives 4 and 6, melt and dilute) would not require decladding of the blanket spent nuclear fuel. This activity also would be performed in the argon cell of the Hot Fuel Examination Facility. The preparation of the blanket spent nuclear fuel under these alternatives would require only that the fuel be cut into segments and cleaned (see Appendix C for details). The following discussion addresses the radiological impact of normal operations at ANL-W for the preparation of the blanket spent nuclear fuel elements and the electrometallurgical treatment of the driver spent nuclear fuel elements. This analysis is applicable to Alternatives 2 through 5.

Gaseous Emissions

Blanket spent nuclear fuel preparation would occur at the Hot Fuel Examination Facility. These activities would cause gaseous fission products to be released into the argon cell. As stated in Section E.4.1, krypton-85 and elemental tritium are the most prevalent gaseous radionuclides that would be released to the environment. The released tritium (H-3) into the cell would not be oxidized because of a very low presence of oxygen and humidity in the argon cell. The argon cell also contains an equilibrium concentration of other radionuclide isotopes. Appendix E, Section E.4.1, provides a list of various isotopes that are present in the argon cell in nanocuries (10^{-9} curies) and are released to the atmosphere through the facility stack, along with the krypton-85 and elemental tritium. The maximum released curies of radioactive gaseous emissions occurs when preparation of the blanket spent nuclear fuel and chopping of the driver spent nuclear fuel (for electrometallurgical treatment processing) are performed simultaneously. This simultaneous operation was estimated to occur over a six-year period starting in 2003. Based on a blanket spent nuclear fuel preparation throughput of 10 metric tons of heavy metal and an electrometallurgical treatment process rate of about 0.6 metric tons of heavy metal of driver spent nuclear fuel elements annually, at most about 809 curies of elemental tritium and 11,860 curies of krypton-85 would be released to the atmosphere annually; see **Table E–9**. This release rate would last about two years, or until all of the EBR-II blanket spent nuclear fuel is processed; then the release rate would drop during the processing of the Fermi-1 blanket spent nuclear fuel (the release rate for the processing of 10 metric tons of heavy metal of Fermi-1 blanket spent nuclear fuel is less than 1 curie of elemental tritium and 6.6 curies of krypton-85). The gaseous fission products generated during treatment processes at the Hot Fuel Examination Facility would be released to the atmosphere through the 31-meter (94-foot) facility stack.

Table E–9 Maximum Annual Radiological Gaseous Emission From Activities Associated With Alternatives 2 Through 5 at ANL-W

Spent Nuclear Fuel Type	*Facility*	*Maximum Processing Rate (metric tons of heavy metal per year)*	*Duration (years)*	*Annual Release (curies)*	
				Tritium [a]	*Krypton-85*
Driver fuel	Fuel Conditioning Facility	0.6	6	738	11,340
EBR-II blanket fuel	Hot Fuel Examination Facility	10	2.4	71.2	520
Fermi-1 blanket fuel	Hot Fuel Examination Facility	10	3.6	0.76	6.6
Maximum annual release [b]			2.4	809	11,860

[a] Elemental tritium; about 1 percent of tritium was assumed to be in oxidized form. See discussion in Section E.4.1.
[b] Maximum annual release occurs during concurrent processing of EBR-II driver and blanket spent nuclear fuel at ANL-W.

Population Impacts

The doses to the maximally exposed offsite individual and the general public residing within the 80 kilometer (50 mile) radius surrounding ANL-W are presented in **Table E–10**. As stated in Section E.4.1 the dose resulting from the release of tritium is highly dependent upon its chemical form. The doses presented in Table E–10 result from releases that are assumed to be 1 percent oxidized tritium, the same assumption used in the analysis of Alternative 1. These impacts are calculated for the preparation of the blanket spent nuclear fuel assemblies, for the processing of the driver spent nuclear fuel assemblies using the electrometallurgical treatment process, and the maximum total impacts. The maximum annual impact is associated with the concurrent treatment of EBR-II driver and blanket spent nuclear fuel. Under alternatives 2 through 5, treatment of the driver and blanket spent nuclear fuel does not begin at the same time. Electrometallurgical treatment of the driver spent nuclear fuel is expected to begin three years before the beginning of treatment of the blanket spent nuclear fuel (see the discussion for each alternative in Chapter 4). This results in the nine-year treatment duration identified in Table E–10, where only driver spent nuclear fuel is treated in the first three years; both driver and blanket spent nuclear fuel are treated in years four through six; and only blanket spent nuclear fuel is treated in the final three years. In Alternative 4, which includes melt and dilute processing of blanket spent nuclear fuel at ANL-W, the gaseous radionuclides, which result in over 99 percent of the offsite dose (tritium, krypton, and iodine), are released during the declad and clean process. It is the six-year duration of this portion of the melt and dilute process that was used as the time frame for modeling the operation releases from the treatment of blanket spent nuclear fuel for Alternative 4. As stated earlier, treatment of Fermi-1 spent nuclear fuel at ANL-W would have a negligible contributing impact. These impacts are applicable to the processing of blanket and driver spent nuclear fuel under Alternatives 2, 3, 4, and 5 at ANL-W.

Table E–10 Annual and Total Radiological Impacts to the Public From Normal Operational Releases Under Alternatives 2 Through 5 at ANL-W

		Population		*Maximally Exposed Offsite Individual*	
Year(s) of Processing	*Spent Nuclear Fuel Type*	*Collective Dose (person-rem per year)*	*Latent Cancer Fatalities (number of cancers)*	*Dose (millirem per year)*	*Latent Cancer Fatality Risk*
1-3	Driver	0.0027	1.4×10^{-6}	0.00033	1.6×10^{-10}
	Blanket	0	0	0	0
	All fuel	0.0027	1.4×10^{-6}	0.00033	1.6×10^{-10}
4-5	Driver	0.0027	1.4×10^{-6}	0.00033	1.6×10^{-10}
	EBR-II blanket	0.00028	1.4×10^{-7}	0.000048	2.4×10^{-11}
	All fuel	0.0030	1.5×10^{-6}	0.00038	1.9×10^{-10}
6	Driver	0.0023	1.2×10^{-6}	0.00028	1.4×10^{-10}
	EBR-II blanket	0.00011	5.6×10^{-8}	0.000019	9.6×10^{-12}
	Fermi-1 blanket	1.9×10^{-6}	9.7×10^{-10}	3.3×10^{-7}	1.6×10^{-13}
	All fuel	0.0024	1.2×10^{-6}	0.00030	1.7×10^{-10}
7-9	Driver	0	0	0	0
	Fermi-1 blanket	3.2×10^{-6}	1.6×10^{-9}	5.5×10^{-7}	2.7×10^{-13}
	All fuel	3.2×10^{-6}	1.6×10^{-9}	5.5×10^{-7}	2.7×10^{-13}
Project total [a]		0.0165	8.3×10^{-6}	0.0021	1.0×10^{-9}

[a] Maximum annual radiological impacts occur during two years of concurrent EBR-II driver and blanket spent nuclear fuel processing.

Worker Impacts

The worker activities under Alternatives 2 through 5 at ANL-W would be similar to those under Alternative 1. Therefore, the annual worker dose and the worker population dose would be similar to those provided in Section E.4.1. The project total dose is provided in Section 4.4.4.1.

E.4.3 PUREX Processing at SRS (Alternative 3)

PUREX processing at F-Canyon would release radioactive gaseous fission products during treatment of about 57 metric tons of heavy metal of EBR-II and Fermi-1 blanket spent nuclear fuel. Since declad and cleaned blanket spent nuclear fuel would be packaged and sent to SRS, no additional gaseous fission products would be expected to be present in that fuel. However, it was assumed conservatively that the gaseous fission products in the blanket spent nuclear fuel would remain within the fuel matrix and would be released to the environment (from the facility stack, 60 meters [198 feet] high) during PUREX processing at SRS. As a result, there would be incurred doses to the public associated with PUREX operations. The duration of PUREX operations was estimated to be six months, based on the F-Canyon's throughput and consistent with assumptions made for the treatment duration of a similar-type fuel at SRS in the *SRS Spent Nuclear Fuel Management Final Environmental Impact Statement* (DOE 2000).

Gaseous Emissions

According to SRS Spent Nuclear Fuel EIS data (DOE 1997), tritium (H-3) and krypton-85 are the only isotopes that would be expected to be released during PUREX processing operations. Based on the assumption that the entire fission gas inventory would remain within the fuel matrix after the decladding and cleaning process, it was assumed that the inventory of krypton-85 and tritium would be released. Using the gaseous fission product inventory provided in Appendix D for the EBR-II and Fermi-1 blanket spent nuclear fuel, the potential airborne radiological release quantities were estimated and are presented in **Table E–11**. This inventory was used to calculate the population doses from air emissions.

Table E–11 Estimated Incremental Releases of Radiological Air Emissions and Liquid Effluent During Normal Operations of PUREX Processing Under Alternative 3 at SRS

Isotope	*Releases to Air (curies)*	*Releases to Liquid (curies)* [a]
H-3	162	1.54
Kr-85	1,188	-
Sr-89/90	-	0.000031
Cs-137	-	0.0022
U-234	-	0.000085
U-235	-	0.000011
U-238	-	0.00019
Pu-238	-	0.000016
Pu-239	-	7.76×10^{-6}

[a] Estimated curies using the information provided in the SRS Environmental Data for 1997 (Arnett and Mamatey 1998).

Liquid Effluent

PUREX processing is the only process among the alternatives considered that would release measurable radioactive nuclides to the surface water. This release would occur through the cooling water system. The expected radiological effluent from processing declad and cleaned blanket spent nuclear fuel at F-Canyon were estimated based on the measured data from various effluent streams at F-Area, as presented in the SRS

Environmental Report and Data for 1997 (Arnett and Mamatey 1998). Since the mechanism associated with releases of liquid effluent from PUREX processing at F-Canyon is essentially the same for almost every fuel type processed, the F-Area 1997 effluent data were used to conservatively represent the potential releases from a six-month operation of F-Canyon. Table E–11 lists the radionuclides and their corresponding curies that are estimated to be released during PUREX processing of blanket spent nuclear fuel.

Population Impacts

Estimated annual radiological impacts associated with the F-Canyon PUREX operations for the maximally exposed offsite individual and the general population residing within the 80-kilometer (50-mile) radius surrounding F-Canyon are presented in **Table E–12**. This table provides the radiological doses to the public from air emissions and liquid effluent separately. According to the SRS Environmental Report, a maximally exposed offsite individual associated with liquid releases is an individual who lives downriver of SRS 365 days per year, drinks 2 liters of untreated water per day from the Savannah River, consumes a large amount of Savannah River fish, and spends the majority of time on or near the river. The general population liquid effluent dose is calculated for the discrete population groups at Beaufort-Jasper and Port Wentworth, as well as for other diffuse population groups that make use of the Savannah River; the majority of this dose is due to the drinking water pathway.

For conservatism, as well as demonstrating compliance with DOE Order 5400.5 (100 millirem annual dose limit to an individual from all pathways), the incremental airborne and liquid doses associated with the F-Canyon processing were summed together even though two distinct individuals are assumed to receive a maximum airborne and a maximum liquid dose. In addition, for analysis purposes, it was assumed that tritium would be released to the atmosphere in oxide form. The public impacts from radiological liquid effluent were estimated based on the results provided in the SRS's Interim Management of Nuclear Materials EIS (DOE 1995). This is consistent with the approach used in the recent SRS Spent Nuclear Fuel Management Final EIS (DOE 2000), which used "per unit" values (per metric tons of fuel processed) to estimate liquid doses associated with the PUREX processing of 20 metric tons of heavy metal of declad blanket spent nuclear fuel. This EIS uses the same approach to estimate the radiological doses to the public from potential radiological liquid effluent from PUREX processing.

Table E–12 Annual and Total Radiological Impacts to the Public From Normal Operational Releases During PUREX Processing Under Alternative 3 at SRS

Population [a]				*Maximally Exposed Offsite Individual* [a]			
Air Dose (person-rem)	***Liquid Dose*** [b] ***(person-rem)***	***Total Collective Dose (person-rem)***	***Latent Cancer Fatalities***	***Air Dose (millirem)***	***Liquid Dose*** [b] ***(millirem)***	***Total Dose (millirem)***	***Latent Cancer Fatality Risk***
0.019	0.00068	0.020	0.000010	0.00039	0.00012	0.00051	2.6×10^{-10}

[a] The dose values presented apply to both annual and project total, since the processing is done in less than a year.
[b] The dose values were estimated based on the results for processing a similar fuel presented in the Interim Management of Nuclear Materials EIS (DOE 1995).

Worker Impacts

Worker population and worker doses associated with PUREX processing at SRS were based on 300 workers and the site administration dose limit of 500 millirem per year for each worker and are consistent with those presented in the SRS Spent Nuclear Fuel Management Final EIS (DOE 2000). The SRS radiation control program incorporates the DOE Administrative Control Level of 2,000 millirem per year per person established for all DOE activities in DOE Order N441.1. Doses and associated impacts are based on a

six-month processing period. **Table E–13** presents estimated values to both the average worker and entire work force population.

Table E–13 Annual and Cumulative Worker Radiological Impacts from Normal Operational Activities Under Alternative 3 at SRS

Worker Population		*Individual Worker*	
Collective Dose (person-rem per year)	*Latent Cancer Fatalities From Six Months of Processing*	*Individual Dose (millirem per year)*	*Latent Cancer Fatality Risk From Six Months of Processing*
75 [a]	0.015	500 [a, b]	1.0×10^{-4}

[a] Processing of blanket spent nuclear fuel will require six months of F-Canyon operation, yielding half of the annual doses presented.
[b] 500 millirem is an annual ALARA administrative dose limit at SRS. The average worker dose is about 50 millirem (DOE 2000).

E.4.4 SRS Building 105-L Melt and Dilute Radiological Releases and Impacts (Alternative 5)

Melt and dilute processing at Building 105-L would release radioactive gaseous fission products during treatment of about 57 metric tons of heavy metal of EBR-II and Fermi-1 blanket spent nuclear fuel. Since declad and cleaned blanket spent nuclear fuel would be packaged and sent to SRS, no additional gaseous fission products would be expected to be present in that fuel. However, it was assumed conservatively that the gaseous fission products in the blanket spent nuclear fuel would remain within the fuel matrix and would be released to the environment from the facility stack (62 meters [203 feet] high) during melt and dilute processing at SRS. As a result, there would be incurred doses to the public associated with these operations. The duration of the melt and dilute process was estimated to be about three years, based on the current design throughput of the melter and an assumption that the final metallic high-level radioactive waste product from this process would contain about 30 percent depleted uranium in aluminum alloy (WSRC 1999).

Gaseous Emissions

Based on the assumption that the entire fission gas inventory would remain within the fuel matrix after the decladding and cleaning process, it was assumed the inventory of krypton-85 and tritium (H-3) would be released during the melt and dilute process. Using the gaseous fission product inventory provided in Appendix D for the EBR-II and Fermi-1 blanket spent nuclear fuel, the potential airborne radiological release quantities were estimated and are presented in **Table E–14**. These inventories then were used to calculate the population doses from air emissions.

Table E–14 Annual Radiological Releases During Normal Melt and Dilute Operations at Building 105-L Under Alternative 5 at SRS

Isotope	*Releases [a] to Air (curies)*
H-3	54
Kr-85	396

[a] There are no liquid releases associated with melt and dilute processing at SRS.

Liquid Effluent

The melt and dilute process would not produce liquid effluent.

Population Impacts

Estimated annual radiological impacts associated with melt and dilute operations at SRS for the maximally exposed offsite individual and the general population residing within the 80 kilometer (50 mile) radius surrounding Building 105-L are presented in **Table E–15**. For analysis purposes, the released tritium was assumed to be in oxide form.

Table E–15 Annual Radiological Impacts to the Public From Normal Operational Releases During Melt and Dilute Processing at Building 105-L Under Alternative 5 at SRS

Population		*Maximally Exposed Offsite Individual*	
Collective Dose (person-rem)	***Latent Cancer Fatalities***	***Dose (millirem)***	***Latent Cancer Fatality Risk***
0.0076	3.8×10^{-6}	0.00010	5.0×10^{-11}

Worker Impacts

Worker population and worker impact doses associated with melt and dilute processing at SRS were based on 100 workers and the site administrative dose limit of 500 millirem per year for each worker and are consistent with those presented in the SRS Spent Nuclear Fuel Management Final EIS (DOE 2000). The SRS radiation control program incorporates the DOE Administrative Control Level of 2,000 millirem per year per person established for all DOE activities in DOE Order N441.1. Doses and associated impacts are based on a three-year processing period. **Table E–16** presents estimated values to both the average worker and entire work force population.

Table E–16 Annual and Cumulative Worker Radiological Impacts From Normal Operational Activities During Melt and Dilute Operations at Building 105-L Under Alternative 5 at SRS

Worker Population		*Individual Worker*	
Collective Dose (person-rem per year)	***Latent Cancer Fatalities From Three Years Melt and Dilute Processing***	***Individual Dose (millirem per year)***	***Latent Cancer Fatality Risk From Three Years Melt and Dilute Processing***
50	0.060	500 [a]	0.00060

[a] 500 millirem per year is the site annual ALARA administrative dose limit at SRS. The average worker dose is about 50 millirem per year (DOE 2000).

E.4.5 Melt and Dilute Processing at ANL-W (Alternative 6)

In Alternative 6, the blanket and driver spent nuclear fuel elements would need to be prepared at the ANL-W facilities prior to their processing at ANL-W. Preparation of the fuel at ANL-W for the melt and dilute process requires only that the fuel be cleaned to remove sodium prior to melt and dilute processing; decladding of the blanket and driver spent nuclear fuel is not necessary. This activity would be performed in the argon cell of the Hot Fuel Examination Facility. The following discussion addresses the radiological impacts of normal operations at ANL-W for the preparation and melt and dilute treatment of the blanket and driver spent nuclear fuel.

Gaseous Emissions

Fuel preparation would occur at the Hot Fuel Examination Facility. These activities would cause gaseous fission products to be released into the argon cell. As stated earlier in Section E.4.1, krypton-85 and elemental tritium (H-3) are the most prevalent gaseous radionuclides that would be released to the

environment. The tritium released into the cell would not be oxidized because of a very low presence of oxygen and humidity in the argon cell. The argon cell also contains an equilibrium concentration of other radionuclide isotopes. Section E.4.1 provides a list of various isotopes that are present in the argon cell in nanocuries (10^{-9} curies) and are released to the atmosphere through the facility stack, along with the krypton-85 and elemental tritium.

The melt and dilute alternative consists of two distinct operations. The spent nuclear fuel first would be declad and cleaned to remove as much sodium as possible and then would be treated using melt and dilute process. Decladding and cleaning operations may start as early as 2003 and could continue for six years. The melt and dilute treatment would be expected to begin two years after the start of the decladding and cleaning operations. The gaseous fission products (including tritium and krypton) would be released during the decladding and cleaning of the spent nuclear fuel, when the fuel temperature would be raised to approximately 500 °C (930 °F). During the melt and dilute process itself, additional radionuclides would be volatilized and particulates would be released. The volatilized elements would be condensed and collected while the airborne particulates would be filtered through a filtration system that reduces any release by a factor of at least 0.00001. Analysis performed for the evaluation of normal operations for Alternative 1, Section E.4.1, showed that, for similar conditions, over 99 percent of the population and maximally exposed offsite individual doses would come from the release of tritium and krypton from processing both the blanket and driver spent nuclear fuel. Therefore, the doses from the release of tritium and krypton are used to represent the offsite impacts of normal operation releases. These releases would occur during the six years of decladding and cleaning activities, beginning in approximately 2003.

The maximum released curies of radioactive gaseous emissions would occur when preparation of the blanket and driver spent nuclear fuel is performed simultaneously. This simultaneous operation was estimated to occur over a six-year period starting in 2003. Based on a blanket spent nuclear fuel preparation throughput of 10 metric tons of heavy metal and a driver spent nuclear fuel process rate of about 1.7 metric tons of heavy metal annually, about 2,162 curies of elemental tritium and 32,650 curies of krypton-85 would be released to the atmosphere annually (see **Table E-17**). This release rate would last about two years, or until all of the EBR-II blanket spent nuclear fuel and the driver spent nuclear fuel assemblies were processed. Afterward the release rate would drop during the processing of the Fermi-1 blanket spent nuclear fuel (the release rate for the processing of 10 metric tons of heavy metal of Fermi-1 blanket spent nuclear fuel is less than 1 curie of elemental tritium and 6.6 curies of krypton-85).

Table E–17 Maximum Annual Radiological Gaseous Emissions During Melt and Dilute Operations Under Alternative 6 at ANL-W

Spent Nuclear Fuel Type	*Facility*	*Maximum Processing Rate (metric tons of heavy metal per year)*	*Duration (years)*	*Annual Release (curies)*	
				Tritium	*Krypton-85*
Driver fuel	Hot Fuel Examination Facility	1.7	2	2091	32,130
EBR-II blanket fuel	Hot Fuel Examination Facility	10	2.4	71.2	520
Fermi-1 blanket fuel	Hot Fuel Examination Facility	10	3.6	0.76	6.6
Maximum annual release [a]			2	2,162	32,650

[a] Maximum annual release rate applies to the two years during which both EBR-II driver and blanket spent nuclear fuel are processed.

Population Impacts

The maximum annual doses to the maximally exposed offsite individual and the general public residing within the 80 kilometer (50 mile) radius surrounding ANL-W are presented in **Table E–18**. As stated in

Section E.4.1, the dose resulting from the release of tritium is highly dependent upon its chemical form. The doses presented in Table E–18 result from releases that are assumed to be 1 percent oxidized tritium, the same assumption used in the analysis of Alternative 1. These impacts are calculated for the preparation and processing of the sodium-bonded blanket and driver spent nuclear fuel assemblies and the total maximum impacts. During the four-year period when only EBR-II or Fermi-1 blanket spent nuclear fuel is being processed, the doses and latent cancer fatality risk would be smaller than the total presented in the table, reduced in direct proportion to the amount of material released.

Table E–18 Annual and Total Radiological Impacts to the Public From Operational Releases Under Alternative 6 at ANL-W

		Population		*Maximally Exposed Offsite Individual*	
Year(s) of Processing	***Spent Nuclear Fuel Type***	***Collective Dose (person-rem per year)***	***Latent Cancer Fatalities (number of cancers)***	***Dose (millirem per year)***	***Latent Cancer Fatality Risk***
1 to 2	Driver	0.012	6.0×10^{-6}	0.0020	1.0×10^{-9}
	EBR-II blanket	0.00028	1.4×10^{-7}	0.000048	2.4×10^{-11}
	All fuel	0.012	6.1×10^{-6}	0.0020	1.0×10^{-9}
3	EBR-II blanket	0.00011	5.5×10^{-8}	0.000019	9.5×10^{-12}
	Fermi-1 blanket	1.9×10^{-6}	9.5×10^{-10}	3.3×10^{-7}	1.6×10^{-13}
	All fuel	0.00012	5.6×10^{-8}	0.000019	9.7×10^{-12}
4 to 6	Fermi-1 blanket	3.2×10^{-6}	1.6×10^{-9}	5.5×10^{-7}	2.7×10^{-13}
	All fuel	3.2×10^{-6}	1.6×10^{-9}	5.5×10^{-7}	2.7×10^{-13}
Project total [a]		0.024	0.000012	0.0040	2.0×10^{-9}

[a] Maximum annual radiological impacts occur during concurrent processing of EBR-II driver and blanket spent nuclear fuel.

It should be noted that the radiological impacts presented in Table E–18 are based on the assumption of simultaneous operation of blanket and driver fuel. If the fuel preparation were to be performed along with the melt and dilute process for each fuel type separately, then the emissions would occur over a 10-year period starting in 2005. This would result in a lower annual dose to the public over a longer duration leading to the same project total dose as presented in Table E–18.

Worker Impacts:

Due to the uncertainties in the start of operation, for the purposes of analysis in this EIS, DOE assumes that the fuel preparation would start at 2003 and the melt and dilute processing of all fuel would end in 2015, for a total of 12 years of operations. The worker activities during fuel preparation and melt and dilute process would be similar to the activities for Alternatives 1 through 5 at ANL-W. Therefore, the annual worker population dose and average worker dose would be 22 person-rem and 60 millirem, respectively. If these estimates were extended over 12 years of treatment activities plus one year for the deactivation of the facility (with 33-person-rem of dose), the project total worker population dose would be 297 person-rem, leading to a risk of 0.12 latent cancer fatalities.

E.4.6 Storage/Direct Disposal (No Action Alternative)

In the No Action Alternative, the blanket and driver spent nuclear fuel assemblies would remain in their current storage facilities at ANL-W and Idaho Nuclear Technology and Engineering Center (INTEC) until a future disposal option is selected. Potentially, the spent nuclear fuel could remain in its current location until its preparation for disposition sometime before the end of 2035. (All of the sodium-bonded spent nuclear fuel must be removed from the site and moved out of the State of Idaho to fulfill the requirements

of the DOE-State of Idaho Settlement Agreement and Consent Order [see Appendix K].) The only activities associated with continued storage, other than monitoring, would be the repackaging of 5 metric tons of blanket spent nuclear fuel (over a two-year period ending in 2001); the repackaging of spent nuclear fuel found to have degraded (e.g., leaking fuel and storage canister); the transfer of 1.2 metric tons of driver spent nuclear fuel currently in wet storage at Basin 603 to dry storage; and the repackaging of all of the spent nuclear fuel prior to its removal from the State of Idaho. The following discussion addresses the radiological impacts of normal operations at ANL-W and INTEC for the continued storage of the blanket and driver spent nuclear fuel.

Gaseous Emissions:

Under both options in this alternative potential radiological releases from sodium-bonded spent nuclear fuel are very small. Under either option, the sodium-bonded spent fuel would remain in storage in sealed canisters while at INEEL (i.e., INTEC or ANL-W). This fuel needs to be removed from the State of Idaho by January 1, 2035, consistent with the DOE-State of Idaho Settlement Agreement and Consent Order, (see Appendix K). However, degradation of sodium-bonded spent nuclear fuel or its enclosure (e.g., a sealed canister) during storage cannot be ruled out. It is expected that a percentage (a small fraction) of the fuel would be degraded during storage, allowing its gaseous fission products to enter the storage canister. These fission gases would be released to the environment only if the sealed canister were to fail or be opened during fuel handling for examination and repackaging.

The current experience of sodium-bonded spent nuclear fuel storage at INTEC (Basins 603 and 666, wet storage facilities) and ANL-W (Radioactive Scrap and Waste Facility, a dry storage facility) indicates some small fuel degradation problems during the storage period (ANL 2000). For example, during the Electrometallurgical Treatment Research and Demonstration Project, only one canister was observed to have a degraded driver fuel element among the 0.4 metric tons of heavy metal (100 assemblies) of EBR-II driver spent nuclear fuel treated. The degraded fuel was among 6,100 fuel elements that were in dry storage for an average of about four years. Based on this limited experience, the likelihood of fuel degradation during dry storage for the driver spent nuclear fuel would be about 0.005 percent per year. All fuel stored at the Radioactive Scrap and Waste Facility is in cathodically protected liners. At ANL-W, no failures of cathodically protected liners have occurred; therefore, any fuel degradation while in storage is not expected to lead to immediate releases into the atmosphere. Since the driver spent nuclear fuel that failed was in storage for a short period, the failure rate was adjusted to 0.015 percent per year, considering an error factor of 3 (or an uncertainty factor of 10). Therefore, if the fuel were to remain in dry storage for 35 years, about 0.5 percent of the sodium-bonded driver spent nuclear fuel would be in a degraded condition.

The EBR-II fuel at INTEC's Basins 603 and 666 are stored inside stainless steel sealed cans to prevent the contact of basin water with the fuel cladding. The experience at INTEC indicates a higher likelihood of fuel/can degradation in wet storage. A total of 3,624 fuel cans of spent nuclear driver fuel currently is stored at INTEC's Basins 603 and 666. There were 2,148 cans in Basin 603, with an average storage of about 17 years. During this period, 10 cans have shown degradation and water in-leakage, leading to an estimated fuel can failure rate of about 0.03 percent per year. This failure rate was adjusted to 0.10 percent per year, consistent with the assumption made for the driver spent nuclear fuel. Water in-leakage had caused fuel degradation and hydrogen generation from sodium water reactions. The sodium-bonded spent nuclear fuel in Basin 666 has been in storage for about 12 years on average with no observed fuel can failure. All spent nuclear fuel, including the sodium-bonded spent nuclear fuel currently in Basin 603 at INTEC, is to be transferred to dry storage by December 2000, independent of the actions considered in this EIS. During transfer, each fuel can containing sodium-bonded spent nuclear fuel would be examined for water in-leakage. If a fuel can were found to be degraded (containing water), it would be packaged and sent to ANL-W for further examination and repackaging. After transfer to a dry storage facility at INTEC, the likelihood of fuel

degradation would be similar to that at ANL-W. The sodium-bonded spent nuclear fuel in Basin 666 would remain in (wet) storage until the planned defueling and facility closure in the year 2023.

In the basin (wet storage), fuel can degradation would cause a fuel-water reaction, producing hydrogen gas, which would create bubbles in the basin leading to failure detection. Upon detection, the fuel can would be removed and sent to ANL-W for further examination and repackaging. If no action were taken to treat the sodium-bonded spent nuclear fuel by 2023, the fuel would be removed from the basin and placed in storage or repackaged in preparation for removal from the State of Idaho by 2035.

Based on the above experience, the likelihood of fuel failure during dry storage was estimated to be about 0.015 percent per year. When the fuel is in dry storage, fuel degradation would not be detected. Over a storage period of up to 2035, it was estimated conservatively that about 0.5 percent of the fuel would be in a degraded condition. This estimate also would be used for the blanket spent nuclear fuel, even though no blanket spent nuclear fuel element failures during storage have been observed. The likelihood of fuel/can failure in wet storage is about 0.10 percent per year. Therefore, for consistency with the assumption of driver spent nuclear fuel failure in dry storage, it was assumed that about 3 percent of the spent nuclear fuel would have failed during the wet storage period of up to 2035.

Using the above spent nuclear fuel failure assumptions, the estimated radiological gaseous emissions during each option of the No Action Alternative are summarized below.

- *Continued Storage Option*—Under this option, only 107 cans containing about 5 metric tons of heavy metal of blanket spent nuclear fuel at ANL-W would be repackaged and returned to dry storage within the first two years. This would lead to a release of about 0.04 curies of tritium and 0.3 curies of krypton-85 over the first two years. Over the same period, the releases of other gaseous fission products, such as iodine-129, would be less than 10^{-7} curies. The spent nuclear fuel in INTEC's Basin 666, which was assumed to remain in the pool up to 2035, would release about 1 curie of tritium oxide (the elemental tritium in the fuel was assumed to be oxidized in the water), 15.1 curies of krypton-85, and 1.5×10^{-6} curies of iodine-129 annually. At some future time, all sodium-bonded spent nuclear fuel at ANL-W would have to be repackaged in preparation for transferring out of the State of Idaho by 2035, consistent with the DOE-State of Idaho Settlement Agreement and Consent Order. The spent nuclear fuel in dry storage at ANL-W and INTEC would release 16.91 curies of tritium oxide, 254.1 curies of krypton-85, and 0.000011 of iodine-129 during fuel repackaging for removal which would occur over three years. The total radiological releases over 35 years would be: 50.51 curies of tritium oxides, 760.3 curies of krypton-85, and 0.000018 curies of iodine-129. Due to uncertainties about when the repackaging would occur, the blanket and driver spent nuclear fuel radionuclide inventories were not decayed beyond the 2000 calendar year. This could result in overestimating the gaseous tritium content by a factor of 8.

- *Direct disposal*—Under this option, all the sodium-bonded spent nuclear fuel at INTEC or ANL-W would be repackaged at ANL-W. The activities to repackage the sodium-bonded fuel in high-integrity cans would occur over three years. These activities would occur sometime after those performed in the first two years under the storage option of the No Action Alternative and before January 2035, the target date for removal of spent nuclear fuel from the State of Idaho. The fuel currently at INTEC would be transferred to ANL-W between 2003 and 2023. The 2023 date corresponds to the target date for closure of the facility containing Basin 666. Therefore, similar to the previous option, the releases under this option would occur over two distinct periods: (1) over two years during repackaging of the blanket spent nuclear fuel (see continued storage option above); and (2) over three years during repackaging and preparation for direct disposal. Since similar activities are performed under both options, the total radiological releases also would be similar; that is, about 51 curies of tritium, 760 curies of krypton-85, and 0.00002 curies of iodine-129 over the entire period.

Population Impacts:

The doses to the maximally exposed offsite individual and the general public residing within the 80 kilometer (50 mile) radius surrounding the ANL-W site are presented in **Table E–19.** All releases producing these impacts are modeled as originating from ANL-W. Due to the relative locations of ANL-W, INTEC, and the surrounding population, the impacts of releases from INTEC are bounded by the impacts of releases from ANL-W. The dose resulting from the release of tritium is highly dependent upon its chemical form. The doses in Table E–19 result from releases that are assumed to be oxidized tritium.

Table E–19 presents the radiological impacts for the storage option as described above (impacts from the direct disposal option would be similar), and includes contributions from the following releases:

- The repackaging of 5 metric tons of blanket spent nuclear fuel during the first two years,
- Leakage from 2 metric tons of driver spent nuclear fuel in wet storage for one year,
- Leakage from 0.8 metric tons of driver spent nuclear fuel in wet storage (Basin 666) for 31 years (1.2 metric tons would be moved from wet [Basin 603] to dry storage within the first year), and
- The repackaging of all the stored sodium-bonded spent nuclear fuel during the final three years.

Table E–19 Annual and Total Radiological Impacts to the Public From Normal Operations Under the No Action Alternative

		Population		*Maximally Exposed Offsite Individual*	
Year(s) of Storage	***Spent Nuclear Fuel Type***	***Collective Dose (person-rem per year)***	***Latent Cancer Fatalities (number of cancers)***	***Dose (millirem per year)***	***Latent Cancer Fatality Risk***
1	Driver	0.00063	3.2×10^{-7}	0.00011	5.5×10^{-11}
	Blanket	4.8×10^{-6}	2.4×10^{-9}	8.3×10^{-7}	4.1×10^{-13}
	All fuel	0.00064	3.2×10^{-7}	0.00011	5.6×10^{-11}
2	Driver	0.00025	1.3×10^{-7}	0.000044	2.2×10^{-11}
	Blanket	4.8×10^{-6}	2.4×10^{-9}	8.3×10^{-7}	4.1×10^{-13}
	All fuel	0.00026	1.3×10^{-7}	0.000045	2.3×10^{-11}
3 to 32	Driver	0.00025	1.3×10^{-7}	0.000044	2.2×10^{-11}
	Blanket	0	0	0	0
	All fuel	0.00025	1.3×10^{-7}	0.000044	2.2×10^{-11}
33 to 35	Driver	0.0014	7.0×10^{-7}	0.00024	1.2×10^{-10}
	Blanket	0.000072	3.6×10^{-8}	0.000013	6.3×10^{-12}
	All fuel	0.0015	7.5×10^{-7}	0.00026	1.3×10^{-10}
Project total [a]		0.013	6.5×10^{-6}	0.0023	1.1×10^{-9}

[a] Annual maximum occur during repackaging of spent nuclear fuel in preparation for shipping off site.

Worker Impacts:

The worker activities under the No Action Alternative during spent nuclear fuel repackaging would be similar to some of the activities performed under Alternative 1. Therefore, for the five years that repackaging activities are ongoing, the first two years and the last three years that the fuel remains on site, the annual worker dose and the worker population dose would be bounded by those values provided in Section E.4.1.

E.5 IMPACTS OF EXPOSURES TO HAZARDOUS CHEMICALS ON HUMAN HEALTH

The potential impacts of exposure to hazardous chemicals released to the atmosphere were evaluated for routine operations associated with the alternatives analyzed in this EIS. The public residing at the site boundary was the receptor considered in this evaluation. Health impacts to workers from hazardous chemicals were not evaluated quantitatively because of the use of personal protective equipment and engineering process controls. Their exposure is limited to levels within applicable Occupational Safety and Health Administration Permissible Exposure Limits, or the American Conference of Governmental Industrial Hygienists Threshold Limit Values.

Human health effects could result from exposure to hazardous/toxic chemicals through one or more of the three common pathways: inhalation, ingestion, and/or dermal (skin) contact. The effects from a particular pathway will depend essentially on the properties of the toxic chemical, its concentration in one or more environmental media (air, water, and soil), and human behavior. Exposure may be dominated by contacts with chemicals in a single medium or may reflect concurrent contacts with multiple media. Therefore, the exposure assessment provides an estimate of how chemicals travel to a receptor, and how those chemicals come into contact with the receptor's body. It also determines whether the chemicals present in the environmental medium are of sufficient concentration to cause significant adverse effects. The exposure assessment assumes inhalation to be the only pathway and air the only medium. This simplification is based principally on the volatility of the chemicals released. Normal human behavior also is considered (i.e., an individual is assumed to perform activities under normal conditions). To maximize the impact of the exposure, the analysis also assumes that the released chemicals will remain in the air with no or negligible partitioning to other media (i.e., water and ground). So no dermal contact or ingestion is considered in this assessment.

Hazardous chemical releases from routine operations generally are expected to result in concentrations below levels that would cause acute toxic health effects. Acute toxic health effects generally result from short-term exposure to relatively high concentrations of the toxic contaminant, such as those resulting from accidental releases. Long-term exposures to lower concentrations can produce adverse chronic health effects, both carcinogenic and noncarcinogenic. Excess incidences of cancer are the endpoint of carcinogenic effects. However, a spectrum of chemical-specific noncancer health effects (e.g., headaches, skin irritation, neurotoxicity, immunotoxicity, reproductive and genetic toxicity, liver/kidney toxicity, and developmental toxicity) could be observed for noncarcinogenic compounds.

E.5.1 Methodology

This EIS estimates the noncancer health effects by comparing the annual concentrations of contaminants to the Reference Concentrations published in the Integrated Risk Information System (EPA 1999). The potential toxic effects on an individual from exposure to a toxic chemical are evaluated by dividing the estimated inhalation concentration of that chemical by its Reference Concentration value to obtain a noncancer hazard quotient (EPA 1989). For exposure to multiple compounds, hazard quotients are calculated for each toxic chemical and then are summed to generate a hazard index:

$$HI = \sum_i \frac{CA_i}{RfC_i}$$

where

RfC_i = Reference Concentration for chemical *I* (in micrograms per cubic meter)
CA_i = Concentration of the chemical *I* in the air (in micrograms per cubic meter)
HI = Hazard Index

The hazard index is the estimate of the total noncancer toxicity impact. According to the EPA risk assessment guidelines, if the hazard index value is less than or equal to 1, the exposure is unlikely to produce adverse toxic effects. However, if it exceeds 1, adverse toxic effects may result from exposure to the considered chemicals.

The risks from exposure to carcinogenic chemicals are evaluated using chemical-specific unit risk factors, which are the estimates of the upper-bound lifetime probability of an individual developing cancer from exposure to the chemical and the chemical concentration in the air. The unit risk factors for carcinogenic chemicals are provided in the EPA's Integrated Risk Information System database. Therefore, for carcinogenic chemicals, the risk is estimated by the following equation (EPA 1989):

$$Risk = 1 - \exp [- CA \times URF]$$

where

CA = Contaminant concentration in the air (in micrograms per cubic meter)
URF = Unit risk factor for inhalation specific to the contaminant obtained from the Integrated Risk Information System in units of cancer per micrograms per cubic meter

Since the value in the bracket is generally small (less than 0.01), the equation is simplified to:

$$Risk = CA \times URF$$

E.5.2 Assumptions

The air is assumed to be the principal medium by which an individual would be exposed to released hazardous chemicals, and the health effects are calculated based solely on inhalation pathway. In addition, no synergistic or antagonistic effects are assumed to occur from the exposure to multiple hazardous chemicals.

Cancer risks associated with exposure to carcinogenic chemicals were not summed to provide a single cancer risk value. In terms of risk evaluation, a value integrated over multiple chemicals is not always appropriate. One cannot simply add the risk values of individual chemicals to calculate the overall risk. With the risk assessment guidelines and the weight of evidence (EPA 1999), a new approach to carcinogenic risk characterization is being implemented. Thus, even though several chemicals may be shown to induce cancer, they do not necessarily act on the same organ. For example, benzene and formaldehyde are both carcinogenic. Formaldehyde could induce nasal cancer (Andjelkovitch, et. al. 1995), while benzene could cause leukemia. Thus, their residual cancer risk is not cumulative, and the cancer risk for each carcinogenic chemical would be presented separately.

E.5.3 Hazardous Chemical Releases to the Environment and Associated Impacts

This section summarizes the estimated hazardous chemical releases to the environment as well as resulting impacts associated with various alternatives assessed in this EIS.

E.5.3.1 Hazardous Chemical Impacts at ANL-W (All Alternatives)

Under all alternatives, including No Action, small quantities of hazardous chemicals are generated from the operation of the emergency diesel generators supporting both the Fuel Conditioning Facility and Hot Fuel Examination Facility at ANL-W. The emissions from these are independent of any of the processes addressed in this EIS. The released chemicals include acetaldehyde, acrolein, benzene, butadiene, formaldehyde, and toluene. The emissions from these diesel generators were modeled as a volume source

releasing at ground level. In addition, the electrometallurgical treatment of driver spent nuclear fuel under Alternatives 1 through 5 releases small quantities of cadmium. This release would occur as an elevated release (61 meters [200 feet]) from the Fuel Conditioning Facility stack.

Site boundary hazardous chemical concentrations in the atmosphere from releases at ANL-W were estimated using the SCREEN 3 computer program (Version 96043), an EPA-approved worst-case screening model (EPA 1995). The model predicts 1-hour concentrations at the site boundary based on a set of worst-case meteorological conditions. Concentrations were predicted at 16 sectors along the site boundary, assuming a flat terrain. The maximum 1-hour concentration at the site boundary then was selected for the determination of health effects. This concentration was converted to an annual concentration using a regulatory-approved scaling factor of 0.05 (SCDHEC 1993). **Table E–20** summarizes the results. These results indicate that no adverse toxic health effects and cancer potency are expected from exposure to hazardous chemical releases under all alternatives at ANL-W.

Table E–20 Hazardous Chemical Impacts to the Public From Operational Activities at ANL-W for All Alternatives Including No Action

Chemical	*Modeled Emission Rate (grams per second)*	*Annual Concentration (milligrams per cubic meter)*	*Reference Concentration Inhalation (milligrams per cubic meter)*	*Unit Cancer Risk (risk per milligram per cubic meter)*	*Hazard Quotient*	*Cancer Risk*
1,3-Butadiene	0.000012	3.6×10^{-8}	None	0.28	None	9.9×10^{-9}
Acetaldehyde	7.6×10^{-6}	2.3×10^{-8}	0.009	0.0022	2.5×10^{-6}	5.0×10^{-11}
Acrolein	2.4×10^{-6}	7.1×10^{-9}	0.00002	None	0.00035	None
Cadmium	1.5×10^{-10}	3.6×10^{-13}	None	1.8	None	6.5×10^{-13}
Benzene	0.00023	6.9×10^{-7}	None	0.0078	None	5.4×10^{-9}
Formaldehyde	0.000024	7.1×10^{-8}	None	0.013	None	9.2×10^{-10}
Toluene	0.000083	2.5×10^{-7}	0.4	None	6.2×10^{-7}	None
				Hazard Index	0.000353	N/A

N/A = Not applicable.
Source: EPA 1999, modeling results.

E.5.3.2 Hazardous Chemical Impacts at SRS (Alternatives 3 and 5)

Hazardous chemical releases associated with the PUREX and melt and dilute processes at SRS were estimated based on information provided in the SRS Spent Fuel Management Final EIS (DOE 2000). The hazardous chemical release estimates at SRS were essentially independent of the processes evaluated; the chemicals are generated from operation of supporting facilities and equipment (i.e., emergency diesel generator, site-wide powerhouse coal-fired boilers and fuel-oil steam generated boilers). The hazardous chemical release values selected for this EIS were the SRS estimated values that were released during treatment of about 20 metric tons of heavy metal of declad and cleaned EBR-II blanket spent nuclear fuel, similar to the fuel considered for treatment at SRS under the SBSNF EIS. These SRS values were adjusted to account for the mass of spent nuclear fuel being treated (about 57 metric tons of heavy metal) at SRS under Alternatives 3 and 5. In addition, the annual hazardous chemical concentrations were estimated using the 24-hour concentration values given in the SRS EIS and the regulatory-approved scaling factor of 0.125 to convert the 24-hour concentration to an annual concentration (SCDHEC 1993).

Tables E–21 and **E–22** present the results of the hazardous chemical analyses for Alternatives 3 and 5, respectively. These results indicate that no adverse toxic health effects and cancer potency are expected from exposure to hazardous chemical releases under these alternatives at SRS.

Table E–21 Hazardous Chemical Impacts to the Public From Operational Activities Under Alternative 3 at SRS

Chemical	*Annual Concentration (milligrams per cubic meter)* [a]	*Reference Concentration Inhalation (milligrams per cubic meter)*	*Unit Cancer Risk (risk per milligrams per cubic meter)*	*Hazard Quotient*	*Cancer Risk*
Benzene	1.4×10^{-6}	None	0.0078	None	1.1×10^{-8}
Ethyl benzene	1.3×10^{-6}	1	None	1.3×10^{-6}	None
Formaldehyde	1.3×10^{-6}	None	0.013	None	1.6×10^{-8}
Hexane	1.4×10^{-6}	0.2	None	7.1×10^{-6}	None
Manganese	1.3×10^{-6}	0.000050	None	0.025	None
Methyl ethyl ketone	2.5×10^{-6}	1	None	2.5×10^{-6}	None
Methylene chloride	7.1×10^{-7}	None	0.00047	None	3.3×10^{-10}
Naphthalene	1.3×10^{-6}	0.003	None	0.00042	None
Toluene	1.4×10^{-6}	0.4	None	3.5×10^{-6}	None
Vinyl acetate	1.3×10^{-6}	0.2	None	6.3×10^{-6}	None
			Hazard Index	0.025	N/A

N/A = Not applicable.
[a] These concentrations were estimated based on values given in Bickford et al. 1997.
Source: EPA 1999.

Table E–22 Hazardous Chemical Impacts to the Public From Operational Activities Under Alternative 5 at SRS

Chemical	*Annual Concentration (milligrams per cubic meter)* [a]	*Reference Concentration Inhalation (milligrams per cubic meter)*	*Unit Cancer Risk (risk per milligrams per cubic meter)*	*Hazard Quotient*	*Cancer Risk*
Benzene	ND	None	0.0078	None	ND
Ethyl benzene	ND	1	None	ND	None
Formaldehyde	1.3×10^{-6}	None	0.013	None	1.6×10^{-8}
Hexane	1.3×10^{-6}	0.2	None	6.3×10^{-6}	None
Manganese	ND	0.00005	None	ND	None
Methyl ethyl ketone	1.3×10^{-6}	1	None	1.3×10^{-6}	None
Methylene chloride	ND	None	0.00047	None	ND
Naphthalene	1.3×10^{-6}	0.003	None	0.00042	None
Toluene	1.3×10^{-6}	0.4	None	3.1×10^{-6}	None
Vinyl acetate	ND	0.2	None	ND	None
			Hazard Index	0.00043	N/A

N/A = Not applicable, ND = Not detectable.
[a] These concentrations were estimated based on values given in Bickford et al. 1997.
Source: EPA 1999.

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APPENDIX F
EVALUATION OF HUMAN HEALTH EFFECTS FROM FACILITY ACCIDENTS

F.1 INTRODUCTION

This appendix presents the methodology and assumptions used for estimating potential impacts and risks associated with both radiological and toxic chemical releases, due to postulated accidents, at the facilities being considered for the treatment and management of sodium-bonded spent nuclear fuel. Analysis of radiological impacts is presented in Section F.2. This is followed by a summary of the risk results for the various alternatives. Chemical risk methodologies and results are presented in Section F.3. Information regarding the impacts of normal operations, along with background information on the health impacts from exposure to ionizing radiation, is provided in Appendix E.

F.2 IMPACTS OF RADIOLOGICAL ACCIDENTS ON HUMAN HEALTH

This section addresses the radiological impacts associated with accidents at management facilities. Potential accident scenarios have been identified for both the Argonne National Laboratory-West (ANL-W) and Savannah River Site (SRS) facilities proposed for the treatment and management of sodium-bonded spent nuclear fuel.

F.2.1 Overview of Methodology and Basic Assumptions

For the radiological evaluation, the GENII computer program (PNL 1988) was used to calculate radiation doses to the general population and selected individuals. Appendix E provides the detailed description of this code; therefore, only the GENII data specific to the accident analysis is presented in this appendix.

The impacts of radiation exposure were evaluated for the following population segments for each accident scenario:

- *Noninvolved Worker*—An individual located 100 meters (330 feet) from the radioactive material release point.[1] The dose to the noninvolved worker was calculated for the 50th percentile meteorology only, as specified in the U.S. Department of Energy (DOE) Hazard Categorization and Accident Analysis Techniques Standard (DOE 1992). Noninvolved workers would be exposed unprotected to the plume for a limited time (a maximum of 5 minutes), receiving exposure via inhalation, air immersion, and ground surface pathways only.

- *Maximally Exposed Offsite Individual*—An individual member of the public living at the management site boundary and receiving the maximum exposure. This individual is located directly downwind of the accident and would be exposed to radioactivity via inhalation, ingestion, air immersion, and ground surface pathways. The individual would be exposed to the plume for the entire release duration.

- *Population*—The general public living within an 80-kilometer (50-mile) radius of the facility, residing directly downwind of the accident, and receiving the maximum exposure via inhalation, ingestion, air immersion, and ground surface pathways.

[1] *For elevated release, the worker dose was calculated at a point of maximum dose. The distance at which the maximum dose could occur is frequently greater than 100 meters (330 feet) for an elevated release.*

The doses to the maximally exposed offsite individual and the general public were calculated for the 50th and 95th percentile meteorological conditions. Meteorology specific to ANL-W and SRS was used in the evaluation. Site-specific meteorological data was obtained in the form of a joint frequency distribution in terms of percentage of time that the wind blows in specific directions for the given midpoint (or average) wind speed and atmospheric stability. Accident consequences were calculated for both 50th and 95th percentile meteorological conditions. The 50th percentile condition represents the median meteorological condition, and is defined as that for which more severe conditions occur 50 percent of the time. The 95th percentile condition represents relatively low-probability meteorological conditions that produce higher calculated exposures, and is defined as that condition not exceeded more than 5 percent of the time. GENII determines 50th and 95th percentile meteorological conditions using site-specific joint frequency distribution weather data.

The following conditions were used in the calculations:

- Meteorological Data
  - Site-specific joint frequency distribution weather data were used to define 50th and 95th percentile meteorological conditions for each processing technology at management sites.
  - Any release through a stack was assumed to occur at an elevated level consistent with the site's effluent emission stack height. The effects of plume rise were not credited in the analysis.
  - Mixing layer height is 1,000 meters (3,280 feet). Airborne materials freely diffuse in the atmosphere near the ground level in what is known as the "mixing depth." A stable layer exists above the mixing depth and restricts vertical diffusion above 1,000 meters (3,280 feet).
  - Wet deposition is zero (it was assumed that no rain occurs to accelerate deposition and reduce the size of the area affected by the release).
  - Dry deposition of the cloud was modeled. During movement of the radioactive plume, a fraction of the radioactive material in the plume is deposited on the ground due to gravitational forces. The quantity of deposited radioactive material is proportional to the particle size and deposition velocities (in meters per second). The deposited material contributes to the exposure from ground surface radiation and ingestion.
- Inhalation Data
  - Breathing rate is 330 cubic centimeters per second (0.7 cubic feet per minute) for the worker and the general public at the site boundary and beyond (maximally exposed offsite individual and population) during the passage of the plume; it is 270 cubic centimeters per second (0.57 cubic feet per minute) for the general public during the other times.
  - Exposure during passage of the entire plume was assessed for the maximally exposed offsite individual and the population. Exposure to the noninvolved worker is to a portion of the plume (i.e., the noninvolved worker is exposed to the plume for a limited time) because the worker is assumed to take emergency action.
  - Inhalation exposure factors are based on the International Commission on Radiological Protection, Publication 30 (ICRP 1982).

Exposure time assumptions for maximally exposed offsite individuals, workers, and the general public are provided in **Table F–1** below. Since all accident releases would be to the air (either gaseous or suspended

particulates), drinking water, aquatic food ingestion, and any other pathways that may involve liquid exposure were not examined. Additional information, common to the analysis of normal operation and accident impacts, is presented in Appendix E.

Table F–1 GENII Plume and Soil Contamination Exposure Parameters (Postulated Accidents)

Maximally Exposed Offsite Individual			*General Population*		
Inhalation and External Exposure			*Inhalation and External Exposure*		
Exposure Time (hours)	*Breathing Rate (cubic centimeters per second)*	*Soil Contamination (hours)*	*Exposure Time (hours)*	*Breathing Rate (cubic centimeters per second)*	*Soil Contamination (hours)*
100 percent of release time	330	6,136	100 percent of release time	330	6,136

Source: PNL 1988.

Radiological impacts to noninvolved workers from postulated accident scenarios were evaluated at onsite locations where a given incident would cause the highest dose. The noninvolved worker was assumed to have an inhalation exposure time of 5 minutes and an external exposure time to soil contamination of 20 minutes. For a ground-level release accident, a noninvolved worker was assumed to be 100 meters (330 feet) from a given release point; for an elevated release, the worker was situated between 200 and 500 meters (660 and 1,640 feet), depending on the given site's atmospheric dispersion characteristics. All doses to noninvolved workers include a component associated with the intake of radioactivity into the body and another component resulting from external exposure to direct radiation.

The radiation doses to individuals and the public resulting from exposure to radioactive releases were calculated using the following potential pathways:

- *Air immersion*—External direct exposure from immersion in the airborne radioactive material
- *Ground surface*—External direct exposure from radioactive material deposited on the ground
- *Inhalation*—Internal exposure from inhalation of radioactive aerosols and suspended particles
- *Ingestion*—Internal exposure from ingestion of contaminated terrestrial food or animal products

The radiation doses were estimated by the GENII computer program, which uses the dose models recommended by the International Commission on Radiological Protection in Publications 26 and 30 (ICRP 1977, ICRP 1982). Committed dose equivalents[2] are calculated individually for organs such as the gonads, breast, red bone marrow, lungs, thyroid, and bone surface; calculations are combined for the liver, upper large intestine, lower large intestine, small intestine, and stomach. Weighting factors are used for various body organs to calculate weighted or committed effective dose equivalents from radiation inside the body due to inhalation or ingestion. The committed effective dose equivalent value is the sum of the committed dose equivalent to a specific organ weighted by the relative risk to that organ compared to an equivalent whole-body exposure. The deep-dose equivalent for the external exposure pathways (immersion in the radioactive material and exposure to the ground contamination) and the 50-year committed effective dose equivalent for the internal exposure pathways were calculated. The sum of the deep-dose equivalent for external pathways and the committed effective dose equivalent for internal pathways is called the "total effective dose equivalent," or simply, the "total dose" in this environmental impact statement (EIS).

[2]*The definitions of committed dose equivalents, committed effective dose equivalents, and total effective dose equivalents are consistent with those given in 10 CFR Part 835, "Occupational Radiation Protection; Final Rule."*

The exposure from ingestion of contaminated terrestrial food or animal products is calculated on a yearly basis. It is expected that continued consumption of contaminated food products by the public would be suspended if the projected dose should exceed that of the protective action guidelines in a radiological accident event (EPA 1991). No reduction of exposure because of protective actions or evacuation of the public was accounted for in this analysis, however. This conservative approach may result in overestimating health effects within an exposed population, but allows for consistent comparison between alternatives.

F.2.2 Selection of Facility Accidents for Detailed Evaluations

The alternatives for the treatment of sodium-bonded spent nuclear fuel assume the use of facilities currently in operation, although modifications to SRS Building 105-L would be necessary before it could be used for the melt and dilute alternative. The selection of accident scenarios was based on those evaluated in the safety analysis reports for the facilities.

Postulated facility accident scenarios were developed based on the review of the analyzed accidents in previous safety analysis, risk assessment, and environmental assessment documents at ANL-W and SRS, where the sodium-bonded spent nuclear fuel may be handled or processed. These documents include the following:

- *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995a)

- *Environmental Assessment Electrometallurgical Treatment Research and Demonstration Project in the Fuel Conditioning Facility at ANL-West* (DOE 1996a)

- *Fuel Cycle Facility Final Safety Analysis Report* (ANL 1998a)

- *Safety Analysis Report for the Hot Fuel Examination Facility* (ANL 1998b)

- *Accident Assessments for Idaho National Engineering Laboratory Facilities* (Slaughterbeck et al. 1995)

- *Safety Analysis-200 Area, Savannah River Site F-Canyon Operation, F-Canyon SAR Addendum* (WSRC 1994)

- *Savannah River Site Spent Nuclear Fuel Management Final Environmental Impact Statement* (DOE 2000)

Based on this review of analyzed accident scenarios at ANL-W and SRS facilities that deal with sodium-bonded spent nuclear fuel, a spectrum of potential accidents was identified. This process started with systematically identifying initiating events, subsequent accident progressions, and onsite or offsite releases. Then, based on accident initiators, selected accidents were grouped into the following three categories:

- Natural phenomena (e.g., earthquake, tornado)
- External events (e.g., aircraft crash)
- Process-related events (e.g., explosion, nuclear criticality, fire, spills)

The potential process-related events were further subdivided based on the impact the accident would have on the accident release factors. High-energy events would be expected to damage some of the confinement barriers provided in the facility design and would result in release factors that approach unity. Medium-energy events could reduce the effectiveness of the barriers, but would not be expected to defeat them, while low-energy events would have almost no impact on the ability of the confinement barriers to perform their function.

A review of the accident scenarios indicated that only severe accident conditions (e.g., accidents involving confinement failure) could result in a significant release of radioactive material to the environment or an increase in radiation levels. These severe accident conditions are associated with beyond-design-basis events, combinations of events for which the facility was not specifically designed. While these events could have consequences larger than those associated with design-basis events, their frequency is expected to be much lower than the design-basis event frequency. Natural phenomena (e.g., earthquake) and fire accidents creating a direct path for releases to the environment represent the situation with the most consequences to the public. Some types of accidents, such as procedure violations, spills of small quantities of material containing radioactive particles, and most other types of common human error occur more frequently than the more severe accidents analyzed. However, these accidents do not involve enough radioactive material or radiation to result in significant release to the environment, although the impact to operational personnel may be as significant as that resulting from beyond-design-basis events. The airborne particles from a process-related accident would normally pass through at least one bank and possibly two to four banks of high-efficiency particulate air filters before entering the environment. Spent nuclear fuel handling operations are performed inside such confinement barriers as hot cells or canyon walls. The hot cells are equipped with significant safety features, such as an inert gas atmosphere, pressure control, and heat detection. These features are credited when their operability is not compromised by the sequence of events associated with the accident progression.

While severe accidents (also referred to as beyond-design-basis events) are expected to have the most significant impact, that is, the highest consequences, on the population, these accidents may not have as significant a risk impact on all receptors as higher-frequency, lower-consequence accidents. For this reason, higher-frequency accident scenarios were included in the accident analysis. Three categories of accidents were identified, and at least one accident scenario for each category was selected for analysis. The three categories consist of abnormal events (defined as events with a frequency of greater than 0.001 per year), design-basis events (frequencies between 1×10^{-3} and 1×10^{-6} per year), and beyond-design-basis events (frequencies less than 1×10^{-6}, but limited to those greater than 1×10^{-7} per year).

Based on review of the existing facility analyses and on guidance provided by the U.S. Department of Energy (DOE) in Section 6.9 of *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements* (DOE 1993a), the following types of accidents were selected for each processing technology:

- Explosions
- Nuclear criticality
- Fire
- Earthquake
- Aircraft crash
- Spills/drops

Finally, no specific analyses of the results of terrorist or sabotage acts were considered. This is because the existing security measures in effect at the management sites would essentially preclude any sabotage or terrorist activity. In addition, any acts of terrorism would be expected to result in consequences that would be bounded by the results of the accident scenarios selected for detailed evaluation.

F.2.2.1 Accident Scenario Descriptions and Source Terms

This section describes the accident scenarios and corresponding source terms developed for ANL-W and SRS. The spectrum of accidents described below was used to determine the incremental consequences (public and worker doses) and risks associated with the treatment of sodium-bonded spent nuclear fuel at each site. These accident scenarios are consistent with those evaluated in either the facility safety analysis report, facility/site environmental reports, or various related DOE safety documents. Secondary accidents were considered when

identified in the safety documents. The selected documents were identified and referenced in each of the accident scenarios described. When information was required to further clarify the accident condition, update some of the parameters, or facilitate the evaluation process, additional assumptions were made. Sometimes it was necessary to use different assumptions than those used in the referenced report; these are identified also. For example, under the proposed action of this EIS, the material at risk during an earthquake can be different than the materials considered in the facility safety analysis report. This change in assumption is necessary because the evaluations in this EIS focus only on the risk resulting from the implementation of alternatives (an incremental risk) and, therefore, address only the risk associated with the treatment of the sodium-bonded spent nuclear fuel. Cumulative risks can be determined by adding the incremental risks to the existing risks.

F.2.2.1.1 Source Terms

The source term (or building source term) is the amount of respirable radioactive material that is released to the air, in terms of curies or grams, assuming the occurrence of a postulated accident. The airborne source term is typically estimated by the following five-component linear equation:

$$\text{Source term} = \text{MAR} \times \text{DR} \times \text{ARF} \times \text{RF} \times \text{LPF}$$

where:

MAR	=	Material at Risk (grams or curies)
DR	=	Damage Ratio
ARF	=	Airborne Release Fraction (or Airborne Release Rate for continuous release)
RF	=	Respirable Fraction
LPF	=	Leak Path Factor

- *Material at Risk*—The material at risk is the amount of radionuclides (in curies of activity or grams for each radionuclide) available for release when acted upon by a given physical stress (i.e., an accident). The material at risk is specific to a given process in the facility of interest. It is not necessarily the total quantity of material present, but is that amount of material in the scenario of interest postulated to be available for release.

- *Damage Ratio*—This is the fraction of material exposed to the effects of the energy, force, or stress generated by the postulated event. For the accident scenarios discussed in this EIS, the value of the damage ratio varies from 0.0001 to 1.

- *Airborne Release Fraction*—This is the fraction of material that becomes airborne due to the accident. In this analysis, airborne release fraction values from the DOE Handbook on airborne release fractions are used (DOE 1994b).

- *Respirable Fraction*—This is the fraction of the material with a 10-micrometer (micron) or less aerodynamic-equivalent diameter particle size that could be retained in the respiratory system following inhalation. The respirable fraction values also are taken from the DOE Handbook on airborne release fractions (DOE 1994b).

- *Leak Path Factor*—The leak path factor accounts for the action of removal mechanisms (e.g., containment systems, filtration, deposition) to reduce the amount of airborne radioactivity that is ultimately released to occupied spaces in the facility or the environment. A leak path factor of 1 (i.e., no reduction) is assigned in accident scenarios involving a major failure of confinement barriers.

F.2.2.1.2 Accident Scenario Descriptions and Source Terms at ANL-W

Accident Scenario Descriptions for Electrometallurgical Treatment Processing—The electrometallurgical treatment process would occur at the Fuel Conditioning Facility and the Hot Fuel Examination Facility at the ANL-W site. This process is detailed in Appendix C. The accident scenarios, identified in **Table F–2** and defined in the following paragraphs, are applicable to the electrometallurgical treatment process as proposed at ANL-W. This section also provides information addressing the material at risk and the various release fractions used to determine the source term for each accident selected for analysis.

Table F–2 Selected Accident Scenarios for Electrometallurgical Treatment Processing at ANL-W

Scenario	*Frequency (per year)*
Process-related spills/drops	
a. Salt powder spill	0.01
b. Cask drop	0.01
c. Salt transfer drop	1×10^{-7}
Transuranic waste fire	0.001
Explosion	Not applicable
Design-basis earthquake	0.0002 [a] / 0.008 [b]
Aircraft crash	6×10^{-7} to 1×10^{-8}
Nuclear criticality	Less than 10^{-7}
Beyond-design-basis earthquake	0.00001

[a] At the Fuel Conditioning Facility.
[b] At the Hot Fuel Examination Facility.

Each accident scenario description sets the condition of the accident and provides a summary of material involved. As stated earlier, some of these accident scenarios are generic, but their applications are consistent with those evaluated in various ANL-W environmental and safety analyses. These scenarios include process-specific as well as generic and process-independent accidents. Tables F–3 through F–8 provide summaries of the accidents analyzed, the material at risk, and the release factors based on the fuel type expected to produce the most significant consequences, typically either Experimental Breeder Reactor-II (EBR-II) blanket or driver spent nuclear fuel, for each postulated accident.

- *Operational accident causing a salt powder spill in the Hot Fuel Examination Facility Main Cell*—Solidified electrorefiner salt is sent from the Fuel Conditioning Facility to the Hot Fuel Examination Facility for processing into a final ceramic waste form. It is brought into the Hot Fuel Examination Facility in solid form and ground. The grinder is located in the Main Cell on a raised floor. In this accident scenario, it was assumed that during a transfer operation, the contents of a ground salt container are spilled into the pit beneath the floor. A portion of the salt powder becomes airborne and is carried through the ventilation system to the high-efficiency particulate air filters and released through the building stack. The release was assumed to occur over a one-hour period. The frequency of this accident was set at 0.01 per year, based on the Safety Analysis Report for the Hot Fuel Examination Facility (ANL 1998b).

  To estimate the fission product inventory in the electrorefiner salt, the option of not blending fuel types during electrorefining was used. The salt was assumed to come from the treatment of 5.56 metric tons of heavy metal of EBR-II blanket spent nuclear fuel elements (Goff et al. 1999b) or 1.1 metric tons of heavy metal of EBR-II driver spent nuclear fuel elements (Goff et al. 1999a), the point at which bulk replacement of salt in the electrorefiner is required either when the sodium limit is reached or when the treatment of each fuel type is completed. For the fuel types selected to represent the driver and blanket spent nuclear fuel, the fission product inventory in the salt would be conservative. Based on the Safety Analysis Report for the Hot Fuel Examination Facility (ANL 1998b), the material at risk was assumed to be 100 kilograms of ground salt containing the radionuclide concentrations as shown in **Table F–3**. Radionuclide distributions were developed for both EBR-II driver and blanket spent nuclear fuel. The radionuclide

distributions for driver and blanket spent nuclear fuel are based on an average plutonium concentration in electrorefiner salt of 1.76 and 7.98 percent by weight, respectively (Goff et al. 1999a and 1999b). Portions of the spilled salt would become airborne. The maximum measured value for the 3-meter (10-foot) free-fall of dry cohesionless particles, with a mass median diameter of 1 to 2 microns, results in an airborne release fraction of 0.002 and a respirable fraction of 0.3 (DOE 1994b). The median particle size of the salt after grinding is approximately 200 microns, with only about 1 percent less than 20 microns in diameter (ANL 1999). The analysis, therefore, conservatively assumed that about 1 percent of the ground salt would have characteristics capable of resulting in the airborne release and respirable fractions identified above, resulting in a damage ratio of 0.01. The ventilation system and high-efficiency particulate air filters were assumed to function normally. The ventilation system consists of a two-stage high-efficiency particulate air filtration system were equivalent, with a first-stage high-efficiency particulate air filter efficiency of 99.9 percent and a second stage efficiency of 99 percent. Therefore, the leak path factor through the high-efficiency particulate air filters is 0.00001.

Table F–3 Material at Risk and Release Fraction Values for a Salt Powder Spill Accident at ANL-W

Material at Risk [a]			*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*	
Isotope	*Blanket (curies)*	*Driver* [b] *(curies)*					*Blanket*	*Driver*
Sr-90	580	35,000	0.01	0.002	0.3	0.00001	3.48×10^{-8}	2.10×10^{-6}
Y-90	580	35,000	0.01	0.002	0.3	0.00001	3.48×10^{-8}	2.10×10^{-6}
I-129	0.00104	0.0131	0.01	0.002	0.3	0.00001	6.24×10^{-14}	7.86×10^{-13}
Cs-134	9.63	313	0.01	0.002	0.3	0.00001	5.78×10^{-10}	1.88×10^{-8}
Cs-137	1,240	39,200	0.01	0.002	0.3	0.00001	7.44×10^{-8}	2.35×10^{-6}
Ba-137M	1,180	37,100	0.01	0.002	0.3	0.00001	7.08×10^{-8}	2.23×10^{-6}
Ce-144	45.1	526	0.01	0.002	0.3	0.00001	2.71×10^{-9}	3.16×10^{-8}
Pr-144	45.1	526	0.01	0.002	0.3	0.00001	2.71×10^{-9}	3.16×10^{-8}
Pm-147	292	14,700	0.01	0.002	0.3	0.00001	1.75×10^{-8}	8.82×10^{-7}
Sm-151	71.9	948	0.01	0.002	0.3	0.00001	4.31×10^{-9}	5.69×10^{-8}
Eu-154	5.28	101	0.01	0.002	0.3	0.00001	3.17×10^{-10}	6.06×10^{-9}
Eu-155	34.6	677	0.01	0.002	0.3	0.00001	2.08×10^{-9}	4.06×10^{-8}
Th-228	0.000111	0.0091	0.01	0.002	0.3	0.00001	6.66×10^{-15}	5.48×10^{-13}
Np-237	0.00602	0.0513	0.01	0.002	0.3	0.00001	3.61×10^{-13}	3.08×10^{-12}
Pu-238	6.44	66.8	0.01	0.002	0.3	0.00001	3.86×10^{-10}	4.01×10^{-9}
Pu-239	517	108	0.01	0.002	0.3	0.00001	3.10×10^{-8}	6.48×10^{-9}
Pu-240	35.5	3.67	0.01	0.002	0.3	0.00001	2.13×10^{-9}	2.20×10^{-10}
Pu-241	144	8.93	0.01	0.002	0.3	0.00001	8.64×10^{-9}	5.36×10^{-10}
Am-241	11.7	0.0694	0.01	0.002	0.3	0.00001	7.02×10^{-10}	4.16×10^{-12}
Am-242M	0.121	0.0000588	0.01	0.002	0.3	0.00001	7.26×10^{-12}	3.53×10^{-15}

[a] Radionuclide inventory from Appendix D.

[b] Use of data contained in the draft report (Goff et al. 1999a) for the driver spent nuclear fuel results in higher material-at-risk values for most isotopes presented in Table F–3 compared to data in the final report (Goff et al. 1999b). Therefore, these material-at- risk estimates were not revised to reflect data in the final report.

- *Cask drop and gaseous fission product release*—Spent nuclear fuel casks would be handled frequently when the sodium-bonded fuel is processed. (Spent nuclear fuel handling at the ANL-W site is not limited to that associated with the treatment of the sodium-bonded spent nuclear fuel. The accident discussed here is intended to address only that portion of the handling activity that can be directly attributed to the treatment of sodium-bonded spent nuclear fuel.) Spent nuclear fuel stored in the Radioactive Scrap and Waste Facility would be transferred to the Fuel Conditioning Facility for processing. Spent nuclear fuel would be received from off site at the Hot Fuel Examination Facility and would be transferred to the Fuel Conditioning Facility for processing. The HFEF-5 cask would be used to move EBR-II driver and blanket

spent nuclear fuel from the Radioactive Scrap and Waste Facility to the Fuel Conditioning Facility. The postulated accident is described in the Safety Analysis Report for the Hot Fuel Examination Facility (ANL 1998b). The accident involves a cask dropped during unloading, resulting in seal and fuel cladding failure sufficient to release gaseous and volatile fission products to the atmosphere. The drop could be initiated by failure of lifting equipment, slings, hooks, cables, or human error by the lifting equipment operator. The cask drop was assumed conservatively to result in an unfiltered release of gaseous and volatile fission products. The release was assumed to be a puff release at ground level. Dropping of casks, while rare, is nevertheless categorized as anticipated, since such events have happened in the past and may be expected to occur over the lifetime of the facility. The frequency of cask dropping was assumed to be 0.01 per year, consistent with that used in the Safety Analysis Report for the Hot Fuel Examination Facility.

The HFEF-5 cask can contain two EBR-II driver spent nuclear fuel assemblies. It was assumed conservatively that the equivalent of one assembly (61 elements) fails in the accident. The material at risk, as shown in **Table F–4**, would be the equivalent of one EBR-II driver or blanket spent nuclear fuel assembly. The damage ratio for the failed elements was assumed to be 1, since all gaseous and volatile fission products conservatively could be released to the cask following cladding failure. The airborne release and respirable fractions for gases were each assumed to be 1, and 1×10^{-7} for cesium from the dislodgement of surface contamination (DOE 1995a). The accident was assumed to occur outdoors, with a leak path factor of 1.

Table F–4 Material at Risk and Release Fraction Values for a Cask Drop Accident at ANL-W

Material at Risk[a]							*Source Term (curies)*	
Isotope	*Blanket (curies)*	*Driver (curies)*	*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Blanket*	*Driver*
H-3 [b]	0.335	5.17	1	1	1	1	0.335	5.17
Kr-85	2.44	79.4	1	1	1	1	2.44	79.4
Cs-134	0.63	7.39	1	1.0×10^{-7}	1	1	6.30×10^{-8}	7.39×10^{-7}
Cs-137	81.3	928	1	1.0×10^{-7}	1	1	8.13×10^{-6}	0.0000928

[a] Data for one assembly based on Appendix D curie content data.
[b] It was assumed that 1 percent of this release becomes oxidized.

- *Salt transfer drop during movement from the Fuel Conditioning Facility to the Hot Fuel Examination Facility*—Solidified electrorefiner salt is sent from the Fuel Conditioning Facility to the Hot Fuel Examination Facility for processing into a final ceramic waste form. It is transferred in large chunks within the HFEF-5 cask. Transfer is via forklift or truck. In this scenario, a severe vehicle accident occurs, resulting in a breach of the inner and outer salt container. The accident could be caused by operator error or equipment failure. The accident is considered beyond-design-basis because of the durability of the shielded HFEF-5 canister. There would be over 200 transfers of salt from the Fuel Conditioning Facility to the Hot Fuel Examination Facility. A probability of 1×10^{-7} was assumed. The release occurs at ground level with a duration of one hour.

Table F–5 provides the isotopic material at risk for a total material at risk of 20 kilograms of salt. The salt is in chunks (i.e., ice cube-size) and is not combustible. No significant release was assumed from the large pieces. Some of the salt pieces would experience brittle fracture and release particulates. A brittle fracture particulate fraction for solidified salt would be 0.0001 for particles less than 10 microns in diameter (ANL 1998b); therefore, a damage ratio of 0.0001 was assumed. Conservatively, the same airborne release fraction and respirable fraction values were used for this scenario as for the salt powder spill in the Hot Fuel Examination Facility Main Cell; that is, the airborne release fraction for powder is 0.002 and the respirable fraction is 0.3 (DOE 1994b). The accident occurs outdoors; therefore, the leak path factor is 1.

Table F–5 Material at Risk and Release Fraction Values for a Salt Transfer Drop Accident at ANL-W

Material at Risk [a]			*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*	
Isotope	*Blanket (curies)*	*Driver (curies)*					*Blanket*	*Driver*
Sr-90	116	7,000	0.0001	0.002	0.3	1	6.96×10^{-6}	0.000420
Y-90	116	7,000	0.0001	0.002	0.3	1	6.96×10^{-6}	0.000420
I-129	0.000207	0.00261	0.0001	0.002	0.3	1	1.24×10^{-11}	1.57×10^{-10}
Cs-134	1.92	62.5	0.0001	0.002	0.3	1	1.15×10^{-7}	3.75×10^{-6}
Cs-137	249	7,850	0.0001	0.002	0.3	1	0.0000149	0.000471
Ba-137M	236	7,420	0.0001	0.002	0.3	1	0.0000142	0.000445
Ce-144	9.02	105	0.0001	0.002	0.3	1	5.41×10^{-7}	6.30×10^{-6}
Pr-144	9.02	105	0.0001	0.002	0.3	1	5.41×10^{-7}	6.30×10^{-6}
Pm-147	58.5	2,930	0.0001	0.002	0.3	1	3.51×10^{-6}	0.000176
Sm-151	14.4	190	0.0001	0.002	0.3	1	8.64×10^{-7}	0.0000114
Eu-154	1.06	20.1	0.0001	0.002	0.3	1	6.36×10^{-8}	1.21×10^{-6}
Eu-155	6.91	135	0.0001	0.002	0.3	1	4.15×10^{-7}	8.10×10^{-6}
Th-228	0.0000223	0.00183	0.0001	0.002	0.3	1	1.34×10^{-8}	1.10×10^{-10}
Np-237	0.00120	0.0103	0.0001	0.002	0.3	1	7.20×10^{-11}	6.18×10^{-10}
Pu-238	1.29	13.4	0.0001	0.002	0.3	1	7.74×10^{-8}	8.04×10^{-7}
Pu-239	103	21.6	0.0001	0.002	0.3	1	6.18×10^{-6}	1.30×10^{-6}
Pu-240	7.11	0.733	0.0001	0.002	0.3	1	4.27×10^{-7}	4.40×10^{-8}
Pu-241	28.8	1.79	0.0001	0.002	0.3	1	1.73×10^{-6}	1.07×10^{-7}
Am-241	2.34	0.0139	0.0001	0.002	0.3	1	1.40×10^{-7}	8.34×10^{-10}
Am-242M	0.0243	0.0000118	0.0001	0.002	0.3	1	1.46×10^{-9}	7.08×10^{-13}

[a] The material at risk is the isotope in 20 kilograms of salt, which is 20 percent of the values given in Table F-3.

- *Transuranic waste fire*—Transuranic waste is generated as a result of treatment operations, as well as other operations, at ANL-W. This waste is placed in containers and temporarily stored (staged) at ANL-W pending shipment to the Radioactive Waste Management Complex. A fire was postulated to occur in a 1.2 × 1.2 × 2.4-meter (4 × 4 × 8-foot) solid transuranic waste box because of spontaneous combustion, pyrophoric material, vehicle accident, electrical failure, or poor housekeeping. The fire consumes the contents of one box of transuranic waste. The accident was assumed to occur outdoors during handling. The release occurs at ground level over one hour. The Final Safety Analysis Report for the Fuel Conditioning Facility assigned an accident frequency in the range of 0.0001 to 0.01 (ANL 1998a). Here, the accident was assumed to have a frequency of 0.001 per year.

  The material at risk, as shown in **Table F–6**, was assumed to be one box of transuranic waste. The waste boxes are loaded with 1/20th of 0.34 curies of alpha activity, as described in the Fuel Conditioning Facility Final Safety Analysis Report (ANL 1998a). The material at risk is 0.017 curies of transuranic nuclides, with the nuclide distribution associated with the generic contents of a transuranic waste container. The damage ratio was assumed to be 1, since all waste in the container was assumed to be involved in the fire. An airborne release fraction of 0.0005 and a respirable fraction of 1 for burning of surface contaminated waste was used (DOE 1994b). The leak path factor was assumed to be 1. No credit was taken for building confinement.

Table F–6 Material at Risk and Release Fraction Values for a Transuranic Waste Fire Accident at ANL-W

Material at Risk [a]		*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*
Isotope	*Curies*					
Pu-238	0.000153	1	0.0005	1	1	7.67×10^{-8}
Pu-239	0.0123	1	0.0005	1	1	6.15×10^{-6}
Pu-240	0.000846	1	0.0005	1	1	4.23×10^{-7}
Pu-241	0.00343	1	0.0005	1	1	1.72×10^{-6}
Am-241	0.000266	1	0.0005	1	1	1.33×10^{-7}

[a] The material at risk is for a generic waste package, not for any specific spent nuclear fuel.

- *Design-basis earthquake - multifacility effects*—In the Fuel Conditioning Facility, the argon cell contains the equipment for processing sodium-bonded spent nuclear fuel into salt and metallic waste forms and a uranium metal product. All operations involving bare fuel are conducted in the argon cell because the inert atmosphere precludes pyrophoric metal fire. Fire cannot occur unless sufficient oxygen enters the cell through a cell breach. The walls, ceiling, and floor of the argon cell are constructed from reinforced concrete with thicknesses ranging from 1.2 to 1.5 meters (4 to 5 feet). It also has a gas-tight steel lining. It was assumed that the accident occurs during electrometallurgical treatment operations. Chopped fuel, electrorefiner salts, cathodes, and anodes are all present in the argon cell. Consistent with the assumption given in the Fuel Conditioning Facility Safety Analysis Report, a design-basis earthquake at this facility would result in a cell breach and in-leakage of air. The air in the cell would cause pyrophoric metals to ignite and burn. The Final Safety Analysis Report for the Fuel Conditioning Facility (ANL 1998a) identifies the seismic design goal for the facility to be the ability to withstand a 0.21 g design-basis earthquake. This event is identified as having a return frequency of 0.0002 per year. At this earthquake level, the electrorefiners are seismically qualified, and no spill of molten salt would occur. The safety exhaust system also would remain operational, although breaches could occur in the argon cell boundary after a design-basis earthquake. The safety exhaust building, which includes the high-efficiency particulate air filters, is designed to withstand an earthquake of 0.24 g, and was assumed to function as designed, filtering the cell atmosphere prior to release through the Fuel Conditioning Facility stack.

  In the Hot Fuel Examination Facility, grinding of salt into powder was assumed to be occurring in the Main Cell. The grinder is located in the Hot Fuel Examination Facility Main Cell on a raised floor consisting of steel plates resting on supports. Underneath the floor is a 2.4-meter-deep (8-foot-deep) pit that houses the ventilation ductwork and high-efficiency particulate air filters. At the Hot Fuel Examination Facility, a design-basis earthquake was assumed to cause the vessel containing ground salt to topple and the powder to spill out. Since the ventilation system was not seismically qualified, it was assumed to fail and result in an unfiltered release. It also was assumed that the design-basis earthquake would cause a loss of electrical power, which would result in failure of the ventilation system. The Main Cell breaches at piping or ventilation penetrations, providing a release path for the suspended powder. The releases occur over a one-hour period, and were modeled as a ground-level release.

  The Hot Fuel Examination Facility has been analyzed for a 0.14 g design-basis earthquake, an event with a return frequency of 0.001 per year and a performance goal of 0.0001 per year. The functionality of equipment after a 0.14 g earthquake has not been determined as yet. However, all major systems remained functional during the 0.03 g Borah earthquake in 1983, an event with a return frequency of 0.008 per year. While it is expected that the equipment would survive a 0.14 g earthquake with a frequency of 0.001 per year, the 0.008 per year earthquake frequency (ANL 1998b) was used conservatively to represent the upper bound of the design-basis earthquake, which would result in a salt powder spill and the failure of the ventilation system. This frequency is nearly two orders of magnitude higher than that corresponding to a 0.21 g earthquake that could impact both the Hot Fuel Examination Facility and the Fuel Conditioning Facility. Therefore, 0.008 per year was used for the design-basis earthquake accident frequency for the Hot Fuel Examination Facility.

In the Fuel Conditioning Facility, the material at risk is chopped spent nuclear fuel and uranium in two electrorefiner cathodes in the argon cell at the time of the accident. **Table F–7** provides material-at-risk values for the isotopes of concern. The bounding inventory is 20 kilograms (44 pounds) of chopped fuel and the uranium in two solid electrorefiner cathodes (ANL 1998a). The solid cathodes contain 17 kilograms (37 pounds) of uranium. (Uranium is considered a toxic chemical in the chemical accident assessment, Section F.3.) The material at risk is, therefore, the 20 kilograms (44 pounds) of chopped spent nuclear fuel. For the metal fire in the argon cell, the damage ratio was assumed to be 1, since all materials in the material at risk are released to the cells in the accident. For the Fuel Conditioning Facility, the airborne release fraction values are 1 for krypton-85, 0.00025 for cesium, and 2.5×10^{-6} for strontium, uranium, and the transuranic waste nuclides; the respirable fractions are each 1 (DOE 1995a). For the Fuel Conditioning Facility, the safety exhaust system remains functional, and the release is filtered through high-efficiency particulate air filters. A leak path factor of 0.00001 was assumed for all particulates.

Table F–7 Material at Risk and Release Fraction Values for a Design-Basis Earthquake at ANL-W

Accident	*Material at Risk* [a]			*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*	
	Isotope	*Blanket (curies)*	*Driver (curies)*					*Blanket*	*Driver*
Design-basis earthquake and salt powder spill at the Hot Fuel Examination Facility	Sr-90	580	35,000	0.01	0.0020	0.30	0.125	0.000435	0.0263
	Y-90	580	35,000	0.01	0.0020	0.30	0.125	0.000435	0.0263
	I-129	0.00104	0.0131	0.01	0.0020	0.30	0.125	7.80×10^{-10}	9.83×10^{-9}
	Cs-134	9.63	313	0.01	0.0020	0.30	0.125	7.22×10^{-6}	0.000235
	Cs-137	1,240	39,200	0.01	0.0020	0.30	0.125	0.000930	0.0294
	Ba-137M	1,180	37,100	0.01	0.0020	0.30	0.125	0.000885	0.0278
	Ce-144	45.1	526	0.01	0.0020	0.30	0.125	0.0000338	0.000395
	Pr-144	45.1	526	0.01	0.0020	0.30	0.125	0.0000338	0.000395
	Pm-147	292	14,700	0.01	0.0020	0.30	0.125	0.000219	0.0110
	Sm-151	71.9	948	0.01	0.0020	0.30	0.125	0.0000539	0.000711
	Eu-154	5.28	101	0.01	0.0020	0.30	0.125	3.96×10^{-6}	0.0000758
	Eu-155	34.6	677	0.01	0.0020	0.30	0.125	0.0000260	0.000508
	Th-228	0.000111	0.00913	0.01	0.0020	0.30	0.125	8.33×10^{-11}	6.85×10^{-9}
	Np-237	0.00602	0.0513	0.01	0.0020	0.30	0.125	4.51×10^{-9}	3.85×10^{-8}
	Pu-238	6.44	66.8	0.01	0.0020	0.30	0.125	4.83×10^{-6}	0.0000501
	Pu-239	517	108	0.01	0.0020	0.30	0.125	0.000388	0.0000810
	Pu-240	35.5	3.67	0.01	0.0020	0.30	0.125	0.0000266	2.75×10^{-6}
	Pu-241	144	8.93	0.01	0.0020	0.30	0.125	0.000108	6.70×10^{-6}
	Am-241	11.7	0.0694	0.01	0.0020	0.30	0.125	8.78×10^{-6}	5.21×10^{-8}
	Am-242M	0.121	0.0000588	0.01	0.0020	0.30	0.125	9.08×10^{-8}	4.41×10^{-11}
Design-basis earthquake and metal fire in the Fuel Conditioning Facility argon cell	H-3	0.142	24.4	1	1	1	1	0.142	24.4
	C-14	0.00119	3,980	1	2.5×10^{-6}	1	0.00001	2.99×10^{-14}	9.95×10^{-8}
	Fe-55	1.80	97.4	1	2.5×10^{-6}	1	0.00001	4.51×10^{-11}	2.44×10^{-9}
	Co-60	0.318	9.62	1	2.5×10^{-6}	1	0.00001	7.95×10^{-12}	2.41×10^{-10}
	Ni-63	0.0612	4.58	1	2.5×10^{-6}	1	0.00001	1.53×10^{-12}	1.15×10^{-10}
	Kr-85	1.04	378	1	1	1	1	1.04	378
	Sr-90	16.1	3,940	1	2.5×10^{-6}	1	0.00001	4.04×10^{-10}	9.85×10^{-8}
	Y-90	16.1	3,940	1	2.5×10^{-6}	1	0.00001	4.04×10^{-10}	9.85×10^{-8}
	Ru-106	2.70	30.2	1	0.00025	1	0.00001	6.75×10^{-9}	7.55×10^{-8}
	Rh-106	2.70	30.2	1	2.5×10^{-6}	1	0.00001	6.75×10^{-11}	7.55×10^{-10}

Accident	*Material at Risk* [a]			*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*	
	Isotope	*Blanket (curies)*	*Driver (curies)*					*Blanket*	*Driver*
Design-basis earthquake and metal fire in the Fuel Conditioning Facility argon cell (cont'd)	Cd-113M	0.0142	0.928	1	2.5×10^{-6}	1	0.00001	3.56×10^{-13}	2.32×10^{-11}
	Sb-125	0.462	59.2	1	2.5×10^{-6}	1	0.00001	1.16×10^{-11}	1.48×10^{-9}
	Te-125M	0.190	24.6	1	2.5×10^{-6}	1	0.00001	4.76×10^{-12}	6.15×10^{-10}
	I-129	0.0000288	0.00147	1	1	1	1	0.0000288	0.00147
	Cs-134	0.268	35.2	1	0.00025	1	0.00001	6.70×10^{-10}	8.80×10^{-8}
	Cs-137	34.6	4,420	1	0.00025	1	0.00001	8.65×10^{-8}	0.0000111
	Ba-137M	32.8	4,180	1	2.5×10^{-6}	1	0.00001	8.20×10^{-10}	1.05×10^{-7}
	Ce-144	1.25	59.2	1	2.5×10^{-6}	1	0.00001	3.14×10^{-11}	1.48×10^{-9}
	Pr-144	1.25	59.2	1	2.5×10^{-6}	1	0.00001	3.14×10^{-11}	1.48×10^{-9}
	Pm-147	8.14	1,650	1	2.5×10^{-6}	1	0.00001	2.04×10^{-10}	4.13×10^{-8}
	Sm-151	2.00	107	1	2.5×10^{-6}	1	0.00001	5.00×10^{-11}	2.67×10^{-9}
	Eu-154	0.147	11.3	1	2.5×10^{-6}	1	0.00001	3.67×10^{-12}	2.84×10^{-10}
	Eu-155	0.962	76.2	1	2.5×10^{-6}	1	0.00001	2.41×10^{-11}	1.91×10^{-9}
	Th-228	3.10×10^{-6}	0.00103	1	2.5×10^{-6}	1	0.00001	7.75×10^{-17}	2.57×10^{-14}
	U-234	0.0000266	0.808	1	2.5×10^{-6}	1	0.00001	6.65×10^{-16}	2.02×10^{-11}
	U-235	0.0000754	0.0262	1	2.5×10^{-6}	1	0.00001	1.89×10^{-15}	6.55×10^{-13}
	U-236	0.0000848	0.0242	1	2.5×10^{-6}	1	0.00001	2.12×10^{-15}	6.05×10^{-13}
	U-238	0.00654	0.00222	1	2.5×10^{-6}	1	0.00001	1.64×10^{-13}	5.55×10^{-14}
	Np-237	2.60×10^{-6}	0.00578	1	2.5×10^{-6}	1	0.00001	6.50×10^{-17}	1.45×10^{-13}
	Pu-238	0.188	3.32	1	2.5×10^{-6}	1	0.00001	4.70×10^{-12}	8.30×10^{-11}
	Pu-239	15.1	5.38	1	2.5×10^{-6}	1	0.00001	3.77×10^{-10}	1.35×10^{-10}
	Pu-240	1.04	0.182	1	2.5×10^{-6}	1	0.00001	2.59×10^{-11}	4.56×10^{-12}
	Pu-241	4.20	0.444	1	2.5×10^{-6}	1	0.00001	1.05×10^{-10}	1.11×10^{-11}
	Am-241	0.326	0.00782	1	2.5×10^{-6}	1	0.00001	8.15×10^{-12}	1.96×10^{-13}
	Am-242M	0.00338	6.62×10^{-6}	1	2.5×10^{-6}	1	0.00001	8.45×10^{-14}	1.66×10^{-16}

[a] Radionuclide inventory from Appendix D.

During the postulated event, 100 kilograms (220 pounds) of solidified salt powder with the same concentration of radionuclides as described previously for the salt powder spill accident are assumed to be spilled in the Hot Fuel Examination Facility Main Cell. As previously discussed, in a salt powder spill, less than 1 percent of the salt would have the characteristics capable of resulting in an airborne release, i.e., a damage ratio of 0.01 was used. For the powder spill within the cell, an airborne release fraction of 0.002 and a respirable fraction of 0.3 were assumed (DOE 1994b). These are the same values as those used for the salt powder spill accident described previously. The Hot Fuel Examination Facility leak path for the release is through three enclosures before reaching the outside: the Main Cell, ducts and pipes, and the building. Consistent with the facility safety analysis report assumption, a leak path factor of 0.5 was assigned to each enclosure for plate-out and settling of the airborne powder. Therefore, the total leak path factor is $0.5 \times 0.5 \times 0.5 = 0.125$.

- *Aircraft crash*—The potential for an aircraft crash was evaluated. The methodology for evaluating the likelihood of an aircraft crash is documented in the *DOE Standard: Accident Analysis for Aircraft Crash into Hazardous Facilities* (DOE 1996c). At Idaho National Engineering and Environmental Laboratory (INEEL), the probabilities of a small and large aircraft crash are 2.3×10^{-4} and 1.0×10^{-6} crashes per square kilometer (9×10^{-5} and 4×10^{-7} crashes per square mile) per year, respectively. Using guidance in this DOE standard, the effective area of the Fuel Conditioning Facility was calculated accounting for aircraft wing span and potential skid distance. The effective area of the Fuel Conditioning Facility is about 0.078 square kilometers (0.03 square miles) for a large aircraft, and 0.018 square kilometers (0.007 square miles) for a small aircraft. The effective area of the Fuel Conditioning Facility is conservative because the

combined area of the air and argon cells, where the hazardous materials are contained, is smaller than the total area of the building. Multiplying the effective area by INEEL-specific crash rates gives an estimated probability of a crash into the Fuel Conditioning Facility of 1×10^{-8} for large aircraft and 6×10^{-7} for small aircraft. Comparable probabilities are applicable to the Hot Fuel Examination Facility. A large aircraft crash is not reasonably foreseeable, and given the 1.2 to 1.5-meter-thick (4 to 5-foot-thick) walls of the cells and the "buffer" provided by the building exterior walls, the crash of a small aircraft is unlikely to result in any damage to the cells. Damage from the more probable seismic events analyzed is considered to bound the damage that could result from a small aircraft crash. Also, seismic events affect more than one facility, while an aircraft crash could affect only one facility. Therefore, an aircraft crash was not analyzed separately.

- *Nuclear criticality*—The potential for a nuclear criticality was considered in the accident analysis. Nuclear criticality has been evaluated in the safety analyses documented for the ANL-W facilities, as required by DOE. The existing safety analyses conclude that nuclear criticality is beyond the design-basis of the facilities proposed for the electrometallurgical treatment alternative and, therefore, has a probability of less than 1×10^{-6} per year. This conclusion is based on a lack of nuclear moderator materials, equipment design, and inventory controls, as well as numerous other administrative controls and operating procedures. The intent of the process is to dilute, rather than concentrate, fissile materials. Fuel storage racks and processing equipment are designed to maintain their safety function during the design-basis earthquake. Even in a beyond-design-basis earthquake (maximum frequency of 0.00001 per year), nuclear materials would have to come together in an ideal critical array for criticality to be possible. For example, it would require more than the equivalent of 10 EBR-II driver spent nuclear fuel assemblies (610 individual elements) in an ideal geometric configuration to create a potential criticality hazard. During processing, some fuel would be stored in the hot cells. This fuel is stored in the storage cans within the floor storage pits. The floor storage pits are evenly spaced 61 centimeters (2 feet) from the center, located almost entirely on a 3-meter-thick (10-foot-thick) hot cell concrete floor. These pits are designed to maintain criticality-safe configurations under all normal and design-basis abnormal conditions, including a design-basis earthquake (ANL 1998a). An evaluation of earthquake loading has concluded that no uplifting of the hot cell floor would occur in a beyond-design-basis earthquake of 0.3 g peak ground acceleration (corresponding to an earthquake frequency of 0.00001 per year) (ANL 1999). Therefore, the conditional probability of creating a criticality hazard configuration, given a beyond-design-basis earthquake, was estimated to be no greater than 0.01. Therefore, criticality is not considered to be reasonably foreseeable, and was not analyzed quantitatively.

- *Beyond-design-basis earthquake*—This scenario is similar to the design-basis earthquake except that the safety exhaust system was not assumed to function at the Fuel Conditioning Facility, and an electrorefiner was assumed to spill its molten salt. Also, since spent nuclear fuel elements are stored in both the Fuel Conditioning Facility and the Hot Fuel Examination Facility, a fraction of stored fuel elements were assumed to experience cladding failure and release of gaseous and volatile fission products. All releases were modeled as ground-level releases. The Fuel Conditioning Facility horizontal acceleration design-basis is 0.21 g, and the newer safety equipment building is designed for a 0.24 g horizontal acceleration. A 0.24 g peak acceleration corresponds to an earthquake frequency at ANL-W of approximately 0.0001 per year (WCFS 1998). The Fuel Conditioning Facility natural phenomena hazard performance goal is a frequency of 0.00001 (DOE 1994a). (The Hot Fuel Examination Facility performance goal is 0.0001.) The performance goal can be interpreted as the frequency level at which facility damage will initiate. The Fuel Conditioning Facility and safety exhaust system are not expected to suffer damage from earthquakes with frequencies higher than this. Therefore, the upper bound for the beyond-design-basis earthquake frequency was assumed to correspond to the frequency of the performance goal, 0.00001per year.

  The material at risk, provided in **Table F–8**, would be the same as for the design-basis earthquake, with the addition of the salt in the electrorefiners and the fuel elements and subassemblies in storage. Although the electrorefiners are seismically qualified, one of the two electrorefiners in the Fuel Conditioning Facility argon cell was assumed conservatively to spill its molten salt. It was assumed that approximately 700 kilograms (1,540 pounds) of salt are fully loaded with radionuclides from the processing of 5.56 metric

tons of heavy metal of blanket spent nuclear fuel elements or 1.1 metric tons of driver spent nuclear fuel elements and are about to be replaced at the time of the accident. The damage ratio for all but the fuel assemblies in storage was assumed to be 1, as in the design-basis earthquake. Both the blanket and driver spent nuclear fuel elements are stored in racks with the cladding intact. In the earthquake, some could be expected to fall out of the racks or be hit by falling debris, but it is not reasonable to assume all assemblies would be damaged. It was assumed that 10 percent of the elements stored in the cells at the time of the earthquake experience cladding failure and release gaseous and volatile fission products. For the driver spent nuclear fuel elements, this is the equivalent of 12 driver assemblies (or 50 kilograms [110 pounds] of heavy metal). Ten percent of the stored blanket elements is the equivalent of 370 kilograms (771 pounds) of heavy metal. The airborne release fraction and respirable fraction values are the same as for the design-basis earthquake, with the addition of krypton and cesium from the failed EBR-II driver and blanket fuel. The airborne release fraction and respirable fraction values for krypton and tritium (H-3), both elements in the gaseous state, are each 1. For the molten salt spill, the airborne release fraction and respirable fraction values for viscous solutions (DOE 1994b) were used: 4×10^{-6} (0.0004 for iodine and cesium) for the airborne release fraction and 0.8 for the respirable fraction. The forces associated with the beyond-design-basis earthquake were assumed to result in the failure of confinement integrity. The cells were assumed to experience major failure, and the release would be directly to the atmosphere. The leak path factor is 1.

Table F–8 Material at Risk and Release Fraction Values for a Beyond-Design-Basis Earthquake at ANL-W

Accident	*Material at Risk*[a]			*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*	
	Isotope	*Blanket (curies)*	*Driver (curies)*					*Blanket*	*Driver*
Beyond-design-basis earthquake and salt powder spill in the Hot Fuel Examination Facility	Sr-90	580	35,000	0.01	0.002	0.3	1	0.00348	0.21
	Y-90	580	35,000	0.01	0.002	0.3	1	0.00348	0.21
	I-129	0.00104	0.0131	0.01	0.002	0.3	1	6.24×10^{-9}	7.86×10^{-8}
	Cs-134	9.63	313	0.01	0.002	0.3	1	0.0000578	0.00188
	Cs-137	1,240	39,200	0.01	0.002	0.3	1	0.00744	0.235
	Ba-137M	1,180	37,100	0.01	0.002	0.3	1	0.00708	0.223
	Ce-144	45.1	526	0.01	0.002	0.3	1	0.000271	0.00316
	Pr-144	45.1	526	0.01	0.002	0.3	1	0.000271	0.00316
	Pm-147	292	14,700	0.01	0.002	0.3	1	0.00175	0.0882
	Sm-151	71.9	948	0.01	0.002	0.3	1	0.000431	0.00569
	Eu-154	5.28	101	0.01	0.002	0.3	1	0.0000317	0.000606
	Eu-155	34.6	677	0.01	0.002	0.3	1	0.000148	0.00406
	Th-228	0.000111	0.00913	0.01	0.002	0.3	1	6.66×10^{-10}	5.48×10^{-8}
	Np-237	0.00602	0.0513	0.01	0.002	0.3	1	3.61×10^{-8}	3.08×10^{-7}
	Pu-238	6.44	66.8	0.01	0.002	0.3	1	0.0000386	0.000401
	Pu-239	517	108	0.01	0.002	0.3	1	0.00310	0.000648
	Pu-240	35.5	3.67	0.01	0.002	0.3	1	0.000213	0.000022
	Pu-241	144	8.93	0.01	0.002	0.3	1	0.000864	0.0000536
	Am-241	11.7	0.0694	0.01	0.002	0.3	1	0.0000702	4.16×10^{-7}
	Am-242M	0.121	0.0000588	0.01	0.002	0.3	1	7.26×10^{-7}	3.53×10^{-10}
Beyond-design-basis earthquake and metal fire in the Fuel Conditioning Facility argon cell	H-3	0.142	24.4	1	1	1	1	0.142	24.4
	C-14	0.00119	3,980	1	2.5×10^{-6}	1	1	2.99×10^{-9}	0.00995
	Fe-55	1.80	97.4	1	2.5×10^{-6}	1	1	4.51×10^{-6}	0.000244
	Co-60	0.318	9.62	1	2.5×10^{-6}	1	1	7.95×10^{-7}	0.0000241
	Ni-63	0.0612	458	1	2.5×10^{-6}	1	1	1.53×10^{-7}	0.00115
	Kr-85	1.04	378	1	1	1	1	1.04	378
	Sr-90	16.1	3,940	1	2.5×10^{-6}	1	1	0.0000404	0.00985
	Y-90	16.1	3,940	1	2.5×10^{-6}	1	1	0.0000404	0.00985
	Ru-106	2.70	30.2	1	0.00025	1	1	0.000675	0.00755

Accident	*Material at Risk*[a]			*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*	
	Isotope	*Blanket (curies)*	*Driver (curies)*					*Blanket*	*Driver*
Beyond-design-basis earthquake and metal fire in the Fuel Conditioning Facility argon cell (cont'd)	Rh-106	2.70	30.2	1	2.5×10^{-6}	1	1	6.75×10^{-6}	0.0000755
	Cd-113M	0.0142	0.928	1	2.5×10^{-6}	1	1	3.56×10^{-8}	2.32×10^{-6}
	Sb-125	0.462	59.2	1	2.5×10^{-6}	1	1	1.15×10^{-6}	0.000148
	Te-125M	0.190	24.6	1	2.5×10^{-6}	1	1	4.76×10^{-7}	0.0000615
	I-129	0.0000288	0.00147	1	1	1	1	0.0000288	0.00147
	Cs-134	0.268	35.2	1	0.00025	1	1	0.000067	0.00880
	Cs-137	34.6	4,420	1	0.00025	1	1	0.00865	1.10
	Ba-137M	32.8	4,180	1	2.5×10^{-6}	1	1	0.000082	0.0105
	Ce-144	1.25	59.2	1	2.5×10^{-6}	1	1	3.14×10^{-6}	0.000148
	Pr-144	1.25	59.2	1	2.5×10^{-6}	1	1	3.14×10^{-6}	0.000148
	Pm-147	8.14	1,650	1	2.5×10^{-6}	1	1	0.0000204	0.00413
	Sm-151	2.00	107	1	2.5×10^{-6}	1	1	5.00×10^{-6}	0.000267
	Eu-154	0.147	11.3	1	2.5×10^{-6}	1	1	3.67×10^{-7}	0.0000284
	Eu-155	0.962	76.2	1	2.5×10^{-6}	1	1	2.41×10^{-6}	0.000191
	Th-228	3.10×10^{-6}	0.00103	1	2.5×10^{-6}	1	1	7.75×10^{-12}	2.57×10^{-9}
	Np-237	0.0000266	0.808	1	2.5×10^{-6}	1	1	6.65×10^{-11}	2.02×10^{-6}
	U-234	0.0000754	0.0262	1	2.5×10^{-6}	1	1	1.89×10^{-10}	6.55×10^{-8}
	U-235	0.0000848	0.0242	1	2.5×10^{-6}	1	1	2.12×10^{-10}	6.05×10^{-8}
	U-236	0.00654	0.00222	1	2.5×10^{-6}	1	1	1.64×10^{-8}	5.55×10^{-9}
	U-238	2.60×10^{-6}	0.00578	1	2.5×10^{-6}	1	1	6.50×10^{-12}	1.45×10^{-8}
	Pu-238	0.188	3.32	1	2.5×10^{-6}	1	1	4.70×10^{-7}	8.30×10^{-6}
	Pu-239	15.1	5.38	1	2.5×10^{-6}	1	1	0.0000377	0.0000135
	Pu-240	1.04	0.182	1	2.5×10^{-6}	1	1	2.59×10^{-6}	4.56×10^{-7}
	Pu-241	4.20	0.444	1	2.5×10^{-6}	1	1	0.0000105	1.11×10^{-6}
	Am-241	0.326	0.00782	1	2.5×10^{-6}	1	1	8.15×10^{-7}	1.96×10^{-8}
	Am-242M	0.00338	6.62×10^{-6}	1	2.5×10^{-6}	1	1	8.45×10^{-9}	1.66×10^{-11}
Beyond-design-basis earthquake and liquid salt spill at the Fuel Conditioning Facility	Sr-90	4,490	245,000	1	4.0×10^{-6}	0.8	1	0.0144	0.784
	Y-90	4,490	245,000	1	4.0×10^{-6}	0.8	1	0.0144	0.784
	I-129	0.00801	0.0917	1	0.0004	0.8	1	2.56×10^{-6}	0.0000293
	Cs-134	74.5	2,190	1	0.0004	0.8	1	0.0238	0.701
	Cs-137	9,620	274,000	1	0.0004	0.8	1	3.08	87.8
	Ba-137M	9,120	260,000	1	4.0×10^{-6}	0.8	1	0.0292	0.831
	Ce-144	349	3,680	1	4.0×10^{-6}	0.8	1	0.00112	0.0118
	Pr-144	349	3,680	1	4.0×10^{-6}	0.8	1	0.00112	0.0118
	Pm-147	2,260	103,000	1	4.0×10^{-6}	0.8	1	0.00723	0.329
	Sm-151	556	6,640	1	4.0×10^{-6}	0.8	1	0.00178	0.0212
	Eu-154	40.8	707	1	4.0×10^{-6}	0.8	1	0.000131	0.00226
	Eu-155	267	4,740	1	4.0×10^{-6}	0.8	1	0.000854	0.0152
	Th-228	0.000862	0.0639	1	4.0×10^{-6}	0.8	1	2.76×10^{-9}	2.05×10^{-7}
	Np-237	0.0465	0.359	1	4.0×10^{-6}	0.8	1	1.49×10^{-7}	1.15×10^{-6}
	Pu-238	49.8	468	1	4.0×10^{-6}	0.8	1	0.000159	0.0015
	Pu-239	4,000	756	1	4.0×10^{-6}	0.8	1	0.0128	0.00242
	Pu-240	274	25.7	1	4.0×10^{-6}	0.8	1	0.000877	0.0000822
	Pu-241	1,110	62.5	1	4.0×10^{-6}	0.8	1	0.00355	0.0002
	Am-241	90.6	0.486	1	4.0×10^{-6}	0.8	1	0.000290	1.55×10^{-6}
	Am-242M	0.940	0.000412	1	4.0×10^{-6}	0.8	1	3.01×10^{-6}	1.32×10^{-9}

Accident	Material at Risk[a]			Damage Ratio	Airborne Release Fraction	Respirable Fraction	Leak Path Factor	Source Term (curies)	
	Isotope	Blanket (curies)	Driver (curies)					Blanket	Driver
Beyond-design-basis earthquake and stored fuel assembly cladding failure	H-3	2.64	62	1	1	1	1	2.64	62
	Kr-85	19.1	953	1	1	1	1	19.1	953

[a] Radionuclide Inventory from Appendix D.

Accident Scenario Descriptions for Melt and Dilute Processing—The melt and dilute process would occur in the Hot Fuel Examination Facility hot cell at ANL-W. Two melt and dilute process options are considered for ANL-W: (1) cleaning blanket spent nuclear fuel (removing metallic sodium), and (2) cleaning blanket and driver (to the extent possible) spent nuclear fuel (see Appendix C for more details). Sufficient steel would be added to both process options to form an alloy with a composition of 50 percent each of uranium and steel. Both options would occur at a temperature range of about 1,400 °C (2,550 °F). For analysis purposes, it was assumed that, on average, 120 batches of melt and dilute processing could be performed per year, considering an 80 percent availability and a three-batches-per-week operation. Each batch would process about 60 kilograms (132 pounds) of heavy metal of blanket spent nuclear fuel or about 16 kilograms (35 pounds) of driver spent nuclear fuel (diluted with depleted uranium to a 60-kilogram-equivalent [132-pound-equivalent] heavy metal). This would lead to eight years of operations for processing blanket spent nuclear fuel and two years of processing for driver spent nuclear fuel. Prior to the melt and dilute process, the sodium-bonded spent fuel elements would be cut into segments. The segmented fuel elements would be heated to a temperature above the 200 °C (392 °F) melting point of sodium and the molten sodium would be drained into a collection tank. The temperature of this bulk sodium would be raised to 690 °C (1,274 °F), to volatilize the cesium and separate it from the sodium (see Appendix C for a more detailed description of this process).

Table F–9 identifies a list of accident scenarios that were considered to be applicable to the melt and dilute process as proposed at ANL-W. These scenarios are based on the analysis of the melt and dilute process provided in the SRS Spent Nuclear Fuel Management Final EIS (DOE 2000). The accident scenarios and the corresponding source terms have been modified to reflect the specifics associated with the design of the Hot Fuel Examination Facility, the characteristics of the fuel type being processed, the material at risk, and the related release fractions.

Table F–9 Selected Accident Scenarios for Melt and Dilute Processing at ANL-W

Scenario	Frequency (per year)
Nuclear criticality	0.0003
Cask drop	0.01
Waste handling accident	0.0024
Sodium fire [a]	0.008
Aircraft crash	6×10^{-7} to 1×10^{-8}
Design-basis earthquake	0.008

[a] This event is evaluated as being a direct consequence of the design-basis earthquake.

Each accident scenario description sets the condition of the accident and provides a summary of the material involved. The following paragraphs provide a summary of the accidents analyzed, the material at risk, and the release factors for the EBR-II blanket and driver spent nuclear fuel (the Fermi-1 blanket spent nuclear fuel has a very low radioactive inventory).

- *Nuclear criticality*—A criticality accident could result from the processing of multiple batches (double batching) of fissile material in the melter. This accident was considered for the driver spent nuclear fuel only. The criticality was assumed to consist of 5×10^{17} fissions (a solid criticality fission yield) (DOE 2000). The Hot Fuel Examination Facility structure would not be compromised and its ventilation system would be expected to continue to function after a criticality event. Procedural controls would be used to prevent such an accident. Therefore, such an accident would be the result of a combination of human errors, as all criticality controls are designed to meet double contingency requirements. The Hot Fuel Examination Facility Safety Analysis Report identifies a criticality event as an incredible event with an assigned frequency of less than 1×10^{-6} per year (ANL 1998b). However, this Safety Analysis Report does not specifically address melt and dilute operations. A criticality event for the SRS melt and dilute process has been addressed (DOE 2000) and, for consistency among alternatives, this analysis has been adapted. Based on the assumption of approximately 120 batches of melt and dilute operations per year and a similar frequency analysis for this type of accident at SRS, the expected frequency of this event was estimated to be 0.0003 per year for the melt and dilute operations at ANL-W. The material at risk and release fractions are provided in **Table F–10**. The damage ratio and leak path factor for the volatile, gaseous fission products were assumed conservatively to be 1. A respirable fraction value of 1 also was used. The airborne release fraction values range from 0.5 to 0.05 (DOE 1994b).

Table F–10 Melt and Dilute Process Material at Risk and Release Fraction Values for a Nuclear Criticality Event at ANL-W

Material at Risk		*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*
Isotope	*Curies*					
Br-83	4.90	1	0.05	1	1	0.25
Br-84	16.3	1	0.05	1	1	0.82
Kr-83M	1.50	1	0.5	1	1	0.75
Kr-85M	7.2	1	0.5	1	1	3.6
Kr-87	32.8	1	0.5	1	1	17
Kr-88	32.9	1	0.5	1	1	17
Kr-89	1820	1	0.5	1	1	910
Te-129	2.70	1	0.07	1	1	0.19
Te-131	57.5	1	0.07	1	1	4.0
Te-131M	0.320	1	0.07	1	1	0.022
Te-132	1.60	1	0.07	1	1	0.11
Te-133	25.7	1	0.07	1	1	1.8
Te-133M	30.3	1	0.07	1	1	2.1
Te-134	90.5	1	0.07	1	1	6.3
I-131	0.212	1	0.05	1	1	0.011
I-132	0.855	1	0.05	1	1	0.043
I-133	6.80	1	0.05	1	1	0.34
I-134	98.0	1	0.05	1	1	4.9
I-135	22.1	1	0.05	1	1	1.1
Xe-133	0.026	1	0.5	1	1	0.013
Xe-135	2.61	1	0.5	1	1	1.3
Xe-135M	23.9	1	0.5	1	1	0.12
Xe-137	1940	1	0.5	1	1	0.097
Xe-138	665	1	0.5	1	1	0.033

- *Cask drop*—This event is similar to the cask drop event analyzed for the electrometallurgical treatment process. Spent nuclear fuel casks would be handled frequently when the sodium-bonded fuel is treated using the melt and dilute process. (Spent nuclear fuel handling at the ANL-W site is not limited to that associated with the treatment of the sodium-bonded spent nuclear fuel. The accident discussed here is

intended to address only that portion of the handling activity that can be directly attributed to the treatment of sodium-bonded spent nuclear fuel.) The accident involves a dropped cask during loading or unloading, seal failure, and spent nuclear fuel cladding failure sufficient to release gaseous and volatile fission products to the atmosphere, and is the same as previously described for the cask drop accident for the electrometallurgical treatment process. The material at risk and release fraction values are provided in Table F–4. (See the accident description for more detail.)

- *Waste handling accident*—The filters used in the melt and dilute off-gas exhaust system must be cleaned periodically and the resultant liquid waste disposed of. Decontamination of the filters was assumed to be performed after 10 batches are processed. Therefore, it was assumed that after processing 600 kilograms (1,320 pounds) of heavy metal of blanket spent nuclear fuel or 160 kilograms (352 pounds) of heavy metal of driver spent nuclear fuel, the filters would be decontaminated. It was postulated that a spill would occur during the transfer of the decontaminated liquid from one container to another. The event frequency is estimated at 0.0024 events per year (WSRC 1998a). The material at risk is from the fission products released during the melting process and collected on the filters. This includes fission products with boiling points at or below 1400 °C (2,550 °F) and some metal oxides that can be expected to form during the heating process (WSRC 1998b). A damage ratio of 0.5 was assumed to account for the spilling of half of the material during the accident. Airborne release fraction and respirable fraction values of 0.0002 and 0.5, respectively, were chosen for the material based on the release of material from aqueous spills (DOE 1994b). The spill was assumed to occur in an area not provided with a filtration system and, therefore, the leak path factor is 1. The material at risk, release fractions, and curies released for this accident for both EBR-II blanket and driver spent nuclear fuel are presented in **Table F–11**.

Table F–11 Melt and Dilute Process Material at Risk and Release Fraction Values for a Waste Handling Accident at ANL-W

Material At Risk [a]			*Damage Ratio* [b]	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*	
Isotope	*Blanket (curies)*	*Driver (curies)*					*Blanket*	*Driver*
Sr-90	484.2	31520	0.5	0.0002	0.5	1	0.024	1.58
Sb-125	13.86	473.6	0.5	0.0002	0.5	1	0.00069	0.024
Te-125M	5.71	196.8	0.5	0.0002	0.5	1	0.00029	0.0098
I-129	0.00086	0.012	0.5	0.0002	0.5	1	4.32×10^{-8}	6.0×10^{-7}
Cs-134	8.04	281.6	0.5	0.0002	0.5	1	0.000402	0.014
Cs-137	1038	35360	0.5	0.0002	0.5	1	0.0519	1.77
Pu-238	5.63	26.6	0.000015	0.0002	0.5	1	8.4×10^{-9}	4.0×10^{-8}
Pu-239	451.8	43.0	0.000015	0.0002	0.5	1	6.8×10^{-7}	6.5×10^{-8}
Pu-240	31.08	1.5	0.000015	0.0002	0.5	1	4.7×10^{-8}	2.3×10^{-9}
Pu-241	126.0	3.6	0.000015	0.0002	0.5	1	1.9×10^{-7}	5.4×10^{-9}
Am-241	9.78	0.063	0.000015	0.0002	0.5	1	1.5×10^{-8}	9.5×10^{-11}
Am-242M	0.10	0.000016	0.000015	0.0002	0.5	1	1.5×10^{-10}	2.4×10^{-14}

[a] Radionuclide inventory from Appendix D.
[b] Damage ratio values for particulates that would not be condensed in the off-gas system include a factor of 0.00003 to account for the fraction oxidized and released from liquid metals and captured on the filters.

- *Aircraft crash*—The potential for an aircraft crash was evaluated for the Hot Fuel Examination Facility and the Fuel Conditioning Facility as part of the evaluation of the electrometallurgical treatment process. The discussion provided previously is applicable to the use of the Hot Fuel Examination Facility in the melt and dilute process (see the discussion for the electrometallurgical treatment process earlier in this section). It was concluded that the likelihood of an aircraft crash causing damage to the facility process is not reasonably foreseeable; therefore, no specific analysis is needed.

- *Sodium Fire*—The sodium fire event selected for analysis was postulated to occur during the fuel cleaning (sodium removal) process for the sodium-bonded spent nuclear fuel. The event is the result of a breach in the Hot Fuel Examination Facility cell followed by a sodium fire. This event can occur as a result of the design-basis earthquake, which results in Main Cell breaches at piping and ventilation penetrations and results in a failure of the ventilation system. The frequency of this event is 0.008 per year (or once in 125 years).

  It has been estimated that approximately 10 percent of the cesium in the spent nuclear fuel has migrated from the fuel region and bonded with the sodium being removed in the fuel cleaning process. Using the radionuclide inventories provided in Appendix D for the EBR-II driver and radial blanket spent nuclear fuel and the Fermi-1 blanket spent nuclear fuel, it was estimated that a total of 670 curies of cesium-134 and 76,000 curies of cesium-137 would be entrained within the sodium. Assuming that as much as one-half of the sodium is accumulated within the collection tank prior to processing to remove cesium from the sodium, the material at risk for the sodium fire would be 340 curies of cesium-134 and 38,000 curies of cesium-137. The release fractions selected for this accident are a damage ratio of 1, an airborne release fraction and a respirable fraction each of 0.00025, and a leak path factor of 0.125. The airborne release fraction and respirable fraction value is the same as that used for cesium release from a metal fire in the design-basis seismic event analysis. The leak path factor is the value used for the Hot Fuel Examination Facility during a design-basis seismic event. The total quantity of cesium released (source term) as a result of this accident is 0.011 curies of cesium-134 and 1.2 curies of cesium-137. The cesium source term from sodium in driver fuel is 0.0095 curies of cesium-134 and 1.14 curies of cesium-137.

- *Design-basis earthquake*—This is the same accident that was developed for the design-basis earthquake for the electrometallurgical treatment process at the Hot Fuel Examination Facility. The equipment availability and damage were assumed to be the same when the facility is used for the melt and dilute process as when it is used for the electrometallurgical treatment process. Consistent with the facility safety analysis report, the ventilation system was assumed to have failed, creating a leak path factor of 0.125. The frequency of this event is 0.008 per year (or once in 125 years).

  The damage ratio, airborne release fraction, respirable fraction, and leak path factor are the same as for the electrometallurgical treatment process design-basis earthquake, with a few exceptions. Because the melt and dilute process at ANL-W operates at an elevated temperature of about 1,400 °C (2,550 °F), some fission products would boil off during the process and enter the off-gas control system. The airborne release fraction for these volatilized fission product materials, e.g., strontium, antimony, cesium, tellurium, and iodine, is set at 1 (DOE 1994b). In addition, even though some of these materials could have been condensed and removed from the off-gas system at the time of the accident, it was assumed conservatively that all of these materials would be volatilized upon initiation of the accident. However, credit is taken for the condensation of these gases as they pass through the structures on the release path. These gases will cool from their initial release temperatures as they pass through the relatively cooler structures of the Hot Fuel Examination Facility. A factor of 0.5 was used for each structure, resulting in an airborne release fraction value (representing the fraction released to the atmosphere from the cell atmosphere) of 0.125. Gaseous krypton and tritium (H-3) were not considered here, since they were assumed to have been released to the environment during the fuel cleaning process. The source terms and release fractions are provided in **Table F–12**.

Table F–12 Melt and Dilute Process Material at Risk and Release Fraction Values for a Design-Basis Earthquake at ANL-W

Material At Risk [a]			*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*	
Isotope	*Blanket (curies)*	*Driver (curies)*					*Blanket*	*Driver*
Co-60	0.95	7.70	1	4.0×10^{-6}	0.8	0.125	3.8×10^{-7}	3.1×10^{-6}
Sr-90	48.4	3152	1	0.125	1	0.125	0.76	49
Y-90	48.4	3152	1	4.0×10^{-6}	0.8	0.125	0.000019	0.0013
Ru-106	8.1	24.16	1	4.0×10^{-6}	0.8	0.125	3.2×10^{-6}	9.8×10^{-6}
Rh-106	8.1	24.16	1	4.0×10^{-6}	0.8	0.125	3.2×10^{-6}	9.8×10^{-6}
Cd-113M	0.043	0.74	1	4.0×10^{-6}	0.8	0.125	1.7×10^{-8}	3.0×10^{-7}
Sb-125	1.39	47.36	1	0.125	1	0.125	0.022	0.74
Te-125M	0.57	19.68	1	0.125	1	0.125	0.0089	0.31
I-129	0.000086	0.0012	1	0.125	1	0.125	1.3×10^{-6}	0.000019
Cs-134	0.80	28.16	1	0.125	1	0.125	0.013	0.44
Cs-137	103.8	3536.0	1	0.125	1	0.125	1.6	55
Ba-137M	98.4	3344.0	1	4.0×10^{-6}	0.8	0.125	0.000039	0.0013
Ce-144	3.76	47.36	1	4.0×10^{-6}	0.8	0.125	1.5×10^{-6}	0.000019
Pr-144	3.76	47.36	1	4.0×10^{-6}	0.8	0.125	1.5×10^{-6}	0.000019
Pm-147	24.4	1321.6	1	4.0×10^{-6}	0.8	0.125	9.8×10^{-6}	0.00053
Sm-151	6.0	85.44	1	4.0×10^{-6}	0.8	0.125	2.4×10^{-6}	0.000034
Eu-154	0.44	9.07	1	4.0×10^{-6}	0.8	0.125	1.8×10^{-7}	3.6×10^{-6}
Eu-155	2.89	60.96	1	4.0×10^{-6}	0.8	0.125	1.2×10^{-6}	0.000024
Pu-238	0.56	2.66	1	4.0×10^{-6}	0.8	0.125	2.2×10^{-7}	1.1×10^{-6}
Pu-239	45.18	4.30	1	4.0×10^{-6}	0.8	0.125	0.000018	1.7×10^{-6}
Pu-240	3.11	0.15	1	4.0×10^{-6}	0.8	0.125	1.2×10^{-6}	6.0×10^{-8}
Pu-241	12.6	0.36	1	4.0×10^{-6}	0.8	0.125	5.0×10^{-6}	1.4×10^{-7}
Am-241	0.98	0.0063	1	4.0×10^{-6}	0.8	0.125	3.9×10^{-7}	2.5×10^{-9}
Am-242M	0.010	1.6×10^{-6}	1	4.0×10^{-6}	0.8	0.125	4.0×10^{-9}	6.4×10^{-13}

[a] The material at risk is the content in one batch: 60 kilograms of heavy metal of blanket fuel or 16 kilograms of heavy metal of driver fuel. Radionuclide inventory from Appendix D.

F.2.2.1.3 Accident Scenario Descriptions and Source Terms at SRS

Accident Scenario Descriptions for Plutonium-Uranium Extraction (PUREX) Processing—The following facilities would be used to store or process sodium-bonded spent nuclear fuel at SRS: F-Canyon, FB-Line, and the plutonium storage facility. The F-Canyon, FB-Line, and plutonium storage facility are part of the Building 221-F (or F-Canyon) structure. Shipments of the declad and cleaned blanket spent nuclear fuel cannot be received directly at the F-Canyon facility. The facility is not equipped to handle the transportation casks being used. The shipments would be received at the L-Reactor disassembly basin, transferred to casks suitable for shipment to F-Canyon, and then moved to F-Canyon. The PUREX process can be used to separate the plutonium from the blanket spent nuclear fuel pins. In the PUREX process, the declad and cleaned blanket spent nuclear fuel would be dissolved in the F-Canyon dissolvers, and fission products would be separated from uranium and plutonium. The plutonium solution then would be pumped to the FB-Line for purification and solidification. The depleted uranium solution would be pumped to A-Line tanks for storage and future processing into depleted uranium oxides.

The accident scenarios, identified in **Table F–13** and defined in the following paragraphs, are applicable to the processing facilities as a whole (i.e., F-Canyon and FB-Line). Transfer and storage accidents also were considered for the analysis of F-Canyon-related activities. The sodium-bonded spent nuclear fuel would be

declad and cleaned prior to shipment from ANL-W. This process results in the release of gases in the gap between the fuel and cladding (see Appendix E, Section E.4), the dominant radionuclides considered during the analysis of transfer (fuel and cask drop) accidents. Therefore, the accidents were not quantified. Accidents associated with storage of the sodium-bonded spent nuclear fuel and storage of the process products (plutonium and various waste forms) were assessed as having no additional impacts beyond those associated with the process-related accidents.

Table F–13 Selected Accident Scenarios for PUREX Processing at SRS

Scenario	*Frequency (per year)*
Explosion: ion exchange column	0.0001
Nuclear criticality [a]	0.0001
Fire	0.000061
Earthquake (design-basis earthquake)	0.00013
Aircraft crash	less than 10^{-7}

[a] Only plutonium criticalities were evaluated. The potential for an americium criticality was considered but dismissed because of the limited americium mass and purity.

- *Explosion*—An explosion in an ion exchange column in the FB-Line was postulated to result from a strong exothermic reaction between nitric acid and the base resin in the cation (or anion) exchange column during plutonium solution exchange. This would result in a thermally induced pressure failure of the ion exchange vessel, and the resulting shrapnel would damage the product run tank and the product hold tank for this ion exchange pair. The explosion would breach the hot cell confinement. The plutonium in nitrite solution in the run and hold tanks would spill onto the cabinet floor and boil due to a subsequent resin fire. Based on the assumptions that the column was at its maximum load before the explosion and that the maximum quantity of liquid at the maximum allowable concentration was present, the estimated release of plutonium through the sand filter and the stack was calculated to be 0.241 grams. No other source term is applicable to the FB-Line accident. Processing in the F-Canyon would remove all other fission products before the plutonium is processed in the FB-Line (DOE 1993b). The frequency of such an event is estimated to be 0.0001 per year.

- *Fire*—In the F-Canyon Safety Analysis Report, a maximum fire was postulated to occur in the plutonium recycle process. The frequency of such a fire was estimated at 0.000061 per year (WSRC 1994). The accident was assumed to burn the contents of the largest tank. The material at risk is 86,700 kilograms (191,000 pounds) of solution. The airborne release fraction and respirable fraction were each estimated to be 0.01 (DOE 1994b). The airborne materials would pass through a sand filter, with a leak path factor of 0.005, before entering the atmosphere. The maximum recycle fire in the F-Canyon would result in the bounding source term (**Table F–14** gives the source terms). Fire in the FB-Line would result in consequences that are several times lower than those from the F-Canyon fire.

- *Nuclear criticality*—A plutonium solution criticality was postulated. The nuclear criticality was assumed to consist of an initial burst of 1×10^{18} fissions in 0.5 seconds, followed at 10-minute intervals for the next 8 hours by bursts of 2×10^{17} fissions, for a total of 1×10^{19} fissions, as specified in the U.S. Nuclear Regulatory Commission's Regulatory Guide 3.35 (NRC 1979) and NUREG-1320 (NRC 1988) and in the DOE-HDBK-3010-YR report (DOE 1994b). The 10^{19} fission yield was based on the assumptions that the solution criticality occurred in a tank with a minimum volume of 3,785 liters (1,000 gallons) and that approximately 100 liters (26 gallons) of this volume evaporated due to heat released during the fission process. Based on the data provided in the DOE Safety Survey Report (DOE 1993c), a 10^{19} criticality event in the FB-Line process would result in the bounding source term (**Table F–15** gives the source terms). The frequency of such an event was estimated to be 0.0001 per year.

Table F–14 Maximum Fire Source Terms

Isotope	*Source Term (curies)*
Sr-90	1.5
Ru-106	12
Ce-144	36
U-234	3.0×10^{-7}
U-235	4.8×10^{-6}
U-236	4.9×10^{-6}
U-238	0.00044
Pu-238	0.19
Pu-239	1.6
Pu-240	0.36
Pu-241	4.2
Pu-242	0.000053
Am-241	0.32

Source: WSRC 1994.

Table F–15 Criticality Source Terms for 10^{19} Fissions in Plutonium Solution

Isotope	*Radioactivity (curies)* [a]			*Airborne Release Fraction* [b]	*Leak Path Factor* [c]	*Source Term (curies)*
	0 to 30 Minutes	*30 Minutes to 8 Hours*	*Total*			
Kr-83m	15	95	110	1	1	110
Kr-85m	9.9	61	70.9	1	1	70.9
Kr-85	0.00012	0.00072	0.00084	1	1	0.00084
Kr-87	60	370	430	1	1	430
Kr-88	32	200	232	1	1	232
Kr-89	1,800	11,000	12,800	1	1	12,800
Xe-131m	0.014	0.086	0.1	1	1	0.1
Xe-133m	0.31	1.9	2.21	1	1	2.21
Xe-133	3.8	23	26.8	1	1	26.8
Xe-135m	460	2,800	3,260	1	1	3,260
Xe-135	57	350	407	1	1	407
Xe-137	6,900	42,000	48,900	1	1	48,900
Xe-138	1,500	9,500	11,000	1	1	11,000
I-131	1.5	9.5	11	0.25	1	2.75
I-132	170	1,000	1,170	0.25	1	293
I-133	22	140	162	0.25	1	40.5
I-134	600	3,700	4,300	0.25	1	1,075
I-135	63	390	453	0.25	1	113
Pu-238 [c, d]			3.6	0.0005	0.005	9.0×10^{-6}
Pu-239 [c, d]			170	0.0005	0.005	0.00043
Pu-240 [c, d]			39	0.0005	0.005	0.0001
Pu-241 [c, d]			2,400	0.0005	0.005	0.006
Pu-242 [c, d]			0.003	0.0005	0.005	7.50×10^{-9}

[a] Regulatory Guide 3.35 (NRC 1979).
[b] Airborne release fractions are equal to 1 for noble gases, 0.25 for iodine, and 0.0005 for plutonium; all particles were assumed to be in the respirable range (i.e., respirable fraction = 1).
[c] Plutonium in 100 liters of solution.
[d] This plutonium was assumed to be released to the atmosphere through a high-efficiency particulate air filter (e.g., SRS's sand filter) with a 0.995 efficiency. The plutonium values are the maximum solution concentration in the FB-Line (DOE 1993b).

- *Earthquake*—Recent analyses of earthquake hazards at F-Canyon indicate that a 0.24 g peak ground acceleration-level earthquake—with a return period of 8,000 years (or a frequency of 0.000125 per year) for the F-Canyon facility—could damage the structure and cause localized interior failures as well as interior and exterior wall cracks (DOE 1996b). Previous analyses of earthquake hazards at F-Canyon estimated the consequences of such an earthquake magnitude with a higher frequency of occurrences—0.0002 per year (DOE 1995b and WSRC 1994). Using the assumptions in the F-Canyon Facility Safety Analysis Report (WSRC 1994), a bounding source term was developed for an earthquake accident (**Table F–16** gives the F-Canyon source terms). Given an earthquake, it was assumed that the plutonium contents in all the processes (F-Canyon and FB-Line) would be spilled on the canyon floor. It was assumed further that the airborne material would enter the environment through the building cracks, which are formed by the loss of sealant between the sections because of differential motion of the section, with a penetration leak path factor of 0.10. For the FB-Line, the material at risk was assumed to be 2,000 grams (4.4 pounds) of plutonium in a molten metal form and 2,000 grams (4.4 pounds) of plutonium in a liquid form. The airborne release fraction multiplied by the respirable fraction is 0.0022 for the molten metal form and 0.000047 for the liquid form, including both the initial and resuspended airborne release fraction multiplied by respirable fraction values. This results in an FB-Line earthquake source term of 0.45 grams of plutonium released to the environment.

Table F–16 Maximum Earthquake Source Terms

Isotope	*Source Term (curies)*	*Isotope*	*Source Term (curies)*
Sr-90	0.086	Pu-239	0.092
Ru-106	70.1	Pu-240	0.021
Ce-144	2.05	Pu-241	0.24
Cs-137	0.0029	Pu-242	3.87×10^{-6}
Eu-154	0.017	Am-241	0.0092
Np-237	2.92×10^{-8}	Am-242m	0.000032
Np-239	0.0058	Am-243	0.0031
U-234	2.06×10^{-7}	Cm-244	0.33
U-235	2.79×10^{-7}	Cm-245	0.000027
U-236	2.81×10^{-7}	Cm-246	0.000042
U-238	0.000025	Cm-247	2.05×10^{-10}
Pu-238	0.015	—	—

Source: WSRC 1994.

- *Aircraft crash*—The F-Canyon facility is located more than 40 kilometers (25 miles) away from any major airport; therefore, no takeoff or landing crash accidents need to be considered. The crashes that could occur in flight need to be considered. According to the DOE Standard on aircraft crash analysis (DOE 1996c), the expected crash frequency for the site is approximately 0.00052 per square kilometer (0.0002 per square mile) per year from general aviation; 1.56×10^{-6} and 5.18×10^{-6} per square kilometer (6×10^{-7} and 2×10^{-6} per square mile) per year from air carrier and air taxies, respectively; and 2.59×10^{-7} and 1.56×10^{-6} per square kilometer (1×10^{-7} and 6×10^{-7} per square mile) per year from large military and small military aircraft, respectively. Using the building dimensions and the data provided in the DOE Standard for aircraft crash analysis, an upper-bound frequency for an aircraft crash into the canyon buildings was estimated to be 4.6×10^{-6} and 1.5×10^{-7} per year for general aviation and commuter (air taxi) aircraft, respectively. These values were calculated without considering any site-specific effects (e.g., the topography and building structures around the facility). Considering the available skid distance of 60 meters (200 feet) that an aircraft could skid before hitting the building, the frequency of an air taxi crashing into the building would be less than 10^{-8} per year. When only crashes that directly hit the structure were considered, general aviation aircraft would have the only estimated crash frequency greater than 10^{-7} per year. The F-Canyon building is a maximum-resistant construction structure designed to withstand a pressure of 47.9 kilopascal (1,000 pounds per square foot). Therefore, crashes of small aircraft (helicopter or a small observation/security aircraft) into these buildings are not expected to damage the

buildings. If a general aviation aircraft were to crash into the buildings, its consequences (both in magnitude and frequency) would be smaller than that hypothesized for a design-basis earthquake.

Accident Scenario Descriptions for the Melt and Dilute Process—The following accidents were considered for the melt and dilute option, when performed at Building 105-L (after receipt of the declad and cleaned spent nuclear fuel at the L-Reactor Disassembly Basin), as proposed in the SRS Spent Nuclear Fuel Management Final EIS (DOE 2000). In this process, the declad and cleaned blanket spent nuclear fuel, along with aluminum metal, would be heated to approximately 1,000 °C (1,830 °F) to form an alloy of 30 percent uranium and 70 percent aluminum, and would be cast as ingots. The heating process would remove some of the radionuclides found in the spent nuclear fuel. The analysis assumed a batch size of 60 kilograms (132 pounds) of heavy metal, which is the batch size limit for this process when performed in Building 105-L. This would lead to three years of operations to melt and dilute the blanket fuel. The radionuclide content of an EBR-II radial blanket spent nuclear fuel batch was used conservatively to represent the radionuclide content of all blanket spent nuclear fuel. The accident scenarios identified in **Table F–17**, and described in the following paragraphs, are applicable to the melt and dilute processing of the blanket spent nuclear fuel in SRS Building 105-L. Accidents associated with the onsite transfer and storage of the declad and cleaned spent nuclear fuel were considered for analysis. As in the accident analysis for the PUREX process, these accidents were not quantified. Accidents associated with the transfer and storage of the spent nuclear fuel and diluted waste forms were assessed as having no additional impacts beyond those analyzed for process-related accidents.

Table F–17 Selected Accident Scenarios for Melt and Dilute Processing at SRS Building 105-L

Scenario	*Frequency (per year)*
Melter eruption/explosion [a]	0.0005
Waste handling spill	0.0064
Loss of electric power	0.006
Fire	0.075
Design-basis earthquake	Not applicable [b]

[a] In the draft EIS, this accident was identified as "loss of cooling water." Consistent with the SRS Spent Nuclear Fuel Management Final EIS (DOE 2000), the accident name was changed.

[b] Building 105-L and the melt and dilute components are expected to remain functioning after a design-basis earthquake. The most significant impact of this event would be a potential loss of offsite power. The consequences of an earthquake up to a design-basis level thereby would be bounded by the loss-of-power event. The loss-of-power event has a higher frequency than the design-basis earthquake and is used in place of the design-basis earthquake.

- *Melter eruption/explosion*—The postulated melter eruption/explosion event could result from a buildup or addition of impurities to the metal melt. Impurities range from water (causing a steam explosion) to chemical contaminants (possible high-temperature exothermic reactions). As a result of the reaction in the metal melt, molten material would be ejected from the melter into the processing structure. Cooling water pipes within the process area could be ruptured as a result of contact with the ejected material. Should this occur, the water released would be converted to steam, resulting in an overpressurization of the enclosure that would be expected to overwhelm the exhaust fans, causing a failure of the exhaust system and an unfiltered release. Although some damage to the exhaust system is expected, there would be insufficient energy in the explosion to damage the facility structure. The melter eruption was assumed to occur with a coincident failure of the high-efficiency particulate air filtration system. The frequency of this event has been estimated to be bound by a value of 0.0005 per year (DOE 2000).

  The material at risk was estimated conservatively to be the full radionuclide content of one melt batch. The metal melt eruption/explosion was assumed to affect all the material in the melter, resulting in a damage ratio of 1 for all material. The airborne release fraction and respirable fraction values were each estimated to be 0.001 for all airborne particulates except cesium, which was estimated to be 0.2 (WSRC 2000, DOE 2000). After such an accident, the particulates would be released in the building and the ventilation fan would draw the airborne particulates to the building stack. Since the ventilation system was

assumed to have failed, the leak path factor was assumed to be 1, allowing all the airborne particulates to enter the environment through the building stack. The material at risk and release fractions are summarized in **Table F–18**.

Table F–18 Melt and Dilute Process Material At Risk and Release Fraction Values for a Melter Eruption/Explosion at Building 105-L

Isotope	*Material at Risk (curies)*	*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*
Sr-90	48.4	1.0	0.001	1.0	1.0	0.048
Y-90	48.4	1.0	0.001	1.0	1.0	0.048
Ru-106	8.1	1.0	0.001	1.0	1.0	0.0081
Rh-106	8.1	1.0	0.001	1.0	1.0	0.0081
Cd-113M	0.0427	1.0	0.001	1.0	1.0	0.00043
Sb-125	1.39	1.0	0.001	1.0	1.0	0.0014
Te-125M	0.571	1.0	0.081	1.0	1.0	0.0057
I-129	0.000086	1.0	1	1.0	1.0	0.000086
Cs-134	0.804	1.0	0.2	1.0	1.0	0.1608
Cs-137	104	1.0	0.2	1.0	1.0	20.8
Ba-137M	98.4	1.0	0.001	1.0	1.0	0.0984
Ce-144	3.76	1.0	0.001	1.0	1.0	0.00376
Pr-144	3.76	1.0	0.001	1.0	1.0	0.00376
Pm-147	24.4	1.0	0.001	1.0	1.0	0.0244
Sm-151	6	1.0	0.001	1.0	1.0	0.006
Eu-154	0.44	1.0	0.001	1.0	1.0	0.00044
Eu-155	2.89	1.0	0.001	1.0	1.0	0.00289
Th-228	9.30×10^{-6}	1.0	0.001	1.0	1.0	9.3×10^{-9}
U-234	0.00008	1.0	0.001	1.0	1.0	8×10^{-8}
U-235	0.000226	1.0	0.001	1.0	1.0	2.26×10^{-7}
U-236	0.000254	1.0	0.001	1.0	1.0	2.54×10^{-7}
U-238	0.0196	1.0	0.001	1.0	1.0	1.96×10^{-5}
Np-237	7.80×10^{-6}	1.0	0.001	1.0	1.0	7.80×10^{-9}
Pu-238	0.563	1.0	0.001	1.0	1.0	0.000563
Pu-239	45.2	1.0	0.001	1.0	1.0	0.0452
Pu-240	3.11	1.0	0.001	1.0	1.0	0.00311
Pu-241	12.6	1.0	0.001	1.0	1.0	0.0126
Am-241	0.978	1.0	0.001	1.0	1.0	0.000978
Am-242M	0.0101	1.0	0.001	1.0	1.0	0.000101

- *Waste handling accident*—The filters used in the melt and dilute off-gas exhaust system must be periodically cleaned and the resultant liquid waste disposed of. Decontamination of the filters was assumed to be performed after 10 batches are processed. Therefore, it was assumed that after processing 600 kilograms (1,320 pounds) of heavy metal of blanket spent nuclear fuel, the filters would be decontaminated. It was postulated that a spill would occur during the transfer of the decontaminant liquid from one container to another. The event frequency is estimated at 0.0024 per year (DOE 2000). The material at risk is from the fission products released during the melting process and collected on the filters. This includes fission products with boiling points at or below 1,000 °C (1,830 °F) and some metal oxides that can be expected to form during the heating process (WSRC 1998b). A damage ratio of 0.5 was assumed to account for the spilling of half of the material during the accident. Airborne release fraction and respirable fraction values of 0.0002 and 0.5, respectively, were chosen for the material based on the release of material from aqueous spills (DOE 1994b). The spill was assumed to occur in an area not provided with a filtration system and, therefore, the leak path factor is 1. The material at risk, release fractions, and curies released for this accident for EBR-II blanket spent nuclear fuel are presented in **Table F–19**.

Table F–19 Melt and Dilute Process Material At Risk and Release Fraction Values for a Waste Handling Accident at Building 105-L

Isotope	*Material at Risk*	*Damage Ratio* [a]	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*
Te-125M	5.71	0.5	0.0002	0.5	1	0.000286
I-129	0.000864	0.5	0.0002	0.5	1	4.32×10^{-8}
Cs-134	8.04	0.5	0.0002	0.5	1	0.000402
Cs-137	1040	0.5	0.0002	0.5	1	0.052
Pu-238	5.63	0.000015	0.0002	0.5	1	8.45×10^{-9}
Pu-239	452	0.000015	0.0002	0.5	1	6.78×10^{-7}
Pu-240	31.1	0.000015	0.0002	0.5	1	4.67×10^{-8}
Pu-241	126	0.000015	0.0002	0.5	1	1.89×10^{-7}
Am-241	9.78	0.000015	0.0002	0.5	1	1.47×10^{-8}
Am-242M	0.101	0.000015	0.0002	0.5	1	1.52×10^{-10}

[a] Damage ratios for neptunium, plutonium, and americium include an airborne release fraction value of 0.00003 to account for the fraction released from liquid metals and captured on the filters.

- *Loss of offsite power*—The loss of offsite power, with the subsequent failure of the onsite power supply, would result in the failure of the off-gas system, and a potential unfiltered release path to the environment. The probability of this combination of events was conservatively estimated at 0.006 per year (WSRC 1998a). The material at risk was assumed to be the volatile radionuclide inventory of one processing batch of material (approximately 60 kilograms [132 pounds] of heavy metal). Additionally, some amount of radioactive metallic and metallic oxide dusts could be generated and released during a loss-of-power event. The airborne release fraction and respirable fraction values for the gaseous fission products were each assumed to be 1, while the metallic dust release fractions at elevated temperatures are an airborne release fraction of 0.00003 and a respirable fraction of 0.04 (DOE 1994b). A leak path factor of 0.5 has been used for all material to account for possible plate-out during migration of material out of the processing area. The material at risk and release fraction values are summarized in **Table F–20**.

Table F–20 Melt and Dilute Process Material At Risk and Release Fraction Values for a Loss-of-Power Event at Building 105-L

Isotope	*Material at Risk*	*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*
Te-125M	0.571	1	1	1	0.5	0.0286
I-129	0.000086	1	1	1	0.5	0.0000432
Cs-134	0.804	1	1	1	0.5	0.0402
Cs-137	104	1	1	1	0.5	52
Pu-238	0.563	1	0.00003	0.04	0.5	3.38×10^{-7}
Pu-239	45.2	1	0.00003	0.04	0.5	0.0000271
Pu-240	3.11	1	0.00003	0.04	0.5	1.87×10^{-6}
Pu-241	12.6	1	0.00003	0.04	0.5	7.56×10^{-6}
Am-241	0.978	1	0.00003	0.04	0.5	5.87×10^{-7}
Am-242M	0.0101	1	0.00003	0.04	0.5	6.06×10^{-9}

- *Area fire*—Fires in Building 105-L have the potential to release material from the chemical decontaminate solution and the off-gas filters and baffles, and have the potential to affect the ventilation and filtration system, resulting in the release modeled for the loss-of-power event. The fire selected for analysis would result in the failure of the waste container and would release some of the decontaminate solution. This fire would have the potential to release more material than a fire that impacts the off-gas filters and baffles. The frequency of a fire in Building 105-L, based on site-wide fire data for SRS, is 0.075 fires per year. This frequency has been conservatively used as the frequency of a fire that impacts the chemical decontaminate

solution. The material at risk would be the same as for the waste handling accident—the volatile gases and metallic and metallic oxide dust that would result from processing 10 batches of material in the melter. All material in the waste container would be at risk and the damage ratio was assumed to be 1. Boiling of a shallow pool of aqueous solution would result in bounding airborne release fraction and respirable fraction values of 0.002 and 1, respectively (DOE 1994b). No credit was taken for any reduction due to the leak path factor (i.e., a leak path factor of 1 was used). **Table F–21** summarizes the material at risk and release fractions for this accident scenario.

Table F–21 Melt and Dilute Process Material At Risk and Release Fraction Values for an Area Fire at Building 105-L

Isotope	*Material at Risk*	*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Source Term (curies)*
Te-125M	5.71	1	0.002	1	1	0.0114
I-129	0.00086	1	0.002	1	1	1.73×10^{-6}
Cs-134	8.04	1	0.002	1	1	0.0161
Cs-137	1040	1	0.002	1	1	2.08
Pu-238	5.63	0.00003	0.002	1	1	3.38×10^{-7}
Pu-239	452	0.00003	0.002	1	1	0.0000271
Pu-240	31.1	0.00003	0.002	1	1	1.87×10^{-6}
Pu-241	126	0.00003	0.002	1	1	7.56×10^{-6}
Am-241	9.78	0.00003	0.002	1	1	5.87×10^{-7}
Am-242M	0.101	0.00003	0.002	1	1	6.06×10^{-9}

F.2.2.2 Consequences and Risk Calculations

Once the source term for each accident scenario is determined, the radiological consequences are calculated. The calculations vary depending on how the release is dispersed, what material is involved, and which receptor is being considered. Risks are calculated based on the accident's frequency and its consequences. The risks also are stated in terms of additional cancer fatalities resulting from a release, using a conversion factor of 0.0005 latent cancer fatalities per person-rem for members of the public and 0.0004 latent cancer fatalities per person-rem for workers.

Radiological consequences to four different receptors were evaluated: a maximally exposed offsite individual (an individual member of the public), the general population, a noninvolved worker, and an involved (facility) worker. The consequences to the facility workers were qualitatively evaluated. For the other receptors, quantitative estimates of consequences were made. Two types of dispersion conditions were considered—95th percentile and 50th percentile meteorological conditions. The 50th percentile condition represents the median meteorological condition and is defined as that for which more severe conditions occur 50 percent of the time. The 95th percentile condition represents relatively low-probability meteorological conditions that produce higher calculated exposures; it is defined as that condition not exceeded more than 5 percent of the time. Both dispersion conditions were modeled using the GENII program, which determines the desired condition from the site-specific meteorological data in the form of a joint frequency distribution. Joint frequency data are usually produced from at least three consecutive years of site weather data in terms of percentage of time that the wind blows in specific directions (e.g., south, south-southwest, southwest) for the given midpoint (or average) wind speed class and atmospheric stability.

Radiological consequences to a receptor from an accident in the FB-Line were estimated based on a calculated 50-year committed dose factor (dose factor) resulting from releases of 1 gram of plutonium with an isotopic distribution associated with the EBR-II blanket spent nuclear fuel (**Table F–22**). This was done because the FB-Line processes only plutonium already separated in the F-Canyon.

The values given in this table represent the maximum dose to the receptor and were obtained using the GENII program.

Table F–22 Receptors' Dose Factors for Accidental Releases of 1 Gram of Plutonium From an Accident Initiated in the FB-Line

Receptor		*95th Percentile Meteorological Condition*	*50th Percentile Meteorological Condition*
Maximally exposed offsite individual (rem)	Elevated release	0.027	Not applicable
	Ground release	0.13	Not applicable
Population (person-rem)	Elevated release	1500	220
	Ground release	5000	270
Noninvolved worker (rem)	Elevated release	Not applicable	0.080
	Ground release	Not applicable	2

Consequences to involved workers were qualitatively assessed. This approach was used for two reasons: first, no adequate method exists for calculating meaningful consequences at or near the location where the accident could occur. Second, safety assurance for workers is demonstrated by both the workers' training and by the establishment of an Occupational Safety and Health Administration process safety management system (29 CFR 1910.119), the evaluations required by such a system, and the products derived from such evaluations (e.g., procedures, programs, emergency plans).

The consequences to the involved worker, presented in **Tables F-23** and **F–24**, are accident-dependent and site-specific. In facilities where the involved worker activities include remote operations, the consequences of accidents would be lower than in facilities where the workers are near the process. The following paragraphs summarize the various potential consequences to the involved workers from the hypothesized accidents at different sites. Additionally, a limited number of fatalities could occur in an indirect or secondary manner—for example, the involved worker could be killed by an earthquake or explosion.

Table F–23 Involved Worker Consequences From Various Hypothesized Accidents

Accident	*Consequences*
Explosion (ion exchange)	Could potentially result in fatal injuries (nonradiological) to the involved worker (SRS only).
Criticality	Could potentially result in a fatal dose to the involved worker. (Worker location outside cells, e.g., outside the argon cell at ANL-W, provides worker protection.)
Fire	No fatality is expected; some workers could inhale the dispersed radioactive materials before using a respirator and leaving the area.
Earthquake	No fatality is expected.
Spill	Involved workers could inhale the dispersed radioactive materials before using a respirator and leaving the area.

Table F–24 Involved Worker Summary

Accident Description *SRS—PUREX Process*	*Number of Workers at F-Canyon and FB-Line*	*Number of Workers at ANL-W*
Earthquake	47	50
Explosion, ion exchange column	16	Not applicable
Nuclear criticality	16	15
Fire	16	4

- *Explosion*—An explosion could result in serious, even fatal, injuries to involved workers from the accident itself. Some of the involved workers could inhale the dispersed radioactive material before using their respirators and evacuating the area. No fatality is expected from the radiological consequences.

- *Fire*—Involved workers could inhale some radioactive material before evacuating the area. No fatality is expected from the radiological consequences.

- *Spill*—Depending on the location of the spill, nearby workers could inhale the airborne radioactive materials before evacuating the area. Involved workers normally would be wearing respirators when handling the radioactive material containers. No fatality is expected to result from such an accident.

- *Earthquake*—Involved workers could receive lethal injuries from the accident itself. No fatality is expected from radiological consequences.

- *Aircraft Crash*—Consequences similar to those of an earthquake could result from the accident.

- *Criticality*—Involved workers could receive substantial, or potentially fatal, doses from prompt neutrons and gamma rays emitted from the first pulse. After the initial pulse, the workers would evacuate the area immediately on the initiation of the criticality monitoring alarms.

Analysis Conservatism and Uncertainty

To assist in evaluating the impacts of the processing options at SRS and ANL-W on a common basis, a spectrum of generic accidents was postulated for each process location. The accident scenarios were based on similar accidents documented in various site documents. When required, accident assumptions were modified to enable comparison between the sites. In cases where similar accidents were evaluated in site-specific documents, the more conservative analysis assumptions were used for all sites to normalize the results for the purpose of comparison. The following accident analysis parameters have a major impact on accident consequence estimates (i.e., the doses to workers and the public): weather conditions existing at the time of the accident, the material at risk, the isotopic breakdown of the material at risk, and the source term released to the environment.

Weather conditions assumed at the time of the accident have a large impact on dose estimates. Accident impacts to the public (both the maximally exposed offsite individual and the population) presented in this appendix were estimated using both 95th percentile and median 50th percentile weather conditions. The impacts presented in the body of the EIS are based on the 50th percentile weather conditions for the population dose (NRC 1976) and 95th percentile weather conditions (NRC 1983) for the maximally exposed offsite individual dose (which provides conservative maximally exposed offsite individual dose estimates). The GENII computer code was used to calculate doses to the public within 80 kilometers (50 miles) of the accident release point. The code calculates the public dose in each of 16 sectors centered at the accident release point. The GENII computer code also assumes that the total source term is released into each sector and that there is no change in the weather (i.e., wind direction, wind speed, and stability class) while the accident plume is traversing the 80-kilometer sector. The use of the 95th percentile weather data rather than the expected or median 50th percentile weather data was considered to be unrealistic for estimating the population dose. Meteorological conditions used in the analysis are based on measured weather data at the site. The 95th percentile represents a very stable site meteorological condition, which cannot be expected to be applicable for a wide area up to 80 kilometers from the site. Therefore, the 50th percentile, which represents a more neutral weather condition, is more representative of expected weather conditions over a wide area.

Uncertainties in accident frequencies do not impact the accident consequences, but do impact accident risk. The site/facility-specific accident frequencies (i.e., earthquake-induced building damage and aircraft crash) were based on data provided by the sites. Process-specific accident frequencies were estimated based on analyses provided in site-specific documentation. In cases where similar accidents were evaluated in site-

specific documents, the more conservative accident frequency was used for all sites to normalize the results for the purpose of comparison.

Due to the layers of conservatism built into the accident analysis for the spectrum of postulated accidents, the estimated consequences and risks to the public represent the upper limit for the individual classes of accidents. The uncertainties associated with the accident frequency estimates are enveloped by the analysis conservatism.

F.2.3 Accident Analyses Consequences and Risk Results

F.2.3.1 No Action Alternative

Under the No Action Alternative, the sodium-bonded spent nuclear fuel would not be treated (no sodium would be removed from the interior of the fuel elements) except for stabilization activities that may be necessary for continued safe and secure storage until 2035 or until a new treatment technology is developed. Under the Electrometallurgical Treatment Research and Demonstration Project, approximately 0.4 metric tons of heavy metal of EBR-II driver spent nuclear fuel and 1.2 metric tons of heavy metal of blanket spent nuclear fuel were processed. This EIS evaluates the impacts associated with activities required to clean up and stabilize any residual waste materials generated during the demonstration project at ANL-W. In addition, at the completion of the project, any remaining sodium-bonded spent nuclear fuel in the process facilities would be packaged and transferred to dry storage in the Radioactive Scrap and Waste Facility. Spent nuclear fuel transfer activities and waste processing activities would be completed in about two years after equipment installation. Some of the spent nuclear fuel handling and processing accidents identified under Alternative 1 are applicable to the No Action Alternative. **Tables F-25** and **F-26** provide the dose calculation results for the design-basis and beyond-design-basis earthquakes for stabilizing the residual waste. The results for the remaining accidents considered for the No Action Alternative (the salt powder spill in the Hot Fuel Examination Facility, the cask drop, and the transuranic waste fire) are provided in the discussion of "Alternative 1: Electrometallurgically Treat Blanket and Driver Fuel at ANL-W." Consequence and risk results are provided for the maximally exposed offsite individual, a noninvolved worker, and the general population. The accident assumptions and parameters used in developing these results are provided in Section F.2.2 of this appendix. EBR-II driver spent nuclear fuel characteristics (radionuclide compositions), which bound the consequences, were used to represent the consequences and risks during stabilization of waste for the demonstration project for the No Action Alternative. The transuranic waste fire accident was analyzed using a generic transuranic waste package composition.

Table F–25 Summary of Dose Calculation Results for the Design-Basis Earthquake (Driver)

			95th Percentile Meteorology			*50th Percentile Meteorology*			
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***	***MEI (millirem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***
Design-basis earthquake	0.008	Dose per event	12	52	0.63	0.64	4.7	1.4	0.017
		Dose per year	0.095	0.42	0.005	0.0051	0.038	0.011	0.00014
		LCF per year	4.8×10^{-8}	0.00021	2.5×10^{-9}	2.6×10^{-9}	1.5×10^{-8}	5.6×10^{-6}	6.8×10^{-8}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality

Table F–26 Summary of Dose Calculation Results for the Beyond-Design-Basis Earthquake (Driver)

			95th Percentile Meteorology			*50th Percentile Meteorology*			
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***	***MEI (millirem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***
Beyond-design-basis earthquake [a]	0.00001	Dose per event	96	42	5.1	5.1	37	11	0.13
		Dose per year	0.00096	0.00042	0.000051	0.000051	0.00037	0.00011	1.3×10^{-6}
		LCF per year	4.8×10^{-10}	2.1×10^{-7}	2.6×10^{-11}	2.6×10^{-11}	1.5×10^{-10}	5.5×10^{-8}	6.5×10^{-13}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.
[a] During stabilization of the demonstration project waste, only the Hot Fuel Examination Facility salt powder spill would be applicable.

F.2.3.2 Alternative 1: Electrometallurgically Treat Blanket and Driver Fuel at ANL-W

The processing technology considered for this alternative consists solely of the electrometallurgical treatment processing of the sodium-bonded spent nuclear fuel at ANL-W, using the Fuel Conditioning Facility and the Hot Fuel Examination Facility. **Tables F–27** through **F–37** provide the dose calculation results for the electrometallurgical treatment-related accidents at ANL-W. Consequence and risk results are provided for the maximally exposed offsite individual, a noninvolved worker, and the general population. The accident assumptions and parameters used in developing these results are provided in Section F.2.2 of this appendix. EBR-II driver and blanket spent nuclear fuel characteristics (radionuclide compositions) were used to develop the consequence and risk factors for all driver and blanket spent nuclear assembly fuel. The transuranic waste fire accident was analyzed using a generic transuranic waste package composition, rather than either a blanket or driver spent nuclear fuel-specific composition.

Table F–27 Summary of Dose Calculation Results for a Salt Powder Spill (Driver)

			95th Percentile Meteorology			*50th Percentile Meteorology*			
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***	***MEI (millirem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***
Hot Fuel Examination Facility salt powder spill	0.01	Dose per event	0.00046	0.0026	0.000031	0.000046	4.7×10^{-7}	0.000098	1.2×10^{-6}
		Dose per year	4.6×10^{-6}	0.000026	3.1×10^{-7}	4.6×10^{-7}	4.7×10^{-9}	9.8×10^{-7}	1.2×10^{-8}
		LCF per year	2.3×10^{-12}	1.3×10^{-8}	1.6×10^{-13}	2.3×10^{-13}	1.9×10^{-15}	4.9×10^{-10}	5.9×10^{-15}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–28 Summary of Dose Calculation Results for a Salt Powder Spill (Blanket)

			95th Percentile Meteorology			50th Percentile Meteorology			
Accident	Frequency (event per year)	Risk	MEI (millirem)	Population (person-rem)	Average Individual (millirem)	MEI (millirem)	Noninvolved Worker (millirem)	Population (person-rem)	Average Individual (millirem)
Hot Fuel Examination Facility salt powder spill	0.01	Dose per event	0.00015	0.00088	0.000011	0.000015	1.3×10^{-6}	0.000033	4.0×10^{-7}
		Dose per year	1.5×10^{-6}	8.8×10^{-6}	1.1×10^{-7}	1.5×10^{-7}	1.3×10^{-8}	3.3×10^{-7}	4.0×10^{-9}
		LCF per year	7.5×10^{-13}	4.4×10^{-9}	5.5×10^{-14}	7.5×10^{-14}	5.3×10^{-15}	1.7×10^{-10}	2.0×10^{-15}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–29 Summary of Dose Calculation Results for a Cask Drop (Driver)

			95th Percentile Meteorology			50th Percentile Meteorology			
Accident	Frequency (event per year)	Risk	MEI (millirem)	Population (person-rem)	Average Individual (millirem)	MEI (millirem)	Noninvolved Worker (millirem)	Population (person-rem)	Average Individual (millirem)
Cask drop	0.01	Dose per event	0.03	0.14	0.0017	0.0016	0.00084	0.0035	0.000042
		Dose per year	0.0003	0.0014	0.000017	0.000016	8.4×10^{-6}	0.000035	4.2×10^{-7}
		LCF per year	1.5×10^{-10}	7.0×10^{-7}	8.5×10^{-12}	8.0×10^{-1} / 2	3.4×10^{-12}	1.7×10^{-8}	2.1×10^{-13}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–30 Summary of Dose Calculation Results for a Cask Drop (Blanket)

			95th Percentile Meteorology			50th Percentile Meteorology			
Accident	Frequency (event per year)	Risk	MEI (millirem)	Population (person-rem)	Average Individual (millirem)	MEI (millirem)	Noninvolved Worker (millirem)	Population (person-rem)	Average Individual (millirem)
Cask drop	0.01	Dose per event	0.0024	0.011	0.00013	0.00013	0.000049	0.00028	3.4×10^{-6}
		Dose per year	0.000024	0.00011	1.3×10^{-6}	1.3×10^{-6}	4.9×10^{-7}	2.8×10^{-6}	3.4×10^{-8}
		LCF per year	1.2×10^{-11}	5.5×10^{-8}	6.5×10^{-13}	6.5×10^{-13}	2.0×10^{-13}	1.4×10^{-9}	1.7×10^{-14}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–31 Summary of Dose Calculation Results for a Single-Container Transuranic Waste Fire

			95th Percentile Meteorology			50th Percentile Meteorology			
Accident	Frequency (event per year)	Risk	MEI (millirem)	Population (person-rem)	Average Individual (millirem)	MEI (millirem)	Noninvolved Worker (millirem)	Population (person-rem)	Average Individual (millirem)
Transuranic waste fire	0.001	Dose per event	0.059	0.27	0.0033	0.0032	0.22	0.0071	0.000085
		Dose per year	0.000059	0.00027	3.3×10^{-6}	3.2×10^{-6}	0.00022	7.1×10^{-6}	8.5×10^{-8}
		LCF per year	3.0×10^{-11}	1.4×10^{-7}	1.6×10^{-12}	1.6×10^{-12}	8.8×10^{-11}	3.6×10^{-9}	4.3×10^{-14}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–32 Summary of Dose Calculation Results for a Design-Basis Earthquake (Driver)

			95th Percentile Meteorology			*50th Percentile Meteorology*			
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***	***MEI (millirem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***
Design-basis earthquake	0.0002 (Multi-facility event)	Dose per event	13	70	0.84	0.95	4.7	2.8	0.034
		Dose per year	0.0026	0.014	0.00017	0.00019	0.00084	0.00056	6.8×10^{-6}
		LCF per year	1.3×10^{-9}	7.0×10^{-6}	8.4×10^{-11}	9.5×10^{-11}	3.8×10^{-10}	2.8×10^{-7}	3.4×10^{-12}
	0.008 (HFEF)	Dose per event	12	52	0.63	0.64	4.7	1.4	0.017
		Dose per year	0.095	0.42	0.0050	0.0051	0.037	0.011	0.00013
		LCF per year	4.8×10^{-8}	0.00021	2.5×10^{-9}	2.6×10^{-9}	1.5×10^{-8}	5.6×10^{-6}	6.6×10^{-11}

MEI = Maximally Exposed Offsite Individual, HFEF = Hot Fuel Examination Facility, LCF = Latent Cancer Fatality.

Table F–33 Summary of Dose Calculation Results for a Design-Basis Earthquake (Blanket)

			95th Percentile Meteorology			*50th Percentile Meteorology*			
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***	***MEI (millirem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***
Design-basis earthquake	0.0002 (Multi-facility event)	Dose per event	4.1	18	0.22	0.23	14	0.49	0.006
		Dose per year	0.00081	0.0036	0.000044	0.000046	0.0027	0.00010	1.2×10^{-6}
		LCF per year	4.1×10^{-10}	1.8×10^{-6}	2.2×10^{-11}	2.3×10^{-11}	1.1×10^{-9}	4.9×10^{-8}	6.0×10^{-13}
	0.008 (HFEF)	Dose per event	4.0	18	0.21	0.22	14	0.47	0.0057
		Dose per year	0.032	0.14	0.0017	0.0018	0.11	0.0038	0.000045
		LCF per year	1.6×10^{-8}	0.000072	8.6×10^{-10}	8.8×10^{-10}	4.5×10^{-8}	1.9×10^{-6}	2.3×10^{-11}

MEI = Maximally Exposed Offsite Individual, HFEF = Hot Fuel Examination Facility, LCF = Latent Cancer Fatality.

Table F–34 Summary of Dose Calculation Results for a Salt Transfer Drop (Driver)

			95th Percentile Meteorology			*50th Percentile Meteorology*			
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***	***MEI (millirem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***
Salt transfer drop	1.0×10^{-7}	Dose per event	0.19	0.84	0.01	0.01	0.073	0.022	0.00026
		Dose per year	1.9×10^{-8}	8.4×10^{-8}	1.0×10^{-9}	1.0×10^{-9}	7.3×10^{-9}	2.2×10^{-9}	2.6×10^{-11}
		LCF per year	9.5×10^{-1}	4.2×10^{-11}	5.0×10^{-16}	5.0×10^{-16}	2.9×10^{-15}	1.1×10^{-12}	1.3×10^{-17}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–35 Summary of Dose Calculation Results for a Salt Transfer Drop (Blanket)

			95th Percentile Meteorology			50th Percentile Meteorology			
Accident	*Frequency (event per year)*	*Risk*	*MEI (millirem)*	*Population (person-rem)*	*Average Individual (millirem)*	*MEI (millirem)*	*Noninvolved Worker (millirem)*	*Population (person-rem)*	*Average Individual (millirem)*
Salt transfer drop	1.0×10^{-7}	Dose per event	0.065	0.29	0.0035	0.0036	0.22	0.0077	0.000092
		Dose per year	6.5×10^{-9}	2.9×10^{-8}	3.5×10^{-10}	3.6×10^{-10}	2.2×10^{-8}	7.7×10^{-10}	9.2×10^{-12}
		LCF per year	3.3×10^{-15}	1.5×10^{-11}	1.8×10^{-16}	1.8×10^{-16}	8.8×10^{-15}	3.9×10^{-13}	4.6×10^{-18}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–36 Summary of Dose Calculation Results for a Beyond-Design-Basis Earthquake (Driver)

			95th Percentile Meteorology			50th Percentile Meteorology			
Accident	*Frequency (event per year)*	*Risk*	*MEI (millirem)*	*Population (person-rem)*	*Average Individual (millirem)*	*MEI (millirem)*	*Noninvolved Worker (millirem)*	*Population (person-rem)*	*Average Individual (millirem)*
Beyond-design-basis earthquake	0.00001	Dose per event	22,000	97,000	1,200	1,200	370	2,500	31
		Dose per year	0.22	0.97	0.012	0.012	0.0037	0.025	0.00031
		LCF per year	2.2×10^{-7}	0.00049	5.9×10^{-9}	6.0×10^{-9}	1.5×10^{-9}	0.000013	1.5×10^{-10}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–37 Summary of Dose Calculation Results for a Beyond-Design-Basis Earthquake (Blanket)

			95th Percentile Meteorology			50th Percentile Meteorology			
Accident	*Frequency (event per year)*	*Risk*	*MEI (millirem)*	*Population (person-rem)*	*Average Individual (millirem)*	*MEI (millirem)*	*Noninvolved Worker (millirem)*	*Population (person-rem)*	*Average Individual (millirem)*
Beyond-design-basis earthquake	0.00001	Dose per event	930	4,200	51	50	560	110	1.3
		Dose per year	0.0093	0.042	0.00051	0.00050	0.0056	0.0011	0.000013
		LCF per year	4.7×10^{-9}	0.000021	2.5×10^{-10}	2.5×10^{-10}	2.3×10^{-9}	5.5×10^{-7}	6.5×10^{-12}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

F.2.3.3 Alternative 2: Clean and Package Blanket Fuel in High-Integrity Cans and Electrometallurgically Treat Driver Fuel at ANL-W

The processing technology considered for this alternative consists of cleaning the sodium from blanket spent nuclear fuel and packaging the cleaned blanket spent nuclear fuel in high-integrity cans. The sodium-bonded driver spent nuclear fuel would be processed using the electrometallurgical treatment process. The dose calculation results for this combination of processes at ANL-W are found in Section F.2.3.2 for driver spent nuclear fuel and in F.2.3.4 for blanket spent nuclear fuel. All of the electrometallurgical treatment accidents for the driver spent nuclear fuel are applicable to this process. For the blanket spent nuclear fuel, the sodium fire and the cask handling accident are applicable. The accident assumptions and parameters used in developing these results are provided in Section F.2.2 of this appendix. EBR-II driver spent nuclear fuel and blanket spent nuclear fuel characteristics (radionuclide compositions) were used to develop the consequence and risk factors for all driver and blanket spent nuclear assembly fuel.

F.2.3.4 Alternative 3: Declad and Clean Blanket Fuel and Electrometallurgically Treat Driver Fuel at ANL-W; PUREX Process Blanket Fuel at SRS

The processing technology considered for this alternative consists of decladding and cleaning the sodium-bonded blanket spent nuclear fuel at the Hot Fuel Examination Facility at ANL-W and shipment of this material to SRS for PUREX processing. In this alternative, the sodium-bonded driver spent nuclear fuel would be processed using the electrometallurgical treatment process at ANL-W. **Tables F–38** through **F–44** provide the dose calculation results for accidents during PUREX processing at SRS and for cask drop and sodium fire accidents at ANL-W. The accident assumptions and parameters used in developing these results are provided in Section F.2.2 of this appendix. EBR-II driver and blanket spent nuclear fuel characteristics (radionuclide compositions) were used to develop the consequence and risk factors for all driver and blanket spent nuclear assembly fuel.

Consequence and risk estimates are provided for both processing the blanket spent nuclear fuel material at ANL-W prior to its shipment to SRS and for processing the material at SRS. Analysis results for processing the driver spent nuclear fuel can be found in the discussion for Alternative 1 in Section F.2.3.2.

Table F–38 Summary of Dose Calculation Results for an F-Canyon Fire

			95th Percentile Meteorology		*50th Percentile Meteorology*	
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***
F-Canyon fire	0.000061	Dose per event	610	36,000	2,300	5,500
		Dose per year	0.037	2.2	0.14	0.34
		LCF per year	1.9×10^{-8}	0.0011	5.6×10^{-8}	0.00017

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–39 Summary of Dose Calculation Results for an FB-Line Explosion

			95th Percentile Meteorology		*50th Percentile Meteorology*	
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***
FB-Line explosion	0.00010	Dose per event	6.5	360	19	53
		Dose per year	0.00065	0.036	0.0019	0.0053
		LCF per year	3.3×10^{-10}	0.000018	7.6×10^{-10}	2.7×10^{-6}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–40 Summary of Dose Calculation Results for an F-Canyon Earthquake

			95th Percentile Meteorology		*50th Percentile Meteorology*	
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***
F-Canyon earthquake	0.00013	Dose per event	1,100	38,000	12,000	2,100
		Dose per year	0.14	4.9	1.56	0.27
		LCF per year	7.2×10^{-8}	0.0025	6.2×10^{-7}	0.00014

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–41 Summary of Dose Calculation Results for an FB-Line Earthquake

			95th Percentile Meteorology		50th Percentile Meteorology	
Accident	*Frequency (event per year)*	*Risk*	*MEI (millirem)*	*Population (person-rem)*	*Noninvolved Worker (millirem)*	*Population (person-rem)*
FB-Line earthquake	0.00013	Dose per event	58	2,250	900	120
		Dose per year	0.0075	0.29	0.12	0.016
		LCF per year	3.8×10^{-9}	0.00015	4.7×10^{-8}	7.8×10^{-6}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–42 Summary of Dose Calculation Results for an F-Canyon Criticality Accident

			95th Percentile Meteorology		50th Percentile Meteorology	
Accident	*Frequency (event per year)*	*Risk*	*MEI (millirem)*	*Population (person-rem)*	*Noninvolved Worker (millirem)*	*Population (person-rem)*
F-Canyon criticality	0.00010	Dose per event	11	380	37	59
		Dose per year	0.0011	0.038	0.0037	0.0059
		LCF per year	5.5×10^{-10}	0.000019	1.5×10^{-9}	3.0×10^{-6}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–43 Summary of Dose Calculation Results for an ANL-W Cask Drop Accident

			95th Percentile Meteorology		50th Percentile Meteorology	
Accident	*Frequency (event per year)*	*Risk*	*MEI (millirem)*	*Population (person-rem)*	*Noninvolved Worker (millirem)*	*Population (person-rem)*
Cask drop	0.01	Dose per event	0.0024	0.011	0.000049	0.00028
		Dose per year	0.000024	0.00011	4.9×10^{-7}	2.8×10^{-6}
		LCF per year	1.2×10^{-11}	5.5×10^{-8}	2.0×10^{-13}	1.4×10^{-9}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–44 Summary of Dose Calculation Results for an ANL-W Sodium Fire

			95th Percentile Meteorology		50th Percentile Meteorology	
Accident	*Frequency (event per year)*	*Risk*	*MEI (millirem)*	*Population (person-rem)*	*Noninvolved Worker (millirem)*	*Population (person-rem)*
Sodium fire during decladding and cleaning	0.008	Dose per event	5.9	26.3	0.054	0.69
		Dose per year	0.047	0.21	0.00043	0.0055
		LCF per year	2.4×10^{-8}	0.00011	1.7×10^{-10}	2.8×10^{-6}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

F.2.3.5 Alternative 4: Melt and Dilute Blanket Fuel and Electrometallurgically Treat Driver Fuel at ANL-W

The processing technology considered for this alternative consists of melting and diluting the cleaned blanket spent nuclear fuel at the Hot Fuel Examination Facility at ANL-W. In this alternative, the sodium-bonded driver spent nuclear fuel would be processed using the electrometallurgical treatment process at ANL-W. The dose calculation results for this alternative are provided in this section. The results for the driver spent nuclear fuel are presented as part of the results for Alternative 1 (Section F.2.3.2) and the results for the blanket spent nuclear fuel are presented as part of the results for Alternative 6 (Section F.2.3.7), where the results for melt

and dilute processing of both driver and blanket spent nuclear fuel are presented. The accident assumptions and parameters used in developing these results are provided in Section F.2.2 of this appendix. EBR-II driver and blanket spent nuclear fuel characteristics (radionuclide compositions) were used to develop the consequence and risk factors for all driver and blanket spent nuclear assembly fuel.

F.2.3.6 Alternative 5: Declad and Clean Blanket Fuel and Electrometallurgically Treat Driver Fuel at ANL-W; Melt and Dilute Blanket Fuel at SRS

The processing technology considered for this alternative consists of decladding, cleaning, and packaging the blanket spent nuclear fuel at the Hot Fuel Examination Facility at ANL-W and shipping the packaged blanket spent nuclear fuel to SRS for melt and dilute processing in Building 105-L. In this alternative, the sodium-bonded driver spent nuclear fuel would be processed using the electrometallurgical treatment process at ANL-W. **Tables F–45** through **F–50** provide the dose calculation results for the melt and dilute process at SRS. The accident assumptions and parameters used in developing these results are provided in Section F.2.2 of this appendix. EBR-II driver and blanket spent nuclear fuel characteristics (radionuclide compositions) were used to develop the consequence and risk factors for all driver and blanket spent nuclear assembly fuel.

Consequence and risk estimates are provided for both processing the blanket spent nuclear material at ANL-W prior to its shipment to SRS, and for processing the material at SRS. Analysis results for processing driver spent nuclear fuel can be found in the discussion for Alternative 1 in Section F.2.3.2.

Table F–45 Summary of Dose Calculation Results for an L-Area Waste Handling Accident

			95th Percentile Meteorology		*50th Percentile Meteorology*	
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***
Waste handling spill	0.0064	Dose per event	2.1	42	0.17	3.6
		Dose per year	0.013	0.27	0.0011	0.023
		LCF per year	6.7×10^{-9}	0.000014	5.5×10^{-10}	0.000012

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–46 Summary of Dose Calculation Results for a Building 105-L Loss-of-Power Event

			95th Percentile Meteorology		*50th Percentile Meteorology*	
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***
Loss-of-power event	0.006	Dose per event	2,100	42,000	140	3,500
		Dose per year	12.6	250	0.84	21
		LCF per year	6.3×10^{-6}	0.13	3.4×10^{-7}	0.011

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–47 Summary of Dose Calculation Results for a Building 105-L Melter Eruption/Explosion

			95th Percentile Meteorology		*50th Percentile Meteorology*	
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***
Melter eruption/ explosion	0.0005	Dose per event	269	6,390	72.9	1,160
		Dose per year	0.14	3.2	0.037	0.58
		LCF per year	7.0×10^{-8}	0.0016	1.5×10^{-8}	0.00029

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–48 Summary of Dose Calculation Results for a Building 105-L Fire

			95th Percentile Meteorology		50th Percentile Meteorology	
Accident	*Frequency (event per year)*	*Risk*	*MEI (millirem)*	*Population (person-rem)*	*Noninvolved Worker (millirem)*	*Population (person-rem)*
Fire	0.075	Dose per event	86	1,700	6.3	140
		Dose per year	6.5	130	0.47	11
		LCF per year	3.2×10^{-6}	0.064	1.9×10^{-7}	0.0053

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–49 Summary of Dose Calculation Results for an ANL-W Cask Drop Accident

			95th Percentile Meteorology		50th Percentile Meteorology	
Accident	*Frequency (event per year)*	*Risk*	*MEI (millirem)*	*Population (person-rem)*	*Noninvolved Worker (millirem)*	*Population (person-rem)*
Cask drop	0.01	Dose per event	0.0024	0.011	0.000049	0.00028
		Dose per year	0.000024	0.00011	4.9×10^{-7}	2.8×10^{-6}
		LCF per year	1.2×10^{-11}	5.5×10^{-8}	2.0×10^{-13}	1.4×10^{-9}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–50 Summary of Dose Calculation Results for an ANL-W Sodium Fire

			95th Percentile Meteorology		50th Percentile Meteorology	
Accident	*Frequency (event per year)*	*Risk*	*MEI (millirem)*	*Population (person-rem)*	*Noninvolved Worker (millirem)*	*Population (person-rem)*
Sodium fire during decladding and cleaning	0.008	Dose per event	5.9	26.3	0.054	0.69
		Dose per year	0.047	0.21	0.00043	0.0055
		LCF per year	2.4×10^{-8}	0.00011	1.7×10^{-10}	2.8×10^{-6}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

F.2.3.7 Alternative 6: Melt and Dilute Blanket and Driver Fuel at ANL-W

The processing technology considered for this alternative consists of cleaning both blanket and driver spent nuclear fuel and melting and diluting the spent nuclear fuel at the Hot Fuel Examination Facility at ANL-W. **Tables F–51** through **F–57** provide the dose calculation results for the melt and dilute process at ANL-W. The accident assumptions and parameters used in developing these results are provided in Section F.2.2 of this appendix. EBR-II driver and blanket spent nuclear fuel characteristics (radionuclide compositions) were used to develop the consequence and risk factors for all driver and blanket spent nuclear assembly fuel.

Consequence and risk estimates are provided for both the declad and clean processing and the melt and dilute processing of the sodium-bonded spent nuclear fuel.

Table F–51 Summary of Dose Calculation Results for a Melt and Dilute Design-Basis Event (Driver)

			95th Percentile Meteorology			*50th Percentile Meteorology*			
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***	***MEI (millirem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***
Design-basis earthquake (includes sodium fire)	0.008	Dose per event	19,000	89,400	1,080	1,080	838	2,250	27
		Dose per year	152	715.2	8.64	8.64	6.7	18	0.22
		LCF per year	0.000076	0.36	4.3×10^{-6}	4.3×10^{-6}	2.7×10^{-6}	0.0090	1.1×10^{-7}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–52 Summary of Dose Calculation Results for a Melt and Dilute Design-Basis Event (Blanket)

			95th Percentile Meteorology			*50th Percentile Meteorology*			
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***	***MEI (millirem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***
Design-basis earthquake (includes sodium fire)	0.008	Dose per event	471	2240	26.9	27	15.2	56.1	0.68
		Dose per year	3.8	17.92	0.22	0.22	0.12	0.45	0.0054
		LCF per year	1.9×10^{-6}	0.0090	1.1×10^{-7}	1.1×10^{-7}	4.8×10^{-8}	0.00022	2.7×10^{-9}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–53 Summary of Dose Calculation Results for a Melt and Dilute Waste Handling Accident (Driver)

			95th Percentile Meteorology			*50th Percentile Meteorology*			
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***	***MEI (millirem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***
Waste handling accident (liquid spill)	0.0024	Dose per event	597	2820	34	33.9	26.7	70.8	.85
		Dose per year	1.43	6.77	0.082	0.081	0.064	0.17	0.0020
		LCF per year	7.2×10^{-7}	0.0034	4.1×10^{-8}	4.1×10^{-8}	2.6×10^{-8}	0.000085	1.0×10^{-9}

MEI - Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–54 Summary of Dose Calculation Results for a Melt and Dilute Waste Handling Accident (Blanket)

			95th Percentile Meteorology			*50th Percentile Meteorology*			
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***	***MEI (millirem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***
Waste handling accident (liquid spill)	0.0024	Dose per event	14.9	70.8	0.85	0.85	0.49	1.8	0.022
		Dose per year	0.036	0.17	0.0020	0.0020	0.0012	0.0043	0.000053
		LCF per year	1.8×10^{-8}	0.000085	1.0×10^{-9}	1.0×10^{-9}	4.8×10^{-10}	2.2×10^{-6}	2.7×10^{-11}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–55 Summary of Dose Calculation Results for a Melt and Dilute Criticality Accident (Driver)

			95th Percentile Meteorology			*50th Percentile Meteorology*			
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***	***MEI (millirem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***
Criticality	0.0003	Dose per event	0.52	1.6	0.019	0.083	0.47	0.085	1.0×10^{-6}
		Dose per year	0.00016	0.00048	0.0000057	0.000025	0.00014	0.000026	3.0×10^{-10}
		LCF per year	8.0×10^{-11}	2.4×10^{-7}	2.9×10^{-12}	1.3×10^{-11}	5.6×10^{-11}	1.3×10^{-8}	1.5×10^{-16}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–56 Summary of Dose Calculation Results for a Melt and Dilute Sodium Fire (Driver)

			95th Percentile Meteorology			*50th Percentile Meteorology*			
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***	***MEI (millirem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***
Sodium fire	0.008	Dose per event	282	1,260	15.2	15.6	2.59	33	0.4
		Dose per year	0.23	10.08	0.12	0.12	0.021	0.26	0.0032
		LCF per year	1.13×10^{-6}	0.0050	6.0×10^{-8}	6.0×10^{-8}	8.3×10^{-9}	0.00013	1.6×10^{-9}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

Table F–57 Summary of Dose Calculation Results for a Melt and Dilute Sodium Fire (Blanket)

			95th Percentile Meteorology			*50th Percentile Meteorology*			
Accident	***Frequency (event per year)***	***Risk***	***MEI (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***	***MEI (millirem)***	***Noninvolved Worker (millirem)***	***Population (person-rem)***	***Average Individual (millirem)***
Sodium fire	0.008	Dose per event	5.9	26.3	0.32	0.33	0.054	0.69	0.0083
		Dose per year	0.047	0.21	0.0026	0.0026	0.00043	0.0055	0.000066
		LCF per year	2.4×10^{-8}	0.00011	1.3×10^{-9}	1.3×10^{-9}	1.7×10^{-10}	2.8×10^{-6}	3.3×10^{-11}

MEI = Maximally Exposed Offsite Individual, LCF = Latent Cancer Fatality.

F.3 IMPACTS OF HAZARDOUS CHEMICAL ACCIDENTS ON HUMAN HEALTH

F.3.1 Chemical Accident Analysis Methodology

Factors such as receptor location, terrain, meteorological conditions, release conditions, and characteristics of the chemical inventory are required as input parameters for hand calculations or computer codes to determine human exposure from airborne releases of toxic chemicals. This section gives a general narrative about these input parameters with degrees of conservatism noted, and describes the computer models used to perform exposure estimates. EPIcode™ is the computer code chosen for estimating airborne concentrations resulting from most releases of toxic chemicals (Homann 1988).

F.3.1.1 *EPIcode™*

EPIcode™ uses the well-established Gaussian Plume Model to calculate the airborne toxic chemical concentrations at the receptor locations. The EPIcode™ library contains information on over 600 toxic substances listed in the *Threshold Limit Values for Chemical Substances and Physical Agents and Biomedical Exposure Indices* (ACGIH 1994). The types of releases that can be modeled, and associated input parameters, are discussed below.

Continuous release models require specifying the source term as an ambient concentration and a release rate. For term releases, the user specifies the release duration and the total quantity of material released. Area continuous and area term releases are useful in calculating the effects of a release from pools of spilled volatile liquids. The user must enter the effective radius of the release (i.e., the radius of the circle encompassing the spill area). Also entered is the temperature of the pool and ambient temperature to establish the release rate from a liquid spill. An upwind virtual point source, which results in an initial lateral diffusion equal to the effective radius of the area source, is used to model an area release.

By specifying a release quantity, duration, and area, the user effectively proposes a release rate per unit spill area. EPIcode™ confirms that the volatility of the spilled substance can support such a release rate. If the proposed release rate exceeds the saturation conditions at the release temperature, the EPIcode™ calculates a lower release rate and a corresponding longer release time.

In calculating effective release height, the actual plume height may not be the physical release height (e.g., the stack height). Plume rise can occur because of the velocity of a stack emission and the temperature differential between the stack effluent and the surrounding air. EPIcode™ calculates both the momentum and buoyant plume rise and chooses the greater of the two results.

Concentrations of chemical and radiological materials are highly dependent upon the effective release height (e.g., the effective height of a stack or an evaporating pool of spilled material). Thermal buoyancy was taken into consideration for those scenarios involving fire or heat sources. In those cases, a temperature of 200 °C (392 °F) was assumed for the thermal buoyancy term. This is conservative, since expected surface temperatures and resulting buoyancy terms are expected to be greater in actual fires or heat sources.

In this application, the standard terrain calculation of EPIcode™ is always used. Except as otherwise noted, both the 50th and 95th percentile meteorological (stability class and wind speed) conditions for INEEL were input into EPIcode™. The receptor height is always ground level (0 meters) and the mixing layer height is always 400 meters (1,300 feet).

As described in its user manual (Homann 1988), the EPIcode™ also performs the following steps:

- Treats a release as instantaneous versus continuous, depending upon the plume length at the specific downwind location being considered
- Corrects the concentration for sampling time
- Adjusts the wind speed for release height

- Depletes the plume as a function of downwind distance
- Adjusts the standard deviations of the crosswind and vertical concentrations for brief releases

As output, EPIcode™ can generate data plots of mean toxic chemical concentration (during a specified averaging time) as a function of downwind distance. From these graphs and numerical output, the concentrations at receptor locations are determined and evaluated for health effects.

EPIcode™ was selected as the computer code for release analysis of chemicals amenable to Gaussian modeling after comparison with a number of codes, primarily CHARM and ARCHIE. It was judged easier to use for this simple application than either the more sophisticated, proprietary CHARM code or the comparable, public domain ARCHIE code. The SLAB code had previously been selected by INEEL as the most appropriate of the refined dispersion models (such as CHARM) for modeling special case releases, such as dense gas dispersion, where negative buoyancy effects must be considered. However, because chemical accident scenarios involving dispersion of denser-than-air gases were not considered in this analysis, the SLAB model was not used. EPIcode™ was judged to be a satisfactory code for the inventory of chemicals analyzed.

F.3.1.2 Health Effects

Hazardous constituents dispersed during an accident could induce adverse health effects among exposed individuals. This possible impact is assessed by comparing the airborne concentrations of each substance at specified downwind receptor locations to standard accident exposure guidelines for chemical toxicity.

Where available, the Emergency Response Planning Guideline (ERPG) values were used for this comparison. The guideline values are estimates of airborne concentration thresholds above which one can reasonably anticipate observing adverse effects. The ERPG values are specific for each substance, and are derived for each of three general severity levels:

- *ERPG-1:* The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.

- *ERPG-2:* The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

- *ERPG-3:* The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

Where ERPG values were not derived for a toxic substance, other chemical toxicity values were substituted, as follows:

- For ERPG-1, threshold-limit value/time-weighted average values (ACGIH 1994) were substituted: The time-weighted average is the concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

- For ERPG-2, level-of-concern values (equal to 0.1 of immediately-dangerous-to-life-or-health values) were substituted: "level of concern" is defined as the concentration of a hazardous substance in air, above which there could be serious irreversible health effects or death as a result of a single exposure for a relatively short period of time (EPA 1987).

- For ERPG-3, immediately-dangerous-to-life-or-health values were substituted: "immediately dangerous to life or health" is defined as the maximum concentration from which a person could

escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible side effects (HHS 1997).

Possible health effects associated with exceeding an ERPG-2 or -3 value are specific for each substance of concern, and must be characterized in that context. When concentrations are found to exceed an ERPG or substitute value, specific toxicological effects for the chemicals of concern are considered in describing possible health effects associated with exceeding a threshold value.

The ERPG values are based upon a one-hour exposure of a member of the general population. In this analysis, the ERPG values were applied only to time-averaged exposures of one hour or less in duration. This approach provides an additional element of conservatism in the evaluation of accidents with releases that are significantly less than one hour. In instances of very short exposures to substances whose effects are concentration-dependent (e.g., chlorine) and where toxicological data support analysis at short exposure times, threshold concentrations of lethality are reported (the minimum concentration necessary to cause a fatality).

F.3.2 Accident Scenario Selection and Descriptions

F.3.2.1 Toxic Chemical Accidents at ANL-W

This section describes the nonradiological consequences of the abnormal event associated with handling uranium ingots. Four accidents have been identified at ANL-W that have the potential to result in the release of either uranium or uranium and cadmium. These accidents, a uranium handling accident, a design-basis uranium fire, a design-basis earthquake, and a beyond-design-basis earthquake, are discussed below.

F.3.2.1.1 Uranium Handling Accident

Uranium ingots (20 percent enrichment or less) from the electrometallurgical treatment process are transferred from the Fuel Conditioning Facility to onsite storage at the Zero Power Physics Reactor Material Building (ANLW-792). Transfers are made using a forklift or by truck. The uranium ingots weigh about 6 kilograms (13 pounds) each. They are stored in containers holding about 140 kilograms (310 pounds) of ingots. Depleted uranium also is stored at ANL-W in containers holding 1,350 kilograms (3,000 pounds) of ingots.

The accident involves a handling accident in which an ingot of uranium is dropped onto a hard surface, small particles are broken off the ingot, and the pyrophoric properties of the uranium result in ignition of the particles. The resulting small fire is assumed to consume 10 percent of the ingot. The accident could occur as a result of a container drop during handling, a drop during inspection, or due to an earthquake. The release occurs at ground level. A handling accident resulting in the drop of a uranium ingot may be anticipated to occur over the life of the project (or about 1 in 10 years). The conditional probability of a fire that consumes 10 percent of the dropped ingot was assumed to be 1 in 10 drops at most. The estimated frequency of the accident is therefore 0.01 per year.

The material at risk is one 6-kilogram ingot of uranium. The damage ratio is 0.1, as it was assumed that 10 percent of the ingot would be consumed in the fire. The airborne release fraction is 0.0001, and the respirable fraction is 1 for metal fires (DOE 1994b). The accident was assumed to occur outdoors or with little confinement. A leak path factor of 1 was assumed. This information is summarized in **Table F–58**.

Table F–58 Toxic Chemical Source Term for a Uranium Handling Accident

Chemical	*Material at Risk (kilograms)*	*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Released (kilograms)*
Uranium	6	0.1	0.0001	1	1	0.00006

F.3.2.1.2 Design-Basis Uranium Fire

Uranium ingots (20 percent enrichment or less) from the electrometallurgical treatment process are transferred from the Fuel Conditioning Facility to onsite storage at the Zero Power Physics Reactor Material Building (ANLW-792). Transfers are made using a forklift or by truck. The uranium ingots weigh about 6 kilograms (13 pounds) each. They are stored in containers holding about 140 kilograms (310 pounds) of ingots. Depleted uranium also is stored at ANL-W in containers holding 1,350 kilograms (3,000 pounds) of ingots.

The accident involves a fire consuming the equivalent of one container of uranium (140 kilograms). The accident could occur due to a handling accident, poor housekeeping in the storage area, electrical failure, or an earthquake. The uranium is in the form of ingots that have a small surface-area-to-mass ratio. Uranium is stored in metal containers that are not combustible. The postulated accident was estimated to have a frequency of 1×10^{-5} per year (see the discussion of radiological accidents in Section F.2).

The material at risk is one 140-kilogram container of uranium. The damage ratio is 1, as it was assumed that all of the uranium would be consumed in the fire. The airborne release fraction is 0.0001, and the respirable fraction is 1 for metal fires (DOE 1994b). The accident was assumed to occur outdoors or with little confinement (e.g., an open storage facility door). A leak path factor of 1 was assumed. This information is summarized in **Table F–59**.

Table F–59 Toxic Chemical Source Term for a Uranium Fire

Chemical	*Material at Risk (kilograms)*	*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Release (kilograms)*
Uranium	140	1	0.0001	1	1	0.014

F.3.2.1.3 Design-Basis Earthquake – Multifacility Effects

This event is the same event as described under radiological accidents for the electrometallurgical treatment of sodium-bonded spent nuclear fuel at ANL-W. The material at risk and release fraction values are summarized in **Table F-60**.

Table F–60 Toxic Chemical Source Term for a Design-Basis Earthquake

Chemical	*Material at Risk (kilograms)*	*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Release (kilograms)*
Uranium	17	1	2.5×10^{-6}	2.5×10^{-6}	1	0.000043

F.3.2.1.4 Beyond-Design-Basis Earthquake – Multifacility Effects

This event is the same event as described under radiological accidents for electrometallurgical treatment at ANL-W. The airborne release fraction and respirable fraction values for cadmium are each 2.5×10^{-6} (Slaughterbeck et al. 1995). The material at risk and release fraction values are summarized in **Table F–61**.

Table F–61 Toxic Chemical Source Term for a Beyond-Design-Basis Earthquake

Chemical	*Material at Risk (kilograms)*	*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Release (kilograms)*
Cadmium	1,000	1	2.5×10^{-6}	2.5×10^{-6}	1	0.0025
Uranium	17	1	2.5×10^{-6}	2.5×10^{-6}	1	0.000043

F.3.2.1.5 Liquid Sodium Fire

This event is the same event as described under radiological accidents for melt and dilute processing at ANL-W. The accident is associated with the fuel cleaning process used during the melt and dilute process or in preparation of the fuel for shipment to SRS for processing.

The accident involves a fire during the declad and clean processing of the spent nuclear fuel due to a breach of the Hot Fuel Examination Facility and exposure of liquid sodium to the air. The most probable cause of air in-leakage is expected to be an earthquake. As discussed in the radiological accident description, this event was assumed to occur with a frequency of 0.008 per year. The material at risk would be the sodium cleaned from the spent nuclear fuel and was conservatively estimated to be half of all of the sodium contained in the spent nuclear fuel, 300 kilograms. The release fraction values are provided in **Table F–62**. The assumption that all of the sodium would be converted to sodium hydroxide and volatilized by the fire results in the airborne release fraction and respirable fraction values of 1 each.

Table F–62 Toxic Chemical Source Term for a Sodium Fire in the Hot Fuel Examination Facility

Chemical	*Material at Risk (kilograms)*	*Damage Ratio*	*Airborne Release Fraction*	*Respirable Fraction*	*Leak Path Factor*	*Release (kilograms)*
Sodium	330	1	1	1	0.125	41.3

F.3.2.2 Toxic Chemical Accidents at SRS

The SRS Spent Nuclear Fuel Management Final EIS (DOE 2000) analyzed the consequences of accidental releases of hazardous chemicals for operations located in F-Area. These accidents involve the spill of materials associated with the wet storage of spent nuclear fuel in F-Area. These are generic-type accidents that are independent of processing cleaned and declad blanket fuel pins at either F-Canyon or Building 105-L. The activities associated with processing the cleaned and declad blanket spent nuclear fuel are not expected to result in the introduction of additional hazardous materials or additional accident scenarios. Therefore, the accident scenarios identified in the SRS Spent Nuclear Fuel Management Draft EIS were selected to represent the hazardous chemical accidents associated with processing sodium-bonded spent nuclear fuel.

F.3.3 Accident Analyses Consequences and Risk Results

Tables F–63 through **F–67** provide the chemical risk calculation results for electrometallurgical treatment process-related accidents at the ANL-W facility. **Table F–68** reproduces the consequences from hazardous chemical accidents at SRS, as originally developed for the SRS Spent Nuclear Fuel Management Final EIS (DOE 2000).

Table F–63 Summary of Toxic Chemical Exposure Results for a Uranium Handling Accident at ANL-W

Receptor Location	*Chemical*	*Concentration (milligrams per cubic meter)*	*Fraction of ERPG-1*	*ERPG-1 Value*
Noninvolved worker	Uranium	0.000177	0.000295	0.6 mg/m^3
Maximally exposed offsite individual	Uranium	1.14×10^{-8}	1.9×10^{-8}	0.6 mg/m^3

mg/m^3 = milligrams per cubic meter.

Table F–64 Summary of Toxic Chemical Exposure Results for a Uranium Fire at ANL-W

Receptor Location	*Chemical*	*Concentration (milligrams per cubic meter)*	*Fraction of ERPG-1*	*ERPG-1 Value*
Noninvolved worker	Uranium	0.0413	0.0688	0.6 mg/m^3
Maximally exposed offsite individual	Uranium	2.7×10^{-6}	4.4×10^{-6}	0.6 mg/m^3

mg/m^3 = milligrams per cubic meter.

Table F–65 Summary of Toxic Chemical Exposure Results for a Design-Basis Earthquake at ANL-W

Receptor Location	*Chemical*	*Concentration (milligrams per cubic meter)*	*Fraction of ERPG-1*	*ERPG-1 Value*
Noninvolved worker	Uranium	100 meters: 1.29×10^{-7} 230 meters: 1.03×10^{-6}	100 meters: 2.15×10^{-7} 230 meters: 1.72×10^{-6}	0.6mg/m^3
Maximally exposed offsite individual	Uranium	5.25×10^{-8}	8.75×10^{-8}	0.6 mg/m^3

mg/m^3 = milligrams per cubic meter.

Table F–66 Summary of Toxic Chemical Exposure Results for a Beyond-Design-Basis Earthquake at ANL-W

Receptor Location	*Chemical*	*Concentration (milligrams per cubic meter)*	*Fraction of ERPG-1*	*ERPG-1 Value*
Noninvolved worker	Cadmium	7.5×10^{-6}	0.00025	0.03 mg/m^3
	Uranium	1.27×10^{-7}	2.12×10^{-7}	0.6 mg/m^3
Maximally exposed offsite individual	Cadmium	3.10×10^{-6}	0.0001	0.03 mg/m^3
	Uranium	5.3×10^{-8}	8.8×10^{-8}	0.6 mg/m^3

mg/m^3 = milligrams per cubic meter.

Table F–67 Summary of Toxic Chemical Exposure Results for a Sodium Fire at ANL-W

Receptor Location	*Chemical*	*Concentration (milligrams per cubic meter)*	*Fraction of PEL-TWA*	*PEL-TWA*
Noninvolved worker	Sodium hydroxide	0.15	0.075	2 mg/m^3
Maximally exposed offsite individual	Sodium hydroxide	0.002	0.001	2 mg/m^3

PEL-TWA = Permissible Exposure Limits–Time-Weighted Average, mg/m^3 = milligrams per cubic meter.
[a] No ERPG value is available for sodium hydroxide; therefore, PEL-TWA was used instead.

Table F–68 Summary of Toxic Chemical Exposure Results for a Wet Storage Container Rupture at SRS

Frequency (event/year)	*Receptor*	*Chemical*	*Concentration* [a]	*Fraction of PEL-TWA*	*PEL-TWA*
0.005	Noninvolved worker	Sodium hydroxide	less than PEL-TWA	N/A[b]	2 mg/m^3
0.005	Noninvolved worker at 640 meters	Nitric acid	3.1×10^{-3} mg/m^3	0.00062	5 mg/m^3
	Maximally exposed offsite individual		4.0×10^{-4} mg/m^3	0.00008	5 mg/m^3
0.005	Noninvolved worker	Sodium nitrite	6.0×10^{-3} mg/m^3	0.0012 [2]	2 mg/m^3 [c]

PEL-TWA = Permissible Exposure Limits–Time-Weighted Average, mg/m^3 = milligrams per cubic meter.
[a] SRS Spent Nuclear Fuel Management Final EIS (DOE 2000).
[b] Not available – SRS Spent Nuclear Fuel EIS states that concentration only in less than the lowest PEL-TWA.
[c] No PEL-TWA for this specific chemical. Lowest PEL-TWA of potential chemical reaction products is 2 milligrams per cubic meter.

Table F-69 provides a summary of the applicability of the analyzed toxic chemical accidents to each of the alternatives considered in detail for processing the sodium-bonded spent nuclear fuel. The hazardous chemical accidents applicable to the No Action Alternative include only those accidents associated with operation at ANL-W. Additionally, only three of the four accidents identified, excluding the beyond-design-basis earthquake, can be associated with this alternative. Accidents associated with this alternative are the result of activities from the final processing of the sodium-bonded spent nuclear fuel treated with the electrometallurgical treatment process as part of the Electrometallurgical Treatment Demonstration Program. Alternatives 2 through 5 include electrometallurgical treatment of at least some of the sodium-bonded spent nuclear fuel and decladding and cleaning of blanket spent nuclear fuel; therefore, all of the identified toxic chemical accidents at ANL-W are applicable to these alternatives. Alternative 1 includes electrometallurgical treatment of fuel, but no decladding and cleaning operations; therefore, for this alternative, all ANL-W accidents except the sodium fire are applicable. Processing of the spent nuclear fuel at SRS occurs only in Alternatives 3 and 5, and the accidents at SRS are applicable to these two alternatives. The accidents identified for ANL-W are associated with the electrometallurgical treatment of the sodium-bonded spent nuclear fuel. Alternative 6 does not include this treatment option and no other accidental releases of hazardous chemicals were identified.

Table F–69 Applicability of Hazardous (Toxic) Chemical Accidents to Sodium-Bonded Spent Nuclear Fuel Alternatives

Alternative		*ANL-W Toxic Chemical Accidents*	*SRS Toxic Chemical Accidents*
	No action	Uranium handling accident Uranium fire Design-basis earthquake	Not applicable
1	Electrometallurgically treat blanket and driver fuel at ANL-W	Uranium handling accident Uranium fire Design-basis earthquake Beyond-design-basis earthquake	Not applicable
2	Clean and package blanket fuel in high-integrity cans and electrometallurgically treat driver fuel at ANL-W	Alternative 1 accidents plus sodium fire	Not applicable
3	Declad and clean blanket fuel and electrometallurgically treat driver fuel at ANL-W; PUREX process blanket fuel at SRS	Alternative 1 accidents plus sodium fire	Wet storage, container rupture
4	Melt and dilute blanket fuel and electrometallurgically treat driver fuel at ANL-W	Alternative 1 accidents plus sodium fire	Not applicable
5	Declad and clean blanket fuel and electrometallurgically treat driver fuel at ANL-W; melt and dilute blanket fuel at SRS	Alternative 1 accidents plus sodium fire	Wet storage, container rupture
6	Melt and dilute blanket and driver fuel at ANL-W	Sodium fire	Not applicable

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APPENDIX G
EVALUATION OF HUMAN HEALTH EFFECTS FROM OVERLAND TRANSPORTATION

G.1 INTRODUCTION

Overland transportation of any commodity involves a risk to both transportation crew members and members of the public. This risk results directly from transportation-related accidents and indirectly from the increased levels of pollution from vehicle emissions, regardless of the cargo. The transportation of certain materials, such as hazardous or radioactive waste, can pose an additional risk due to the unique nature of the material itself. To permit a complete appraisal of the environmental impacts of the proposed action and alternatives, the human health risks associated with the overland transportation of spent nuclear fuel are assessed.

This appendix provides an overview of the approach used to assess the human health risks that may result from overland transportation. The topics in this appendix include the scope of the assessment, packaging and determination of potential transportation routes, analytical methods used for the risk assessment (e.g., computer models), and important assessment assumptions. It also presents the results of the assessment. In addition, to aid in the understanding and interpretation of the results, specific areas of uncertainty are described with an emphasis on how the uncertainties may affect comparisons of the alternatives.

The risk assessment results are presented in this appendix in terms of "per-shipment" risk factors, as well as for the total risks for a given alternative. Per-shipment risk factors provide an estimate of the risk from a single shipment. The total risks for a given alternative are found by multiplying the expected number of shipments by the appropriate per-shipment risk factors.

G.2 SCOPE OF ASSESSMENT

The scope of the overland transportation human health risk assessment, including the alternatives and options, transportation activities, potential radiological and nonradiological impacts, and transportation modes considered, is described below. Additional details of the assessment are provided in the remaining sections of the appendix.

Proposed Action and Alternatives

The transportation risk assessment conducted for this environmental impact statement (EIS) estimates the human health risks associated with the transportation of sodium-bonded spent nuclear fuel for all alternatives. There are several shipping arrangements for various fuel types that cover all alternatives evaluated. Consistent with the scope of the overland transportation human health risks, this evaluation focuses on using onsite and offsite public highways.

Transportation-Related Activities

The transportation risk assessment is limited to estimating the human health risks incurred during overland transportation for each alternative. The risks to workers or to the public during loading, unloading, and handling prior to or after shipment are not included in the overland transportation assessment, but are addressed in Appendix F of this EIS. The transportation risk assessment does not address possible impacts from increased transportation levels on local traffic flow, noise levels, or infrastructure.

Radiological Impacts

For each alternative, radiological risks (i.e., those risks that result from the radioactive nature of the spent nuclear fuel) are assessed for both incident-free (i.e., normal) and accident transportation conditions. The radiological risk associated with incident-free transportation conditions would result from the potential exposure of people to external radiation in the vicinity of a loaded shipment. The radiological risk from transportation accidents would come from the potential release and dispersal of radioactive material into the environment during an accident and the subsequent exposure of people.

All radiological impacts are calculated in terms of committed dose and associated health effects in the exposed populations. The radiation dose calculated is the total effective dose equivalent (see 10 CFR 20), which is the sum of the effective dose equivalent from external radiation exposure and the 50-year committed effective dose equivalent from internal radiation exposure. Radiation doses are presented in units of roentgen equivalent man (rem) for individuals and person-rem for collective populations. The impacts are further expressed as health risks in terms of latent cancer fatalities and cancer incidence in exposed populations using the dose-to-risk conversion factors established by the National Council on Radiation Protection and Measurement (NCRP 1993).

Nonradiological Impacts

In addition to the radiological risks posed by overland transportation activities, vehicle-related risks are also assessed for nonradiological causes (i.e., causes related to the transport vehicles and not the radioactive cargo) for the same transportation routes. The nonradiological transportation risks, which would be incurred for similar shipments of any commodity, are assessed for both incident-free and accident conditions. The nonradiological risks during incident-free transportation conditions would be caused by potential exposure to increased vehicle exhaust emissions. The nonradiological accident risk refers to the potential occurrence of transportation accidents that directly result in fatalities unrelated to the shipment of cargo. State-specific transportation fatality rates are used in the assessment. Nonradiological risks are presented in terms of estimated fatalities.

Transportation Modes

All shipments are assumed to take place by truck transportation modes.

Receptors

Transportation-related risks are calculated and presented separately for workers and members of the general public. The workers considered are truck crew members involved in the actual overland transportation. The general public includes all persons who could be exposed to a shipment while it is moving or stopped during transit. The affected population includes individuals living within 800 meters (0.5 miles) of each side of the road. Potential risks are estimated for the affected populations and for the hypothetical maximally exposed individual. For incident-free operation, the maximally exposed individual would be an individual stuck in traffic next to the shipment for 30 minutes. For accident conditions, the maximally exposed individual would be an individual located 33 meters (108 feet) directly downwind from the accident. The risk to the affected population is a measure of the radiological risk posed to society as a whole by the alternative being considered. As such, the impact to the affected population is used as the primary means of comparing various alternatives.

G.3 PACKAGING AND REPRESENTATIVE SHIPMENT CONFIGURATIONS

Regulations that govern the transportation of radioactive materials are designed to protect the public from the potential loss or dispersal of radioactive materials, as well as from routine radiation doses during transit.

The primary regulatory approach to promote safety is the specification of standards for the packaging of radioactive materials. Because packaging represents the primary barrier between the radioactive material being transported and radiation exposure to the public and the environment, packaging requirements are an important consideration for transportation risk assessment. Regulatory packaging requirements are discussed briefly below. The representative packaging and shipment configurations assumed for this EIS also are described below.

G.3.1 Packaging Overview

Although several Federal and state organizations are involved in the regulation of radioactive waste transportation, primary regulatory responsibility resides with the U.S. Department of Transportation and the U.S. Nuclear Regulatory Commission (NRC). All transportation activities must take place in accordance with the applicable regulations of these agencies as specified in 49 CFR 172 and 173 and 10 CFR 71.

Transportation packaging for small quantities of radioactive materials must be designed, constructed, and maintained to contain and shield their contents during normal transport conditions. For large quantities and for more highly radioactive material, such as high-level radioactive waste or spent nuclear fuel, they must contain and shield their contents in the event of severe accident conditions. The type of packaging used is determined by the total radioactive hazard presented by the material within the packaging. Four basic types of packaging are used: Excepted, Industrial, Type A, and Type B. Another packaging option, "Strong, Tight," is still available for some domestic shipments.

Excepted packages are limited to transporting materials with extremely low-levels of radioactivity. Industrial packages are used to transport materials that, because of their low concentration of radioactive materials, present a limited hazard to the public and the environment. Type A packages are designed to protect and retain their contents under normal transport conditions and must maintain sufficient shielding to limit radiation exposure to handling personnel. These packages are used to transport radioactive materials with higher concentrations or amounts of radioactivity than Excepted, or Industrial packages. Strong, Tight packages are used in the United States for shipment of certain materials with low-levels of radioactivity, such as natural uranium and rubble from the decommissioning of nuclear reactors. Type B packages are used to transport material with the highest radioactivity levels, are designed to protect and retain their contents under transportation accident conditions, and are described in more detail in the following sections.

G.3.2 Regulations Applicable to Type B Casks

Regulations for the transport of radioactive materials in the United States are issued by the U.S. Department of Transportation and are codified in 49 CFR 173. The regulation authority for radioactive materials transport is jointly shared by the U.S. Department of Transportation and the NRC. As outlined in a 1979 Memorandum of Understanding with the NRC, the U.S. Department of Transportation specifically regulates the carriers of spent nuclear fuel and the conditions of transport, such as routing, handling and storage, and vehicle and driver requirements. The U.S. Department of Transportation also regulates the labeling, classification, and marking of all spent nuclear fuel packages. The NRC regulates the packaging and transport of spent nuclear fuel for its licensees, which include commercial shippers of spent nuclear fuel. In addition, NRC sets the standards for packages containing fissile materials and spent nuclear fuel.

Department of Energy (DOE) policy requires compliance with applicable Federal regulations regarding domestic shipments of spent nuclear fuel. Accordingly, DOE has adopted the requirements of 10 CFR 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions," and 49 CFR 173, "Shippers--General Requirements for Shipping and Packaging." DOE Headquarters can issue a certificate of compliance for a package to be used only by DOE and its contractors.

G.3.2.1 Cask Design Regulations

Spent nuclear fuel is transported in robust "Type B" transportation casks that are certified for transporting radioactive materials. Casks designed and certified for spent nuclear fuel transportation within the United States must meet the applicable requirements of NRC for design, fabrication, operation, and maintenance as contained in 10 CFR 71.

Cask design and fabrication can only be done by approved vendors with established quality assurance programs (10 CFR 71.101). Cask and component suppliers or vendors are required to obtain and maintain documents that prove the materials, processes, tests, instrumentation, measurements, final dimensions, and cask operating characteristics meet the design-basis established in the Safety Analysis Report for Packaging (described in the next section) for the cask and that the cask will function as designed.

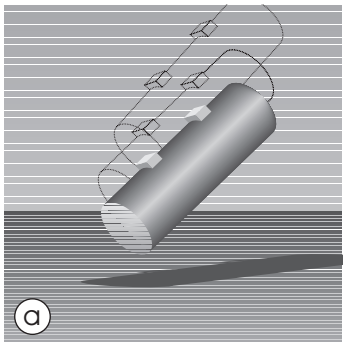
Regardless of where a transportation cask is designed, fabricated, or certified for use, it must meet certain minimum performance requirements (10 CFR 71.71–71.77). The primary function of a transportation cask is to provide containment and shielding. Regulations require that casks must be operated, inspected, and maintained to high standards to ensure their ability to contain their contents in the event of a transportation accident (10 CFR 71.87). There are no documented cases of a release of radioactive materials from spent nuclear fuel shipments, even though thousands of shipments have been made by road, rail, and water transport. Further, a number of obsolete casks have been tested under severe accident conditions to demonstrate their adherence to design criteria without failure.

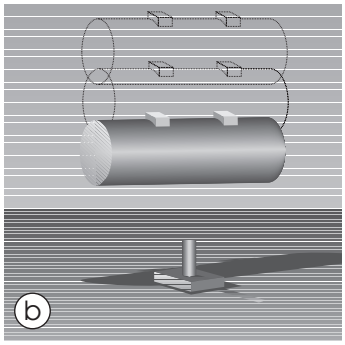
Transportation casks are built out of heavy, durable structural materials such as stainless steel. These materials must ensure cask performance under a wide range of temperatures (10 CFR 71.43). In addition to the structural materials, shielding is provided to limit radiation levels at the surface and at prescribed distances from the surface of transportation casks (10 CFR 71.47). Shielding typically consists of dense material such as lead or depleted uranium. The assemblies are supported by internal structures, called baskets, that provide shock and vibration resistance and establish minimum spacing and heat transfer to maintain the temperature of the contents within the limits specified in the Safety Analysis Report for Packaging.

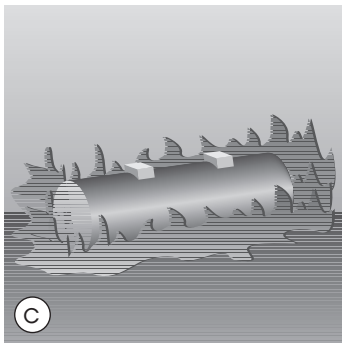
Finally, to limit impact forces and minimize damage to the structural components of a cask in the event of a transportation accident, impact-absorbing structures may be attached to the exterior of the cask. These are usually composed of balsa wood, foam, or aluminum honeycomb that is designed to readily deform upon impact to absorb impact energy. All of these components are designed to work together in order to satisfy the regulatory requirements for a cask to operate under normal conditions of transportation and maintain its integrity in an accident.

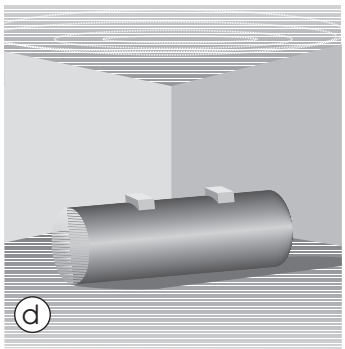
G.3.2.2 Design Certification

For certification, transportation casks must be shown by analysis and/or testing to withstand a series of hypothetical accident conditions. These conditions have been internationally accepted as simulating damage to transportation casks that could occur in most reasonably foreseeable accidents. The impact, fire, and water-immersion tests are considered in sequence to determine their cumulative effects on one package. These accident conditions are described in **Figure G–1**. The NRC issues regulations (10 CFR 71) governing the transportation of radioactive materials. In addition to the tests shown in Figure G–1, the regulations affecting Type B casks require that a transportation cask with activity greater than 10^6 curies (which is applicable to spent nuclear fuel) be designed and constructed so that its undamaged containment system would withstand









Standards for Type B Casks

For certification by the U.S. Nuclear Regulatory Commission, a cask must be shown by test or analysis to withstand a series of accident conditions without releasing its contents. These conditions have been internationally accepted as simulating damage to spent nuclear fuel casks that could occur in most severe credible accidents. The impact, fire, and water-immersion tests are considered in sequence to determine their cumulative effects on one package. An undamaged containment system is subjected to a deep water-immersion test. The details of the tests are as follows:

Impact

Free Drop (a) – The cask drops 9 meters (30 feet) onto a flat, horizontal, unyielding surface so that it strikes at its weakest point.

Puncture (b) – The cask drops 1 meter (40 inches) onto a 15.2-centimeter (6-inch) diameter steel bar at least 20.3 centimeters (8 inches) long; the bar strikes the cask at its most vulnerable spot.

Fire (c)

After the impact tests, the cask is totally engulfed in a 802 °C (1,475 °F) thermal environment for 30 minutes.

Water Immersion (d)

The cask is completely submerged under at least 1 meter (40 inches) of water for 8 hours. Additionally, undamaged containment systems (casks) are required to withstand more rigorous immersion tests.

Figure G–1 Standards for Transportation Casks

an external water pressure of 2 megapascals (290 pounds per square inch), or immersion in 200 meters (656 feet) of water, for a period of not less than one hour without collapse, buckling, or allowing water to leak into the cask.

Under the Federal certification program, a Type B packaging design must be supported by a Safety Analysis Report for Packaging, which demonstrates that the design meets Federal packaging standards. The Safety Analysis Report for Packaging must include a description of the proposed packaging in sufficient detail to identify the packaging accurately and provide the basis for evaluating its design. The Safety Analysis Report for Packaging must provide the evaluation of the structural design, materials' properties, containment boundary, shielding capabilities, and criticality control, and present the operating procedures, acceptance testing, maintenance program, and the quality assurance program to be used for design and fabrication. Upon completion of a satisfactory review of the Safety Analysis Report for Packaging to verify compliance to the regulations, a Certificate of Compliance is issued.

G.3.2.3 Transportation Regulations

To ensure that the transportation cask is properly prepared for transportation, trained technicians perform numerous inspections and tests (10 CFR 71.87). These tests are designed to ensure that the cask components are properly assembled and meet leak-tightness, thermal, radiation, and contamination limits before shipping radioactive material. The tests and inspections are clearly identified in the Safety Analysis Report for Packaging and/or the Certificate of Compliance for each cask. Casks can only be operated by registered users who conduct operations in accordance with documented and approved quality assurance programs meeting the requirements of the regulatory authorities. Records must be maintained that document proper cask operations in accordance with the quality requirements of 10 CFR 71.91. Reports of defects or accidental mishandling must be submitted to NRC. DOE will be the Shipper-of-Record for the shipments that could be sent.

External radiation from a package must be below specified limits that minimize the exposure of handling personnel and the general public. For these types of shipments, the external radiation dose rate during normal transportation conditions must be maintained below the following limits of 49 CFR 173:

- 10 millirem per hour at any point 2 meters (6.6 feet) from the vertical planes projected by the outer lateral surfaces of the transport vehicle (referred to as the regulatory limit throughout this document), and
- 2 millirem per hour in any normally occupied position in the transport vehicle

Additional restrictions apply to package surface contamination levels, but these restrictions are not important for the transportation radiological risk assessment. Current contamination standards assure that workers and public receive doses much lower than those associated with radiation emitted from the casks. For risk assessment purposes, it is important to note that all packaging of a given type is designed to meet the same performance criteria. Therefore, two different Type B designs would be expected to perform similarly during incident-free and accident transportation conditions. The specific containers selected or designed, however, will determine the total number of shipments necessary to transport a given quantity material.

G.3.2.4 Communications

Proper communication assists in ensuring safe preparation and handling of transportation casks. Communication is provided by labels, markings, placarding, shipping papers, or other documents. Labels (49 CFR 172.403) applied to the cask document the contents and the amount of radiation emanating from the cask by giving the transport index. The transport index lists the ionizing radiation level (in millirem per hour) at a distance of 1 meter (3.3 feet) from the cask surface.

In addition to the label requirements, markings (49 CFR 173.471) should be placed on the exterior of the cask to show the proper shipping name and the consignor and consignee in case the cask is separated from its original shipping documents (49 CFR 172.203). Transportation casks are required to be permanently marked with the designation "Type B," the owner's (or fabricators') name and address, the Certificate of Compliance number, and the gross weight (10 CFR 71.83).

Placards (49 CFR 172.500) are applied to the transport vehicle or freight container holding the transportation cask. The placards indicate the radioactive nature of the contents. Spent nuclear fuel, which constitutes a highway route-controlled quantity or "HRCQ," must be placarded according to 49 CFR 172.507. Placards provide the first responders to a traffic or transportation accident with initial information about the nature of the contents.

Shipping papers for the spent nuclear fuel should contain the notation "HRCQ" and have entries identifying the following: the name of the shipper, emergency response telephone number, description of contents, and the shipper's certificate, as described in 49 CFR 172 Subpart C.

In addition, drivers of motor vehicles transporting radioactive material must have been trained in accordance with the requirements of 49 CFR 172.700. The training requirements include familiarization with the regulations, emergency response information, and the communication programs required by the Occupational Safety and Health Administration. Drivers are also required to have been trained on the procedures necessary for safe operation of the vehicle used to transport the spent nuclear fuel.

G.3.3 Packages Used in the Transportation of Spent Nuclear Fuel

Two Type B casks, a formerly certified Type B cask, and an NRC-certified cask would provide primary transportation services for sodium-bonded fuel where public roads are involved. A commercially available cask would be certified and used for single shipments of miscellaneous sodium-bonded fuel from Tennessee and New Mexico. One other cask for onsite fuel transfers at ANL-W which does not use public roads will be employed. It is discussed below.

The TN-FSV is a certified Type B cask that would be used for intrasite transportation, and NAC-LWT would be used for the intersite transportation. The Peach Bottom (PB-1) is a formerly certified Type B cask that would be used for some of the intrasite transportation. The NRC-certified T-3 cask would be used for shipping the Fast Flux Test Facility Driver fuel from Washington to Idaho. The NRC-license is equivalent to the Type B certification described in the earlier sections.

The TN-FSV cask is a steel and lead shielded shipping cask originally designed for high temperature gas–cooled reactor fuel elements from the Fort St. Vrain reactor. The cask is a right circular cylinder, with a balsa and redwood impact limiter at each end. The cask body is made of two concentric shells of type 304 stainless steel, welded to a bottom plate and a top closure flange. The inner shell has an inside diameter of 46 centimeters (18 inches) and is 2.8 centimeters (1.1 inches) thick, and the cavity is 505 centimeters (199 inches) long. The outer shell has an outside diameter of approximately 76 centimeters (30 inches) and is 3.8 centimeters (1.5 inches) thick. The gross package weight, including the contents, is 21,319 kilograms (47,000 pounds). **Figure G–2** shows the TN-FSV.

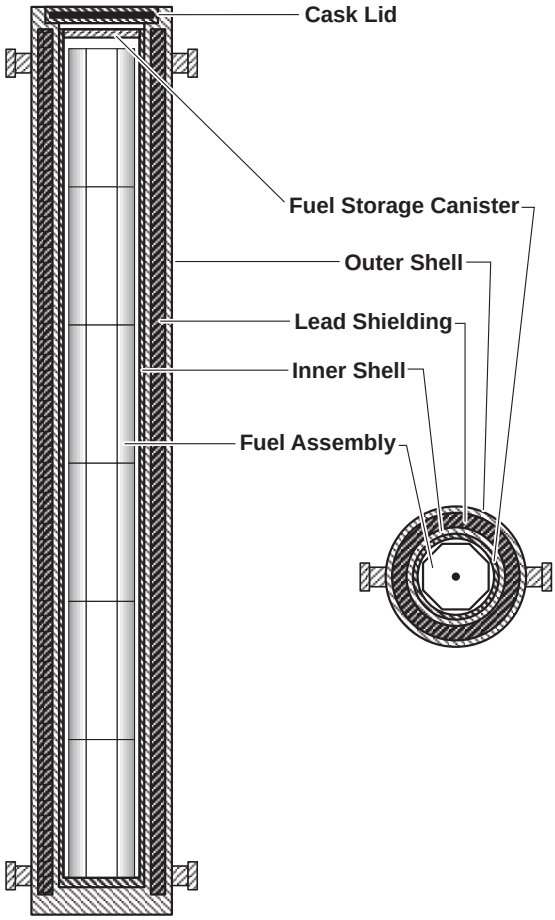


Figure G–2 TN-FSV Cask

The TN-FSV cask first received an NRC Certificate of Compliance in March 1993, and this certificate has been supplemented several times since that time. The current Certificate of Compliance expires in May 2004. The Certificate of Compliance would have to be supplemented for the materials that could be carried in this program. In addition to the size of the cavity, the limiting factors for this cask on the current Certificate of Compliance are a maximum of 360 watts of decay heat and a maximum total weight of contents of 2268 kilograms (5,000 pounds), including the fuel elements, fuel storage container and shield plug (NRC 1998).

The NAC-LWT is a steel encased lead shielded shipping cask. The overall dimensions with impact limiters are 589 centimeters (232 inches) long by 165 centimeters (65 inches) in diameter. The cask body is approximately 508 centimeters (200 inches) in length and 112 centimeters (44 inches) in diameter. The cask cavity is approximately 0.41 cubic meters (14.5 cubic feet). The maximum weight of the package is 23,587 kilograms (52,000 pounds) and the maximum weight of the contents and basket is 1,814 kilograms (4,000 pounds). **Figure G–3** shows the NAC-LWT.

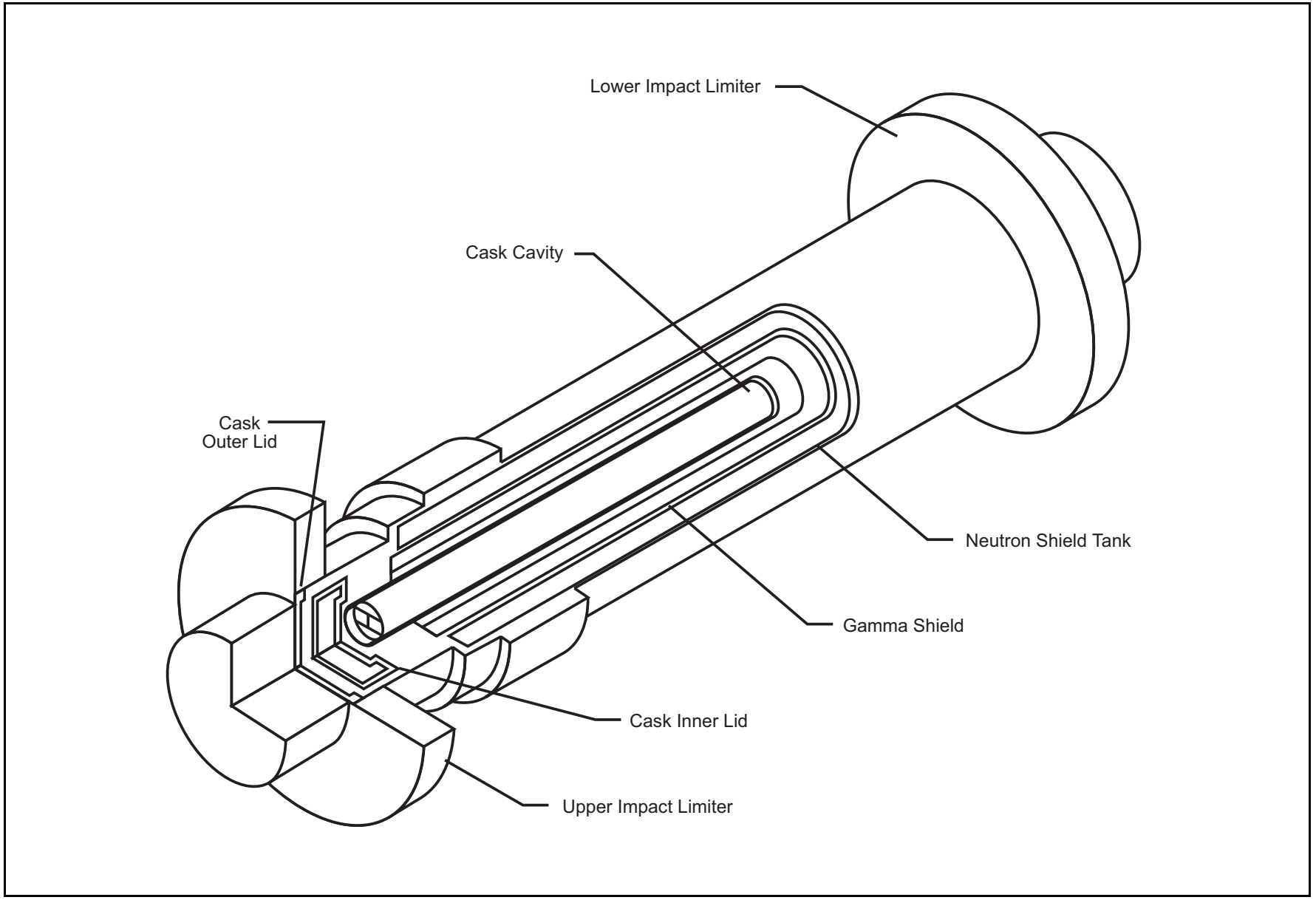


Figure G–3 Simplified Drawing of a NAC-LWT (Legal Weight Truck) Shipping Cask

The NAC-LWT first received an NRC Certificate of Compliance in March 1995, and this certificate has been supplemented several times. The current Certificate of Compliance expired in February 2000; it is likely that it will be renewed. The Certificate of Compliance would not need to be supplemented for the materials that could be carried in this program. The cask is designed to carry up to 42 reactor fuel assemblies. Besides the size of the cavity and weight, the limiting factor for this cask on the current Certificate of Compliance is a maximum of 210 watts of decay heat.

The intrasite transportation of Fermi-1 blanket fuel would use the formerly certified PB-1 cask. This cask was originally licensed for carrying Peach Bottom fuel, and was used to bring the Fermi-1 spent nuclear fuel to the Idaho Nuclear Technology and Engineering Center (INTEC). The Certificate of Compliance for this cask has expired. Since the movement is a short distance on closed DOE-controlled roads, DOE procedures and NRC regulations do not require the use of a certified Type B cask. The use of formerly certified casks provides a margin of safety beyond that required by NRC regulations. The level of safety for intrasite shipments is carefully controlled by internal procedures, and the level of protection given by the PB-1 cask is approximately equivalent to that of a certified Type B cask. Since the roads are closed and site is uninhabited, there would be no measurable impact to the public.

The Experimental Breeder Reactor II (EBR-II) driver and blanket fuel currently in storage at Argonne National Laboratory-West (ANL-W) is stored in HFEF-5 sealed canisters. The canisters are single use, welded steel cans. DOE packs these cans in an unlicensed HFEF-5 cask for onsite shipping. Fast Flux Test Facility driver material currently in storage at the Hanford Site would be shipped in the NRC-certified T-3 cask.

Waste from ANL-W will be shipped to the Idaho National Engineering and Environmental Laboratory (INEEL) Dry Transfer Facility in cans designed to closely fit the DOE standardized canisters. Waste includes ceramic waste form, metallic waste form, spent nuclear fuel and melt and dilute product. The standardized canisters are either a 46 centimeter (18-inch) outside diameter with a 0.95 centimeter (0.375 inch) thick pipe or 61 centimeter (24 inch) outside diameter with a 1.27 centimeter (0.5 inch) thick pipe made of Type 316L stainless steel with welded flanges on each end. DOE has not determined which Type B cask will be used to carry these canisters.

G.3.4 Ground Transportation Route Selection Process

According to DOE guidelines, spent nuclear fuel shipments must comply with both the NRC and U.S. Department of Transportation regulatory requirements. NRC regulations cover the packaging and transport of spent nuclear fuel, whereas the U.S. Department of Transportation specifically regulates the carriers and the conditions of transport, such as routing, handling and storage, and vehicle and driver requirements. The highway routing of nuclear material is systematically determined according to U.S. Department of Transportation regulations 49 CFR 171–179 and 49 CFR 397 for commercial shipments. Specific routes cannot be publicly identified in advance for DOE's Transportation Safeguards Division's shipments because they are classified to protect national security interests.

The U.S. Department of Transportation routing regulations require that shipment of a highway route-controlled quantity of radioactive material be transported over a preferred highway network, including interstate highways, with preference toward interstate system bypasses and beltways around cities and state-designated preferred routes. A state or tribe may designate a preferred route to replace or supplement the interstate highway system in accordance with U.S. Department of Transportation guidelines (DOT 1992).

Carriers of highway route-controlled quantities are required to use the preferred network unless they are moving from their origin to the nearest interstate highway or from the interstate highway to their destination, they are making necessary repair or rest stops, or emergency conditions render the interstate highway unsafe or impassable. The primary criterion for selecting the preferred route for a shipment is travel time. Preferred

routing takes into consideration accident rate, transit time, population density, activities, time of day, and day of the week.

The HIGHWAY computer code (Johnson et al. 1993) is used for selecting highway routes in the United States. The HIGHWAY database is a computerized road atlas that currently describes over 386,000 kilometers (240,000 miles) of roads. The Interstate System and all U.S. (US-designated) highways are completely described in the database. In addition, most of the principal state highways and many local and community roads are also identified. The code is updated periodically to reflect current road conditions and has been benchmarked against reported mileages and observations of commercial truck firms. Features in the HIGHWAY code allow the user to select routes that conform to U.S. Department of Transportation regulations. Additionally, the HIGHWAY code contains data on the population densities along the routes. The distances and populations from the HIGHWAY code are part of the information used for the transportation impact analysis in this EIS.

G.4 METHODS FOR CALCULATING TRANSPORTATION RISKS

The overland transportation risk assessment method is summarized in **Figure G–4**. After the EIS alternatives were identified and the goals of the shipping campaign were understood, data was collected on material characteristics and accident parameters. Accident parameters were largely based on the NRC studies of transportation accidents undertaken for the *Final Environmental Impact Statement on the Transportation of Radioactive Material by Air and Other Modes* (NRC 1977) and the Modal Study (NRC 1987).

Representative routes that may be used for the shipments were selected for risk assessment purposes using the HIGHWAY code. They do not necessarily represent the actual routes that would be used to transport nuclear materials. Specific routes cannot be identified in advance because the routes cannot be finalized until they have been reviewed and approved by the NRC. The selection of the actual route would be responsive to environmental and other conditions that would be in effect or could be predicted at the time of shipment. Such conditions could include adverse weather conditions, road conditions, bridge closures, and local traffic problems. For security reasons, details about a route would not be publicized before the shipment.

The first analytic step in the ground transportation analysis was to determine the incident-free and accident risk factors on a per-shipment basis. Risk factors, as with any risk estimate, are the product of the probability of exposure and the magnitude of the exposure. Accident risk factors were calculated for radiological and nonradiological traffic accidents. The probabilities, which are much lower than one, and the magnitudes of exposure were multiplied, yielding very low risk numbers. Incident-free risk factors were calculated for crew and public exposure to radiation emanating from the shipping container (cask) and public exposure to the chemical toxicity of the transportation vehicle exhaust. The probability of incident-free exposure is unity (one).

For each alternative, risks were assessed for both incident-free transportation and accident conditions. For the incident-free assessment, risks are calculated for both collective populations of potentially exposed individuals and for maximally exposed individuals. The accident assessment consists of two components: (1) a probabilistic accident risk assessment that considers the probabilities and consequences of a range of possible transportation accident environments, including low-probability accidents that have high consequences and high-probability accidents that have low consequences, and (2) an accident consequence assessment that considers only the consequences of the most severe postulated transportation accidents.

The RADTRAN 5 computer code (Neuhauser and Kanipe 1998) is used for incident-free and accident risk assessments to estimate the impacts on population. RADTRAN 5 was developed by Sandia National Laboratories to calculate population risks associated with the transportation of radioactive materials by a

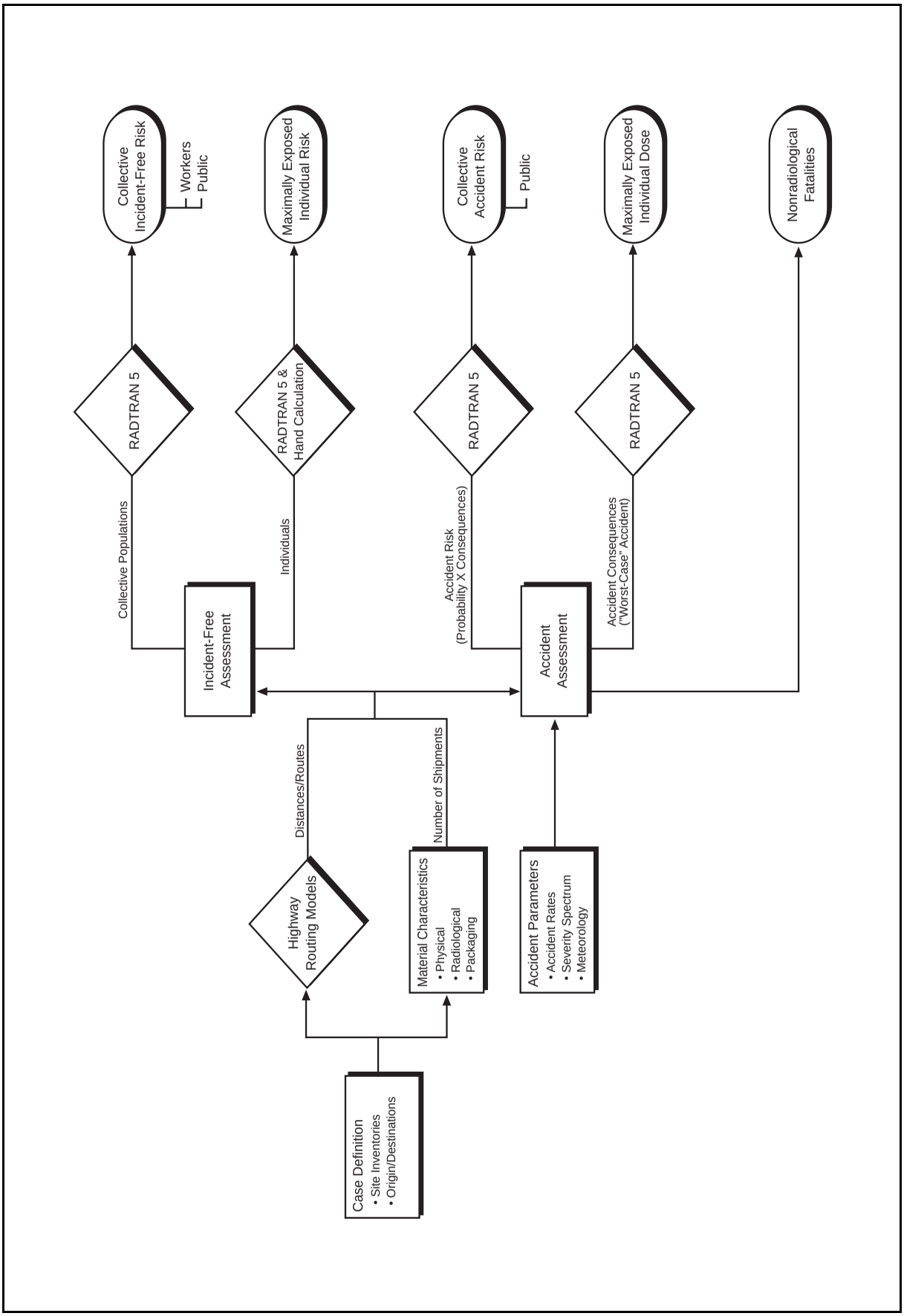


Figure G–4 Overland Transportation Risk Assessment

variety of modes, including truck, rail, air, ship, and barge. RADTRAN 5 was used to calculate the doses to the maximally exposed individuals.

The RADTRAN 5 population risk calculations include both the consequences and probabilities of potential exposure events. The RADTRAN 5 code consequence analyses include the cloud shine, ground shine, inhalation, and resuspension exposures. The collective population risk is a measure of the total radiological risk posed to society as a whole by the alternative being considered. As such, the collective population risk is used as the primary means of comparing the various alternatives.

G.5 ALTERNATIVES, PARAMETERS, AND ASSUMPTIONS

G.5.1 Material Inventory and Shipping Campaigns

Table G–1 lists the fuel that could be shipped as a result of implementing an alternative to treat sodium-bonded spent nuclear fuel.

Table G–1 Transportation Summary for Sodium-Bonded Fuel

Fuel Type	*Applicable Alternatives* [a]	*Metric Tons of Heavy Metal*	*Origin/State*	*Destination/ State*	*Cask*	*Number of Shipments/Type of Transport*
EBR-II driver	All	1.1	ANL-W/ID	ANL-W/ID	HFEF-5	84/On site, intrafacility transfers
EBR-II driver	All	2.0	INTEC/ID	ANL-W/ID	TN-FSV, or NAC-LWT	17/On site with roads open, or 43/On site with roads open
EBR-II blanket	All	22.4	ANL-W/ID	ANL-W/ID	HFEF-5	165/On site, intrafacility transfers
Fast Flux Test Facility driver [b]	All	0.33	Hanford/WA	ANL-W/ID	T-3	10/Public highways
Fermi-1 blanket	All	34.2	INTEC/ID	ANL-W/ID	PB-1	14/On site with road closed
Miscellaneous [b]	All	0.1	Oak Ridge National Laboratory/TN Sandia National Laboratories/ NM SRS/SC	ANL-W/ID	To be determined by DOE	1/Public highways 1/Public highways 1/Public highways
Declad EBR-II blanket	3 and 5	22.4	ANL-W/ID	SRS/SC	NAC-LWT	11/Public highways
Declad Fermi-1 blanket	3 and 5	34.2	ANL-W/ID	SRS/SC	NAC-LWT	18/Public highways

[a] "All" includes the proposed action plus the No Action Alternative.
[b] This fuel is assumed to be in Idaho per amended Record of Decision for the Programmatic Spent Nuclear Fuel EIS (61 FR 9441).
Key: ID = Idaho; NM = New Mexico; SC = South Carolina; TN = Tennessee; WA = Washington.

The following shipment campaigns related to sodium-bonded spent nuclear fuel were analyzed by DOE in other National Environmental Policy Act documents and are not treated in detail here.

- Fast Flux Test Facility driver material is currently stored at the Hanford Site, and the transportation impacts are included in the *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final EIS* (Programmatic Spent Nuclear Fuel EIS) (DOE 1995), and finalized in the Amendment to the Record of Decision (61 FR 9441).

- Miscellaneous spent nuclear fuel is currently stored at the Oak Ridge National Laboratory and at Sandia National Laboratory/New Mexico, and the transportation impacts are included in the Programmatic Spent Nuclear Fuel EIS (DOE 1995), and finalized in the Amendment to the Record of Decision (61 FR 9441).

Impacts of transporting sodium-bonded spent nuclear fuel to INEEL were calculated using a similar approach to that used in the Programmatic Spent Nuclear Fuel EIS (DOE 1995). In the Programmatic Spent Nuclear Fuel EIS, the representative transportation routes were analyzed using HIGHWAY Code (Johnson et al. 1993), and the risks were quantified using RADTRAN 4 Code, an older version of the code used in this EIS. The impact analysis in the Programmatic EIS was based on regulatory limit for cask dose rate and representative fuel isotope inventories. The isotopic inventories of the various sodium-bonded spent nuclear fuel presented in Appendix D are orders of magnitude less than those used in the Programmatic EIS. In addition, shipping cask dose rate containing sodium-bonded spent nuclear fuel would be between two to four orders of magnitude less than the regulatory limit dose rate (SAIC 1999). Therefore, the transportation impacts as presented in the Programmatic Spent Nuclear Fuel EIS would be very conservative for this EIS.

All EBR-II blanket and some EBR-II driver fuel are currently stored at ANL-W and would be subject to a building-to-building movement for processing. Since the movement is a short distance, on closed DOE-controlled roads, DOE procedures and NRC regulations do not require the use of a certified Type B cask. DOE would use the HFEF-5 canister which is the sealed canister in which the spent nuclear fuel is currently stored. No incident-free risk analysis is necessary, because the public would receive no measurable exposure. Worker dose is included in the process and handling dose estimates because the same personnel would be moving the spent nuclear fuel. No accident analysis is necessary because potential accidents during movement are bounded in frequency and consequence by handling accidents. Once the cask is closed for the low-speed movement to the nearby building, the likelihood and consequence of any foreseeable accident are very small and not further quantified.

Fermi-1 blanket fuel would be shipped from the INTEC to ANL-W in the formerly certified Type B cask, the PB-1 Cask. Since DOE would close the roads between INTEC and ANL-W using existing traffic gates, and there are no homes in the vicinity of the road within the INEEL site boundary, no quantitative analysis is necessary. No incident-free risk analysis is necessary, because the public would receive no measurable exposure. Worker dose is included in the process and handling dose estimates because the same personnel would be moving the spent nuclear fuel. Once the cask is closed for the movement on the INEEL site roads, the likelihood and consequence of any foreseeable accident are very small.

EBR-II driver fuel currently stored at INTEC would be shipped to ANL-W in a certified Type B cask, either TN-FSV or NAC-LWT. Since the cask would be certified, DOE would not close the roads between INTEC and ANL-W. However, since there are no homes in the vicinity of the road within the INEEL site boundary, limited quantitative analysis is necessary. No incident-free risk analysis for exposure to the public at stops or in their homes is necessary. Worker dose is analyzed for the transportation crew, and the dose to other vehicles using the road is estimated. No accident analysis is necessary, because potential accidents during movement are bounded in frequency and consequence, by the handling accidents. Once the cask is closed for the movement on the INEEL site roads, the likelihood and consequence of any foreseeable accident are very small and not further quantified.

Waste production canisters generated at ANL-W will be shipped to the INEEL Dry Transfer Facility for eventual shipment to and disposal in a geological repository. These canisters would be shipped in a certified cask, so DOE would not close the roads between INEEL and ANL-W. However, since there are no homes in the vicinity of the road with the INEEL site boundary, limited quantitative analysis is necessary. No incident-free risk analysis for exposure to the public at stops or in their homes is necessary. Worker dose is analyzed for the transportation crew, and the dose to other vehicles using the road is estimated. No detailed accident analysis is necessary because potential accidents during movement are bounded in frequency and consequence by the handling accidents. Once the cask is closed for the movement on the INEEL site roads, the likelihood and consequence of any foreseeable accidents are very small and not further quantified.

EBR-II and Fermi-1 blanket fuel that is cleaned and declad at ANL-W (Alternatives 3 and 5) would be transported to Savannah River Site (SRS) in NAC-LWT casks. The impacts associated with these shipments are analyzed in detail, including incident-free exposure to the truck crew and public, and accident risk. **Table G-2** summarizes the shipping campaigns necessary to complete each alternative.

Table G–2 Summary of Shipments Under Each Alternative

	Spent Nuclear Fuel for Processing				*Waste Production Canisters to INEEL Dry Transfer Facility*				
	At ANL-W		*At SRS*						
Alternative	*EBR-II Driver*	*Fermi-1 Blanket*	*Declad EBR-II Blanket*	*Declad Fermi-1 Blanket*	*Ceramic Waste Form*	*Metallic Waste Form*	*Spent Fuel*	*Melt and Dilute Product*	*Total*
No Action	43	14	—	—	15	1	355	—	428
1	43	14	—	—	125	5	—	—	187
2	43	14	—	—	27	2	63	—	149
3	43	14	11	18	27	2	—	—	115
4	43	14	—	—	27	2	—	114	200
5	43	14	11	18	27	2	—	—	115
6	43	14	—	—	32	1	—	164	254

G.5.2 Representative Routes

Representative overland truck routes were selected for the shipments from ANL-W to SRS. The routes were selected consistent with current routing practices and all applicable routing regulations and guidelines (DOT 1992). However, the routes were determined for risk assessment purposes. They do not necessarily represent the actual routes that would be used to transport spent nuclear fuel in the future. Specific routes cannot be identified in advance. The representative truck routes are shown in **Figure G–5**.

Route characteristics that are important to the radiological risk assessment include the total shipment distance and the population distribution along the route. The specific route selected determines both the total potentially exposed population and the expected frequency of transportation-related accidents. Route characteristics are summarized in **Table G–3**. The population densities along each route are derived from 1990 U.S. Bureau of Census data. Rural, suburban, and urban areas are characterized according to the following breakdown: rural population densities range from 0 to 54 persons per square kilometer (0 to 139 persons per square mile); the suburban range is from 55 to 1,284 persons per square kilometer (140 to 3,326 persons per square mile); and the urban range includes all population densities greater than 1,284 persons per square kilometer (3,326 persons per square mile). The affected population includes all persons living within 800 meters (0.5 mile) of each side of the road. The affected population, for route characterization and incident-free dose calculation, includes all persons living within 800 meters (0.5 mile) of each side of the road.

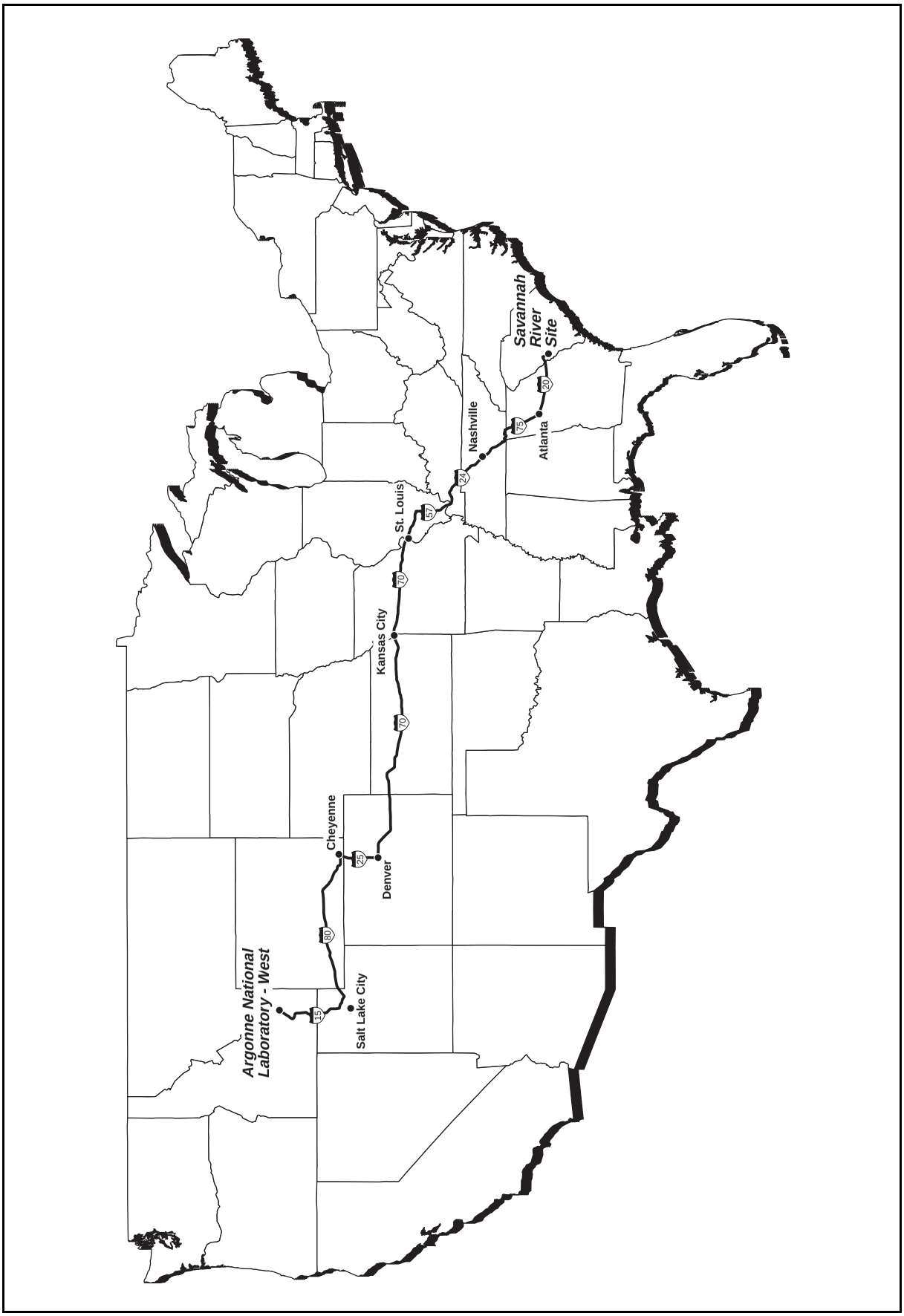


Figure G–5 Representative Overland Truck Route

Table G–3 Potential Shipping Routes Evaluated for the Sodium Bonded Spent Nuclear Fuel EIS

From	To	Distance (kilometers)	Percentages in Zones			Population Density in Zone (per square kilometer)			Number of Affected Persons
			Rural	Suburban	Urban	Rural	Suburban	Urban	
Truck Routes									
ANL-W	SRS	3,759.3	82.8	15.4	1.8	7.4	353	2,173.3	599,000
INTEC	ANL-W	38.6	100	0	0	1.0	N/A	N/A	62

N/A = not applicable.
The shipment impact to SRS are all based on the distance and population exposed on a trip from ANL-W to SRS.

G.5.3 External Dose Rates

External dose rates are calculated for the spent nuclear fuel being shipped on public roads (SAIC 1999). For the EBR-II blanket fuel, the dose rate on contact with the cask is 0.6 millirem per hour and the dose rate at 2 meters (6 feet) from the cask is 0.1 millirem per hour. For the Fermi-1 blanket fuel, the dose rate on contact with the cask is 0.00071 millirem per hour and the dose rate at 2 meters (6 feet) from the cask is 0.00014 millirem per hour. For the EBR-II driver fuel shipped to ANL-W, the dose rate on contact with the cask is 0.59 millirem per hour and the dose rate at 2 meters (6 feet) from the cask is 0.12 millirem per hour.

External dose rates for the waste production canisters could not be calculated because the Type B cask has not been identified. Ceramic waste form, metallic waste form and melt and dilute product canisters are conservatively assumed to have a dose rate at 2 meters (6 feet) from the vehicle equal to the maximum regulatory limit of 10 millirem per hour. The spent nuclear fuel waste is conservatively estimated to have a dose rate of 0.5 millirem per hour at 2 meters (6 feet) from the cask.

G.5.4 Health Risk Conversion Factors

The health risk conversion factors used to estimate expected cancer fatalities were: 0.0005 and 0.0004 latent cancer fatalities per person-rem for members of the public and workers, respectively (NCRP 1993).

G.5.5 Accident Frequencies

For the calculation of accident risks, vehicle accident and fatality rates are taken from data provided in other reports (ANL 1994). Accident rates are generically defined as the number of accident involvements (or fatalities) in a given year per unit of travel in that same year. Therefore, the rate is a fractional value, with accident-involvement count as the numerator of the fraction and vehicular activity (total travel distance in truck-kilometers) as its denominator. Accident rates are generally determined for a multi-year period. For assessment purposes, the total number of expected accidents or fatalities is calculated by multiplying the total shipment distance for a specific case by the appropriate accident or fatality rate.

For truck transportation, the rates presented are specifically for heavy combination trucks involved in interstate commerce. Heavy combination trucks are rigs composed of a separable tractor unit containing the engine and one to three freight trailers connected to each other. Heavy combination trucks are typically used for radioactive waste shipments. The truck accident rates are computed for each state based on statistics from 1986 to 1988 compiled by the U.S. Department of Transportation Office of Motor Carriers. Saricks and Kvitek (ANL 1994) present accident involvement and fatality counts; estimated kilometers of travel by state; and the corresponding average accident involvement, fatality, and injury rates for the three years investigated. A fatality caused by an accident is the death of a member of the public who is killed instantly or dies within 30 days due to the injuries sustained in the accident.

G.5.6 Container Accident Response Characteristics and Release Fractions

G.5.6.1 Development of Conditional Probabilities

NUREG-0170 (NRC 1977) originally was used to estimate the conditional probabilities associated with the accidents involving transportation of radioactive materials. The Modal Study, an initiative taken by the NRC (NRC 1987) to refine more precisely the analysis presented in NUREG-0170 for spent nuclear fuel shipping casks, was used to estimate the conditional probabilities of accidents.

Whereas the NUREG-0170 analysis was primarily performed using best engineering judgments and presumptions concerning cask response, the Modal Study relies on sophisticated structural and thermal engineering analysis and a probabilistic assessment of the conditions that could be experienced in severe transportation accidents. The Modal Study results are based on representative spent nuclear fuel casks assumed to have been designed, manufactured, operated, and maintained according to national codes and standards. Design parameters of the representative casks were chosen to meet the minimum test criteria specified in 10 CFR 71. The study is believed to provide realistic, yet conservative, results for radiological releases under transport accident conditions.

In the Modal Study, potential accident damage to a cask is categorized according to the magnitude of the mechanical forces (impact) and thermal forces (fire) to which a cask may be subjected during an accident. Because all accidents can be described in these terms, severity is independent of the specific accident sequence. In other words, any sequence of events that results in an accident in which a cask is subjected to forces within a certain range of values is assigned to the accident severity region associated with that range. The accident severity scheme is designed to take into account all potential foreseeable transportation accidents, including accidents with low probability but high consequences, and those with high probability but low consequences.

As discussed above, the accident consequence assessment only considers the potential impacts from the most severe transportation accidents. In terms of risk, the severity of an accident must be viewed in terms of potential radiological consequences, which are directly proportional to the fraction of the radioactive material within a cask that is released to the environment during the accident. Although regions span the entire range of mechanical and thermal accident loads, they are grouped into accident categories that can be characterized by a single set of release fractions and are, therefore, considered together in the accident consequence assessment. The accident category severity fraction is the sum of all conditional probabilities in that accident category.

G.5.6.2 Release Fraction Assumptions

The release fractions were taken from the Programmatic Spent Nuclear Fuel EIS (DOE 1995), which was based on the above described Modal Study. Spent nuclear fuel could be shipped in two different forms: unaltered or declad. The construction and cladding of the spent nuclear fuel are assumed to be similar enough to the aluminum-clad fuel analyzed in that EIS that the performance in an accident would be similar. The declad fuel would also exhibit similar performance, since the fuel is placed in a shipping can which is in turn placed inside the transportation cask.

G.5.7 Nonradiological Risk (Vehicle-Related)

Vehicle-related health risks resulting from incident-free transport may be associated with the generation of air pollutants by transport vehicles during shipment and are independent of the radioactive nature of the shipment. The health end-point assessed under incident-free transport conditions is the excess latent mortality due to inhalation of vehicle exhaust emissions. Risk factors for pollutant inhalation in terms of

latent mortality have been generated (Neuhauser and Kanipe 1998). These risks are 1×10^{-7} mortality per kilometer (1.6×10^{-7} per mile) of truck travel in urban areas. The risk factors are based on regression analyses of the effects of sulfur dioxide and particulate releases from diesel exhaust on mortality rates. Excess latent mortalities are assumed to be equivalent to latent cancer fatalities. Vehicle-related risks from incident-free transportation (affecting the population in urban areas along the transportation route) are calculated for each case by multiplying the total distance traveled in urban areas by the appropriate risk factor. Similar data are not available for rural and suburban areas.

Risks are summed over the entire route and over all shipments for each case. This method has been used in several EISs to calculate risks from incident-free transport. Lack of information for rural and suburban areas is an obvious data gap, although the risk factor would presumably be lower than for urban areas because of lower total emissions from all sources and lower population densities in rural and suburban areas.

G.6 RISK ANALYSIS RESULTS

Per-shipment risk factors have been calculated for the collective populations of exposed persons and for the crew for all anticipated routes and shipment configurations. The radiological risks are presented in doses per shipment for each unique route, material, and container combination. The radiological dose per shipment factors for incident-free transportation are presented in **Table G–4** for the transportation routes analyzed for this EIS. For spent nuclear fuel to be transferred to INEEL, consistent with the Record of Decision for the Programmatic Spent Nuclear Fuel EIS, the following analysis is performed. As stated in Section G.5.1, the Programmatic Spent Nuclear Fuel EIS (DOE 1995) used very conservative assumptions to analyze the shipments from the Oak Ridge Reservation, Hanford Site, and Sandia National Laboratory/New Mexico. For these 12 shipments, the incident free public risk is 0.00097 latent cancer fatalities from radiation and 8.1×10^{-6} latent cancer fatalities from exhaust emissions. The crew radiological risk is 0.00031 cancer fatalities. The public risk from radiological accidents is 0.00004 latent cancer fatalities and from nonradiological accidents is 0.0012 fatalities.

Doses are calculated for the crew, off-link public (i.e., people living along the route), on-link public (i.e., pedestrians and drivers along the route), and public at rest and fueling stops (i.e., stopped cars, buses and trucks, workers, and other bystanders). For the onsite shipments from INTEC to ANL-W, the stop dose is set to zero, because a truck would not be expected to stop during a trip that takes less than an hour. The off-link dose is zero because no persons are residing within 800 meters (0.5 miles) of the road.

The radiological dose risk factors for transportation accidents are also presented in Table G–2. The accident risk factors are called "dose risk" because the values incorporate the spectrum of accident severity probabilities and associated consequences. The accident dose is very low because, although persons are residing in an 80 kilometers (50 miles) radius of the road, they are generally quite far from the road. Since RADTRAN 5 uses an assumption of homogeneous population from the road out to 80 kilometers (50 miles), it would greatly overestimate the actual doses. However, the doses are clearly several factors of ten lower than the doses for the other transportation legs shown in Table G–4.

The nonradiological risk factors are presented in fatalities per shipment in **Table G–5**. Separate risk factors are provided for fatalities resulting from exhaust emissions (caused by hydrocarbon emissions known to be carcinogens) and transportation accidents (fatalities resulting from impact).

Table G–6 shows the risks of transportation for each alternative. The risks are calculated by multiplying the previously given per-shipment factors by the number of shipments over the duration of the program and, for the radiological doses, by the health risk conversion factors.

Table G–4 Radiological Risk Factors for Single Shipments

From	To	Material and Package	Incident-Free Dose (person-rem)					Accident Dose (person-rem)
				Public				
			Crew	Off-Link	On-Link	Stops	Total	
ANL	SRS	EBR-II blanket	0.000107	0.000174	0.000902	3.25×10^{-7}	0.00108	2.71×10^{-7}
ANL	SRS	Fermi-1 blanket	1.34×10^{-7}	2.18×10^{-7}	1.13×10^{-6}	4.06×10^{-10}	1.35×10^{-6}	3.55×10^{-9}
INTEC	ANL-W	EBR-II driver	1.10×10^{-6}	0	8.10×10^{-6}	0	8.10×10^{-6}	less than 1×10^{-10}
ANL-W	INEEL	Ceramic waste - driver	0.000137	0	0.00101	0	0.00101	less than 1×10^{-10}
ANL-W	INEEL	Ceramic waste - blanket	4.12×10^{-6}	0	0.0000304	0	0.0000304	less than 1×10^{-10}
ANL-W	INEEL	Metallic waste - driver	0.000137	0	0.00101	0	0.00101	less than 1×10^{-10}
ANL-W	INEEL	Metallic waste - blanket	4.12×10^{-6}	0	0.0000304	0	0.0000304	less than 1×10^{-10}
ANL-W	INEEL	Melt and dilute waste - driver	0.000137	0	0.00101	0	0.00101	less than 1×10^{-10}
ANL-W	INEEL	Melt and dilute waste - blanket	0.000137	0	0.00101	0	0.00101	less than 1×10^{-10}
ANL-W	INEEL	Spent fuel	4.12×10^{-6}	0	0.0000304	0	0.0000304	less than 1×10^{-10}

Table G–5 Nonradiological Risk Factors per Shipment

Nonradiological Risk Estimates (fatalities/shipment)			
From	To	Exhaust Emission	Accident
ANL-W	SRS	6.8×10^{-6}	0.000030
INTEC	ANL-W	0	3.0×10^{-7}

Table G–6 Risks of Transporting the Hazardous Materials[a]

Material Shipped [b]	*Alternative*	*Distance on Public Roads (kilometers)*	*Incident-Free*				*Accident*
			Radiological		*Nonradiological*		
			Crew	*Public*	*Emission*	*Traffic*	*Radiological*
EBR-II driver and Fermi-1 blanket fuel	No Action	15,980	1.22×10^{-6}	0.000011	0	0.00025	less than 1×10^{-9}
EBR-II driver and Fermi-1 blanket fuel	1	6,678	1.77×10^{-6}	0.000016	0	0.00010	less than 1×10^{-9}
EBR-II driver and Fermi-1 blanket fuel	2	5,211	1.71×10^{-6}	0.000016	0	0.00008	less than 1×10^{-9}
EBR-II driver and declad and cleaned EBR-II and Fermi-1 blanket fuel	3	111,799	2.08×10^{-6}	0.000021	0.00039	0.0018	1.7×10^{-9}
	3 (SRS)	109,020	4.7×10^{-7}	0.000006	0.00039	0.0017	1.5×10^{-9}
	3 (ANL-W)	2,779	1.6×10^{-6}	0.000015	0	0.000045	less than 10^{-9}
EBR-II driver and Fermi-1 blanket fuel	4	7,180	7.86×10^{-6}	0.000072	0	0.00011	less than 1×10^{-9}
EBR-II driver and declad and cleaned EBR-II and Fermi-1 blanket fuel	5 [c]	111,799	2.08×10^{-6}	0.000021	0.00039	0.0018	1.7×10^{-9}
EBR-II driver and Fermi-1 blanket fuel	6	9,264	0.000011	0.00010	0	0.00014	less than 1×10^{-9}

[a] All risks are expressed as number of latent cancer fatalities, except for the Accident-Traffic column, which lists number of accident fatalities.
[b] Also includes shipments of ceramic and metallic high-level radioactive waste under all alternatives.
[c] For details on breakdown of risk, see the values given for Alternative 3.

The risks to various exposed individuals under incident-free transportation conditions have been estimated for hypothetical exposure scenarios. The estimated doses to workers and the public are presented in **Table G–7.**

Table G–7 Estimated Dose to Exposed Individuals During Incident-Free Transportation Conditions

Receptor		*Dose to Maximally Exposed Individual*	
		Idaho to SRS	*Intrasite*
Workers	Crew member (truck driver) [a]	0.00008 rem per year	0.002 rem per year
	Inspector	0.000029 rem per event	Not applicable
Public	Resident	4.0×10^{-9} rem per event	Not applicable
	Person in traffic congestion	0.00011 rem per event	0.003 rem per event
	Person at service station	0.00001 rem per event	Not applicable

[a] Assumes that an individual driver takes every shipment.

All doses are presented on a per-event basis (person-rem per event) because it is not likely that the same person will be exposed to multiple events. The maximum dose to a crew member is based on the same individual being responsible for driving every shipment for the duration of the campaign. Note that the potential exists for larger individual exposures if multiple exposure events occur. For example, the dose to a person stuck in traffic next to a shipment for 10 minutes is calculated to be 0.03 millirem. However, since the intersite shipments pass through urban areas, a 30-minute exposure time is considered. Using the estimated dose rates, the maximally exposed individual would receive 0.1 millirem. The onsite shipments have a higher dose rate, but the maximum time stuck in traffic next to the waste shipment is considered to be 10 minutes. If the exposure duration were longer, the dose would rise proportionally. In addition, a person working at a truck service station could receive a significant dose if trucks were to use the same stops repeatedly. The dose to a person fueling a truck could be as much as 0.01 millirem per event.

The cumulative dose to a resident was calculated assuming all shipments passed his or her home. The cumulative doses assume that the resident is present for every shipment and is unshielded at a distance of 30 meters (about 98 feet) from the route. Therefore, the cumulative dose depends on the number of shipments passing a particular point and is independent of the actual route being considered. The maximum dose to this resident, if all the material were to be shipped via this route, would be less than 0.01 millirem.

The estimated dose to transportation crew members is presented for a commercial crew. No credit is taken for the shielding associated with the tractor or trailer.

The accident consequence assessment is intended to provide an estimate of the maximum potential impacts posed by the most severe potential transportation accidents involving a shipment. The maximum foreseeable (frequency greater than 1×10^{-7} per year) offsite transportation accident involves a shipment of EBR-II blanket fuel material under neutral (average) weather conditions. The accident has a probability of occurrence of about 1 every 10 million years and could result in 0.46 person-rem to the public. Additionally the accident could result in a dose of 0.0019 rem to the hypothetical maximally exposed individual in the immediate vicinity of the accident. The probability of an accident occurring and the exposed populations are lower for the onsite shipment of EBR-II blanket fuel. The source term is lower for the offsite shipments of Fermi blanket fuel. This accident would fall into Severity Category 5 of the Modal Study accident matrix (NRC 1987), and would occur in a suburban population zone. To incur this level of damage, the cask would have to collide with an immovable object at a speed of much greater than 88 kilometers per hour (55 miles per hour). The probability of an accident with a more energetic collision or a significant fire, which could lead to higher consequences, is lower.

G.7 CONCLUSIONS AND LONG-TERM IMPACTS OF TRANSPORTATION

G.7.1 Conclusions

It is unlikely that the transportation of radioactive materials will cause an additional fatality.

G.7.2 Long-Term Impacts of Transportation

The Programmatic Spent Nuclear Fuel EIS (DOE 1995) analyzed the cumulative impacts of all transportation of radioactive materials, including impacts from reasonably foreseeable actions that include transportation of radioactive material for a specific purpose and general radioactive materials transportation that is not related to a particular action. The total worker and general population collective doses are summarized in **Table G–8**. The table shows that the impacts of this program are quite small compared with overall transportation impacts. Total collective worker dose from all types of shipments (historical, the alternatives, reasonably foreseeable actions, and general transportation) was estimated to be 320,000 person-rem (130 latent cancer fatalities) for the period 1943 through 2035 (93 years). Total general population collective dose was also estimated to be 320,000 person-rem (160 latent cancer fatalities). The majority of the collective dose for workers and the general population was due to the general transportation of radioactive material. Examples of these activities are shipments of radiopharmaceuticals to nuclear medicine laboratories and shipments of commercial low-level radioactive waste to commercial disposal facilities. The total number of latent cancer fatalities estimated to result from radioactive materials transportation over the period between 1943 and 2035 was 290. Over this same period (93 years), approximately 28 million people would die from cancer, based on 300,000 cancer fatalities per year. It should be noted that the estimated number of transportation-related latent cancer fatalities would be indistinguishable from other latent cancer fatalities, and the transportation-related latent cancer fatalities are 0.0010 percent of the total number of latent cancer fatalities.

Table G–8 Cumulative Transportation-Related Radiological Collective Doses and Latent Cancer Fatalities (1943 to 2035)

Category	*Collective Worker Dose (person-rem)*	*Collective General Population Dose (person-rem)*
Sodium-bonded spent nuclear fuel impacts (from Table G–4)	less than 1	less than 1
Other Nuclear Material Shipments		
Truck	11,000	50,000
Rail	820	1,700
General transportation (1943–2035)	310,000	270,000
Total collective dose	322,000	322,000
Total latent cancer fatalities	130	160

Source: DOE 1995.

G.8 UNCERTAINTY AND CONSERVATISM IN ESTIMATED IMPACTS

The sequence of analyses performed to generate the estimates of radiological risk for transportation includes: (1) determination of the inventory and characteristics, (2) estimation of shipment requirements, (3) determination of route characteristics, (4) calculation of radiation doses to exposed individuals (including estimating of environmental transport and uptake of radionuclides), and (5) estimation of health effects. Uncertainties are associated with each of these steps. Uncertainties exist in the way that the physical systems being analyzed are represented by the computational models; in the data required to exercise the models (due

to measurement errors, sampling errors, natural variability, or unknowns simply caused by the future nature of the actions being analyzed); and in the calculations themselves (e.g., approximate algorithms used by the computers).

In principle, one can estimate the uncertainty associated with each input or computational source and predict the resultant uncertainty in each set of calculations. Thus, one can propagate the uncertainties from one set of calculations to the next and estimate the uncertainty in the final, or absolute, result; however, conducting such a full-scale quantitative uncertainty analysis is often impractical and sometimes impossible, especially for actions to be initiated at an unspecified time in the future. Instead, the risk analysis is designed to ensure, through uniform and judicious selection of scenarios, models, and input parameters, that relative comparisons of risk among the various alternatives are meaningful. In the transportation risk assessment, this design is accomplished by uniformly applying common input parameters and assumptions to each alternative. Therefore, although considerable uncertainty is inherent in the absolute magnitude of the transportation risk for each alternative, much less uncertainty is associated with the relative differences among the alternatives in a given measure of risk.

In the following sections, areas of uncertainty are discussed for the assessment steps enumerated above. Special emphasis is placed on identifying whether the uncertainties affect relative or absolute measures of risk. The reality and conservatism of the assumption are addressed. Where practical, the parameters that most significantly affect the risk assessment results are identified.

G.8.1 Uncertainties in Material Inventory and Characterization

The inventories and the physical and radiological characteristics are important input parameters to the transportation risk assessment. The potential amount of transportation for any alternative is determined primarily by the projected dimensions of package contents, the strength of the radiation field, the heat that must be dissipated, and assumptions concerning shipment capacities. The physical and radiological characteristics are important in determining the material released during accidents and the subsequent doses to exposed individuals through multiple environmental exposure pathways.

Uncertainties in the inventory and characterization are reflected in the transportation risk results. If the inventory is overestimated (or underestimated), the resulting transportation risk estimates are also overestimated (or underestimated) by roughly the same factor. However, the same inventory estimates are used to analyze the transportation impacts of each of the EIS alternatives. Therefore, for comparative purposes, the observed differences in transportation risks among the alternatives, as given in Table G-5, are believed to represent unbiased, reasonably accurate estimates from current information in terms of relative risk comparisons.

G.8.2 Uncertainties in Containers, Shipment Capacities, and Number of Shipments

The transportation required for each alternative is based in part on assumptions concerning the packaging characteristics and shipment capacities for commercial trucks. Representative shipment capacities have been defined for assessment purposes based on probable future shipment capacities. In reality, the actual shipment capacities may differ from the predicted capacities such that the projected number of shipments and, consequently, the total transportation risk would change. However, although the predicted transportation risks would increase or decrease accordingly, the relative differences in risks among alternatives would remain about the same.

G.8.3 Uncertainties in Route Determination

Representative routes have been determined between all origin and destination sites considered in the EIS. The routes have been determined to be consistent with current guidelines, regulations, and practices, but may

not be the actual routes that would be used in the future. In reality, the actual routes could differ from the representative ones concerning distances and total population along the routes. Moreover, since materials could be transported over an extended time starting at some time in the future, the highway infrastructures and the demographics along routes could change. These effects have not been accounted for in the transportation assessment; however, it is not anticipated that these changes would significantly affect relative comparisons of risk among the alternatives considered in the EIS. Specific routes cannot be identified in advance because the routes are classified to protect national security interests.

G.8.4 Uncertainties in the Calculation of Radiation Doses

The models used to calculate radiation doses from transportation activities introduce a further uncertainty in the risk assessment process. Estimating the accuracy or absolute uncertainty of the risk assessment results is generally difficult. The accuracy of the calculated results is closely related to the limitations of the computational models and to the uncertainties in each of the input parameters that the model requires. The single greatest limitation facing users of RADTRAN, or any computer code of this type, is the scarcity of data for certain input parameters.

Uncertainties associated with the computational models are reduced by using state-of-the-art computer codes that have undergone extensive review. Because many uncertainties are recognized but difficult to quantify, assumptions are made at each step of the risk assessment process intended to produce conservative results (i.e., overestimate the calculated dose and radiological risk). Because parameters and assumptions are applied to all alternatives, this model bias is not expected to affect the meaningfulness of relative comparisons of risk; however, the results may not represent risks in an absolute sense.

Post accident mitigative actions are not considered for dispersal accidents. For severe accidents involving the release and dispersal of radioactive materials in the environment, no post accident mitigative actions, such as interdiction of crops or evacuation of the accident vicinity, have been considered in this risk assessment. In reality, mitigative actions would take place following an accident according to U.S. Environmental Protection Agency radiation protection guides for nuclear incidents (EPA 1991). The effects of mitigative actions on population accident doses are highly dependent upon the severity, location, and timing of the accident. For this risk assessment, ingestion doses are only calculated for accidents occurring in rural areas (the calculated ingestion doses, however, assume all food grown on contaminated ground is consumed and is not limited to the rural population). Examination of the severe accident consequence assessment results has shown that ingestion of contaminated foodstuffs contributes about 50 percent of the total population dose for rural accidents. Interdiction of foodstuffs would act to reduce, but not eliminate, this contribution.

G.9 REFERENCES

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APPENDIX H
ENVIRONMENTAL JUSTICE ANALYSIS

H.1 INTRODUCTION

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, directs Federal agencies to identify and address, as appropriate, the disproportionately high and adverse health or environmental effects of their programs, policies, and activities on minority populations and low-income populations.

The Council on Environmental Quality has oversight responsibility for documentation prepared in compliance with the National Environmental Policy Act (NEPA). In December 1997, the Council released its guidance on environmental justice under NEPA (CEQ 1997). The Council's guidance was adopted as the basis for the analysis of environmental justice contained in this environmental impact statement (EIS).

This appendix provides an assessment of the potential for disproportionately high and adverse human health or environmental effects on minority or low-income populations that could result from implementation of alternatives for management of the U.S. Department of Energy's (DOE) inventory of sodium-bonded spent nuclear fuel.

H.2 DEFINITIONS AND APPROACH

Minority Individuals and Population

The following definitions of minority individuals and population were used in this analysis of environmental justice:

- **Minority Individuals**—Members of any of the following population groups: Hispanic, Native American, Asian or Pacific Islander, or Black

- **Minority Population**—The total number of minority individuals residing within a potentially affected area

In discussions of environmental justice in this EIS, persons self-designated as Hispanic are included in the Hispanic population, regardless of race. For example, the Asian or Pacific Islander population is composed of persons self-designated as Asian or Pacific Islander and not of Hispanic origin. Asian or Pacific Islanders who designate themselves as having Hispanic origins are included in the Hispanic population. Data for the analysis of minorities and racial population were extracted for the year 2010 from the U.S. Census Bureau's worldwide web site (DOC 1999).

Executive Order 12898 specifically addresses "disproportionately high and adverse effects" on "low-income" populations. The Council on Environmental Quality recommends that poverty thresholds be used to identify "low-income" individuals (CEQ 1997).

Low-Income Individuals and Population

The following definitions of low-income individuals and population were used in this analysis:

- **Low-Income Individuals**—Persons whose self-reported incomes are less than the poverty threshold
- **Low-Income Population**—The total number of poverty-level individuals residing within a potentially affected area

Data for the analysis of low-income populations were extracted from the U.S. Census Bureau's Table P121 of Standard Tape File 3 (DOC 1992).

Disproportionately High and Adverse Human Health Effects

Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts to human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk of exposure rate for the general population or, where available, for another appropriate comparison group (CEQ 1997).

Disproportionately High and Adverse Environmental Impacts

A disproportionately high environmental impact refers to an impact or risk of an impact in a low-income or minority community that is significant and exceeds the environmental impact on the larger community. An adverse environmental impact is a deleterious environmental impact that is determined to be significant. In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed low-income or minority populations were considered (CEQ 1997).

Potentially affected areas examined in this EIS include areas defined by an 80-kilometer (50-mile) radius centered on candidate facilities for the treatment and management of sodium-bonded spent nuclear fuel at Argonne National Laboratory-West (ANL-W) and the Savannah River Site (SRS).

H.3 METHODOLOGY

H.3.1 Spatial Resolution

For the purposes of enumeration and analysis, the U.S. Census Bureau has defined a variety of areal units (DOC 1992). Areal units of concern in this EIS include (in order of increasing spatial resolution) states, counties, census tracts, block groups, and blocks. The block is the smallest of these entities and offers the finest spatial resolution. This term refers to a relatively small geographical area bounded on all sides by visible features such as streets and streams or by invisible boundaries such as city limits and property lines. During the 1990 census, the U.S. Census Bureau subdivided the United States and its territories into 7,017,425 blocks. For comparison, the number of counties, census tracts, and block groups used in the 1990 census were 3,248; 62,276; and 229,192, respectively. While blocks offer the finest spatial resolution, economic data required for identification of low-income populations are not available at the block level of spatial resolution. In the analysis below, block groups are used throughout as the areal unit. Block groups generally contain between 250 and 500 housing units (DOC 1992).

During the decennial census, the U.S. Census Bureau collects data from individuals and aggregates the data according to residence in a geographical area, such as a county or block group. Boundaries of the areal units are selected to coincide with features such as streams and roads or political boundaries such as county and city borders. Boundaries used for aggregation of the census data usually do not coincide with boundaries used in the calculation of health effects. As discussed in Chapter 4 of this EIS, radiological health effects due to an accident at each of the sites are evaluated for persons residing within a distance of 80 kilometers (50 miles) of the accident site. In general, the boundary of the circle with an 80-kilometer (50-mile) radius centered at the accident site will not coincide with boundaries used by the U.S. Census Bureau for enumeration of the population in the potentially affected area. Some block groups lie completely inside or outside of the radius for health effects calculation. However, other block groups are only partially included. As a result of these partial inclusions, uncertainties are introduced into the estimate of the population at risk from the accident.

To estimate the populations at risk in partially included block groups, it was assumed that populations are uniformly distributed throughout the area of each block group. For example, if 30 percent of the area of a block group lies within 80 kilometers (50 miles) of the accident site, it was assumed that 30 percent of the population residing in that block group would be at risk. An upper bound for the population at risk was obtained by including the total population of partially included block groups in the population at risk. Similarly, a lower bound for the population at risk was obtained by excluding the population of partially included blocks from the population at risk. As a general rule, if the areas of geographic units defined by the U.S. Census Bureau are small in comparison with the potentially affected area, then the uncertainties due to partial inclusions will be relatively small.

Tables H-1 through **H-3** show lower and upper population bounds for the ANL-W site located within the boundary of the Idaho National Engineering and Environmental Laboratory (INEEL) in Idaho, and F- and L-Areas at SRS in South Carolina. Estimated populations listed in column 3 of these tables were obtained under the assumption that populations are distributed uniformly throughout each block group that lies at least partly within 80 kilometers (50 miles) of the candidate sites. Lower population bounds given in column 2 were obtained by summing only those populations residing in block groups that are wholly included within a circle of an 80-kilometer radius centered at each candidate site. Upper bounds shown in column 4 are the sum of populations residing within all block groups that are at least partly included within that circle. For these candidate sites, lower bounds differed from the corresponding estimate by no more than 12.9 percent, while upper bounds differed from the corresponding estimate by 10.4 percent or less. As discussed in Chapter 4 and summarized in Table 2-4 of Chapter 2, implementation of the alternatives would pose no significant radiological or nonradiological risks to the general public. Under normal operations, the radiological risk of a latent cancer fatality among the surrounding population is approximately one in 90,000 or less. In the event of an accident involving a radiological release affecting the general population, the maximum risk to the public would occur at SRS under Alternative 5, where 0.013 latent cancer fatalities would be expected. Under Alternative 5, unless the population at risk near SRS were increased by nearly a factor of 77 over the estimated value, no latent cancer fatalities would be expected. Thus, uncertainties in the estimates of total, minority, and low-income populations are not large enough to noticeably affect the conclusions regarding environmental effects on minority and low-income populations that would result from implementation of the proposed action or alternatives.

Table H–1 Total Population Estimates and Bounds in 1990 for Candidate Sites

Candidate Site	*Lower Bound*	*Estimated Total Population*	*Upper Bound*
ANL-W	168,365	181,088	197,519
F-Area	569,693	608,891	660,363
L-Area	559,870	606,819	663,376

Table H–2 Minority Population Estimates and Bounds in 1990 for Candidate Sites

Candidate Site	*Lower Bound*	*Estimated Minority Population*	*Upper Bound*
ANL-W	13,712	15,737	17,369
F-Area	215,781	230,116	251,696
L-Area	218,414	237,094	260,629

Table H–3 Low-Income Population Estimates and Bounds in 1990 for Candidate Sites

Candidate Site	*Lower Bound*	*Estimated Low-Income Population*	*Upper Bound*
ANL-W	22,966	25,105	27,455
F-Area	98,972	106,281	116,037
L-Area	98,519	107,469	117,988

H.3.2 Population Projections

Health effects were calculated for populations projected to reside in potentially affected areas during the year 2010. Extrapolations of the total population for individual states are available from both the U.S. Census Bureau and various state agencies (Campbell 1996). The U.S. Census Bureau also projects populations by ethnic and racial classification in one-year intervals for the years from 1995 to 2025 at the state level. State agencies project total populations for individual counties. No Federal or state agency projects block groups or low-income populations. Data used to project minority populations were extracted from the U.S. Census Bureau's Internet web site (DOC 1999). To project minority populations in potentially affected areas, minority populations determined from the 1990 census data were taken as a baseline for each block group. Then it was assumed that percentage changes in the minority population of each block group for a given year (compared to the 1990 baseline data) will be the same as percentage changes in the state minority population projected for the same year. An advantage to this assumption is that the projected populations are obtained using a consistent method, regardless of the state and associated block group involved in the calculation. A disadvantage is that the method is insensitive to localized demographic changes that could alter the projection in a specific area.

The U.S. Census Bureau uses the cohort-component method to estimate future populations for each state (Campbell 1996). The set of cohorts is composed of: (1) age groups from 1 year or less to 85 years or more, (2) male and female populations in each age group, and (3) the following racial and ethnic groups in each age group: Hispanic, non-Hispanic Asian, non-Hispanic African American, non-Hispanic Native American, and non-Hispanic White. Components of the population change used in the demographic accounting system are births, deaths, net state-to-state migration, and net international migration. If P(t) denotes the number of individuals in a given cohort at time "t," then:

$$P(t) = P(t_0) + B - D + DIM - DOM + IIM - IOM \quad (1)$$

where:

$P(t_0)$	=	Cohort population at time t_0 is less than or equal to t. For this analysis, t_0 denotes the year 1990.
B	=	Births expected during the period from t_0 to t.
D	=	Deaths expected during the period from t_0 to t.
DIM	=	Domestic migration into the state expected during the period from t_0 to t.
DOM	=	Domestic migration out of the state expected during the period from t_0 to t.
IIM	=	International migration into the state expected during the period from t_0 to t.
IOM	=	International migration out of the state expected during the period from t_0 to t.

Estimated values for the components shown on the right side of the equation are based on past data and various assumptions regarding changes in the rates for birth, mortality, and migration (Campbell 1996). Persons of Hispanic origin are included in the Hispanic population regardless of race. It should be noted that the U.S. Census Bureau does not project populations of individuals who identified themselves as "other race" during the 1990 census. This population group is less than 2 percent of the total population in each of the states. However, to project total populations in the environmental justice analysis, population projections for the "other race" group were made under the assumption that the growth rate for the "other race" population will be identical to the growth rate for the combined minority and White populations.

H.4 Environmental Justice Assessment

The analysis of environmental justice effects was based on an assessment of the impacts reported in Chapter 4 of this EIS. This analysis was performed to identify any disproportionately high and adverse human health or environmental impacts on minority or low-income populations surrounding ANL-W and SRS. Demographic information obtained from the U.S. Census Bureau was used to identify the minority populations and low-income communities in the zone of potential impact surrounding the two sites. The zone, or region of influence, is a circle that has an 80-kilometer (50-mile) radius around the proposed sites. This radius is consistent with that used to evaluate the collective dose for human health effects, air impact modeling, and socioeconomic impacts, and is judged to encompass all of the impacts that may occur.

H.5 Results for the Sites

As discussed in Chapter 2 of this EIS, candidate sites for the treatment and management of sodium-bonded spent nuclear fuel are located at ANL-W and SRS. This section describes the environmental justice analysis of potentially affected minority and low-income populations residing near the candidate sites. It should be noted that projections of the total population provided in this appendix differ from the projected total populations used in the health effects calculations described in Chapter 4. This is because the projections used in the analysis of environmental justice are based on projections for the states provided by the U.S. Bureau of the Census (Campbell 1996). Projections used in the analysis of health effects are based on county-wide projections provided by state agencies. As discussed in Section H.3.2, the county projections are more sensitive to localized demographic changes. However, the states do not provide projections for minority populations. Therefore, the U.S. Bureau of the Census projections were used in the analysis of environmental justice. Population projections obtained with the two approaches differ by 8 percent or less and have essentially no effect on these results of the analyses.

H.5.1 Argonne National Laboratory-West

Figure H–1 shows the racial and ethnic composition of the minority population of ANL-W projected to reside in the potentially affected area in the year 2010. In the interval between 1990 and 2010, the percentage of the total population composed of minorities is projected to increase from 8.7 percent to 13.3 percent. For comparison, during the 1990 census, minorities were found to compose approximately one-quarter of the total national population. By the year 2010, minorities are projected to compose closer to one-third of the total national population. The percentage of the minority population residing in the potentially affected area surrounding ANL-W was less than the corresponding national percentage in 1990, and is expected to remain so through the year 2010. Hispanics are the largest minority group residing in the potentially affected area, while the Asian and Hispanic populations are projected to show the largest growth rates.

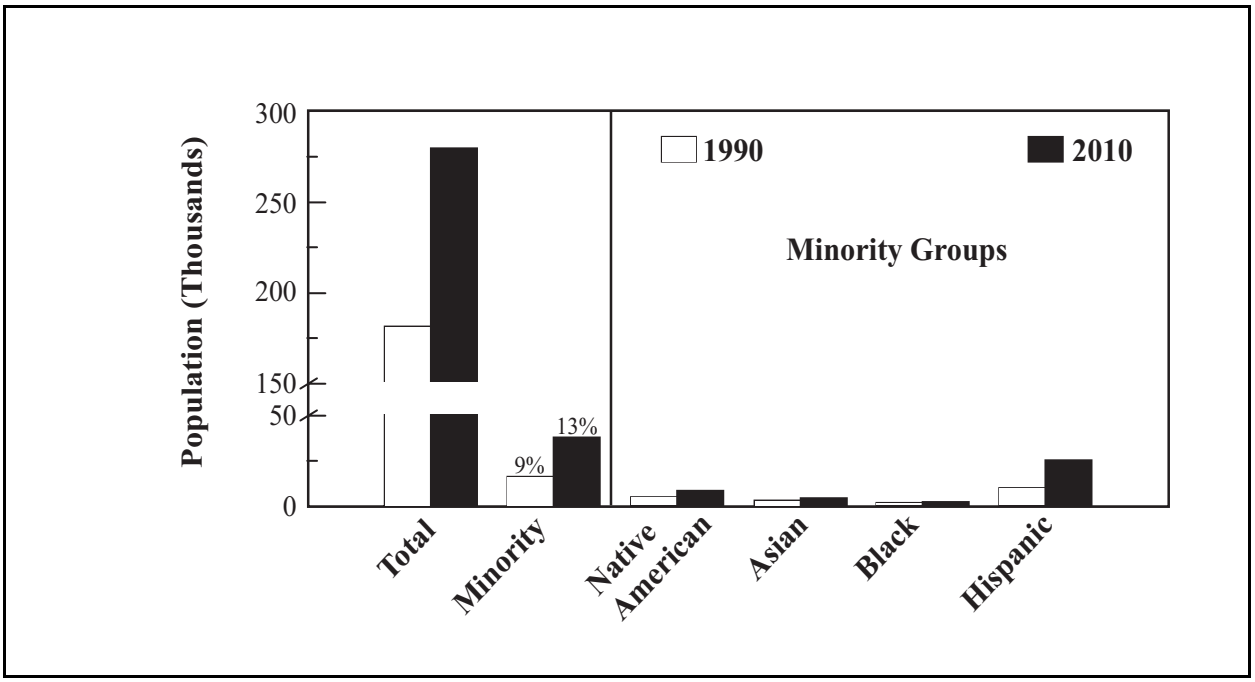

Figure H–1 Projected Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of ANL-W in 2010

Figure H–2 shows the location of minority populations residing near the ANL-W in 1990. As indicated in the figure, block groups for which the percentage of minority residents exceeds the corresponding national percentage are located throughout the potentially affected area.

During the 1990 census, 15 percent of the residents within the potentially affected area surrounding ANL-W reported incomes below the poverty threshold. Slightly over 13 percent of the national population reported incomes below the poverty threshold, and approximately 13 percent of the residents of Idaho reported incomes below the poverty threshold during the same year. Thus, the percentage of the low-income population residing within the potentially affected area exceeded that for the nation and the state of Idaho by approximately 2 percent. **Figure H–3** shows the geographical distribution of low-income residents surrounding the ANL-W site in 1990. Block groups for which the percentage of low-income residents exceeds the corresponding national percentage are located throughout the potentially affected area.

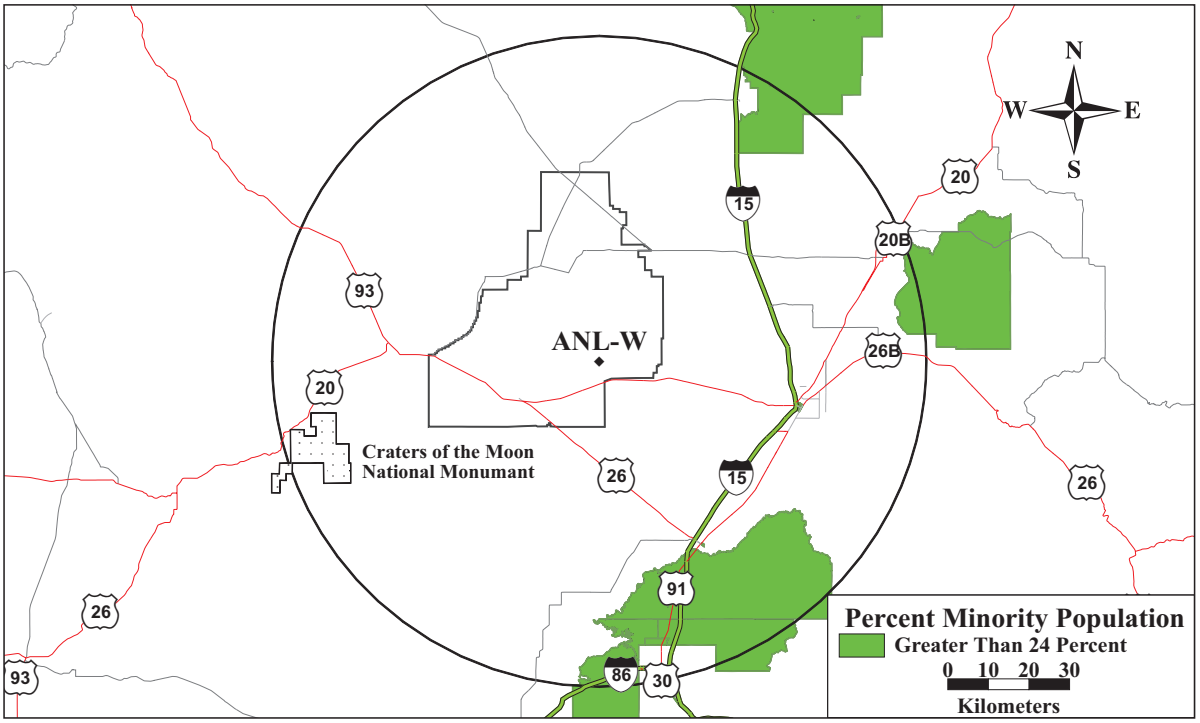

Figure H-2 Minority Population Residing Within 80 Kilometers (50 Miles) of the ANL-W Site in 1990

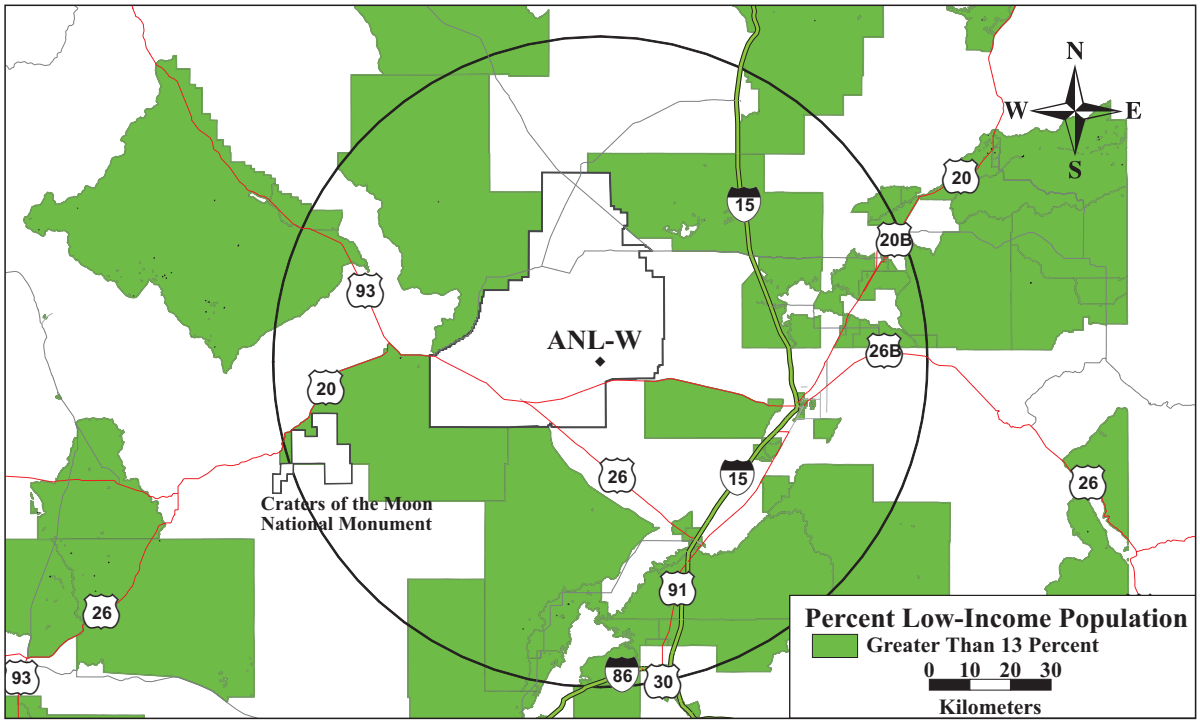

Figure H-3 Low-Income Population Residing Within 80 Kilometers (50 Miles) of ANL-W in 1990

H.5.2 The Savannah River Site F-Area

Figure H–4 shows the racial and ethnic composition of the minority population residing within 80 kilometers (50 miles) of F-Area at SRS in 1990, and the minority population projected to reside in the potentially affected area in the year 2010. In the interval between 1990 and 2010, the percentage of the total population composed of minorities is projected to increase from 37.9 percent to 42 percent. For comparison, during the 1990 census, minorities were found to compose approximately one-quarter of the total national population. By the year 2010, minorities are projected to compose nearly one-third of the total national population. The percentage of the minority population residing in the potentially affected area surrounding F-Area was larger than the corresponding national percentage in 1990, and is expected to remain so through the year 2010. Blacks are the largest minority group residing in the potentially affected area, while the Asian and Hispanic populations are projected to show the largest growth rates.

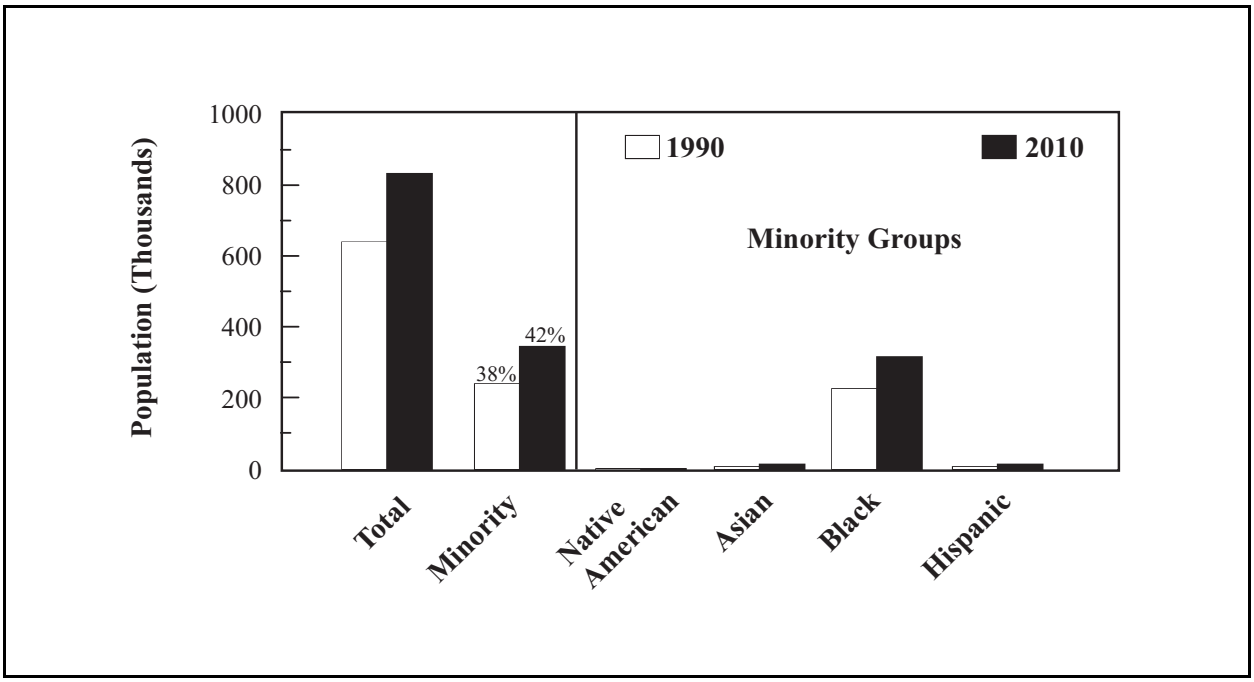

Figure H-4 Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of the SRS F-Area in 2010

Figure H–5 shows the geographical distribution of minority populations residing near the SRS F-Area (and L-Area) in 1990. L-Area is discussed in Section H.5.3, below. Block groups for which the percentage of the minority population exceeds the national percentage are located throughout the potentially affected area surrounding F-Area.

During the 1990 census, 18 percent of the residents within the potentially affected area surrounding F-Area reported incomes below the poverty threshold. Slightly over 13 percent of the national population reported incomes below the poverty threshold, and nearly 15 percent of the residents of the combined States of Georgia and South Carolina reported incomes below the poverty threshold during the same year. Thus, the percentage of low-income population residing within the potentially affected area exceeded that for the Nation and the States of Georgia and South Carolina. **Figure H–6** shows the geographical distribution of low-income residents surrounding the F-Area site (and L-Area Site) in 1990. Block groups for which the percentage of low-income residents exceeds the corresponding national percentage are located throughout the potentially affected area.

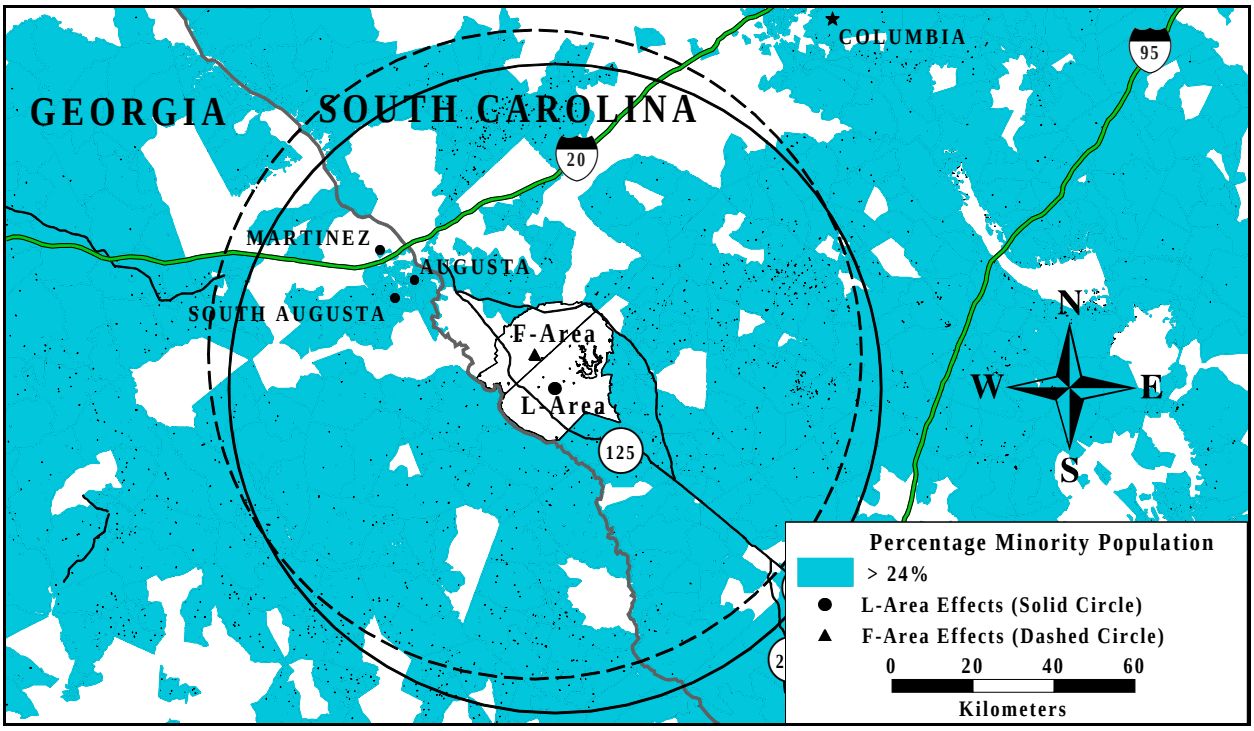

Figure H–5 Minority Population Residing Within 80 Kilometers (50 Miles) of SRS F-Area and L-Area in 1990

H.5.3 The Savannah River Site L-Area

Figure H–7 shows the racial and ethnic composition of the minority population projected to reside in the potentially affected area surrounding the SRS L-Area by the year 2010. In the interval between 1990 and 2010, the percentage of the total population composed of minorities is projected to increase from 39.1 percent to 43 percent. For comparison, during the 1990 census, minorities were found to compose approximately one-quarter of the total national population. By the year 2010, minorities are projected to compose close to one-third of the total national population. The percentage of the minority population residing in the potentially affected area surrounding L-Area was larger than the corresponding national percentage in 1990, and is expected to remain so through the year 2010. Blacks are the largest minority group residing in the potentially affected area, while the Asian and Hispanic populations are projected to show the largest growth rates.

Figure H–5 shows the geographical distribution of minority populations residing near the SRS L-Area and F-Area in 1990. F-Area was discussed in Section H.5.2 above. As indicated in the figure, block groups for which the percentage of minority residents exceeds the national percentage are distributed throughout the potentially affected area surrounding L-Area.

During the 1990 census, 20.6 percent of the residents within the potentially affected area surrounding L-Area reported incomes below the poverty threshold. Slightly over 13 percent of the national population reported incomes below the poverty threshold, and nearly 15 percent of the residents of the combined States of Georgia and South Carolina reported incomes below the poverty threshold during the same year. Thus, the percentage low-income population residing within the potentially affected area exceeded that for the Nation and the States of Georgia and South Carolina. As shown in Figure H–6, block groups for which the percentage of low-income residents exceeds the corresponding national percentage are located throughout the potentially affected area.

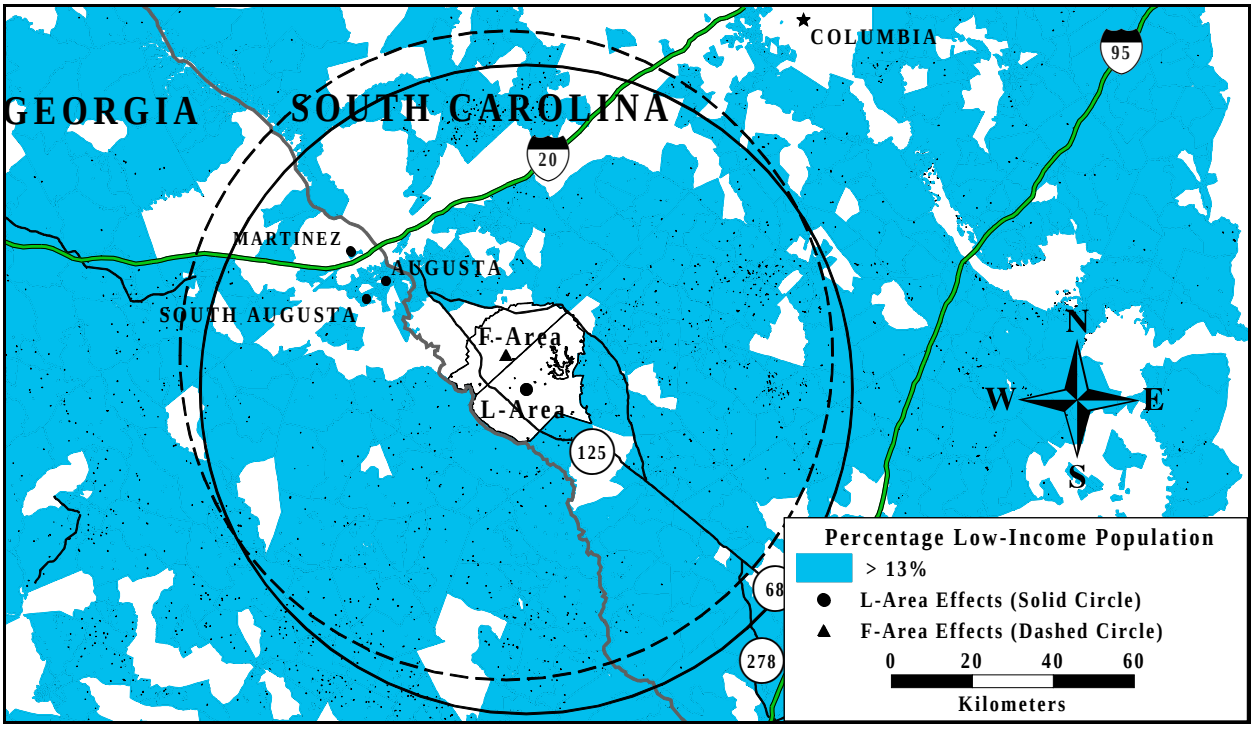

Figure H-6 Low-Income Populations Residing Within 80 Kilometers (50 Miles) of SRS F-Area and L-Area in 1990

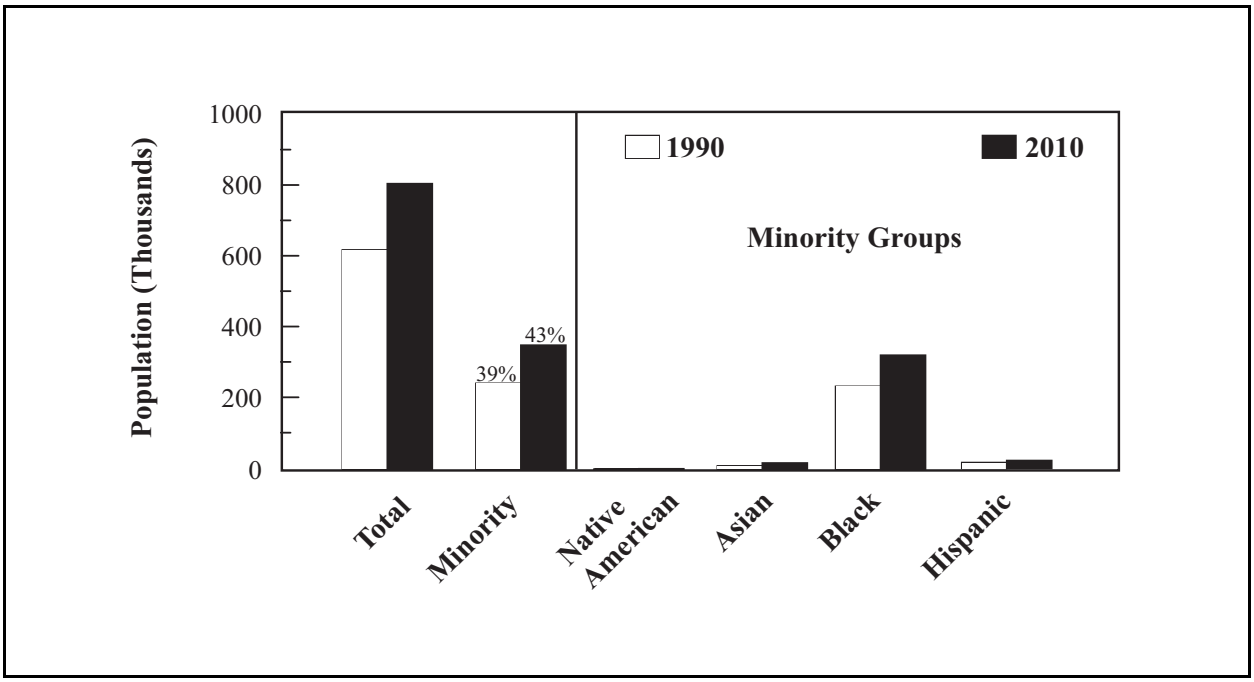

Figure H-7 Racial and Ethnic Composition of the Minority Population Residing Within 80 Kilometers (50 Miles) of the SRS L-Area in 2010

H.5.4 Environmental Impacts at the Sites

Environmental effects that would result from implementation of the various alternatives are discussed in Chapter 4 and summarized in Table 2-4 of Section 2. It was demonstrated in Chapter 4 that implementation of the alternatives would pose no significant radiological or nonradiological risks to the public. **Table H-4** summarizes the radiological impacts described in Chapter 4 that are relevant to the evaluation of environmental justice. Columns 3 and 4 of the table show the estimated likelihood of latent cancer fatalities for the maximally exposed offsite individual and the surrounding population, respectively, under normal operations over the lifetime of the project. For most of the alternatives, the risk of a latent cancer fatality calculated for the maximally exposed offsite individual was too small to be physically observable. Estimated latent cancer fatalities from accidents were less than those expected for normal operations. As indicated in columns 3 and 4 of the table, as well as the discussions of Chapter 4, implementation of the alternatives would pose no significant radiological risks to the general public, and these risks are independent of the racial, ethnic, and economic composition of potentially affected populations. Thus, implementation of the alternatives would pose no disproportionate risks to minority populations or low-income populations within the general population.

Table H–4 Summary of Radiological Effects of the Alternatives on the Public

Alternative	*Project Duration (years)*	*Estimated Likelihood of an Latent Cancer Fatality for the Offsite Maximally Exposed Individual*	*Estimated Likelihood of an Latent Cancer Fatality Among the Population at Risk*
No Action	35	Essentially Zero	1 in 154,000
1	13	Essentially Zero	1 in 125,000
2	09	Essentially Zero	1 in 118,000
3	09	Essentially Zero	1 in 100,000
4	12	Essentially Zero	1 in 118,000
5	09	Essentially Zero	1 in 91,000
6	10	Essentially Zero	1 in 83,000

H.6 RESULTS FOR TRANSPORTATION ROUTES

As discussed in Chapter 4 of this EIS, no significant radiological or nonradiological risks along representative transportation routes would result from implementation of the alternatives for the treatment and management of sodium-bonded spent nuclear fuel. Therefore, implementation of these alternatives would pose no disproportionately high and adverse risks to minority and low-income groups within the general public.

H.7 OTHER ENVIRONMENTAL IMPACTS

No significant adverse impacts to biotic resources, air resources, socioeconomics, land use, or cultural resources were identified in Chapter 4. Therefore, no disproportionately high and adverse impacts were identified for any segment of the population. None of the alternatives would have a significant adverse impact on the previously mentioned resources because, under all of the alternatives, all activities associated with the treatment and management of sodium-bonded spent nuclear fuel would take place within existing facilities at ANL-W and SRS.

H.8 CUMULATIVE IMPACTS

Based on the analysis of the environmental impacts evaluated in this EIS, along with the impacts of other past, present, and reasonably foreseeable future activities, no reasonably foreseeable cumulative disproportionate and adverse impacts are expected to affect the surrounding minority and low-income populations.

H.9 REFERENCES

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APPENDIX I
ECOLOGICAL RESOURCES

I.1 INTRODUCTION

Table I–1 contains a listing of the scientific names of animal and plant species found in the text. Species are grouped and listed in alphabetical order by common name.

Table I–1 Scientific Names of Animal and Plant Species Referred to in the Text

Common Name	*Scientific Name*
Mammals	
Black-tailed jackrabbit	*Lepus californicus*
Coyote	*Canis latrans*
Eastern cottontail	*Sylvilagus floridanus*
Elk	*Cervus elaphus*
Feral hog	*Sus scrofa*
Gray fox	*Urocyon cinereoargenteus*
Gray wolf	*Canis lupus*
Mountain lion	*Felis concolor*
Mule deer	*Odocoileus hemionus*
Pronghorn	*Antilocapra americana*
Pigmy rabbit	*Brachylagus idahoensis*
Raccoon	*Procyon lotor*
Townsend's big-eared bat	*Corynorhinus townsendii*
Townsend's ground squirrel	*Spermophilus townsendii*
Whitetail deer	*Odocoileus virginianus*
Birds	
Bald eagle	*Haliaeetus leucocephalus*
Black vulture	*Coragyps atratus*
Carolina chickadee	*Parus carolinensis*
Common crow	*Corvus brachyrhynchos*
Cooper's hawk	*Accipiter cooperii*
Golden eagle	*Aquila chrysaetos*
Loggerhead shrike	*Lanius ludovicianus*
Peregrine falcon	*Falco peregrinus*
Prairie falcon	*Falco mexicanus*
Red-cockaded woodpecker	*Picoides borealis*
Sage grouse	*Centrocercus urophasianus*
Sage sparrow	*Amphispiza belli*
Wood stork	*Mycteria americana*
Reptiles	
American crocodile	*Crocodylus acutus*
American alligator	*Alligator mississippiensis*
Eastern box turtle	*Terrapene carolina*
Gopher snake	*Pituophis melanoleucus*
Short-horned lizard	*Phyrnosoma douglassi*

Common Name	*Scientific Name*
Amphibians	
Slimy salamander	*Plethodon glutinosus*
Fish	
American shad	*Alosa sapidissima*
Black crappie	*Pomoxis nigromaculatus*
Blueback herring	*Alosa aestivalis*
Bluegill	*Lepomis macrochirus*
Brook trout	*Salvelinus fontinalis*
Creek chubsucker	*Erimyzon oblongus*
Dusky shiner	*Notropis cummingsae*
Kokanee salmon	*Oncorhynchus nerka*
Lake chubsucker	*Erimyzon sucetta*
Largemouth bass	*Micropterus salmoides*
Mosquitofish	*Gambusia affinis*
Mountain whitefish	*Prosopium williamsoni*
Mud sunfish	*Acantharchus pomotis*
Rainbow trout	*Oncorhynchus mykiss*
Redbreast sunfish	*Lepomis auritus*
Redfin pickerel	*Esox americanus*
Shorthead sculpin	*Cottus confusus*
Speckled dace	*Rhinichthys osculus*
Spotted sunfish	*Lepomis punctatus*
Striped bass	*Morone saxatilis*
Sunfish	*Lepomis spp.*
Threadfin shad	*Dorosoma petenense*
Yellow bullhead	*Ictalurus natalis*
Yellowfin shiner	*Notropis lutipinnis*
Mollusks	
Giant oyster	*Crassostrea gigantissima*
Plants	
American ginseng	*Panax quinquefolium*
Bald cypress	*Taxodium distichum*
Big sagebrush	*Artemisia tridentata*
Bluebunch wheatgrass	*Agropyron spicatum*
Bottlebrush squirreltail	*Sitanion hystrix*
Button snakeroot	*Erynglum yuccifolium*
Cottonwood	*Populus spp.*
Crested wheatgrass	*Agropyron desertorum*
Cypress	*Taxodium spp.*
Giant wildrye	*Elymus condensatus*
Gray horsebrush	*Tetradymia canescens*
Green rabbitbrush	*Chrysothamnus greenei*
Hickory	*Carya spp.*
Indian ricegrass	*Oryzopsis hymenoides*
Juniper	*Juniperus spp.*
Loblolly pine	*Pinus taeda*
Longleaf pine	*Pinus palustris*
Low sagebrush	*Artemisia arbuscula*
Needle-and-tread grass	*Stipa comata*
Oak	*Quercus spp.*

Common Name	***Scientific Name***
Oconee azalea	*Rhododendron flammeum*
Pine	*Pinus spp.*
Poverty-weed	*Monolepis nuttaliana*
Prickly pear cactus	*Opuntia spp.*
Rabbitbrush	*Chrysothamnus spp.*
Redroot	*Lachnanthese carolinianum*
Rush	*Juncus spp.*
Sagebrush	*Artemisia spp.*
Saltbush	*Atriplex spp.*
Slash pine	*Pinus elliottii*
Smooth purple coneflower	*Echinacea laevigata*
Thickspike wheatgrass	*Agropyron dasytachyum*
Threetip sagebrush	*Artemisia tripartita*
Tupelo	*Nyssa slyvotica*
Utah juniper	*Juniperus osteosperma*
Western wheatgrass	*Agropyron smithii*
Willow	*Salix spp.*
Winterfat	*Eurotia lanata*

DEPARTMENT OF ENERGY

Notice of Intent To Prepare an Environmental Impact Statement for Electrometallurgical Treatment of Sodium-Bonded Spent Nuclear Fuel in the Fuel Conditioning Facility at Argonne National Laboratory-West, Idaho National Engineering and Environmental Laboratory, Idaho

AGENCY: U.S. Department of Energy.

ACTION: Notice of intent to prepare an environmental impact statement.

SUMMARY: The Department of Energy announces its intent to prepare an Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act (NEPA) for the proposed electrometallurgical treatment of Department of Energy-owned sodium-bonded spent nuclear fuel in the Fuel Conditioning Facility at Argonne National Laboratory-West (ANL–W). ANL–W, a center of nuclear technology development and testing, is located on the Idaho National Engineering and Environmental Laboratory (INEEL) site in southeastern Idaho. The Department proposes to treat its inventory of sodium-bonded spent nuclear fuel to remove and stabilize the reactive metallic sodium constituent and to produce metal and ceramic waste forms, considered to be high-level waste, that would facilitate interim storage and ultimate disposal of this material. The EIS will evaluate reasonable action alternatives to electrometallurgical treatment in the Fuel Conditioning Facility at ANL-W and a no-action alternative. The Department invites the general public, other Federal agencies, American Indian tribes, state and local governments, and all other interested

parties to comment on the scope of this EIS.

DATES: To ensure consideration in the preparation of the draft EIS, comments should be transmitted or postmarked by April 8, 1999. Comments submitted after that date will be considered to the extent practicable.

The Department will conduct public scoping meetings in Idaho Falls and Boise in Idaho, near the Department's Savannah River Site (SRS) in South Carolina, and in the Washington, DC area, to provide the public with information about the proposed project and to receive oral and written comments on the scope of the EIS, including reasonable alternatives and environmental issues that the Department should consider. The dates, times, and locations for these public meetings are as follows:

March 9, 1999 (6:00 pm–9:00 pm)
Shilo Inn, 780 Lindsay Blvd., Idaho Falls, ID 83402, (208) 523–0088
March 11, 1999 (6:00 pm–9:00 pm)
Boise Centre on the Grove, 850 West Front Street, Boise, ID 83702, (208) 336–8900
March 15, 1999 (6:00 pm–9:00 pm)
North Augusta Community Center, 495 Brookside Avenue, North Augusta, SC 29842, (803) 441–4290
March 18, 1999 (2:00 pm–5:00 pm)
Hyatt Regency Crystal City, 2799 Jefferson Davis Highway, Arlington, VA 22202, (703) 418–1234

These public scoping meetings will also be announced in local media at least 15 days prior to the meeting dates. During the first hour of each meeting attendees may register, view displays and discuss issues and concerns informally with Department representatives, after which there will be a formal presentation, a follow-on question, answer, and comment period, and the opportunity for additional informal discussions.

ADDRESSES: Written comments on the scope of the EIS, requests to speak at the public scoping meetings, requests for special arrangements to enable participation at scoping meetings (e.g., an interpreter for the hearing impaired), requests to be placed on the EIS document distribution list, and questions concerning the project should be sent to: Susan Lesica, Document Manager, Office of Nuclear Facilities Management, Office of Nuclear Energy, Science, and Technology, U.S. Department of Energy, NE–40, 19901 Germantown Road, Germantown, Maryland 20874–1290

Interested parties may also submit comments and requests by facsimile to (877) 621–8288, or they may call (877) 450–6904 to leave a detailed message with their comments and requests. These are both toll-free telephone numbers. Comments and requests may also be submitted by electronic mail to emtEIS@hq.doe.gov.

FOR FURTHER INFORMATION CONTACT: For general information on the Department of Energy NEPA process, please contact: Carol Borgstrom, Director, Office of NEPA Policy and Assistance, Office of Environment, Safety and Health, U.S. Department of Energy, EH–42, 1000 Independence Avenue, SW, Washington, DC 20585–0119, 202–586–4600 or leave a message at 1–800–472–2756.

SUPPLEMENTARY INFORMATION:

Background

The Department of Energy is responsible for the safe and efficient management of 250 different types of spent nuclear fuel, including its ultimate disposition (which is expected to be disposal in a geologic repository). Some Department spent fuels may be suitable for disposal with little or no stabilizing treatment. Other spent fuel types may not be suitable for disposal without significant treatment or stabilization.

One type of spent nuclear fuel that may not be suitable for disposal without treatment is sodium-bonded spent nuclear fuel. Sodium-bonded spent nuclear fuel contains metallic sodium, a highly reactive material. Metallic sodium reacts vigorously with water or moist air producing heat, potentially explosive hydrogen gas, and sodium hydroxide, a corrosive substance. Sodium metal was used as a heat transfer medium within the stainless steel cladding of sodium-bonded fuel and as coolant in the nuclear reactors in which these fuels were used. To the extent possible, the highly reactive sodium has been removed from external surfaces of these fuels after their use, but a portion remains bonded to the uranium metal alloy fuel within the cladding and cannot be removed without further treatment. The presence of reactive or pyrophoric material, such as metallic sodium, could complicate the process of qualifying and licensing such spent fuel for disposal, which would require data and predictive analyses sufficient to demonstrate that emplacement of the spent fuel would not adversely affect a repository's ability to protect the environment and public health.

The Department believes that treatment to remove metallic sodium and convert this spent nuclear fuel into a compact waste form would reduce complications of disposal qualification and licensing. Technologies for spent nuclear fuel treatment that might facilitate such qualification and licensing should therefore be considered in reaching a disposition decision for Department-owned sodium-bonded fuels. One such technology for sodium-bonded spent fuel disposition is the electrometallurgical treatment technique that the Department is developing and demonstrating at the Argonne National Laboratory. This technology is currently the most developed for treatment of sodium-bonded spent fuel. In addition to electrometallurgical treatment, the Department will examine all reasonable alternative technologies and assess the technical risks associated with these various potential solutions.

In a 1995 report, the National Research Council Committee on Electrometallurgical Techniques for DOE Spent Fuel Treatment recommended that the Department confirm the technical feasibility and cost effectiveness of electrometallurgical treatment of its sodium-bonded spent nuclear fuel through a technology demonstration using sodium-bonded spent nuclear fuel that had been removed from the Experimental Breeder Reactor–II (EBR–II) at ANL–W. Prior to acting on the recommendation, the Department prepared the Environmental Assessment for the Electrometallurgical Treatment Research and Demonstration Project in the Fuel Conditioning Facility at Argonne National Laboratory-West (DOE/EA–1148) and issued a Finding of No Significant Impact on May 15, 1996. The demonstration project addresses both kinds of spent fuel assemblies in the EBR–II spent nuclear fuel inventory. These are driver fuel assemblies and blanket fuel assemblies, and they total about 26 metric tons of heavy metal (MTHM).

One MTHM is equal to 2,200 pounds of uranium, thorium, or plutonium. The driver fuel contains highly enriched uranium and was used in the active region of the nuclear reactor core. Blanket fuel contains depleted uranium and was used in areas around and near the driver fuel in the reactor core. The demonstration project now nearing completion involves treatment of 100 EBR–II driver assemblies and 25 EBR–II blanket assemblies (approximately 1.6 MTHM, or only 6.25% of the EBR–II inventory) in the Fuel Conditioning Facility at ANL–W. The research and demonstration project was initiated in June 1996 and is scheduled to be completed in August 1999.

The National Research Council is continuing to evaluate the electrometallurgical treatment research

and demonstration project. In its most recent report titled, Electrometallurgical Techniques for U.S. Department of Energy Spent Fuel Treatment—Spring 1998 Status Report on Argonne National Laboratory's R&D Activity (National Academy Press, Washington, DC, 1998), the Council acknowledged progress in the demonstration and recommended that the demonstration be carried to completion. The Department believes that this progress and the absence of significant roadblocks to successful completion of the demonstration warrant proposing electrometallurgical treatment of the remainder of the EBR–II and other sodium-bonded spent fuels (i.e., a total of 62 MTHM) and is initiating the environmental review process under NEPA. Accordingly, the Department is announcing its intent to prepare an EIS for the proposed treatment of the remainder of Department sodium-bonded spent nuclear fuel.

Data from the ongoing demonstration project will be used in preparing the EIS. The National Research Council will issue a final report on the technology demonstration upon completion of the demonstration project. DOE will consider the Council's report in reaching a decision regarding the disposition of sodium-bonded spent nuclear fuel.

Purpose and Need for Agency Action

In a 1995 agreement with the State of Idaho [Settlement Agreement and Consent Order issued by the Court on October 17, 1995, in the actions *Public Service Co. of Colorado* v. *Batt*, No. CV 91–0035–S–EJL (D. Id.), and *United States* v. *Batt*, No. CV 91–0054–EJL (D. Id.), the Department committed to remove all spent nuclear fuel from Idaho by 2035. More than 98 percent of the Department's sodium-bonded spent nuclear fuel is located at INEEL near Idaho Falls, Idaho, and is subject to the requirements of the Settlement Agreement and Consent Order. The remaining Department sodium-bonded spent nuclear fuel included in the proposed action is at the Hanford Reservation in Richland, Washington, the Sandia National Laboratories in Albuquerque, New Mexico, and the Oak Ridge National Laboratory in Oak Ridge, Tennessee. In order to remove sodium-bonded spent nuclear fuel from the State of Idaho to meet the terms of the Settlement Agreement and Consent Order referenced above, the Department believes the best approach would be to stabilize or remove the reactive metallic sodium constituent and prepare a waste form that may be more assuredly demonstrated to be acceptable for disposal.

It is also prudent to evaluate the electrometallurgical treatment proposal and alternative technologies now, while the Department is performing site characterization activities for a potential geologic repository. Contemplated waste forms resulting from treatment or packaging of sodium-bonded spent fuel should be developed as much as possible in parallel with any repository development to promote consistency between the two efforts and to minimize technical risks associated with waste form qualification and acceptance for geologic disposal. While the alternative technologies for treatment of sodium-bonded spent fuel may not be as mature as the electrometallurgical treatment technology, their potential utility can be assessed in this EIS. Should the Department decide, after completing this EIS, to pursue a disposition path other than electrometallurgical treatment, there will still be sufficient time to develop an alternative technology. If a treatment technology decision is significantly delayed, however, the Department could functionally lose its expertise and corporate experience in the specialized electrometallurgical treatment technology at ANL–West, which would hamper future consideration and increase the cost of electrometallurgical treatment for sodium-bonded spent fuel disposal. Therefore, the Department believes it is prudent to proceed now with this EIS for electrometallurgical treatment of sodium-bonded spent fuel.

Proposed Action

The Department proposes to treat its sodium-bonded spent nuclear fuel [1] using the electrometallurgical treatment process in the Fuel Conditioning Facility at ANL–W. Electrometallurgical processing involves the dissolution of spent nuclear fuel by use of an electric current in a molten salt mixture. The uranium in the fuel would be collected from a molten salt mixture at the cathode and subsequently melted and cast into metal ingots. The metal cladding from the fuel elements and noble metal fission products would be retrieved undissolved from the anode, melted, and cast into metal ingots. Remaining fission products and all transuranic elements would be removed from the molten salt mixture by ion exchange and subsequently isolated in a ceramic waste form. In this process, the metallic sodium in the spent nuclear fuel would be converted to non-reactive sodium chloride (same composition as table salt) and incorporated in the ceramic waste form.

Based on available information, the Department believes the electrometallurgical treatment process would produce metal and ceramic high-level radioactive waste forms that could be qualified and licensed for disposal. In addition, uranium would be separated from both the driver fuel and the blanket fuel and not disposed of. The highly enriched uranium separated from the driver fuel assemblies would be immediately blended down in the Fuel Conditioning Facility to form low-enriched uranium. This low-enriched uranium and the depleted uranium that would be separated from blanket fuel assemblies would be cast as metal ingots and stored with other uranium metal inventories at INEEL. The disposition of these materials would be included in future Departmental decisions regarding other similar materials.

The sodium-bonded spent nuclear fuel inventory being proposed for electrometallurgical treatment totals approximately 62 MTHM. This inventory of sodium-bonded spent nuclear fuel is currently stored as follows:

- Approximately 24 MTHM of EBR–II sodium-bonded driver and blanket assemblies currently stored at ANL–W and approximately 2 MTHM at the Idaho Nuclear Technology and Engineering Center (INTEC), both located at INEEL.
- Approximately 35 MTHM of sodium-bonded spent nuclear fuel from the Fermi-1 reactor, currently stored at INTEC.
- Less than one MTHM consisting of six irradiated sodium-bonded fuel assemblies and a number of sodium-bonded spent nuclear fuel pins currently stored at the Hanford Reservation near Richland, Washington.
- Less than 0.1 MTHM consisting of experimental capsules currently stored at INTEC and Clinch River Breeder Reactor Program experimental capsules currently stored at Sandia National Laboratories, Albuquerque, New Mexico.
- Less than 0.01 MTHM consisting of miscellaneous fast reactor development fuel currently stored at Oak Ridge National Laboratory, Oak Ridge, Tennessee.

[1] The Department has no plan or intention to apply this technology to any other types of spent nuclear fuel. Nevertheless, the Department can foresee a potential need to treat small quantities of certain spent fuels if a non-treatment (e.g., high integrity can) approach to disposing of such spent fuels were to be determined not to meet disposal requirements. In that case, electrometallurgical treatment might be among the reasonable alternative treatment technologies that would be considered.

The sodium-bonded spent nuclear fuels located at the Hanford Reservation, Oak Ridge, and Sandia can be transported to INEEL pursuant to the Record of Decision (60 FR 28680, June 1, 1995) for the Department of Energy's Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Final Environmental Impact Statement (DOE/EIS–0203–F), under the Settlement Agreement and Consent Order described above. These spent fuels pose the same waste form acceptability issues and are amenable to the same treatments as the EBR–II and Fermi-1 fuels stored at INEEL.

Alternatives To Be Evaluated

The Department has identified the following alternatives to the proposed electrometallurgical treatment of sodium-bonded spent nuclear fuel in the Fuel Conditioning Facility at ANL–W.

A. *No Action Alternative:* Under this alternative, the Department would not treat its sodium-bonded spent nuclear fuel to facilitate disposal. Analyses will address the viability of disposal without treatment, and the impacts of continued storage at current locations. Both temporary storage (to await alternative technology development) and indefinite storage (in lieu of disposal) will be considered in these analyses. Indefinite storage of spent nuclear fuel in Idaho would not be consistent with the Settlement Agreement and Consent Order in which the Department committed to remove all spent nuclear fuel from Idaho by 2035.

B. *Technology Alternatives:* The National Research Council independently assessed other treatment technologies as possible alternatives to electrometallurgical treatment for EBR–II sodium-bonded spent nuclear fuel. It concluded that all of the alternative treatment processes evaluated, except the Plutonium-Uranium Extraction (PUREX) process, are at an early stage of development. Significant research, development, and demonstrations would be required to develop these alternative treatment processes to the level of technical maturity of the electrometallurgical treatment process for sodium-bonded spent fuel. However, the Department will examine and analyze these alternative technologies:

1. PUREX Process. This solvent extraction method for separating and purifying uranium, plutonium, and other radionuclides from spent nuclear fuel and irradiated targets is presently practiced at the SRS for stabilization of materials that are not suitable for prolonged storage in their present forms, and as such pose potential health and safety risks. In the Savannah River Site Spent Nuclear Fuel Management EIS, the Department is currently evaluating use of the PUREX process for stabilizing approximately 17 MTHM of previously declad EBR–II spent nuclear fuel stored at the SRS site. Use of the PUREX facility to treat sodium-bonded spent nuclear fuel being considered under this alternative would require development of specific processes for removing the stainless-steel cladding and sodium from the spent fuel.

The Department intends to evaluate the PUREX process at SRS as an alternative to electrometallurgical treatment of the sodium-bonded spent fuel inventory. Material streams from the PUREX process would be uranium trioxide, plutonium metal, high-level waste in the form of borosilicate glass canisters, and grouted low-level waste.

2. High-Integrity Cans. Under this alternative, the spent fuel would be placed in high-integrity cans, after as little treatment as necessary, to prepare it for disposal. This alternative would include removal of as much of the metallic sodium as possible from the spent fuel prior to loading it in the cans.

3. Glass Material Oxidation and Dissolution System (GMODS). The basic concept is to combine unprocessed sodium-bonded spent nuclear fuel and a sacrificial oxide, lead-borate glass, in a glass melter at a temperature of 800–1000 °C. The uranium and the plutonium in the spent fuel would be converted into oxides and dissolved in the glass. Options to be analyzed are direct production of a borosilicate glass waste form from the melt, using the melt as a feed to the PUREX process, and coupling GMODS to the SRS Defense Waste Processing Facility, where the melt would be fed directly to the existing glass melter. Due to the powerful dissolution and oxidation properties of the lead-borate glass melt, containment is a concern, and a water-cooled, cold-wall, induction-heated melter must be used.

4. Melt and Dilute Process. The process would be similar to that proposed for the treatment of aluminum-based spent nuclear fuels at the SRS. The sodium-bonded spent fuel would be chopped and melted at approximately 650 to 850 °C and then diluted by the addition of depleted uranium and iron.

5. Chloride Volatility Process. This process would use the differences in volatilities of chloride compounds to separate the constituents of spent nuclear fuel. The major steps are: (1) high-temperature chlorination at about 1500 °C and conversion of metallic fuel and cladding to gaseous chloride compounds; (2) removal of the transuranic chlorides and most of the fission products in a molten zinc chloride bed at approximately 400 °C; (3) condensation of the other chlorides (e.g., uranium hexachloride) in a series of fluidized beds and condensers at successively lower temperatures; and (4) zinc chloride regeneration/recycling. The transuranics and fission product chlorides would then be converted into either fluorides or oxides for disposal.

6. Direct Plasma Arc-Vitreous Ceramic Process. In this process, the spent nuclear fuel would be melted and oxidized with the help of an oxygen lance in a rotating furnace containing molten ceramic materials at a temperature of 1600 °C or higher. A direct current plasma torch would supply the energy required in the process. Rotation would be used to keep the molten pool in the furnace. When the spent fuel is homogeneously melted and oxidized throughout the ceramic, rotation would be slowed to allow the molten vitreous ceramic to pour out by gravity flow into a canister.

C. *Location Alternatives:* An alternative location for electrometallurgical treatment on the INEEL site is the Test Area North Hot Cell Facility. This alternative to the Fuel Conditioning Facility at ANL–W will be evaluated in the EIS.

U.S. Nonproliferation Policy Implications

The United States does not encourage the civil use of plutonium, and accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes. Consistent with this policy, the proposed action would not separate plutonium from the processed sodium-bonded spent fuels. Further, by removing and diluting the highly enriched uranium in the sodium-bonded driver fuel to low-enriched uranium, the proposed project would support the U.S. goal of minimizing civilian use of highly enriched uranium. However, to address the concerns that the treatment of this fuel could encourage reprocessing in other countries, the Department (Office of Nonproliferation and National Security) will assess the nonproliferation impacts of all the treatment technologies in the draft EIS. This assessment will be made publicly available during the EIS process. The combination of the information contained in the draft EIS, the public comment in response to the draft EIS, and the nonproliferation impacts assessment report will enable

the Department to make a sound decision regarding how to manage the sodium-bonded spent nuclear fuel.

Preliminary Identification of Environmental Issues

The issues listed below have been tentatively identified for analysis in the EIS. This list is presented to facilitate public comment on the scope of the EIS. It is not intended to be all-inclusive or to predetermine the potential impacts of any of the alternatives. The Department seeks public comment on the adequacy and inclusiveness of the following issues.

- Potential impact on ecosystems, including air quality, surface, and groundwater quality, and plants and animals.
- Potential health and safety impact to on-site workers and to the public resulting from operations, including reasonably foreseeable accidents.
- Potential health and safety, environmental, and other impact related to the transport of spent nuclear fuel for treatment.
- Considerations related to the generation, treatment, storage, and disposal of wastes, including the potential acceptability of waste forms at a geologic repository.
- Potential cumulative impacts of electrometallurgical and alternative treatment process operations, including relevant impact from other past, present, and reasonably foreseeable activities at the operation site.
- Potential impact on cultural resources.
- Potential socioeconomic impact, including any disproportionate impacts on minority and low income populations.
- Pollution prevention and waste minimization opportunities.

Related NEPA Documentation

NEPA documents that have been or are being prepared for activities related to the proposed action include, but are not limited to, the following:

- U.S. Department of Energy, ''Electrometallurgical Treatment Research and Demonstration Project in the Fuel Conditioning Facility at Argonne National Laboratory-West; Environmental Assessment,'' DOE/EA–1148, May 1996
- U.S. Department of Energy, ''Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management; Final Environmental Impact Statement,'' DOE/EIS–0203–F, April 1995, and Record of Decision, May 30, 1995
- U.S. Department of Energy, ''Savannah River Site, Spent Nuclear Fuel Management, Draft Environmental Impact Statement,'' DOE/EIS–0279D, December 1998
- U.S. Department of Energy, ''Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada,'' DOE/EIS–0250—in preparation

Public Involvement Opportunities

The Department encourages public involvement in the preparation of the EIS and solicits public comments on its scope and content, as well as public participation at the public scoping meetings in Idaho, South Carolina, and the Washington, DC area. Department of Energy personnel will be available at the scoping meetings to explain the proposed project and answer questions. The Department will designate a facilitator for the scoping meetings. At the opening of each meeting, the facilitator will establish the order of speakers and will announce any additional procedures necessary for conducting the meeting. Additionally, during the first hour of each meeting attendees may register, view displays and discuss issues and concerns informally with Department representatives, after which there will be a formal presentation, a question and answer, and comment period, and the opportunity for additional informal discussions. To ensure that all persons wishing to make a presentation during the period for questions and answers or comments are given the opportunity to speak, a five-minute limit may be applied for each speaker, except that public officials and representatives of groups would be allotted ten minutes each. The Department encourages those providing oral comments to also submit them in writing. Comment cards will be available at the meetings for those who prefer to submit their comments in writing. Speakers may be asked clarifying questions to ensure that the Department representatives fully understand the comments and suggestions made by meeting participants, but the scoping meetings will not be conducted as evidentiary hearings.

The Department will make transcripts of public scoping meetings, copies of background documents, and other materials related to the proposed project and the development of the EIS available for public review in the following reading rooms:

Washington, DC: U.S. Department of Energy, Freedom of Information Reading Room, Forrestal Building, Room 1E–190, 1000 Independence Avenue, SW, Washington, DC 20585–0117, 202–586–3142

Idaho Falls, Idaho: Idaho National Engineering and Environmental Laboratory, DOE—Idaho Operations Office Public Reading Room, 1776 Science Center Drive, Idaho Falls, ID 83415, 208–526–0271

Richland, Washington: [for vicinity of the Hanford Reservation], DOE Public Reading Room, 2770 University Drive, CIC, Room 101L, Richland, WA 99352, 509–372–7443, (Fax) 509–372–7444

Albuquerque, New Mexico: [for vicinity of Sandia National Laboratories], University of New Mexico, Government Information Department, Zimmerman Library, Albuquerque, NM 87131–1466, 505–277–0582

Aiken, South Carolina: [for vicinity of the Savannah River Site], University of South Carolina—Aiken, Gregg-Graniteville Library, 171 University Parkway, Aiken, SC 29803, 803–648–6851

Oak Ridge, Tennessee: [for vicinity of the Oak Ridge National Laboratory], DOE Public Reading Room, 230 Warehouse Road, Bldg 1916–T–2, Suite 300, Oak Ridge, TN 37831, 423–241–4780 and DOE Information Resource Center, 105 Broadway Avenue, Oak Ridge, TN 37830, 423–241–4582

NEPA Process

The EIS for Electrometallurgical Treatment of Sodium-Bonded Spent Nuclear Fuel in the Fuel Conditioning Facility at ANL–W will be prepared in accordance with the NEPA of 1969, the Council on Environmental Quality's Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Parts 1500–1508), and the U.S. Department of Energy NEPA Implementing Procedures (10 CFR Part 1021).

A 45-day comment period on the draft EIS is planned, during which public hearings to receive comments will be held. The draft EIS is scheduled to be issued in July 1999. Availability of the draft EIS, the dates of the public comment period, and information about the public hearings will be announced in the **Federal Register** and in local news media when the draft EIS is distributed. The final EIS, which will consider and respond to the public comments received on the draft EIS, is scheduled to be issued in December 1999. No sooner than 30 days after the U.S. Environmental Protection Agency's notice of availability of the final EIS is published in the **Federal Register**, the Department will issue its Record of

Decision and publish it in the **Federal Register**.

Signed in Washington, DC, this 16th day of February 1999.

Peter N. Brush,

Principal Deputy Assistant Secretary, Environment, Safety and Health.

[FR Doc. 99–4289 Filed 2–19–99; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

Availability of the Draft Environmental Impact Statement (EIS) for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel

AGENCY: Department of Energy.

ACTION: Notice of availability.

SUMMARY: The Department of Energy announces the availability of the ''Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel'' (DOE/EIS–0306D) for public review and comment. This draft EIS, prepared under the National Environmental Policy Act (NEPA), assesses the potential environmental impacts associated with the treatment and management of the Department's sodium-bonded spent nuclear fuel in one or more spent nuclear fuel management facilities: Argonne National Laboratory-West at the Idaho National Engineering and Environmental Laboratory (near Idaho Falls, Idaho) and either the F-Canyon or Building 105–L at the Savannah River Site (near Aiken, South Carolina). The Department is considering ways to prepare the sodium-bonded spent nuclear fuel for disposal in a geologic repository. Such treatment would remove or stabilize the chemically reactive sodium in the fuel. The EIS evaluates reasonable alternatives for treatment of the Department's sodium-bonded spent nuclear fuel and a no-action alternative. The Department has no preferred alternative at this time.

DATES: The Department invites the general public, other Federal agencies, Tribal, State and local Governments to provide comments on this draft EIS. The 45-day comment period extends through September 13, 1999. To ensure consideration in the preparation of the final EIS, comments should be transmitted or postmarked by September 13, 1999. Comments submitted after that date will be considered to the extent practicable. The information obtained during the comment period will assist the Department in preparing the final EIS, which is scheduled to be completed by December 31, 1999.

During the review period, the Department will hold public hearings to discuss the proposed action and to receive oral and written comments on the draft EIS. The hearings are scheduled for the following dates, times, and locations.

August 17, 1999, (6:00 p.m. to 9:00 p.m.), North Augusta Community Center, 495 Brookside Avenue, North Augusta, South Carolina 29842, (803) 441–4290

August 24, 1999, (6:00 p.m. to 9:00 p.m.), Owyhee Plaza Hotel, 1109 Main Street, Boise, Idaho 83702, (208) 343–4611

August 26, 1999, (6:00 p.m. to 9:00 p.m.), Shilo Inn, 780 Lindsay Boulevard, Idaho Falls, Idaho 83402, (208) 523–0088

August 31, 1999, (2:00 p.m. to 5:00 p.m.), Hyatt Regency Crystal City, 2799 Jefferson Davis Highway, Arlington, Virginia 22202, (703) 418–1234

The format for the hearings will include an opportunity for informal discussions with project personnel before and after the formal presentation. After the presentation, there will be an opportunity to provide comments on the draft EIS to Departmental representatives. The Department encourages those providing oral comments at the hearings to also submit them in writing. Comment forms will be available at the hearings for those who prefer to submit their comments in writing.

The Department will make transcripts of the draft EIS hearings, copies of background documents, and other materials related to the proposed project and development of the EIS available for public review in the following reading rooms:

Washington, D.C.: U. S. Department of Energy, Freedom of Information Reading Room, Forrestal Building, Room 1E–190,

1000 Independence Avenue, S.W., Washington, D.C. 20585–0117, 202–586–3142

Idaho Falls, Idaho: Idaho National Engineering and Environmental Laboratory, DOE-Idaho Operations Office Public Reading Room, 1776 Science Center Drive, Idaho Falls, Idaho 83415, 208–526–0271

Richland, Washington: DOE Public Reading Room, 2770 University Drive, CIC, Room 101L, Richland, Washington 99352, 509–372–7443

Albuquerque, New Mexico: University of New Mexico, Government Information Department, Zimmerman Library, Albuquerque, New Mexico 87131, 505–277–0582

Aiken, South Carolina: University of South Carolina-Gregg Graniteville Library, 471 University Parkway, Aiken, South Carolina 29803, 803–648–6851

Oak Ridge, Tennessee: DOE Public Reading Room, 230 Warehouse Road, Building 1916–T–2, Suite 300, Oak Ridge, Tennessee 37831, 423–241–4780 and the DOE Information Resource Center, 105 Broadway Avenue, Oak Ridge, Tennessee 37830, 423–241–4582

ADDRESSES: Written comments on the draft EIS, requests for special arrangements to enable participation in the hearings (e.g., an interpreter for the hearing impaired), requests to be placed on the EIS distribution list, and questions concerning the project should be sent to: Ms. Susan M. Lesica, EIS Document Manager, Office of Nuclear Facilities Management, Office of Nuclear Energy, Science and Technology, U.S. Department of Energy, NE–40, 19901 Germantown Road, Germantown, Maryland 20874–1290.

Comments and requests may also be submitted by toll free facsimile to (877) 621–8288 or telephone (877) 450–6904. Comments and requests may also be submitted by electronic mail to emtEIS@hq.doe.gov.

FOR FURTHER INFORMATION CONTACT: For general information on the Department's National Environmental Policy Act (NEPA) process, please contact: Ms. Carol M. Borgstrom, Director, Office of NEPA Policy and Assistance (EH–42), Office of Environment, Safety and Health, U.S. Department of Energy, 1000 Independence Avenue, SW Washington, DC 20585–0119; or telephone (202) 586–4600 or leave a message at 1–800–472–2756.

SUPPLEMENTARY INFORMATION: The Department is responsible for the safe and efficient management of several types of spent nuclear fuel including its ultimate disposition (that is expected to be disposal in a geologic repository). Some Departmental spent fuels may be suitable for disposal with little or no stabilizing treatment. Other spent fuel types may not be suitable for disposal without significant treatment or stabilization.

One type of spent nuclear fuel that may not be suitable for disposal without treatment is sodium-bonded spent nuclear fuel. Sodium-bonded spent nuclear fuel contains metallic sodium, a highly chemically reactive material. Metallic sodium reacts vigorously with water or moist air producing heat, potentially explosive hydrogen gas, and sodium hydroxide, a corrosive substance. Sodium metal was used as a heat transfer medium within the stainless steel cladding of sodium-bonded fuel and as coolant in the nuclear reactors in which these fuels were used. To the extent possible, the highly reactive sodium has been removed from external surfaces of these fuels after their use, but a portion remains bonded to the uranium metal alloy fuel within the cladding and cannot be removed without further treatment. The presence of reactive or pyrophoric material such as metallic sodium, could complicate the process of qualifying and licensing such spent fuel for disposal, which would require data and predictive analyses sufficient to demonstrate that emplacement of the spent fuel would not adversely affect a repository's ability to protect the environment and public health.

The Department believes that treatment to remove metallic sodium and convert this spent nuclear fuel into a compact waste form would facilitate disposal qualification of this fuel. Technologies for spent nuclear fuel treatment that might facilitate such qualification should, therefore, be considered in deciding how to manage Department-owned sodium-bonded fuels. The EIS analyzes, under the proposed action, six reasonable alternatives that employ one or more of the following technology options: electrometallurgical treatment; the plutonium-uranium extraction process; packaging in high-integrity cans; and the melt and dilute treatment process. The EIS also evaluates a no action alternative, under which the sodium-bonded spent nuclear fuel would continue to be stored indefinitely; The Department would pursue research and development of a new treatment technology or would directly dispose of the sodium-bonded spent nuclear fuel in high-integrity cans without treatment.

The Department has not identified a preferred alternative in the draft EIS. Environmental analysis in this EIS, public comments, the findings of an independent cost study and a nonproliferation report that are being prepared concurrently with the EIS, as well as other program policy factors, will be considered in determining a preferred alternative in the final EIS. A Record of Decision will be issued no sooner than 30 days after the final EIS has been distributed.

Issued in Washington, D.C., this 22, day of July 1999.

William D. Magwood, IV,

Director, Office of Nuclear Energy, Science and Technology.

[FR Doc. 99–19522 Filed 7–29–99; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

Draft Environmental Impact Statement (EIS) for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel; Public Comment Period Extension

AGENCY: Department of Energy (DOE).

ACTION: Extension of public comment period.

SUMMARY: In response to requests from the public, DOE has decided to extend the deadline for the transmittal of public comments on the ''Draft Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel'' (DOE/EIS–0306D) from September 13, 1999, to September 28, 1999.

DATES: Comments should be transmitted or postmarked by September 28, 1999, to ensure consideration. Comments submitted after that date will be considered to the extent practicable.

ADDRESSES: Written comments on the draft EIS, requests to be placed on the EIS distribution list, and questions concerning the project should be sent to: Ms. Susan M. Lesica, EIS Document Manager, Office of Nuclear Facilities Management, Office of Nuclear Energy, Science and Technology, U.S. Department of Energy, NE–40, 19901 Germantown Road, Germantown, Maryland 20874–1290.

Comments and requests may also be submitted by toll-free facsimile to (877) 621–8288 or telephone (877) 450–6904. Comments and requests may also be submitted by electronic mail to sodium.fuel.eis@hq.doe.gov.

FOR FURTHER INFORMATION CONTACT: For general information on DOE's NEPA process, please contact: Ms. Carol M. Borgstrom, Director, Office of NEPA Policy and Assistance (EH–42), Office of Environment, Safety and Health, U.S. Department of Energy, 1000 Independence Avenue, SW, Washington, DC 20585–0119; or telephone (202) 586–4600 or leave a message at 1–800–472–2756.

SUPPLEMENTARY INFORMATION: On July 30, 1999, DOE published a notice in the **Federal Register** (64 FR 41404) announcing the availability of the draft EIS. DOE received requests from several

parties to extend the comment period. In response to these requests and to ensure that all interested parties have time to comment, the deadline for transmittal of comments has been extended to September 28, 1999. Comments should be postmarked by September 28, 1999, to ensure consideration.

Issued in Washington, DC, this 3rd day of September 1999.

William D. Magwood, IV,

Director, Office of Nuclear Energy, Science and Technology.

[FR Doc. 99–23567 Filed 9–9–99; 8:45 am]

BILLING CODE 6450–01–P

ENVIRONMENTAL PROTECTION AGENCY

[ER–FRL–6244–8]

Environmental Impact Statements; Notice of Availability

Responsible Agency: Office of Federal Activities, General Information (202) 564–7167 OR (202) 564–7153.

Weekly receipt of Environmental Impact Statements, Filed July 19, 1999 Through July 23, 1999, Pursuant to 40 CFR 1506.9.

EIS No. 990253, FINAL EIS, FHW, MN, MN–TH–14 Corridor Reconstruction, MN–TH–60 to I–35, Funding and COE Section 404 Permit Issuance, Blue Earth, Waseca and Steele Counties, MN, Due: August 30, 1999, Contact: Cheryl Martin (651) 291–6120.

EIS No. 990254, DRAFT EIS, FHW, VA, ADOPTION—Grundy Flood Damage Reduction/Highway Upgrade Project, Implementation, Town of Grundy, Buchanan County, CA, Due: August 30, 1999, Contact: Doris Bush (540) 645–1667.

U.S. Department of Transportation's, Federal Highway Administration (FHW) has adopted the Corps of Engineer's, Air National Guard FEIS #950407 filed 8–30–95. FHW was not a Cooperating Agency for the above final EIS. Recirculation of the document is necessary under Section 1506.3(b) of the Council on Environmental Quality Regulations.

EIS No. 990255, DRAFT EIS, FHW, WV, US–35, Funding and COE Section 404 Permit, Mason and Putnam Counties, WV, Due: September 23, 1999, Contact: David E. Bender (304) 347–5928.

EIS No. 990256, FINAL EIS, UMC, AZ, Yuma Marine Corps Air Station (MCAS), To Improve Ordnance Handling and Storage, Construct a new Combat Aircraft Loading Area (CALA); New Station Ordnance Area and Relocation of MCAS Yuma, AZ, Due: August 30, 1999, Contact: Richard Samrah (520) 341–3163.

EIS No. 990257, DRAFT EIS, AFS, MT, Good Creek Resource Management Project, Implementation, Vegetation Treatments and Other Activities to Restore Watershed, Flathead National Forest, Tally Lake Ranger District, Flathead County, MT, Due: September 13, 1999, Contact: Bryan Donner (406) 863–5408.

EIS No. 990258, FINAL EIS, FHW, PA, Central Bradford County Traffic Improvement Project, Construction US 6 Highway through Towanda Borough and North Towanda Township to US 220, Bradford County, PA, Due: August 30, 1999, Contact: Ronald W. Carmichael, PE (717) 221–3461.

EIS No. 990259, FINAL EIS, DOC, PR, VI, Corals and Reef Associated Plants and Invertebrates, Fishery Management Plan, Amendment I Marine Conservation District (MCD), Exclusive Economic Zone (EEZ), Puerto Islands and U.S. Virgin Islands, PR and VI, Due: August 30, 1999, Contact: William Hogarth (727) 570–5305.

EIS No. 990260, DRAFT EIS, FHW, NY, Albany Shaker Road and Watervliet Shakey Road Improvement Project, Construction and Reconstruction, Funding and COE Section 404 Permit, Town of Colonie, Albany County, NY, Due: September 15, 1999, Contact: Harold J. Brown (518) 431–4137.

EIS No. 990261, DRAFT EIS, USN, Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA), To Improved Capability to Detect Quieter and Harder-to-Find Foreign Submarines, Implementation, Due: October 28, 1999, Contact: Kim DaPaul (703) 604–1233.

EIS No. 990262, DRAFT EIS, DOE, Sodium-Bonded Spent Nuclear Fuel for the Treatment and Management, Candidate Sites are Argonne National Laboratory-West (ANL–W) Located within the boundaries of the Idaho National Laboratory I and the Savannah River Sites (SRS) F-Area and L Area, SC, Due: September 13, 1999, Contact: Susan M. Lesica (301) 903–8755.

EIS No. 990263, FINAL EIS, FRC, MA, Holyoke Hydroelectric Relicensing Project. ((FERC) Nos. 2004–073 and 11607–000), Construction, Operation and Maintenance, Located on the Connecticut River, Hampshire, Hampden and Franklin Counties, MA, Due: August 30, 1999, Contact: Allan E. Creamer (202) 219–0365.

EIS No. 990264, FINAL EIS, BLM, UT, Grand Staircase-Escalante National Monument Management Plan, Implementation, Cedar City, UT, Due: August 30, 1999, Contact: Jerry Meredith (435) 865–5100.

EIS No. 990265, DRAFT EIS, APH, Fruit Fly Cooperative Control Program, Eradication Program, Implementation, Due: October 12, 1999, Contact: Harold T. Smith (310) 734–8565.

Amended Notices

EIS No. 990162, DRAFT EIS, USN, GU, Surplus Navy Property Identified in the Guam Land Use Plan (GLUP '94) for Disposal and Reuse, Implementation, GU, Due: September 15, 1999, Contact: Gerald Gibbons (808) 471–9338. Published FR 05–21–99—Review Period extended from 7–6–99 to 9–15–99.

Dated: July 27, 1999.

William D. Dickerson,

Director, NEPA Compliance Division, Office of Federal Activities.

[FR Doc. 99–19625 Filed 7–29–99; 8:45 am]

BILLING CODE 6560–50–M

APPENDIX C SETTLEMENT AGREEMENT

Public Service Co. of Colorado v. Batt
and United States v. Batt

UNITED STATES COURTS
DISTRICT OF IDAHO

OCT 17 1995

8:34 A.M. RECD _____
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UNITED STATES COURTS

DISTRICT OF IDAHO

SETTLEMENT AGREEMENT

The State of Idaho, through the Attorney General and Governor Philip E. Batt in his official capacity; the Department of-Energy, through the General Counsel and Assistant Secretary for Environmental Management; and the Department of the Navy, through the General Counsel and Director, Naval Nuclear Propulsion Program, hereby agree on this 16th day of October, 1995, to the following terms and conditions to fully resolve all issues in the actions Public Service Co. of Colorado v. Batt, No. CV 91-0035-S-EJL (D. Id.) and United States v. Batt, No. CV-91-0054-S-EJL (D. Id.):

A. DEFINITIONS

For purposes of this Agreement, the following definitions shall apply:

1. The "State" shall mean the State of Idaho and shall include the Governor of the State of Idaho and the Idaho State Attorney General.

2. The "federal parties" means U.S. Department of Energy (DOE) and the U.S. Department of the Navy (the Navy), including any successor agencies.

3. "Treat" shall be defined, as applied to a waste or spent fuel, as any method, technique, or process designed change the physical or chemical character of the waste or fuel to render it less hazardous; safer to transport, store, dispose of; or reduce in volume.

4. "Transuranic waste" shall be defined as set forth in the EIS, Volume 2, Appendix E.

5. "One shipment of spent fuel" shall be defined as the transporting of a single shipping container of spent fuel.

6. "High-level waste" shall be defined as set forth in the EIS, Volume 2, Appendix E.

7. "DOE spent fuel" shall be defined as any spent fuel which DOE has the responsibility for managing with the exception of naval spent fuel and commercial spent fuel which DOE has accepted or will take title to pursuant to the Nuclear Waste Policy Act of 1982, 42 U.S.C. _ 10101 et seq. or comparable statute.

8. "Naval spent fuel" shall be defined as any spent fuel removed from naval reactors as a result of refueling overhauls (refueling) or defueling inactivations (defueling).

9. "Metric ton of spent fuel" shall be defined as a metric ton of heavy metal of spent fuel.

10. "Naval reactors" shall be defined as nuclear reactors used aboard naval warships (submarines, aircraft carriers, or cruisers), naval research or training vessels, or at land-based naval prototype facilities operated by the Naval Nuclear Propulsion Program for the purposes of research, development, or training.

11. "Calendar year" shall be defined as the year beginning on January 1, and ending on December 31.

12. "Mixed Waste" shall be defined as set forth in the EIS, Volume 2, Appendix E.

13. "EIS" shall be defined as the Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Program Final Environmental Impact Statement issued April, 1995.

14. "ROD" shall be defined as the Record of Decision issued by DOE on June 1, 1995, concerning the EIS.

15. "INEL" shall be defined as the Idaho National Engineering Laboratory. .

16. "Running Average" shall mean the total number of shipments of naval spent fuel to INEL, or transuranic waste from INEL, over any period' of three years, divided by three.

17. "The Court" shall mean the United States District Court for the District of Idaho before which is pending Public Service Company of Colorado v. Batt, No. CV 91-0035-S-EJL and United States v. Batt, No. CV 91-0054-S-EJL, and any appellate court to which an appeal may be taken, or with which an application for a writ of certiorari may be filed, under applicable law.

B. TRANSURANIC WASTE SHIPMENTS LEAVING IDAHO

1. "DOE shall ship all transuranic waste now located at INEL, currently estimated at 65,000 cubic-meters in volume, to the Waste Isolation Pilot Plant (WIPP) or other such facility designated by DOE, by a target date of December 31, 2015, and in. no event later than December 31, 2018. DOE shall meet the following interim deadlines:

a. The first shipments of transuranic waste from INEL to WIPP or other such facility designated by DOE shall begin by April 30, 1999. ,

b. By December 31, 2002, no fewer than 3,100 cubic meters (15,000 drum-equivalents) of transuranic waste shall have been shipped out of the State of Idaho.

c. After January 1, 2003, a running average of no fewer than 2,000 cubic meters per year shall be shipped out of the State of Idaho.

2. The sole remedy for failure by DOE to meet any of these deadlines or requirements shall be the suspension of DOE spent fuel shipments to INEL as set forth in Section K.1.

C. SPENT FUEL & HIGH-LEVEL WASTE SHIPMENTS LEAVING IDAHO

1. DOE shall remove all spent fuel, including naval spent fuel and Three Mile Island spent fuel from Idaho by January 1, 2035. Spent fuel being maintained for purposes of testing shall be excepted from removal, subject to the limitations of Section F.1 of this Agreement.

2. Until all of the aluminum-clad spent fuel then stored at INEL has been shipped to the Savannah

River Site, the cumulative number of shipments of spent fuel from the Savannah River Site to INEL under Section D as of the end of any calendar year shall not exceed the cumulative number of shipments of aluminum-clad spent fuel from INEL to the Savannah River Site for the same period.

3. DOE shall treat all high-level waste currently at INEL so that it is ready to be moved out of Idaho for disposal by a target date of 2035.

D. SHIPMENTS OF SPENT FUEL TO INEL

The federal parties may transport shipments of spent fuel to INEL only in accordance with the following terms and conditions.

1. Shipments of naval spent fuel to INEL shall take place as follows:

a. The Navy may make only those shipments of naval spent fuel to INEL that are necessary to meet national security requirements to defuel or refuel nuclear powered submarines, surface warships, or naval prototype or training reactors, or to ensure examination of naval spent fuel from these sources. The Secretary of Defense, upon notice to the Governor of the State of Idaho, shall certify the total number of such shipments of naval spent fuel required to be made through the year 2035.

b. The Navy shall not ship more than twenty four (24) shipments to INEL from the date of this Agreement through the end of 1995, no more than thirty six (36) shipments in 1996, and no more than twenty (20) shipments per year in calendar years 1997 through 2000. From calendar year 2001 through 2035, the Navy may ship a running average of no more than twenty (20) shipments per year to INEL. The total number of shipments of naval spent fuel to INEL through 2035 shall not exceed 575. Shipments of naval spent fuel to INEL through 2035 shall not exceed 55 metric tons of spent fuel.

c. Prior to January 1 of each calendar year through the year 2035, the Navy shall provide to Idaho an estimate of the number of shipments and the number of metric tons of naval spent fuel to be shipped during the following calendar year.

d. By January 31 of each calendar year, the Navy shall provide to Idaho the actual number of shipments and actual number of metric tons of naval spent fuel shipped during the preceding calendar year.

e. The naval spent fuel stored at INEL on the date of the opening of a permanent repository or interim storage facility shall be among the early shipments of spent fuel to the first permanent repository or interim storage facility.

f. The sole remedy for the Navy's failure to meet any of the deadlines or requirements set forth in this section shall be suspension of naval spent fuel shipments to INEL as set forth in Section K.1.

2. Shipments of DOE spent fuel to INEL shall take place as follows:

a. If DOE and the U.S. Department of State adopt a policy to accept spent fuel from foreign research reactors into the United States, DOE may send to INEL a maximum of 61 shipments of spent fuel from foreign research reactors during the period beginning on the date such a policy is adopted and ending on December 31, 2000. The Secretary of Energy, upon notice to the Governor of the State of Idaho, must certify that these shipments are necessary to meet national security and nonproliferation requirements. Upon such certification, DOE may ship not more than 10 such shipments from the date such policy is adopted through December 31, 1996, not more than 20 such shipments from the date the policy is adopted through December 31, 1997, and not more than 40 such shipments from the date the policy is adopted through December 31, 1998.

b. Until such time as a permanent repository or interim storage facility for storage or disposal of spent fuel, located outside of Idaho, is operating and accepting shipments of spent fuel from INEL, DOE shall be limited to shipments of spent fuel to INEL as set forth in Sections D.2.a., c., d., e., and f. After a permanent repository or interim storage facility is operating and accepting shipments of spent fuel from INEL, the State of Idaho and DOE may negotiate and reach agreement concerning the timing and number of shipments of DOE spent fuel that may be sent to INEL, in addition to those otherwise permitted under this Section D.2., for preparation for storage or disposal outside the State of Idaho.

c. After December 31, 2000, DOE may transport shipments of spent fuel to INEL constituting a total of no more than 55 metric tons of DOE spent fuel (equivalent to approximately 497 truck shipments) and subject to the limitations set forth in Sections D.2.e., f., g., and h. below, except that the limitations of Section-D:2.a. above will not apply.

d. No shipments of spent fuel shall be made to INEL from Fort St. Vrain, unless a permanent repository or interim storage facility for spent fuel located outside of Idaho has opened and is accepting spent fuel from INEL, in which case such shipments may be made for the purpose of treating spent fuel to make it suitable for disposal or storage in such a repository or facility. Shipments of spent fuel from Fort St. Vrain shall remain at INEL only for a period of time sufficient to allow treatment for disposal or storage in such a repository or facility. The total number of Fort St. Vrain shipments shall not exceed 244, constituting no more than sixteen (16) metric tons of spent fuel, and shall be in addition to those allowed under Section D 2.c. above.

e. Except as set forth in Section D.2.d. above, DOE will make no shipments of spent fuel from commercial nuclear power plants to INEL.

f. After December 31, 2000, and until an interim storage facility or permanent repository is opened and accepting spent fuel from INERT, DOE shall not ship to INEL more than 20 truck shipments of spent fuel in any calendar year, except that:

(i) In one calendar year only, DOE may make not more than 83 truck shipments of spent fuel to INEL from the West Valley Demonstration Project;

(ii) DOE may not make more than 13 truck shipments in any of the nine calendar years succeeding the shipment of the West Valley Demonstration Project spent fuel to INEL; and

(iii) Shipments DOE is entitled to make to INEL in any calendar year, but has not made, may be shipped in any subsequent calendar year, notwithstanding the limitations in this Section D.2.f. on the number of shipments per year.

For purposes of this section and Section D.2.c., in determining the number of truck shipments, one rail shipment shall be deemed equivalent to 10 truck shipments, except that in the case of shipments from West Valley Demonstration Project, seven rail shipments shall be deemed to be equal to 83 truck shipments. DOE may elect to make rail shipments in lieu of truck shipments, in accordance with this conversion formula and subject to other limitations of this section.

g. Prior to January 1 of each calendar year through the year 2035, DOE shall provide to Idaho an estimate of the number of shipments and the number of metric tons of DOE spent fuel to be shipped during the following calendar year.

h. No later than January 31st of each calendar year, DOE shall provide to Idaho the actual number of shipments and actual number of metric tons of DOE spent fuel shipped during the preceding year.

i. The sole remedy for DOE's failure to meet any of the deadlines or requirements set forth in this section shall be the suspension of DOE spent fuel shipments to INEL as set-forth in Section K.1.

E. TREATMENT & TRANSFER OF EXISTING WASTES AT INEL

1. Treatment Commitment. DOE agrees to treat spent fuel, high-level waste, and transuranic wastes in Idaho requiring treatment so as to permit ultimate disposal outside the State of Idaho.

2. Mixed Waste Treatment Facility. DOE shall, as soon as practicable, commence the procurement of a treatment facility ("Facility") at INEL for the treatment of mixed waste, transuranic waste and alpha-emitting mixed low-level waste ("Treatable Waste"). DOE shall execute a procurement contract for the Facility by June 1, 1997, complete construction of the Facility by December 31, 2002, and commence operation of the Facility by March 31, 2003. Commencement of construction is contingent upon Idaho approving necessary permits.

a. Treatment of Non-INEL Wastes. Any and all Treatable Waste shipped into the State of Idaho for treatment at the Facility shall be treated within six months of receipt at the Facility, with the exception of two cubic meters of low-level mixed waste from the Mare Island Naval Shipyard which will complete base closure for nuclear work in 1996. DOE may request an exception to the six month time period on a case-by-case basis, considering factors at the shipping site such as health and safety concerns, insufficient permitted storage capacity, and base or site closures. Any transuranic waste received from another site for treatment at the INEL shall be shipped outside of Idaho for storage or disposal within six months following treatment. DOE shall continue to use the Federal Facility Compliance Act process, as facilitated by the National Governors' Association, to determine what locations are suitable for mixed low-level waste treatment and storage.

3. Operation of High-Level waste Evaporator. DOE shall commence operation of the high-level waste evaporator by October 31, 1996; and operate the evaporator in such a manner as to reduce the tank farm liquid waste volume by no fewer than 330,000 gallons by December 31, 1997. Efforts will continue to reduce the remaining volume of the tank farm liquid waste by operation of the high-level waste evaporator.

4. Calcination of Remaining Non-Sodium Bearing Liquid Wastes. DOE shall complete the process of calcining all the remaining non-sodium bearing liquid high-level wastes currently located at INEL by June 30, 1998.

5. Calcination of Sodium-Bearing Wastes. DOE shall commence calcination of sodium-bearing liquid high-level wastes by June 1, 2001. DOE shall complete calcination of sodium-bearing liquid high-level wastes by December 31, 2012.

6. Treatment of Calcined Wastes. DOE shall accelerate efforts to evaluate alternatives for the treatment of calcined waste so as to put it into a form suitable for transport to a permanent repository or interim storage facility outside Idaho. To support this effort, DOE shall solicit proposals for feasibility studies by July 1, 1997. By December 31, 1999, DOE shall commence negotiating a plan and schedule with the State of Idaho for calcined waste treatment. The plan and schedule shall provide for completion of the treatment of all calcined waste located at INEL by a date established by the Record of Decision for the Environmental Impact Statement that analyzes the alternatives for treatment of such waste. Such Record of Decision shall be issued not later than December 31, 2009. It is presently contemplated by DOE that the plan and schedule shall provide for the completion of the treatment of all calcined waste located at INEL by a target date of December 31, 2035. The State expressly reserves its right to seek appropriate relief from the Court in the event that the date established in the Record of Decision for the Environmental Impact Statement that analyzes the alternatives for treatment of such waste is significantly later than DOE's target date. In support of the effort to treat such waste, DOE shall submit to the State of Idaho its application for a RCRA (or statutory equivalent) Part B permit by December 1, 2012.

7. Transfer of Three Mile Island Fuel. DOE shall complete construction of the Three Mile Island dry

storage facility by December 31, 1998. DOE shall commence moving fuel into the facility by March 31, 1999, and shall complete moving fuel into the facility by June 1, 2001.

8. Transfer out of Wet Storage. By December 31, 1999, DOE shall commence negotiating a schedule with the State of Idaho for the transfer of all spent fuel at INEL out of wet storage facilities. DOE shall complete the transfer of all spent fuel from wet storage facilities at INEL by December 31, 2023. If DOE determines that transfer to dry storage of any portion of such spent fuel is technically infeasible, or that transfer to such dry storage presents significantly greater safety or environmental risks than keeping the fuel in wet storage, DOE shall inform the State and propose a later date or alternative action. If the State does not agree to such later date or alternative action, DOE may apply to the Court for appropriate relief. DOE shall, after consultation with the State of Idaho, determine the location of the-dry storage facilities within INEL, which shall, to the extent technically feasible, be at a point removed from above the Snake River Plain Aquifer ("Aquifer").

9. The sole remedy for DOE's failure to meet any of the deadlines or requirements set forth in this section shall be the suspension of DOE spent fuel shipment to INEL as set forth in Section K.1.

F. SPENT FUEL PROGRAM

1. Establishment of INEL as DOE Spent Fuel Lead Laboratory. DOE shall, within thirty days of entry of this Agreement as a court order, designate INEL as the Department's lead laboratory for spent fuel. DOE shall direct the research, development and testing of treatment, shipment and disposal technologies for all DOE spent fuel, and all such DOE activities shall be coordinated and integrated under the direction of the Manager, DOE-Idaho Operations Office. Such designation shall not permit the shipment to INEL of any spent fuel beyond that permitted by this Agreement with the exception that quantities of spent fuel brought to INEL for testing in excess of those permitted by this Agreement shall leave the State of Idaho within five years of the date of receipt at INEL.

2. Construction of Dry Storage. DOE shall include in its appropriation request for federal fiscal year 1998 to the Executive Office of the President funds necessary for DOE to initiate the procurement of dry storage at INEL to replace wet, below ground facilities. Spent fuel loading into dry storage shall commence by July 1, 2003.

3. Funding for Dry Cell Expansion Project. The Naval Nuclear Propulsion Program shall include in its appropriation request to the Executive Office of the President for federal fiscal year 1997 funds necessary for the Dry Cell Expansion Project ("Project") at the Expended Core Facility at the Naval Reactors Facility to accommodate removal of excess material and examination of naval spent fuel in a dry condition. The Project shall commence as soon as Idaho issues the required permit under the Clean Air Act and funding is appropriated. Completion of this project shall result in the expenditure of approximately $26 million dollars over the next five years.

4. Multi-Purpose Canisters. DOE and the Navy shall employ Multi-Purpose Canisters ("MPCs") or comparable systems to prepare spent fuel located at INEL for shipment and ultimate disposal of such fuel outside Idaho. Procurement shall be performed in accordance with the Federal Acquisition Regulation which ensures that companies in Idaho will have opportunity to bid on and obtain any competitive contracts for such work. The Record of Decision on the NEPA analysis shall be completed by April 30, 1999.

5. ECF Hot Cell Facility Upgrade. The Naval Nuclear Propulsion Program shall include in its appropriation request for federal fiscal year 1997 to the Executive Office of the President funds necessary to proceed with upgrades which shall require approximately $12 million of expenditures during the next three years.

6. ECF Dry Storage Container Loading Station. The Naval Nuclear Propulsion Program shall include

in its appropriation request for federal fiscal year 1997 to the Executive Office of the President funds necessary to proceed with design and construction of a dry storage container loading station at ECF. This project shall require no less than $20 million of expenditures during the next five years.

7. Funding for Discretionary Environmental Remediation Work at the Naval Reactors Facility. The Naval Nuclear Propulsion Program shall undertake environmental remediation efforts at the Naval Reactors Facility totaling approximately $45 million over the next five years.

8. Water Pool Reracking. DOE may proceed with installing new racks into the water pool in the building at the Idaho Chemical Processing Plant Facility currently holding naval spent fuel to provide enhanced capability for spent fuel storage in the existing water pool space until dry storage can be made available. Installation of the new racks may commence as soon as Idaho issues the necessary permit under the Clean Air Act. Idaho shall issue said permit within 180 days after DOE re-submits its application to Idaho.

G. INEL ENVIRONMENTAL RESTORATION PROGRAM

1. INEL Environmental Restoration Program to Continue. DOE shall continue to implement the INEL environmental restoration program in coordination with Idaho and EPA. Such implementation shall be consistent with the schedules contained in the Federal Facilities Agreement and Consent Order (FFA/CO) entered into with the State of Idaho, EPA and DOE, and it shall include schedule requirements developed pursuant to the completed and future Records of Decision under the FFA/CO. The sole remedies for failure to implement the environmental restoration activities specified in the FFA/CO shall be those specified in the FFA/CO.

H. OBTAINING TIMELY FEDERAL FUNDING FOR COMPLIANCE WITH THIS ORDER

1. Compliance Funding. DOE and the Naval Nuclear Propulsion Program shall share budget information concerning INEL with Idaho prior to submitting the budget request to the Executive Office of the President. Consultations with the State of Idaho shall continue throughout the budget process. The current DOE estimate for the costs of the activities and projects described in Sections A through G over the next five years is approximately $200 million above established budget targets.

I. FEDERAL FINDS FOR THIS SETTLEMENT AGREEMENT

1. DOE shall provide to the State of Idaho beginning in federal fiscal year 1996 and continuing through 1997-2000, a total amount of $30 million for community transition purposes and any other purposes that are mutually acceptable to the parties, such as the non-Federal development of Boron Neutron Capture Therapy and Radiological Toxicology technology in Idaho.

2. Acoustic Research Funding. The Navy shall include in its appropriation request to the Executive Office of the President for federal fiscal year 1997 no less than $7 million for the Navy to construct a Ships Model Engineering and Support Facility at the Naval Surface Warfare Center, Carderock Division, Acoustic Research Detachment at Bayview, Idaho.

J. GOOD FAITH COMPLIANCE & AFFIRMATIVE SUPPORT

1. The federal parties and Idaho agree that the activities to be performed under this Agreement and the subsequent Consent Order are in the public interest. The federal parties and Idaho acknowledge the complexity of this Agreement and have agreed to act in good faith to effectuate its fulfillment. The federal parties and Idaho shall affirmatively support this Agreement and its terms, conditions, rights and obligations in any administrative or judicial proceeding. The federal parties and Idaho intend to seek a sense of the Congress resolution expressing support for the terms, conditions, rights and obligations contained in this Agreement- and the subsequent Consent Order and recommending to

future Congresses that funds requested by the President to carry out this Agreement be appropriated. In any administrative or judicial proceeding, Idaho shall support the adequacy of the EIS and ROD against any challenges by third parties. Idaho shall have the ability, in its sole discretion, to waive performance by the federal parties of any terms, conditions and obligations contained in this Agreement.

2. Idaho shall promptly issue, upon submission of legally sufficient applications, all permits, licenses or other approvals needed by the DOE, the Navy or the Naval Nuclear Propulsion Program for the performance of any of their respective obligations set forth in this Agreement.

3. No provision of this Agreement shall compel any party to act without due legal authority. Performance by every party under this Agreement shall be subject to and comply with all applicable federal statutes, regulations and orders, including the Anti-Deficiency Act. The inability of any party to comply with the provisions of this Agreement, or a delay in such compliance, as a result of any applicable federal statute, regulation or order shall not subject that party to judicial enforcement under Section K.2.a, but shall not preclude the application of Sections K.1.a. or K.1.b.

4. In the event any required NEPA analysis results in the selection after October 16, 1995, of an action which conflicts with any action identified in this Agreement, DOE or the Navy may request a modification of this Agreement to conform the action in the Agreement to that selected action. Approval of such modification shall not be unreasonably withheld. If the State refuses to accept the requested modification, DOE or the Navy may seek relief from the Court. On motion of any party, the Court may extend the time for W E or the Navy to perform until the Court has decided whether to grant relief. If the Court determines that the State has unreasonably withheld approval, the Agreement shall be conformed to the selected action. If the Court determines that the State has reasonably withheld approval, the time for DOE or the Navy to perform the action at issue shall be as set forth in this Agreement and subject to enforcement as set forth section in Section K.1.

5. Effect of Certain Court Orders.

a. Navy. In the event that a court order is entered in the case of Snake River Alliance Education Fund v. United States Department of Energy, No. CV-95-0331-S-EJL (D. Idaho), or in any other judicial proceeding, that prohibits in whole or in part any shipment of spent fuel to INEL by the Navy under section D, then all obligations, requirements and deadlines of the federal parties under this Agreement shall be suspended during the period of applicability of the order. Upon the vacating, dissolving or reversing of any such order, the obligations, deadlines and requirements provided for in this Agreement shall be extended by a period that corresponds to their period of suspension.

b. DOE. In the event that a court order is entered in the case of Snake River Alliance Education Fund v. United States Department of Energy, No. CV-95-0331-S-EJL (D. Idaho), or in any other judicial proceeding, that prohibits in whole or in part any shipment of spent fuel to INEL by DOE under section D, then the DOE has the option to suspend all DOE shipments to INEL and suspend all of DOE's obligations, requirements and deadlines under this Agreement during the period of applicability of the order. If DOE exercises this option, then upon the vacating, dissolving, or reversing of any such order, DOE's obligations, deadlines and requirements provided for in this Agreement shall be extended by a period that corresponds to their period of suspension.

K. ENFORCEMENT

1. Succession of Shipments.

a. DOE. If DOE fails to satisfy the substantive obligations or requirements it has agreed to in this Agreement or fails to meet deadlines for satisfying such substantive obligations or requirements, shipments of DOE spent fuel to INEL shall be suspended unless and until the parties agree or the

Court determines that such substantive obligations or requirements have been satisfied. .

b. Navy. If the Navy or the Naval Nuclear Propulsion Program fails to satisfy the substantive obligations or requirements it has agreed to in this Agreement or fails to meet deadlines for satisfying such substantive obligations or requirements, shipments of Navy spent fuel to INEL shall be suspended unless and until the parties agree or the Court determines that such substantive obligations or requirements have been satisfied.

2. Other Enforcement

a. Judicial Enforcement. The Court may enforce the rights, obligations and requirements assigned by this Agreement, other than those exclusively enforceable under Section K.1., pursuant to all legal and equitable remedies available to the courts of the United States, including, but not limited to, use of the Court's contempt powers.

b. RCRA Enforcement. Nothing in this Agreement shall prohibit the State of Idaho from requiring necessary remedial actions as set forth in the Resource Conservation and Recovery Act, 42 U.S.C. section 6929 ("RCRA") (or statutory equivalent), including penalty and fine procedures, the sums of which shall be payable to the State of Idaho.

c. Payment Obligation. In the event that the federal parties do not carry out the requirement that all spent fuel located at INEL be removed from Idaho by January 1, 2035, then subject to the availability of the appropriations provided in advance for this purpose, the federal parties shall pay to the State of Idaho $60,000 for each day such requirement has not been met.

3. Prior Orders. Agreements end Decisions. The terms of this Agreement shall supersede all rights, duties and obligations set forth in any prior orders, agreements or decisions entered in this litigation, captioned Public Service Company of Colorado v. Batt, and United States of America v. Batt, Nos. CV 91-0035-S-EJL and CV 91-0054-S-EJL, except for the provisions of paragraph 4 of the December 22, 1993 Court Order.

4. Dispute Resolution. In the event that any party to this Agreement contends that any other party has violated any terms of the Agreement, the parties shall seek to resolve their differences informally before asking for resolution by the Court.

L. CONSENT ORDER

1. The parties agree they shall jointly present this Agreement to the U.S. District Court with a proposed Consent Order which will provide for the incorporation of this Agreement, continuing jurisdiction of the Court and the administrative termination of this action without prejudice to the right of the parties to reopen the proceedings for good cause shown. This Agreement and Consent Order shall not preclude any party from applying to the Court under Rule 60, of the Federal Rules of Civil Procedure, or the Court from granting relief thereunder.

2. If the Consent Order is not entered by the Court, in accordance with Section L.1 above, within 45 days of lodging with the Court, then either party to this Agreement may elect to terminate this Agreement, in which case this Agreement becomes null and void, and of no force or effect.

For the Federal Parties:

/s/
Robert R Nordhaus
General Counsel
Department of Energy

/s/
Thomas P. Grumbly
Assistant Secretary for Environmental Management
Department of Energy

/s/
Steven S Honigman
General Counsel
Department of the Navy

/s/
Admiral Bruce DeMars
Director, Naval Nuclear Propulsion Program

For the State of Idaho

/s/
Philip E Batt
Governor, State
State of Idaho

/s/
Alan G Lance
Attorney General,
State of Idaho

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF EIS FOR THE TREATMENT AND MANAGEMENT OF SODIUM-BONDED SPENT NUCLEAR FUEL

CEQ regulations at 40 CFR 1506.5(c), which have been adopted by DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project," for the purposes of this disclosure, is defined in the March 23, 1981 guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Question 17a and b.

"Financial or other interest in the outcome of the project 'includes' any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)." 46 FR 18026-18038 at 18031.

In accordance with these requirements, the offeror and any proposed subcontractors hereby certify as follows: (check either (a) or (b) to assure consideration of your proposal)

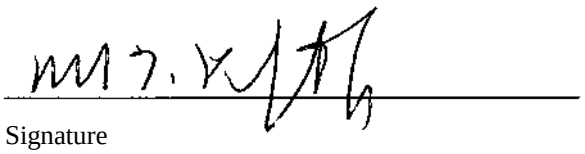
(a) ___✓___ Offeror and any proposed subcontractor have no financial interest in the outcome of the project.

(b) _____ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests:

1.
2.
3.

Certified by:



Signature

Richard T. Profant
Name

Corporate Vice President
Integrated Environmental Services Operation

July 14, 2000
Date

Science Applications International Corporation