

## ENVIRONMENTAL ASSESSMENT

### Management of Spent Nuclear Fuel on the Oak Ridge Reservation Oak Ridge, Tennessee

February 1996



U.S. Department of Energy  
Oak Ridge Operations  
Oak Ridge, Tennessee

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DOE/EA-1117

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## TABLE OF CONTENTS

LIST OF TABLES .....	iii
LIST OF FIGURES .....	iii
LIST OF APPENDICES .....	iii
ACRONYMS AND ABBREVIATIONS .....	v
SUMMARY .....	ix
1. INTRODUCTION .....	1
1.1 Purpose of and Need for Action .....	1
1.2 Background .....	3
1.2.1 SNF Storage Facilities Within the Scope of this EA .....	3
1.2.2 SNF Storage Facilities Beyond the Scope of this EA .....	7
1.3 Scope of Environmental Assessment .....	9
2. ALTERNATIVES, INCLUDING PROPOSED ACTION .....	11
2.1 No Action .....	11
2.2 Proposed Action (Preferred Alternative) .....	11
2.2.1 Dry Cask Storage Facility Construction .....	11
2.2.2 SNF Management Operations .....	14
2.2.2.1 Segregation and Repackaging .....	14
2.2.2.2 On-Site Transport .....	14
2.2.2.3 Dry Cask Storage Facility Operation .....	16
3. EXISTING ENVIRONMENT .....	17
3.1 Natural Features .....	17
3.1.1 Oak Ridge Reservation .....	17
3.1.2 Melton Valley .....	18
3.1.2.1 Soils .....	18
3.1.2.2 Groundwater Hydrology .....	18
3.1.2.3 Surface Water .....	19
3.1.2.4 Aquatic Ecology .....	19
3.1.2.5 Terrestrial Ecology/Land Use .....	21
3.1.2.6 Historic and Archaeological Resources .....	22
3.1.3 Dry Cask Facility Sites .....	22
3.1.3.1 Preferred Site .....	22
3.1.3.2 Alternative Site .....	23
3.2 Background Radiation Dose .....	23

3.2.1	Public Radiation Dose .....	23
3.2.2	Occupational Radiation Dose .....	24
4.	ENVIRONMENTAL IMPACTS .....	27
4.1	Construction of Dry Cask Storage Facility .....	27
4.1.1	Preferred Site .....	27
4.1.1.1	Air Quality .....	27
4.1.1.2	Water Resources .....	27
4.1.1.3	Ecological Resources .....	27
4.1.1.4	Health and Safety .....	28
4.1.2	Alternative Site .....	28
4.1.2.1	Air Quality .....	28
4.1.2.2	Water Resources .....	28
4.1.2.3	Ecological Resources .....	29
4.1.2.4	Health and Safety .....	29
4.2	Handling and On-Site Transportation of SNF .....	29
4.2.1	Air Quality .....	29
4.2.2	Water Resources .....	30
4.2.3	Ecological Resources .....	30
4.2.4	Health and Safety .....	30
4.3	Accidents .....	34
4.3.1	Construction .....	34
4.3.2	Handling and On-Site Transportation of SNF .....	34
4.4	Socioeconomics and Environmental Justice .....	35
4.5	Cumulative Impacts .....	35
4.5.1	Groundwater Hydrology .....	38
4.5.2	Surface Water Hydrology .....	39
4.5.3	Wetlands .....	40
4.5.4	Aquatic Ecology .....	40
4.5.5	Terrestrial Ecology .....	41
4.5.6	Air Quality .....	43
4.5.7	Historic and Archaeological Resources .....	44
4.5.8	Health and Safety .....	44
4.5.9	Transportation .....	46
5.	REGULATORY COMPLIANCE AND AGENCY CONSULTATION .....	49
6.	REFERENCES .....	51
7.	LIST OF PREPARERS .....	57



## LIST OF TABLES

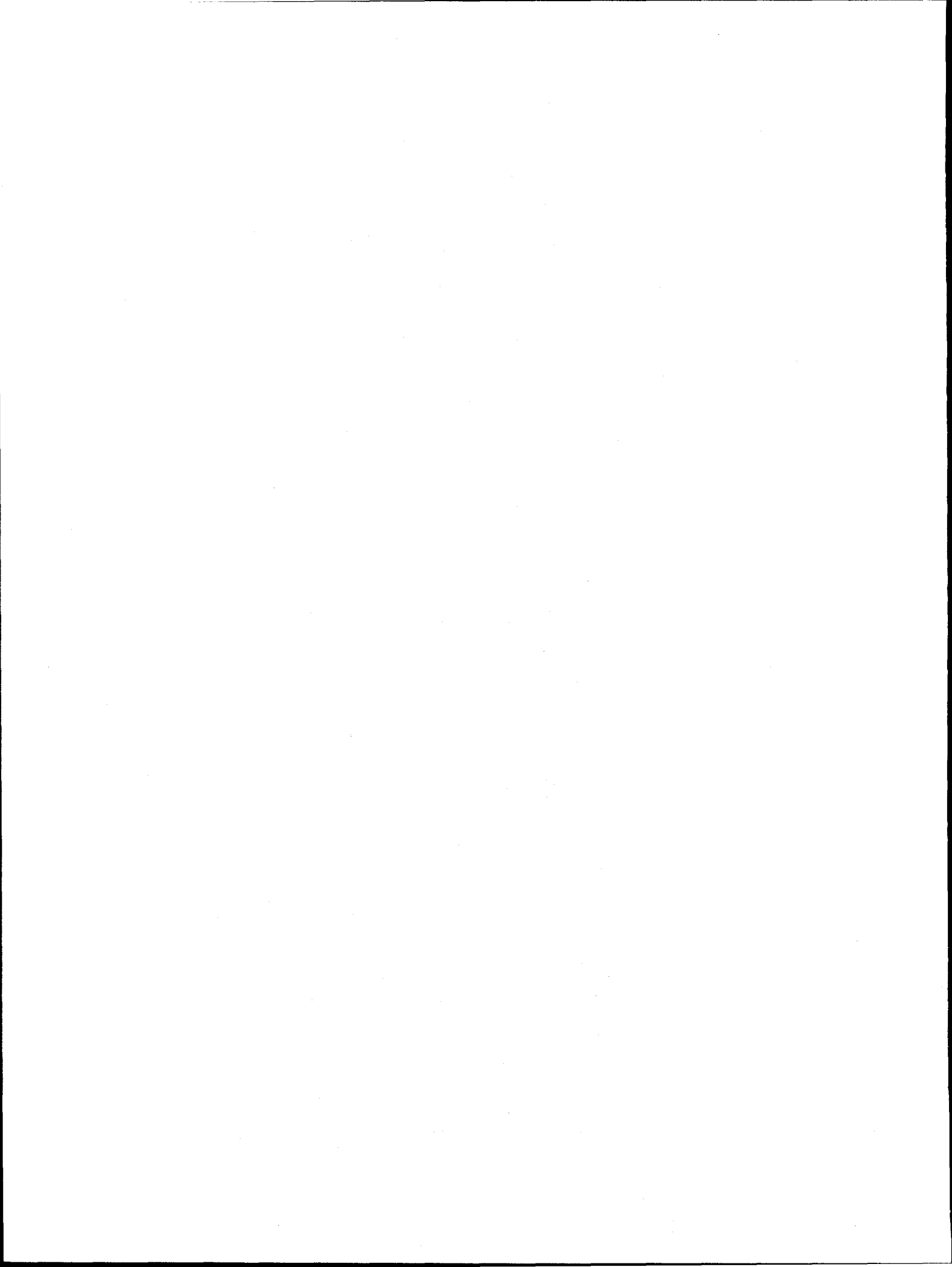
Table 1.1. Spent Nuclear Fuel Stored on the Oak Ridge Reservation, Oak Ridge, TN and Within the Scope of this EA .....	4
Table 1.2. Spent Nuclear Fuel on the Oak Ridge Reservation, Oak Ridge, TN Facilities Beyond the Scope of this EA .....	8
Table 2.1. Summary of Handling Activities for Spent Nuclear Fuel on the Oak Ridge Reservation. ....	15
Table 3.1 Annual Radiation Effective Dose Equivalents (EDEs) from ORR and ORNL ..	25
Table 4.1. On-Site Transportation Distance Estimations .....	32
Table 4.2. Estimated Dose and Latent Cancer Fatalities (LCF) from On-Site Transportation .....	33

## LIST OF FIGURES

Figure 1.1. General Location of the Oak Ridge Reservation and Main Facilities in Oak Ridge, TN .....	2
Figure 1.2. Oak Ridge Reservation Spent Nuclear Fuel Storage Sites Addressed in this Environmental Assessment. ....	5
Figure 2.1. Proposed Locations for the Dry Cask Storage Facility: SWSA 5 and West of HFIR .....	13
Figure 3.1. White Oak Creek Watershed .....	20
Figure 4.1. Site Locations for Oak Ridge National Laboratory's Proposed Waste Management Projects for Melton Valley through 1995. ....	37

## LIST OF APPENDICES

APPENDIX A:	Glossary
APPENDIX B:	Site Selection Criteria for Dry Cask Storage Facility
APPENDIX C:	Status of Protected Species on the Oak Ridge Reservation
APPENDIX D:	Technical Support Data
APPENDIX E:	Consultation Letters



## ACRONYMS AND ABBREVIATIONS

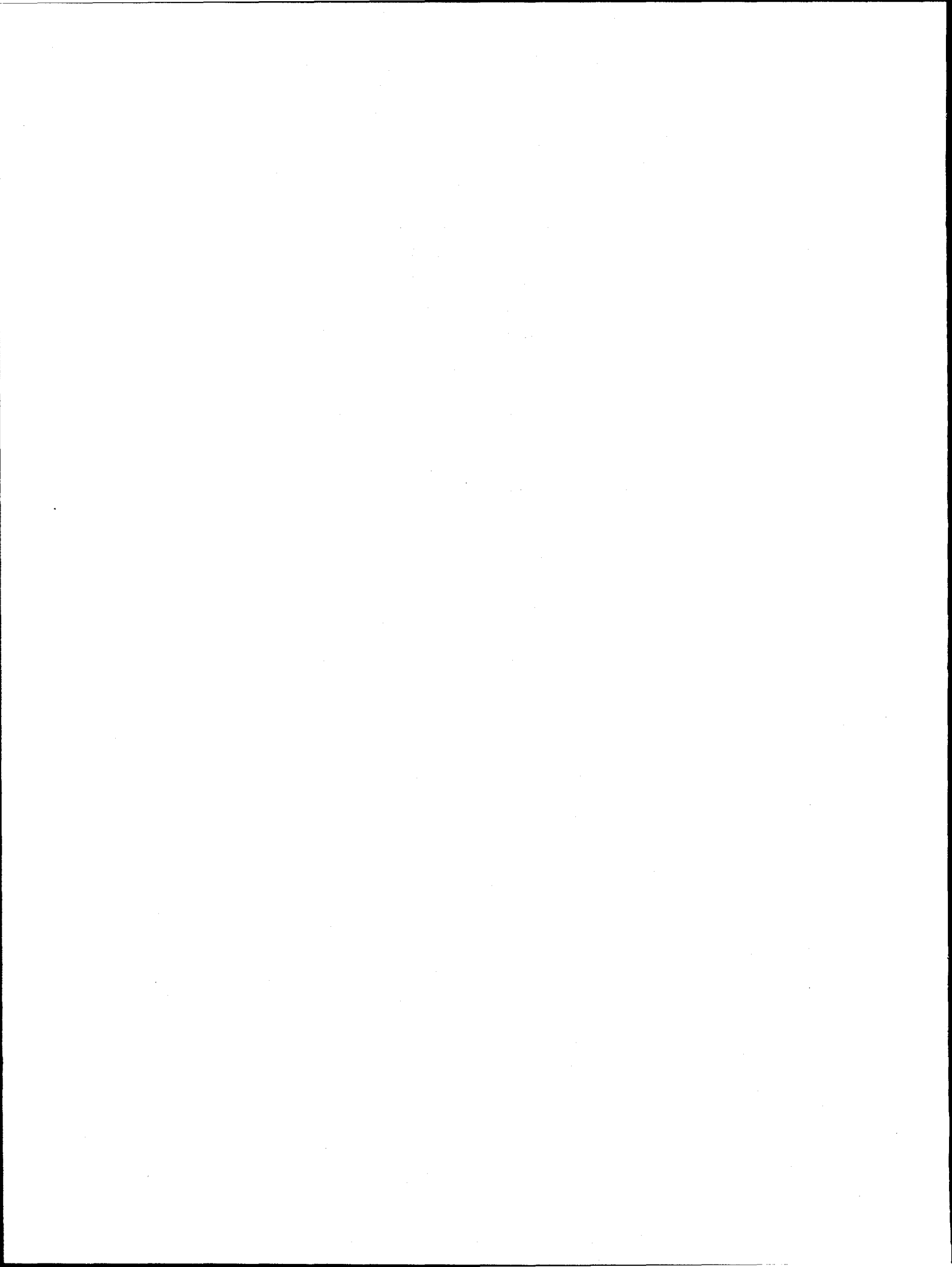
ac	acres
ALARA	as low as reasonably achievable
Bldg.	building
Bq	becquerel
BMAP	Biological Monitoring and Abatement Program
BSR	Bulk Shielding Reactor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH	contact-handled
Ci	Curie
cm	centimeter
DOE	U.S. Department of Energy
dpm	disintegrations per minute
EA	environmental assessment
EDE	effective dose equivalent
EIS	environmental impact statement
EPCRA	Emergency Planning and Community Right-to-Know Act
FONSI	finding of no significant impact
ft	foot (feet)
ft <sup>2</sup>	square foot/feet
ft <sup>3</sup>	cubic foot/feet
g	gram
ha	hectare
HEPA	high-efficiency particulate air (filter)
HFIR	High Flux Isotope Reactor
h	hour
HRLEL	High Radiation-Level Examination Laboratory
in	inch
INEL	Idaho National Engineering Laboratory
ISCST	Industrial Source Complex Short-term (model, EPA)
kg	kilogram
km	kilometer
km <sup>2</sup>	square kilometer

## ACRONYMS AND ABBREVIATIONS, continued

L	liter
lb	pound
LCF	latent cancer fatality
LLW	liquid low-level waste
LLW	low-level waste
m	meter
m <sup>2</sup>	square meter
m <sup>3</sup>	cubic meter
mg	milligram
mph	miles per hour
mrad	millirad
mrem	millirem
MSRE	Molten Salt Reactor Experiment
mSv	millisievert
MT	metric ton
MTHM	metric tons of heavy metal
MVST-CIP	Melton Valley Storage Tank-Capacity Increase Project
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NPDES	National Pollutant Discharge Elimination System
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
ORRR	Oak Ridge Research Reactor
OSHA	Occupational Safety and Health Administration
p	pico
P&E	Plant & Equipment Division
PEIS	programmatic environmental impact statement
PM	particulate matter
ppm	parts per million
REDC	Radiochemical Engineering Development Center
RM	remote-handled
ROD	Record of Decision

## ACRONYMS AND ABBREVIATIONS, continued

SDP .....	Site Development Plan
sec .....	second
SHPO .....	state historic preservation officer
SLLW .....	solid low-level waste
SNF .....	spent nuclear fuel
SRS .....	Savannah River Site
$^{90}\text{SrTiO}_3$ .....	strontium 90 titanate
Sv .....	sievert
SWSA .....	solid waste storage area
TRU .....	transuranic
TSR .....	Tower Shielding Reactor
yd .....	yard
yr .....	year
$\mu\text{m}$ .....	micrometer



## SUMMARY

On June 1, 1995, the U.S. Department of Energy (DOE) issued a Record of Decision (ROD)\* [60 *Federal Register* 28680] based on the analyses presented in a programmatic environmental impact statement (PEIS) (DOE 1995a) for the Department-wide management\* of spent nuclear fuel\* (SNF)<sup>1</sup>. In the ROD, DOE selected regionalized storage\* of SNF by fuel type as the preferred alternative. Implementation of the preferred alternative would require that aluminum-clad SNF from the DOE complex be transported to storage at the DOE Savannah River Site in South Carolina and non-aluminum-clad SNF, except for production reactor\* fuel from Hanford, be transported to storage at the DOE Idaho National Engineering Laboratory, pending ultimate disposition\*.

The proposed action evaluated in this environmental assessment (EA) is the management of SNF on the DOE Oak Ridge Reservation (ORR) to implement the preferred alternative of regional storage. To implement the ROD, ORR SNF would be retrieved from storage; transferred by truck to a hot-cell facility, if segregation by fuel type and/or repackaging is required; loaded into containers/transport casks that meet Federal regulatory requirements; and shipped via truck to off-site storage at either the Savannah River Site or the Idaho National Engineering Laboratory. Transport from Oak Ridge to off-site storage and impacts at off-site storage locations were evaluated in the PEIS and would not be part of the proposed action addressed in this EA. The proposed action would also include construction and operation of a dry cask SNF storage facility on the ORR to help ensure continuation of reactor operations. Construction and operation of the dry cask storage facility would only occur if there was interruption of off-site shipments of HFIR SNF, resulting in inadequate SNF storage.

A no-action alternative was also evaluated. No action would not include construction or operation of the dry cask storage facility or the shipment of SNF from the ORR. This would result in the eventual shutdown of the High Flux Isotope Reactor when SNF wet storage space is exhausted.

Impacts analyses resulted in the following findings:

*Air*--There would be no atmospheric emissions during handling and on-site transportation. Fugitive dust from construction would be short-term, localized at

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<sup>1</sup>Technical terms indicated by an asterisk (\*) are defined in the Glossary (Appendix A), and acronyms are defined in a list at the beginning of this EA.

construction site, and sporadic. Off-site ambient concentrations of criteria pollutants would not be affected and National Ambient Air Quality Standards would not be violated.

**Water**--No emissions or effluents would occur during handling, packaging, and on-site transport. Erosion and sedimentation to surface waters during construction would be controlled by best management practices.

**Geology and Soils**--No prime farmland would be impacted, and erosion would be controlled with best management practices.

**Ecology**--For construction of a dry cask storage\* facility, up to 1.2 ha (3 ac) of land would be cleared. This would result in loss of less than 0.05% of the pine forest on the ORR. No federally listed, threatened, or endangered species of plants or animals or designated critical habitats are known to occur on or near the site. Best management practices during construction would protect against impacts due to erosion. Construction of the dry cask storage facility would contribute to cumulative impacts on ORR vegetation, wildlife, and wildlife habitat. Less than 1% of forested areas in Melton Valley would be cleared for construction of all planned facilities.

**Floodplain/Wetlands**--There would be no construction activities within either a floodplain or wetland for either the preferred or alternative site. A small, man-made wetland near the preferred site will be marked with flags prior to construction to prevent potential disturbance.

**Radiological Impact: Operation**--Operation of the dry cask storage Facility would result in worker doses\* less than DOE's annual limit of 50 mSv (5 rem) and dose rates less than as-low-as-reasonably-achievable levels of 0.025 mSv/h (2.5 mrem/h). Impacts to the public would be negligible.

**Radiological Impact: Transportation**--On-site transportation of SNF associated with segregating, repackaging, and storage activities would result in potential radiological impacts to the worker handling SNF and to the public\* that are less than those predicted in the PEIS:  $1.36 \times 10^{-4}$  (0.000136) occupational fatal cancers and  $4.28 \times 10^{-6}$  (0.00000428) public\* fatal cancers. To put these values in



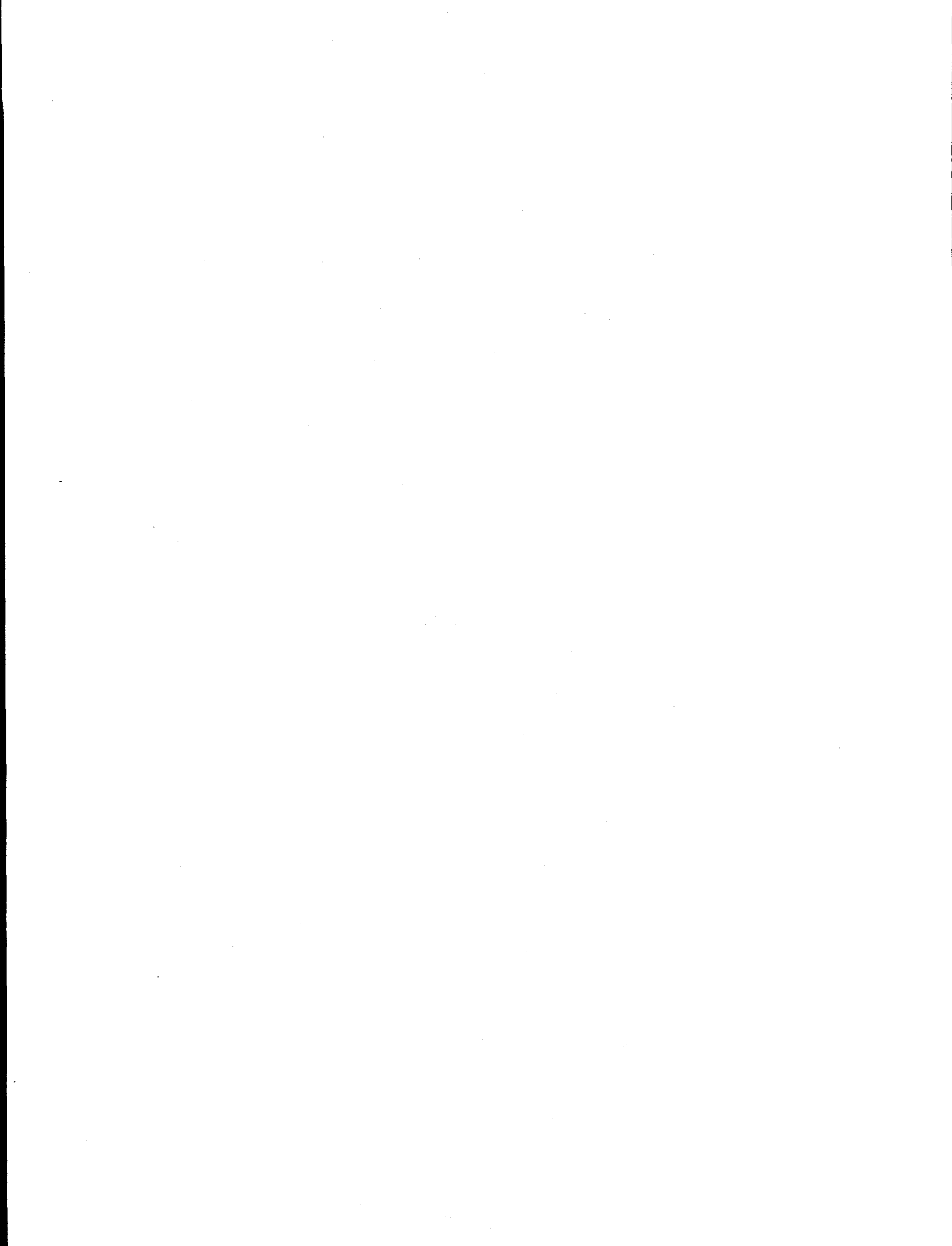
perspective, the DOE occupational limit for radiological exposures would result in a cancer fatality risk\* of  $2 \times 10^{-3}$  (0.002), and background annual exposure would be associated with a cancer fatality risk of approximately  $2 \times 10^{-4}$  (0.0002).

***Radiological Impact--Accidents--***Accidents\* involving handling the SNF would result in a probabilistic cancer fatality risk to the maximally exposed individual (public) and to the worker of  $9.6 \times 10^{-7}$  and  $1.9 \times 10^{-7}$  (0.00000096 and 0.00000019), respectively. This compares to a  $2 \times 10^{-4}$  (0.0002) fatality risk resulting from background radiation exposure. Therefore, the cancer risk from accidents is extremely small.

***Socioeconomics--***The small workforce necessary for construction would be drawn from the ORR labor pool. There would be no influx of workers associated with any of the proposed projects.

***Historic Preservation--***Although there is one historic structure in Melton Valley, it would not be affected by the proposed action.

***Environmental Justice--***Because the proposed action would have no adverse impacts, no minority or economically disadvantaged populations would be disproportionately affected.



## 1. INTRODUCTION

### 1.1 Purpose of and Need for Action

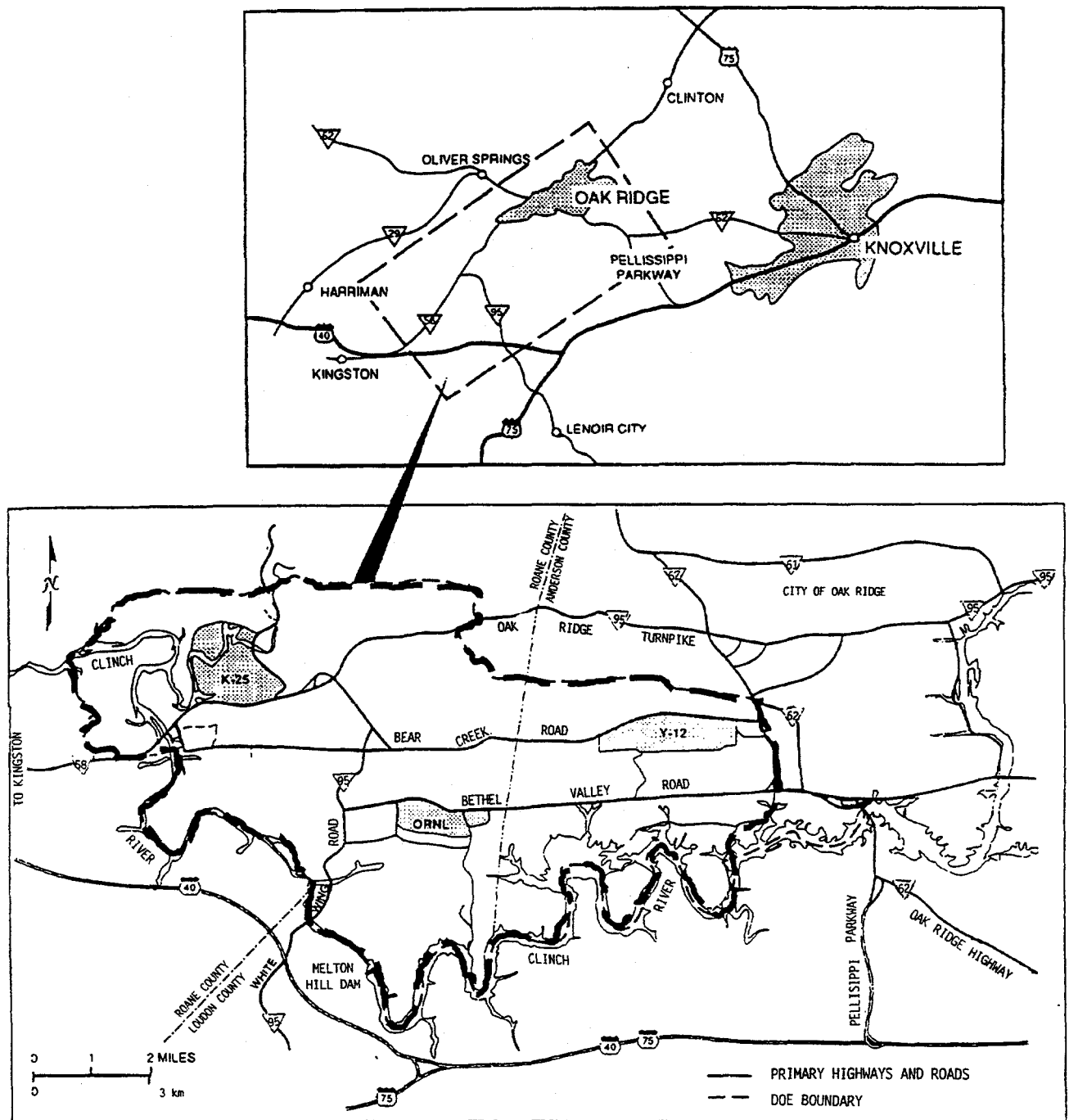
On June 1, 1995, the U.S. Department of Energy (DOE) issued a Record of Decision (ROD\*) [60 *Federal Register* 28680] based on the analyses presented in a programmatic environmental impact statement (PEIS) (DOE 1995a) for the Department-wide management\* of spent nuclear fuel\* (SNF\*)<sup>1</sup>. In the ROD, DOE selected regionalized storage\* of SNF by fuel type as the preferred alternative. Implementation of the preferred alternative would require that aluminum-clad SNF from the DOE complex be transported to storage at the DOE Savannah River Site (SRS) in South Carolina and non-aluminum-clad SNF, except for production reactor\* fuel from Hanford, be transported to storage at the DOE Idaho National Engineering Laboratory (INEL), pending ultimate disposition\*.

The proposed action evaluated in this environmental assessment (EA) is the management\* of SNF on the DOE Oak Ridge Reservation (ORR) to implement the preferred alternative of regional storage. To implement the ROD, ORR SNF would be retrieved from storage; transferred by truck to a hot-cell facility, if segregation\* by fuel type and/or repackaging is required; loaded into container/transportation casks that meet Federal regulatory requirements; and shipped via truck to off-site storage at either the SRS or the INEL. Transport from Oak Ridge (Figure 1.1) to off-site storage and impacts at off-site storage locations were evaluated in the PEIS and are not part of the proposed action addressed in this EA. The proposed action would also include construction and operation of a dry cask SNF storage facility on the ORR to help ensure continuation of reactor operations. Construction and operation of the dry cask storage facility would only occur if there was interruption of off-site shipments of HFIR SNF, resulting in inadequate SNF storage.

Action is needed to enable DOE to continue operation of the High Flux Isotope\* Reactor (HFIR) facility that generates SNF. The HFIR and related facilities produce radioisotopes\* for industrial and medical applications. Shipment of the current inventory of ORR SNF would make storage space available for future SNF generated by HFIR. Re-racking of SNF storage positions in the HFIR is necessary in order to store additional HFIR SNF. Even with this re-racking, storage space will be filled by 2001 if HFIR SNF is not shipped. The dry cask storage facility would allow continued HFIR to continue to operate after 2001, even if SNF shipments are discontinued. This would ensure that the supply of

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<sup>1</sup>Technical terms indicated by an asterisk (\*) are defined in the glossary, and acronyms (Appendix A) are defined in a list at the beginning of this EA.



**Figure 1.1. General Location of the Oak Ridge Reservation and DOE Facilities (K-25, ORNL, and Y-12) in Oak Ridge, TN.**

important isotopes for industry and nuclear medicine would not be interrupted. If the HFIR continues operating through the year 2035, the predicted SNF production would be approximately an additional 480 fuel assemblies.

## **1.2 Background**

Spent nuclear fuel is that which has been used in a nuclear reactor and removed from the core when its uranium content has been depleted. For the purpose of this EA, SNF also includes reactor fuel assemblies, uranium/neptunium target materials, blanket subassemblies, pieces of fuel, and debris. SNF is stored dry or wet. In dry storage, fuel is not immersed in liquid for the purpose of cooling and/or shielding from radiation\*. In wet storage, SNF is placed in a pool of water.

Facilities that have either generated or stored SNF on the ORR are described below (see also DOE 1995a: PEIS, Appendix F - ORR, pp. 3.2-8 through 3.2-16). A summary of SNF storage at these locations on the ORR is provided in Table 1.1, and the locations are presented in Figure 1.2.

### **1.2.1 SNF Storage Facilities Within the Scope of this EA**

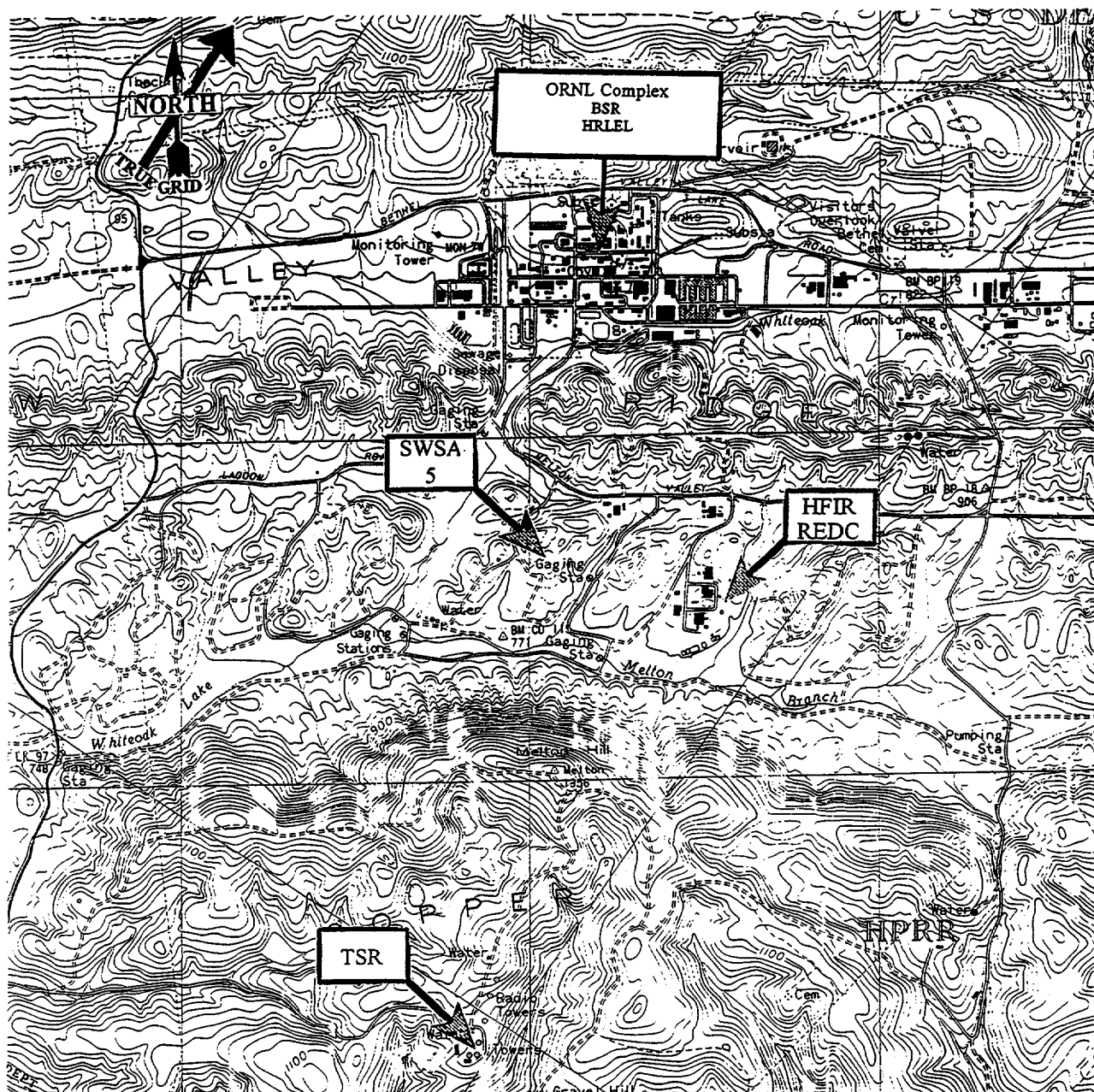
- (1) **High Flux Isotope Reactor (Building 7900)**--The 85-megawatt (MW) HFIR is an operating beryllium-reflected, light-water-cooled and moderated, flux-trap-type reactor. It is the primary or sole source of several important isotopes, and is the only facility on the ORR currently generating SNF. The reactor uses aluminum-clad fuel plates containing highly enriched uranium\*-235. Since 1985, HFIR spent fuel has been placed in wet storage\* at HFIR. As of September 1, 1995, 65 fuel assemblies are stored in the stainless steel-lined HFIR pool. Current HFIR operation yields approximately one additional fuel assembly per month. After the pool is reracked (in progress), remaining storage space for SNF would accommodate about 75 additional months (about 6 years) of HFIR operation.
- (2) **Tower Shielding Reactor (TSR, Building 7700)**--The 1-MW Tower Shielding Reactor is a light-water-moderated research reactor\* that was shut down in 1992. The reactor was placed in standby in September 1992 pending

**Table 1.1. Spent Nuclear Fuel Stored on the Oak Ridge Reservation, Oak Ridge, TN  
and Within the Scope of this EA<sup>a</sup>**

SNF Storage Facilities Facility Name	Facility Description	SNF Stored at Facility	No. of items	Units	Mass (MT) <sup>b</sup>	Volume (m <sup>3</sup> )	Heavy Metal Mass (MTHM) <sup>b</sup>
High Flux Isotope Reactor (HFIR; 7900)	Operating research reactor; wet storage	HFIR fuel <sup>c</sup>	65 <sup>d</sup>	assemblies	8.674	7.38	0.626
Tower Shielding Reactor (TSR; 7700)	Reactor shut down in 1992; wet storage	TSR fuel <sup>b</sup>	1	assembly	0.182	0.1	0.009
Bulk Shielding Reactor (BSR; 3010)	Reactor shut down in 1991; wet storage	BSR & ORRR fuel <sup>b</sup>	73	elements	0.2367	0.39	0.059
High-Rad Level Examination Laboratory (HRLLEL, 3525)	Hot cell facility*; dry storage*	Misc. fuel samples	1	unit	0.001	0.1	0.0001
Radiological Engineering Development Center (REDC, 7920)	Hot cell facility; dry storage	Dresden-1 fuels Mark-42	2 18	cans cans	0.0057 0.99	0.1 0.0053	0.004 0.001
Solid Waste* Area 5 North: -- Facility 7823A	Dry storage facility	Misc. fuel	9	cans	0.175	1.2	0.0019
-- Facility 7827	Dry storage facility	Al-, stainless steel-, & zircalloy-clad Peach Bottom fuels <sup>e</sup>	67	cans	2.009	3.68	0.156
-- Facility 7829	Dry storage facility	Peach Bottom <sup>d</sup> fuels	14	cans	0.552	1.15	0.0161
<b>TOTAL</b>					<b>11.926</b>	<b>14.08</b>	<b>0.872</b>

\*See Glossary (Appendix A)

- a. Sources: DOE 1995, Appendix F; Klein 1995.
- b. MT = Metric Tons; MTHM = Metric Tons of Heavy Metal.
- c. Aluminum-clad fuel.
- d. As of September 1, 1995.
- e. Peach Bottom Nuclear Plant fuels are from research and development.



BSR	Bulk Shielding Reactor
HRLEL	High Radiation-Level Examination Lab
HFIR	High Flux Isotope Reactor
REDC	Radiochemical Engineering Development Center
TSR	Tower Shielding Reactor
SWSA 5	Solid Waste Storage Area 5

PTRL-DRWG-2-200901

**Figure 1.2. Oak Ridge Reservation Spent Nuclear Fuel Storage Sites Addressed in this Environmental Assessment.**

- DOE direction to prepare the facility for shutdown. The existing spent fuel assembly remains in the reactor. There are no current plans for resuming operations.
- (3) **Bulk Shielding Reactor (BSR, Building 3010)**--The 2-MW Bulk Shielding Reactor is an open-pool, light-water-moderated and -reflected training and research reactor. This reactor was built in 1951 and shut down in 1991; there are no plans for resumption of operations at this time. There are 41 elements from the BSR and 32 elements from the Oak Ridge Research Reactor (ORRR) in wet storage in the BSR pool, which has an epoxy/fiberglass liner.
- (4) **High Radiation\*-Level Examination Laboratory (HRLEL, Building 3525)**--This two-story brick structure was built in 1963 and contains hot cells\*. The facility mission has been disassembly and examination of irradiated fuel and components. Building 3525 hot cells contain research reactor fuel in the form of fuel samples and targets\*. These facilities are designed to handle, examine, and provide interim storage of SNF. All operations are designed to be performed in a dry environment.
- (5) **Radiochemical Engineering Development Center (REDC, Building 7920)**--This building is a multipurpose hot cell facility with equipment, shielding, and containment provisions to safely process and store significant quantities of targets from the HFIR. Building 7920 contains research reactor fuel in the form of fuel samples in dry storage\*.
- (6-8) **Solid Waste\* Storage Area 5 (SWSA 5, Dry Storage Facilities 7823A, 7827, and 7829)**--The storage configurations for these shielded, retrievable storage facilities are dry storage positioned below grade in SWSA 5 North. They vary from 20 to 76 cm (8 to 30 in.) in diameter and from 3 to 4.6 m (10 to 15 ft) in depth. The stainless-steel storage tubes were placed on a concrete pad and held in place by concrete slabs and are surrounded by soil or concrete. Spent fuel and other materials were placed in the storage positions beginning in 1972.



### 1.2.2 SNF Storage Facilities Beyond the Scope of this EA

A summary of SNF stored on the ORR, but not within the scope of this EA is presented in Table 1.2.

- (1) **Molten Salt Reactor Experiment (MSRE, Building 7503)**--The MSRE operated from June 1965 to December 1969. The purpose of the reactor was to test the practicality of a molten-salt reactor concept for central power station applications. Following reactor shutdown, the fuel and flush salts were drained to critically safe storage tanks and isolated. The SNF inventory at the MSRE consists of approximately 4650 kg (about 9500 lb) of fuel salt mixture in dry storage. The uranium salt is predominantly uranium-233 [31 kg (68 lb)] with lesser amounts of uranium-234, uranium-235, uranium-238, and plutonium-239. The MSRE is part of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA\*) site and is awaiting decommissioning\* and decontamination\*. Future actions at the MSRE, including management of the MSRE SNF, will be determined through the CERCLA process.
- (2) **SWSA 6 - KEMA Suspension Test Reactor Fuel**--The KEMA Suspension Test Reactor (located in the Netherlands) was an experimental fluidized bed test reactor. One can of SNF was placed in SWSA 6 for storage. As with the MSRE, future actions at the KEMA SWSA 6 site will be determined through the CERCLA process. SNF stored at this site is, therefore, not within the scope of this EA.
- (3) **High-Level Radiochemical Laboratory (Building 4501)**--Constructed in 1951, this facility contains centrally located hot cells supported by various laboratories capable of handling radioactive materials. It no longer contains SNF, and the facility is, therefore, not in the scope of the EA.
- (4) **Oak Ridge Research Reactor (ORRR, Building 3042)**--The ORRR was shut down permanently in 1987 and has been defueled. Most of the fuel was transported to the SRS, but some of the fuel was transferred to the BSR pool (see Item 3, Section 1.2.1). No SNF is currently stored at the ORRR, and the facility is therefore not in the scope of this EA.

**Table 1.2. Spent Nuclear Fuel on the Oak Ridge Reservation, Oak Ridge, TN**  
**Facilities Beyond the Scope of this EA <sup>a</sup>**

SNF Storage Facilities Facility Name	Facility Description	SNF Stored at Facility	No. of Items	Units	Mass (MT) <sup>b</sup>	Volume (m <sup>3</sup> )	Heavy Metal Mass (MTHM) <sup>b</sup>
Molten Salt Reactor Experiment <sup>c</sup> (MSRE; 7503) <sup>c</sup>	Reactor closed in 1969; dry storage*	MSRE fuel	1	core*	8.940	1.81	0.038
Solid Waste Storage Area 6 --KEMA Suspension Test Reactor 5	Disposal facility	KEMA Suspension Test Reactor fuel	1	pipe	0.132	0.01	0.023
Bldg. 4501--High-Level Radiochemical Laboratory	Hot cell facility*; dry storage	None (misc. fuels canned and moved to dry storage in Facility 7827)	0	pin	0	0	0.00
Oak Ridge Research Reactor (ORRR; 3042)	Reactor shut down in 1987 and defueled	None (moved to SRS or BSR pool)	0		0	0	0.00

\*See Glossary (Appendix A)

- a. Sources: DOE 1995, Appendix F; Klein 1995.
- b. MT = Metric Tons; MTHM = Metric Tons of Heavy Metal.
- c. Covered in CERCLA actions.

### 1.3 Scope of Environmental Assessment

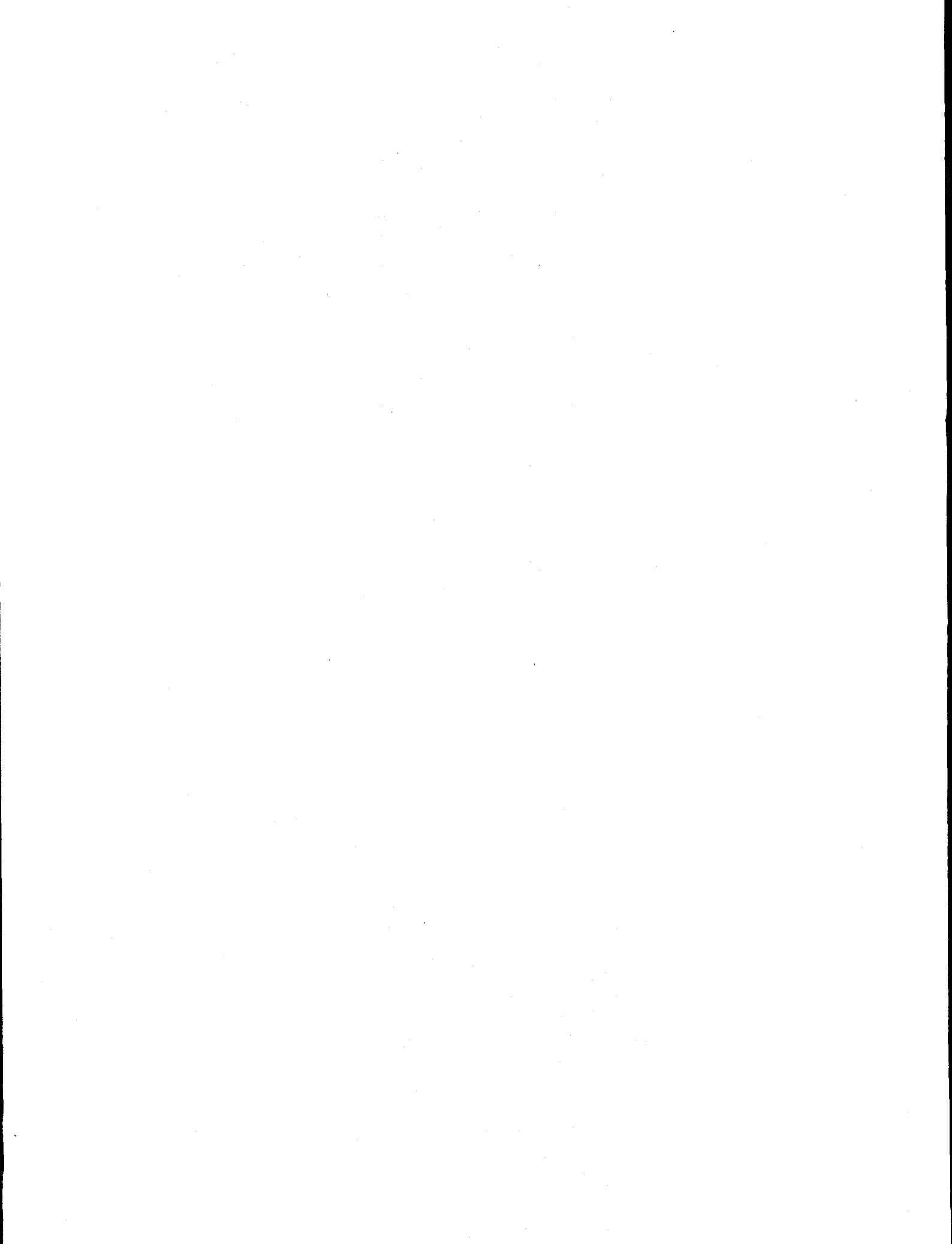
This EA evaluates the environmental impacts on the ORR of implementing DOE's ROD on the SNF Management PEIS. The EA also evaluates the no action alternative.

Implementation of the ROD would require the following actions:

- Preparation of SNF on the ORR for transportation to the SRS and INEL-- This would include retrieval\* of the fuel, movement to a handling facility, sorting, characterizing, possible repackaging, and placement into an off-site shipping cask. These procedures would differ at each storage facility. Potential impacts may affect worker health and safety, public health, and transportation. No ecological impacts are anticipated because existing facilities would be used.
- Shipment of SNF to SRS and INEL--Potential impacts of shipment of these fuels to SRS and INEL are reported in the PEIS (DOE 1995a, Appendix I, p. I-105); therefore, off-site shipment need not be discussed in this EA.
- Construction and operation of a dry cask storage facility--The storage facility would be designed to store SNF generated from the HFIR in the future (at a rate of approximately one fuel assembly per month for 40 years). This new facility would only be constructed if SNF could not be shipped to the SRS or INEL and storage space was predicted to be filled less than a year after the dry cask storage facility would be ready for operation. Construction could affect terrestrial ecology, air quality, surface water runoff, cultural resources, and socioeconomics.
- Operation of the dry cask storage facility--Worker health and safety, public health, and on-site transportation could be affected.

Safety documentation and criticality safety limits exist for each of the facilities where SNF is stored or managed. Impacts from credible accidents will be evaluated in this EA.

This EA will result in either a finding of no significant impact (FONSI), or the preparation of an environmental impact statement (EIS) if the potential for significant impacts is indicated.



## **2. ALTERNATIVES, INCLUDING PROPOSED ACTION**

### **2.1 No Action**

If no action is taken, current SNF management practices on the ORR would continue. No SNF would be shipped from the ORR to off-site storage, and the dry storage facility would not be built. Lack of SNF storage space would require shutdown of the HFIR by 2001. Shutdown of the HFIR would eliminate:

- the national capacity to provide transuranic isotopes,
- the only western-world source of some medical isotopes, and
- the nationally and internationally important capability for research and development in the structure of materials and radiation effects on materials (DOE 1995a, Appendix F, p. 3.3-2).

No action would also result in continued on-site storage of SNF and maintenance of storage facilities to meet health and safety requirements. Current impacts from these facilities are part of the description of the baseline environment (Chapter 3).

### **2.2 Proposed Action (Preferred Alternative)**

The proposed action is the management of SNF on the DOE ORR to implement the preferred alternative of regional storage. To implement the ROD, ORR SNF would be retrieved from storage; transferred by truck to a hot-cell facility, if segregation by fuel type and/or repackaging is required; loaded into transport casks/containers that meet regulatory requirements; and shipped via truck to off-site storage at either the SRS or the INEL. The proposed action would also include construction and operation of a dry cask SNF storage facility on the ORR to help ensure continued HFIR reactor operations. Construction and operation of the dry cask storage facility would only occur if there was interruption of off-site shipments of HFIR SNF, resulting in inadequate SNF storage. Transport from Oak Ridge to off-site storage and impacts at off-site storage locations were evaluated in the PEIS and, therefore, are not addressed in this EA.

#### **2.2.1 Dry Cask Storage Facility Construction**

A dry cask storage facility is proposed to house SNF currently stored in eight locations on the ORR (Table 1.1). This is consistent with the national SNF program, which encourages dry

cask storage for new interim SNF storage facilities (DOE 1994a). The storage facility would also be designed to store SNF generated from the HFIR in the future (at a rate of approximately one fuel assembly per month for 40 years). This new facility would only be constructed if SNF could not be shipped to the SRS or INEL and existing on-site storage space would not be adequate to allow continued operation of the HFIR. The construction schedule of the storage facility would ensure that the facility would be available for operation less than a year before the existing storage space for HFIR SNF was filled. The facility would be designed for 40 years of operation and to meet DOE and/or the Nuclear Regulatory Commission (NRC) regulations. If necessary, the proposed facility could also store other materials classified as SNF from the ORR (e.g., KEMA and MSRE fuels), which are currently not part of this proposed action (Section 4.5.10).

Dry storage systems are mature technologies that are being applied at U. S. commercial and foreign nuclear electric generating systems (DOE 1995a). In a dry storage system, cooling of SNF is accomplished by heat transfer to the inner wall of the storage system, with eventual heat rejection through vents to the air surrounding the storage system. A modular dry cask system is preferred at Oak Ridge. A modular system would easily accommodate the relatively small quantities of existing SNF at the ORR (Appendix B). Incremental additions can be readily made as needed to accommodate future SNF being generated by the HFIR. A number of large storage casks are available in the DOE system and in commercial applications. The concrete and steel casks are top- or end-loading (DOE 1995a).

One preferred and one alternate location for the dry cask storage facility are shown in Figure 2.1. A site selection committee chose these two sites out of seven alternative sites on the ORR, based on health and safety, functional, environmental, and programmatic criteria (Appendix B). Either site would consist of a maximum of 1.2 ha (3 ac) and would be cleared and graded for construction.

The facility would be a reinforced concrete pad within a double security fence. A gravel area would be provided for cask loading and unloading. A concrete pad of about 20 m  $\times$  50 m (70 ft  $\times$  160 ft) would serve as a storage area for concrete cylinders approximately 7 m (25 ft) tall with about a 3 m (10 ft) diameter. A hollow center in the cylinder would house the SNF. The SNF would be packaged in different ways and could include stackable baskets, borated aluminum pipes, canisters, or other storage devices and configurations (Lockheed Martin 1995a). Design specifications of the dry cask storage facility ensure that the area is 1.8 m (6 ft) above the seasonal high level of the groundwater table and the 100-year floodplain\*.

The facility would be constructed in a modular fashion; storage space would be added as needed. Construction would be completed before the reracked HFIR pool is full. If the

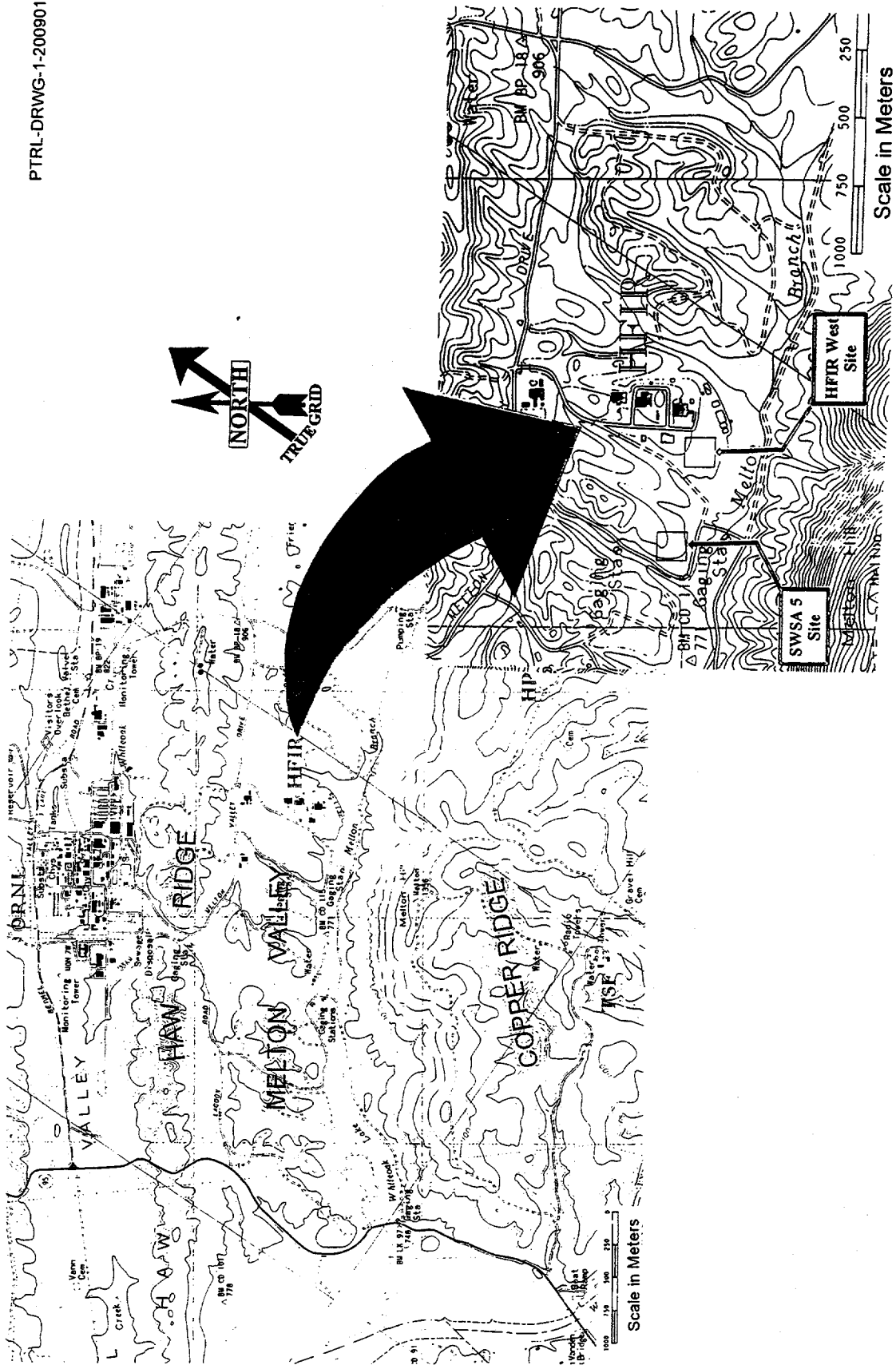


Figure 2.1. Proposed Locations for the Dry Cask Storage Facility: SWSA 5 and West of HFIR

maximum facility size were constructed at one time, construction would occur during about a two-year period. Approximately 10 construction workers would be needed for construction activities.

## **2.2.2 SNF Management Operations**

Operational activities associated with the proposed action would include:

- segregation of SNF by fuel type and repackaging, if necessary,
- on-site transportation,
- storage in the dry cask storage facility, and
- loading and transloading\* for off-site shipment.

Each of these activities are described in this section.

### **2.2.2.1 Segregation and Repackaging**

Before off-site transport, some SNF would need to be repackaged to meet the acceptance criteria of the receiving site. Repackaging involves unpacking the SNF, segregating it by fuel type, and re-packaging it for shipment. Aluminum-clad fuel, excluding that from the BSR and HFIR, would be placed into aluminum cans to meet SRS SNF acceptance criteria. Non-aluminum-clad SNF would be placed in stainless steel cans to meet INEL acceptance criteria. Most SNF has been previously characterized. If required, additional characterization would involve visual examination, verification that the package contents meet the acceptance criteria, and possibly chemical analysis of samples at an on-site laboratory.

Segregation and repackaging, if needed, could take place at six locations (see Table 2.1). These locations contain hot cells that are used for this type of operation, particularly if the fuel is not intact. It is expected that most repackaging would be conducted in the hot cells in Building 3525.

### **2.2.2.2 On-Site Transport**

The movement of SNF on the ORR would depend on the type of SNF, its storage location, and preparation required for each shipment. For example, some SNF may need to be transported to a repackaging facility prior to storage or off-site shipment. Also, some SNF



**Table 2.1. Summary of Handling Activities for Spent Nuclear Fuel on the Oak Ridge Reservation.**

Facility Name	No. Of Items of SNF	Units	Possible Repackaging Locations	Possible Transloading Locations	Maximum No. of Shipments	Maximum Distance per Shipment km (mi)	Total Distance km (mi)
HFIR (7900)	65	elements	Not required	HFIR pool	545 <sup>a</sup>	3.8 (2.4)	2071 (1287)
TSR (7700)	1	assembly	TSR, Bldg. 7920, HFIR, Bldg. 3047	TSR, Bldg. 7920, HFIR, Bldg. 3047	23	20.6 (12.8)	474 (294)
BSR (3010)	73	elements	Not required	HFIR, Bldg. 3047, ORRR (Bldg. 3042)	73	7.0 (4.3)	511 (318)
HRLEL (3525)	1	unit	Bldg. 3525, Bldg. 3019	SWSA 5, Bldg. 3047, Bldg.7920, Bldg.3042	1	6.9 (4.3)	6.9 (4.3)
REDC (7920)	20	cans	Bldg. 3525, Bldg. 3019	SWSA 5, Bldg. 3047, Bldg.7920, Bldg.3042	20	9.4 (5.8)	188 (117)
SWSA 5 North: -- Facility 7823A	9	cans	Bldg. 3525, Bldg. 3019	SWSA 5, Bldg. 3047, Bldg.7920, Bldg.3042	90	8.4 (5.2)	756 (470)
-- Facility 7827	67	cans					
-- Facility 7829	14	cans					
TOTAL							4007 (2490)
Source: DOE 1995a, Appendix F; Klein 1995; Socolof et al. 1995.							

a. 545 shipments = 65 currently stored fuel elements + 480 fuel elements generated at 1/month for the next 40 years.

might need to be placed in interim storage at the proposed dry cask storage facility prior to off-site shipment. On-site transportation casks are made of various steel alloys.

Once off-site transport is imminent, the SNF would be placed into an off-site shipping cask. For example, SNF in SWSA 5 could be transloaded at SWSA 5, Building 3047, or Building 7920. TSR fuel could be transloaded at TSR, HFIR Building 7290, or Building 3047. All the location options are presented in Table 2.1, which lists the expected locations for repacking and transloading SNF, the maximum possible on-site shipment distance for each SNF storage facility, and number of anticipated shipments. On-site transport would involve a crew of about 5 workers.

Different on-site routes would be used to transport SNF from each storage location. The upper-bound cases of SNF on-site transport would consider the maximum number of trips along the longest distances between repackaging, storage, and transloading locations. For example, from Table 2.1, the bounding case for SWSA 5 fuel (in Facilities 7823A, 7827, and 7829) would be transporting SNF 1.9 km (1.2 mi) to Building 3525 for repackaging; 3.0 km (1.9 mi) to the dry cask storage facility for interim storage; and then 3.5 km (2.1 mi) to Building 3047 for transloading to an off-site shipping cask for shipment off-site (e.g., SRS). The total distance equals 8.4 km (5.2 mi) per shipment. The number of on-site shipments is also presented in Table 2.1, which can be used to calculate a total distance for SNF from each current storage location.

#### **2.2.2.3 Dry Cask Storage Facility Operation**

The dry cask storage facility would house storage casks and would not require constant attendance by operating personnel. The facility would only be occupied during transfers of SNF to the facility. Radiation exposure of operations personnel in the storage area must comply with 10 CFR 20 ("Standards for Protection Against Radiation") and 40 CFR 191 ("Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-level, and Transuranic Radiation Wastes"). To meet the DOE Order 5480.11 as-low-as-reasonably achievable (ALARA)\* goals, the maximum dose rate to operations personnel from the highest-activity SNF cannot exceed 2.5 mrem/h. A radiological alarm system would be provided in accessible work areas and a criticality monitoring system would be provided.

### **3. EXISTING ENVIRONMENT**

#### **3.1 Natural Features**

This section briefly describes the natural features of the ORR. It then provides a description of the natural features of Melton Valley. Finally, it provides details on the proposed and alternative sites for the dry cask storage facility.

##### **3.1.1 Oak Ridge Reservation**

The DOE-owned ORR is located in Oak Ridge, Tennessee, approximately 25 miles west of Knoxville. The ORR consists of 14,245 ha (35,200 ac) in a rural area bounded by the Clinch River on its eastern, southern, and western borders (Figure 1.1). It is topographically characterized by valleys and ridges.

Abundant precipitation is the driving mechanism of the hydrologic system. The surface water hydrology\* on the ORR is characterized by a small network of streams that are tributaries to the Clinch River. The Clinch River is the primary source of water for the ORR and the City of Oak Ridge. The water intake is upstream of the ORR.

Groundwater in the area supplies water to rural residents, industries, and public water utilities as well as sustaining base flow in streams and rivers. The properties of groundwater on the ORR are highly dependent on the geology of the area. The geologic units through and upon which the groundwater passes affect its flow and quality (Chance 1991).

There are wetland areas within ORR consisting mostly of small, swampy areas generally less than 9 m (30 ft) wide located within and around major drainage basins (Chance 1991). Wetlands are found in stream drainages and along Melton Hill and Watts Bar Reservoir (Cunningham and Pounds 1991).

The dominant plant association on ORR is oak-hickory forest that is most widely distributed on ridges and dry slopes (Kitchings and Mann 1976). Southern yellow pines are also common, especially in areas that were cleared and farmed before 1942. The most common understory trees throughout ORR are red maple, blackgum, and sourwood. ORR provides habitat for a large number of animal species, including about 60 reptilian and amphibian species, more than 152 species of birds (including 32 species of waterfowl, wading birds, and shorebirds), and about 40 mammalian species. Habitats supporting the greatest number of species are those dominated by hardwood forests and wetlands.

Suitable habitat for the federally listed threatened bald eagle exists on Melton Hill Lake, which borders the ORR on the south, and eagles have recently been observed there.

Also, a federally listed, endangered gray bat was recently found dead at the Y-12 plant. No other federally listed threatened or endangered plant or animal species are known to occur on the ORR except for threatened peregrine falcons which are uncommon visitors.

Of the animals listed by the State of Tennessee as endangered or threatened (Hatcher 1994a), only the threatened osprey is known to occur regularly on the ORR. Other state endangered or threatened species of wildlife may occasionally visit the ORR, but suitable breeding habitat is not present (Kroodsma 1987). A number of other animals listed by the state as being in need of management are found on the ORR. These species are listed in Appendix C.

A number of plant species that are found on the ORR are candidates for federal listing or are listed by the State of Tennessee as endangered, threatened, or of special concern. These species are listed in Appendix C.

A minimum of ten extensive archaeological reconnaissance surveys have been conducted on the ORR with many documented by DOE (DOE 1983). Various archaeological sites exist on the ORR, including Freels Cabin, an historic site, and the Jones House site. Freels Cabin is listed in the *National Register of Historic Places* pursuant to 36 CFR 60.4(d) and the Jones House is considered eligible for inclusion in the list.

### **3.1.2 Melton Valley**

Melton Valley (Figure 2.1) is the area within the ORR where the dry cask storage facility is proposed to be located. Several designated waste management\* areas, including solid waste storage areas are located there. The following sections describe natural features of Melton Valley.

#### **3.1.2.1 Soils**

The only prime agricultural soil in the vicinity of Melton Valley is Pope soil. This bottomland soil type occurs in areas less than 30 m (100 ft) wide adjacent to some stream drainages. Because of the small size of these areas, they would not be valuable for agricultural use.

#### **3.1.2.2 Groundwater Hydrology**

Groundwater movement in the Melton Valley Conasauga Group of rocks has been extensively investigated (McCold et al. 1992; Rothschild et al. 1984). The current

understanding of Melton Valley is that this area is a groundwater discharge area; recharge of the groundwater in the Conasauga Group occurs at Haw Ridge (Figure 2.1). The primary direction of groundwater movement in the Conasauga is parallel to the strike (N55°E). This observation suggests that the greatest permeability in unweathered bedrock is associated with partings between beds and perhaps with residue of more soluble units.

### **3.1.2.3 Surface Water**

The majority of Melton Valley is drained in a southwesterly direction by the White Oak Creek watershed which covers 16.4 km<sup>2</sup> (6.37 mi<sup>2</sup>) (Figure 3.1). Melton Branch, the primary tributary of White Oak Creek, joins the main stem at White Oak Creek Mile 1.55 and has a drainage area of 3.83 km<sup>2</sup> (1.48 mi<sup>2</sup>) above the confluence. Surface runoff in Melton Valley discharges directly into Melton Branch via several small tributaries. Rapid runoff is promoted by the clayey, poorly drained, relatively impervious soils characteristic of East Tennessee. Approximately 30% (up to 85% on steep slopes) of the incident rain falling on unpaved, grassy surfaces flows overland into Melton Branch and associated tributaries (van der Leeden et al. 1991).

Liquid releases from the Oak Ridge National Laboratory (ORNL) enter the White Oak Creek watershed. Water quality, including radiological and non-radiological constituents, of White Oak Creek and Melton Branch is monitored just upstream of their confluence at locations designated as NPDES permitted discharge points. White Oak Creek was dammed to form White Oak Lake (Figure 3.1). White Oak Lake serves as a settling basin for radionuclides\* and chemical pollutants that have been discharged in the White Oak Creek watershed through the years. The White Oak Creek Embayment sediment control structure prevents further sediment transport out of White Oak Creek.

Melton Branch and White Oak Creek do not serve as municipal or industrial water supplies. They are not suitable for contact recreation, and fishing is prohibited. The entire White Oak Creek watershed, including Melton Branch, is located within the confines of ORR. Access to this DOE-fenced area is restricted and not open to the public.

### **3.1.2.4 Aquatic Ecology**

Except during the summer, there is sufficient flow in Melton Branch to allow the establishment of a relatively diverse benthic macroinvertebrate community and a small fish community (Ryon 1988; Smith 1988a, 1992). The most recent fish surveys in lower Melton Branch [0.6 km (0.4 miles) above its confluence with White Oak Creek] contained creek

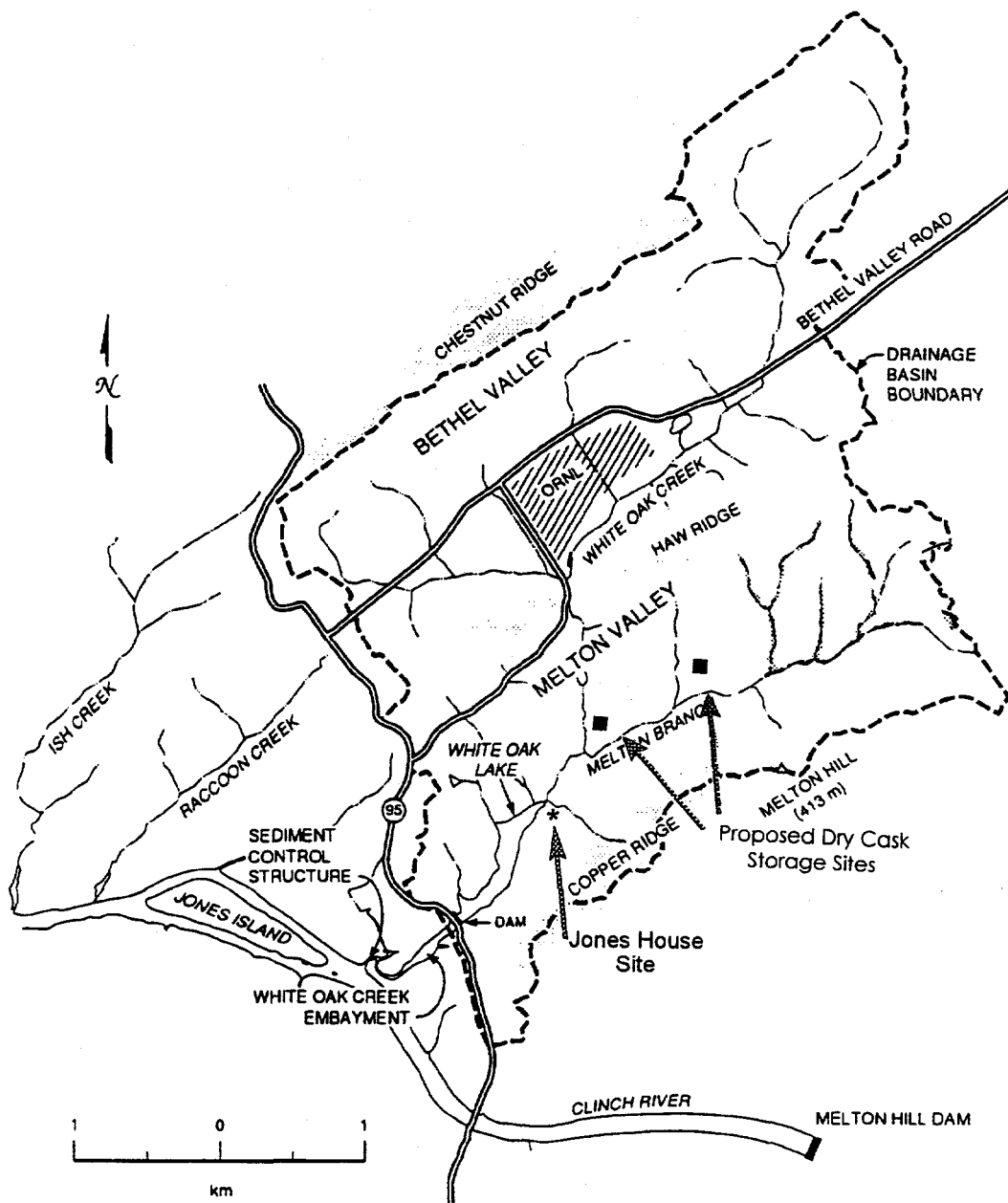


Figure 3.1. White Oak Creek Watershed

chubs, blacknose dace, and redbreast sunfish (Loar et al. 1991). The densities and standing crops of fish in lower Melton Branch are comparable with values from other small headwater streams in the area. Samples in uppermost Melton Branch [Melton Branch km 1.4 and 2.1 (miles 0.86 and 1.30)] found only creek chubs and blacknose dace. A weir on Melton Branch upstream of km 2.1 (mile 1.3) serves as a barrier to movement of fish further upstream. Most of the benthic macroinvertebrate taxa sampled in Melton Branch are typical of either moderately distributed or relatively undisturbed streams on ORR (Smith 1988a, 1988b, Smith and Ryon 1989). There are no federally listed or proposed endangered or threatened aquatic species on the ORR. However, the Tennessee dace, a fish listed by the State as being in need of management, is found on the ORR.

### **3.1.2.5 Terrestrial Ecology/Land Use**

Melton Valley contains a variety of ecosystems from those that are greatly disturbed to some that are relatively undisturbed. Where the valley has been heavily disturbed, the current vegetation cover is primarily grass and weeds. Vegetation of the rest of the valley is typical of forests found throughout ORR (Cunningham et al. 1988). Relatively undisturbed second-growth forests of mixed oak-hickory occur on the ridges and dry slopes, while pine and pine-hardwood on the lower slopes and valleys are typical of abandoned, eroded farmland on the ORR.

Wildlife in Melton Valley is also typical of ORR (Kroodsma 1985). Wildlife representative of that which occurs in the valley includes the rat snake, black racer, red-eyed vireo, scarlet tanager, red-tailed and red-shouldered hawks, yellow-billed cuckoo, coyote, deer mouse, gray squirrel, flying squirrel, and white-tailed deer.

No federally listed or proposed endangered or threatened plant or animal species or designated or proposed critical habitats\* are known to regularly occur in Melton Valley, but the threatened bald eagle and the threatened peregrine falcon are uncommon visitors to the vicinity (Appendix C).

While some state listed endangered or threatened species of wildlife (Hatcher 1994a) may occasionally visit the vicinity, no suitable breeding habitat is present, and no such animal species are known to regularly occur there (Kroodsma 1987). Of species listed by the state as in need of management (Hatcher 1994b), the southeastern shrew, the Cooper's hawk, the sharp-shinned hawk, and the yellow-bellied sapsucker are known to be present in Melton Valley. Other animal species listed by the state as in need of management that may be found in wetlands in Melton Valley are the northern harrier, the little blue heron, the great egret, and the snowy egret (Mitchell 1995).

Some plants listed by the state as threatened or endangered are known to occur in

Melton Valley. Pink lady's slipper, a species endangered in Tennessee due to commercial exploitation, and ginseng, a species listed by the state as threatened, grow in the valley. A small population of the state-listed threatened Canada lily grows in one wetland area about 200 meters (656 ft) from the preferred site. River bulrush and lesser lady's tresses, species listed by the state as of special concern, have also been reported from Melton Valley (Socolof 1995).

A wetlands survey has been done for most of Melton Valley. Forested, scrub-shrub, and emergent wetlands in seep and spring areas in the Melton Branch, White Oak Creek tributary bottom lands. Wetlands range in size from approximately 0.0031 ha (0.0077 ac) to almost 10 ha (27.4 ac).

### **3.1.2.6 Historic and Archaeological Resources**

There is one known historical site in Melton Valley, the Jones House (DuVall and Associates 1992) (Figure 3.1).

### **3.1.3 Dry Cask Facility Sites**

The two proposed sites, a preferred site and an alternate site (Figure 2.1), are described below.

#### **3.1.3.1 Preferred Site**

The preferred site (HFIR west site) is located to the southwest of the HFIR (Figure 2.1). Much of the northern half of the site has been cleared and is used as a 45-50 m (148-164 ft) wide utility line corridor which has been reseeded with grasses (Rosensteel 1995). The remainder of the site is a second-growth forest dominated by Virginia pine and is typical in vegetation and wildlife of abandoned farmland on ORR.

The site is bounded on the south by a light-use, graveled dead-end road. On the upslope side of the road are two ponded seeps that are classified as wetlands (Rosensteel 1995). The total area of these two ponded seeps is approximately 0.02 hectares (<0.05 ac). Water insects, tadpoles, and frogs were observed in and around the ponds. The primary ecological function of these particular ponds is probably as habitat for aquatic and semi-aquatic species.

Twenty-one soil borings were drilled on and near the site in 1991 as part of a geotechnical study for a proposed HFIR maintenance facility (ERCE 1991). This exploratory



program revealed that subsurface\* materials at the site consist of a thin veneer of topsoil, underlain by fill, residual soil/saprolite, and shale bedrock. No analysis was performed for radioactive contamination\*. Depths to groundwater ranged from 3.9 to 7.0 m (12.7 to 22.9 ft) below ground surface. No historical or archaeological sites were identified on the preferred site.

### **3.1.3.2 Alternative Site**

The alternative location (SWSA 5 site) is southeast of SWSA 5 (Figure 2.1). The site is dominated by Virginia pine, tulip poplar, sweetgum, oak saplings, flowering dogwood, Japanese honeysuckle, and microstegium. A survey of the site for wetlands found no springs, seeps, streams, or wetlands (Rosensteel 1995).

Although no geological or groundwater investigations have been performed on this site, conditions are expected to be similar to undisturbed areas in the southeastern portion of SWSA 5 (BNI 1944). Based on SWSA 5 investigations, soils at the alternative location should be similar to those at the preferred location.

Based on water level measurements in wells in the southeastern portion of SWSA 5, groundwater at the alternative location should be encountered from 1 to 6 m (3 to 20 ft) below ground surface. Groundwater depths should be greater in the topographically higher portions of the site and during the dry part of the year (i.e., from April through November).

No historical or archaeological sites were identified on the alternative site (DuVall and Associates 1992).

## **3.2 Background Radiation Dose**

### **3.2.1 Public Radiation Dose**

The average annual radiological effective dose equivalent (EDE)\* to an individual residing in the United States is approximately 3.6 mSv/yr (360 mrem/yr) (NCRP 1987). External radiation exposure rates from background sources have been measured in Tennessee. The measured rates are equivalent to an average EDE of 0.42 mSv/yr (42 mrem/yr), ranging between 0.19 and 0.72 mSv/yr (19 and 72 mrem/yr) (Myrick et al. 1981). A typical annual EDE to the maximally exposed individual due to external radiation from ORR is about 0.01 mSv (1 mrem), which is about 2.4% of the natural external radiation background EDE to an average Tennessee resident. Airborne emission from ORR are expected to contribute to internal (e.g., inhalation) and external off-site radiation exposures.

Table 3.1 shows the 1993 EDEs from ORR and ORNL airborne emissions to the hypothetically maximally exposed individual and the collective population within 80 km (50 miles). The collective population EDE from ORR airborne emissions, of about 0.26 person-Sv (26 person-rem), represents approximately 0.01% of the  $2.6 \times 10^3$  person-Sv ( $2.6 \times 10^5$  person-rem) the surrounding population would receive from all sources of natural radiation (i.e., radon and other natural sources) (Kornegay et al. 1994b).

Table 3.1 also shows the EDE from all exposure pathways from gaseous and liquid releases to the maximally exposed individual. DOE Order 5400.5, "Radiation Protection of the Public and the Environment," limits the EDE that an off-site individual may receive from all exposure pathways and all radionuclides released from ORR during 1 year to no more than 1.0 mSv (100 mrem). The 1993 exposures are 3% of this DOE Order limit.

### 3.2.2 Occupational Radiation Dose

The annual average EDE to radiation workers\* in the United States (e.g., medicine, industry, nuclear fuel\* cycle, government) is approximately 2.2 mSv/yr (220 mrem/yr) (NCRP 1987). In 1989, a total of 925 workers at low-level waste\* disposal facilities were monitored, 119 of whom had measurable exposures. The average dose to those with measurable exposures was 3 mSv (300 mrem). The individual exposures ranged from nonmeasurable to approximately 0.02 Sv (2 rem) (NRC 1992).

At ORNL the average dose to 57 waste operations radiation workers in 1991 was 0.40-mSv (40 mrem). The maximum dose equivalent received by an individual worker was 1.40 mSv (140 mrem) and the minimum was 0 mSv (0 mrem) (Setaro 1992).

DOE Order 5480.11, "Radiation Protection for Occupational Workers," establishes radiation protection standards and program requirements for DOE and DOE contractor operations with respect to the protection of workers from ionizing radiation. DOE's limiting value for a worker's radiation dose is 50 mSv/yr (5 rem/yr) (annual EDE) from both internal and external sources received in any year for the whole body. The Energy Systems Radiation Control Manual (DOE/EH-0256T) sets an Energy Systems administrative control level of 15 mSv (1.5 rem) per year for all activities. Exceeding this control level requires approval of the Laboratory Director and Energy Systems President. DOE also has a policy that requires exposures to be ALARA. ORNL's 1995 ALARA control level goal is to keep individual occupational exposures below 6.5 mSv/yr (0.65 rem/yr). Permission from an ORNL division director is required if exposure is to exceed 6.5 mSv/yr (0.65 rem/yr). The ORNL ALARA Steering Committee may approve individual exposures to exceed 6.5 mSv/yr (0.65 rem/yr)

without exceeding the Energy Systems administrative control level of 15 mSv/yr (1.5 rem/yr).

**Table 3.1 Annual Radiation Effective Dose Equivalents (EDEs) from ORR and ORNL<sup>a</sup>**

Annual EDE		
	Maximally Exposed Individual [mSv/yr (mrem/yr)]	Population Within 80 km (50 mi) <sup>b</sup> [person-Sv/yr (person-rem/yr)]
<i>All exposure pathways (internal, external) from airborne emissions</i>		
ORR	0.014 (1.4)	0.26 (26)
ORNL	0.001 (0.1)	0.06 (6)
<i>All exposure pathways (internal, external) from all releases (gaseous, liquid)</i>		
ORR	0.03 (3.0)	not available

a. Source: Kornegay et al. 1994b.

b. Approximately 880,000 persons.



## **4. ENVIRONMENTAL IMPACTS**

### **4.1 Construction of Dry Cask Storage Facility**

#### **4.1.1 Preferred Site**

##### **4.1.1.1 Air Quality**

Disturbance of 3 acres would generate fugitive dust and gaseous exhaust. Emissions would be short-term, localized at the site, and sporadic. Therefore, ambient air quality away from the construction zone would not be affected.

##### **4.1.1.2 Water Resources**

Based on limited groundwater studies, the depth to the water table in the area of the preferred site ranges from approximately 3.7 to 7.0 m (13 to 23 ft) below ground surface (ECRE 1991). Therefore, cut and fill operations and groundwater suppression measures would not be necessary to ensure that the storage facility remains 1.8 m (6 ft) above the water table (design criteria).

There are no surface waters located on the preferred site. However, construction activities could result in soil erosion and subsequent sedimentation in Melton Branch or its tributaries, which are approximately 30.4 m (100 ft) from the site. Site clearing and grading would be done to minimize alteration of the existing surface water drainage pattern of the site. Also, use of sediment containment structures (such as silt fences) would minimize impacts to water quality and aquatic biota in Melton Branch.

##### **4.1.1.3 Ecological Resources**

For the dry cask storage facility, up to 1.2 ha (3 ac) of pine forest and/or low growing herbaceous plants in the power line corridor would be cleared. The total forest that would be cleared for this project is a very small fraction of the roughly 2300 ha (5600 ac) of pine forest on ORR. Even if the clearing were all taken from the pine forest, the cleared area would only be 0.05% of the pine forest on ORR. Thus, only a small amount of natural vegetation on this site would be lost with a correspondingly small amount of wildlife populations also lost. Areas disturbed during construction but not needed for the facility would be revegetated after

construction is completed with native species following Executive Order 11987, "Exotic Organisms" and DOE 5400.1/AI-1 which restrict the introduction of exotic species into natural ecosystems on federally owned land.

No federally listed, threatened, or endangered species of plants or animals or designated critical habitats are known to occur on or near the site. Also, no species listed by the state as threatened, endangered, or in need of management are known to regularly occur on the site. Therefore, none would be affected by construction.

To prevent wetlands disturbance, the facility would be sited north of the existing transmission line, and the boundaries of the small, man-made wetlands south of the transmission line would be marked with flags before construction. Because the proposed project would not involve construction activity within a wetland, consultation with the U.S. Corps of Engineers regarding a Section 404 permit is not necessary.

#### **4.1.1.4 Health and Safety**

All routine construction activities would be conducted in accordance with ORNL, Energy Systems, and DOE policy regarding protection of personnel and the environment. All activities would also be conducted in accordance with ALARA objectives. ORNL Health Physics and Industrial Hygiene personnel would monitor the site for potential soil contamination during excavation. Potential impacts from accidents are discussed in Section 4.3.1.

#### **4.1.2 Alternative Site**

##### **4.1.2.1 Air Quality**

Disturbance of 3 acres would generate fugitive dust and gaseous exhaust. Emissions would be short-term, localized at the construction site, and sporadic. Therefore, ambient air quality away from the construction zone would not be affected.

##### **4.1.2.2 Water Resources**

Based on data from groundwater level measurements in SWSA 5, which is directly to the west of the alternative site, the depth to the water table in the area of the alternative site should range from approximately 1 to 6 m (3 to 20 ft) below ground surface. Therefore, cut and fill operations and/or the installation of groundwater control measures would be required

to ensure that the storage facility remains 1.8 m (6 ft) above the water table (design criteria). There are no surface waters located at the alternative site. However, construction activities could result in soil erosion and sedimentation of White Oak Creek and Melton Branch. These streams are approximately 30.4 m (100 ft) and 61.0 m (200 ft), respectively, from the site. Site clearing and grading, along with sediment containment structures, would be used to minimize impacts to water quality and aquatic resources.

#### **4.1.2.3 Ecological Resources**

If the dry cask storage facility were built at this site, up to 1.2 ha (3 ac) of second-growth forest would be cleared. This site has more second-growth forest, than the preferred site. There are no wetlands or threatened or endangered species or species in need of special management on or near this site.

Strontium 90 titanate ( $^{90}\text{SrTiO}_3$ ) soil contamination was found in one sample plot taken on the site (see Appendix D.1). Based on the conservative cumulative impact assessment (Sects. 4.5.6 and 4.5.8), the potential exposure from soil contamination found at this location is below concern to humans and thus the risk to biota are assumed to be negligible. It is estimated that conditions that would result in a mSv/yr (100 mrem/yr) human environmental exposure would lead to dose rates to plants and animals of less than 1 mGy/day (100 mrad/day) (IAEA 1992). Irradiation of even the most sensitive species at chronic dose rates of 1 mGy/day (100 mrad/day) or less, or 10 mGy/day (1000 mrad/day) or less would not affect terrestrial animal or plant populations, respectively.

#### **4.1.2.4 Health and Safety**

Health and safety impacts are minimal and would be the same as those described for the preferred site in Section 4.1.1.4.

### **4.2 Handling and On-Site Transportation of SNF**

#### **4.2.1 Air Quality**

There will be no atmospheric emissions during handling and transport of SNF on the ORR. No emissions from the operations of the facility are expected. Therefore, there should be no impacts to air quality.

#### **4.2.2 Water Resources**

When construction of the dry cask storage facility is complete, a concrete pad would hold the concrete storage casks with a gravel area next to it for parking trucks during loading and unloading operations. The concrete pad would be sloped to collect water from the dry cask storage facility. The State of Tennessee (State) has not yet determined whether an NPDES permit would be required.

The concrete pad could increase the flow and quantity of storm water runoff because there would be less natural ground surface for infiltration and retention. A natural vegetation buffer of 30 m (98 ft) between the concrete pad and Melton Branch paved would be adequate to decrease runoff and sedimentation. This change would probably not affect the hydrology of the small wetlands south of the preferred site because they are likely the result of the road south of them which blocks downslope drainage (Rosensteel 1995).

#### **4.2.3 Ecological Resources**

Except for truck noise, operation of the dry cask storage facility would not impact vegetation, wildlife, or rare plants or animals. Noise from trucks carrying SNF to the site and equipment at the site might disturb wildlife. However, this impact would be minimal since the noise on the site would be infrequent.

#### **4.2.4 Health and Safety**

Operations would include handling, characterization, repackaging, and storing SNF. The primary health hazard during operations would be the presence of radioactive material. In general, the potential human exposure pathways for radiation exposure include external radiation, inhalation of airborne radionuclides, ingestion or direct contact with waterborne radionuclides, and ingestion of radionuclides in the food chain. Incident-free handling would be expected to result in low dose rates of external radiation exposure. At all times SNF would be contained in shielded containers to minimize personal external exposure. During transport, the SNF would be contained in shielded shipping casks; during storage, in shielded concrete storage casks; and during characterization and repackaging activities, in shielded hot cells designed for remote manipulation of radioactive material.

Impacts on human health from operations are bounded by the PEIS analysis (DOE 1995a, Volume 1, Appendix F-ORR) and, therefore, are not detailed here. The PEIS-estimated exposures to the average SNF storage facility worker of approximately 0.40



mSv/yr (40 mrem/yr). The analysis is bounding\* because the PEIS assesses a large centralized facility for storage of all DOE SNF throughout the United States. This estimated exposure rate is the same as the average dose to ORNL waste operations workers described in Section 3.2.2.

To ensure safe working conditions, all workers would be monitored to achieve, if possible, the ALARA goal of 6.5 mSv/yr (0.65 rem/yr), and the Energy Systems' administrative control level of 15 mSv/yr (1.5 rem/yr). This would ensure that exposures would not exceed DOE's annual limit of 50 mSv (5 rem). Furthermore, as stated in Section 2.2.2.3, radiation exposure of operations personnel in the dry cask storage area must comply with other radiation protection regulations. A radiological alarm system and criticality monitoring system would provide protection against radiological exposure and preclude a criticality event. This system would be designed to operate during a power failure.

The off-site population dose within an 80-km (50-mile) radius of ORR from SNF operations was estimated at 0.052 person-Sv/yr (5.2 person-rem/yr) in the PEIS. This bounding exposure level is 20% of the current dose from airborne emissions from the ORR of 0.26 person-Sv/yr (26 person-rem/yr) (Section 3.2.1).

The PEIS analysis also estimated exposures and cancer fatalities to workers and the public from incident-free transportation. This PEIS analysis is bounding because it assumed greater on-site distances [4680 km (2909 mi)] are traveled than would be for the proposed action [4007 km (2490 mi)]. The estimated on-site transportation distance and estimated number of shipments associated with each SNF facility is given in Table 4.1.

The distance traveled is conservative because it represents the maximum on-site transportation distance required for each SNF facility. The total on-site transportation distance for all shipments is the summation of the product of distances and number of trips for each SNF facility. Therefore, impacts from currently proposed SNF activities on ORR would be less than those calculated in the PEIS:  $1.36 \times 10^{-4}$  (0.000136) occupational fatal cancers and  $4.28 \times 10^{-6}$  (0.00000428) public fatal cancers (Table 4.2). To put these values in perspective, the DOE occupational limit of 50 mSv/yr (5 rem/yr) would be associated with a cancer fatality risk of  $2 \times 10^{-3}$  (0.002), and the background individual annual exposure of 3.6 mSv/yr (360 mrem/yr) to the general public would be associated with a cancer fatality risk of approximately  $2 \times 10^{-4}$  (0.0002).

**Table 4.1. On-Site Transportation Distance Estimations**

<b>Name of Facility</b>	<b>Distance Traveled per Shipment km (miles)</b>	<b>Number of Shipments</b>	<b>Total Distance km (miles)</b>
HFIR (7900)	3.8 (2.3)	545	2071 (1287)
TSR (7700)	20.6 (12.8)	23	474 (294)
BSR (3010)	7.0 (4.3)	78	511 (318)
HRLEL (3525)	6.9 (4.3)	1	7 (4)
REDC (7920)	9.4 (5.8)	20	188 (117)
SWSA 5 N	8.4 (5.2)	90	756 (470)
<b>Totals</b>		749	4007 (2490)
<b>PEIS Estimated Values</b>		480	4680 (2909)

BSR = Bulk Shielding Reactor  
 HRLEL = High Radiation-Level Examination Laboratory  
 HFIR = High Flux Isotope Reactor  
 PEIS = Programmatic Environmental Impact Statement (DOE 1995a)  
 REDC = Radiochemical Engineering Development Center  
 SWSA 5 N = Solid Waste Storage Area 5 North  
 TSR = Tower Shielding Reactor

**Table 4.2. Estimated Dose<sup>a</sup> and Latent Cancer Fatalities (LCF) from On-Site Transportation**

	Unit Cancer Risk (Person-rem <sup>b</sup> /km)	Dose (Person-rem <sup>b</sup> )	LCF/Person-rem <sup>b</sup>	LCF
<b>On-site</b>				
Occupational	$7.16 \times 10^{-5}$ (0.0000716)	$2.85 \times 10^{-1}$ (0.285)	$4 \times 10^{-4}$ (0.0004)	$1.15 \times 10^{-4}$ (0.000115)
Public	$1.83 \times 10^{-6}$ (0.00000183)	$7.3 \times 10^{-3}$ (0.0073)	$5 \times 10^{-4}$ (0.0005)	$3.67 \times 10^{-6}$ (0.00000367)
<b>PEIS<sup>c</sup> Estimate</b>				
Occupational	$7.16 \times 10^{-5}$ (0.0000716)	$3.35 \times 10^{-1}$ (0.335)	$4 \times 10^{-4}$ (0.0004)	$1.34 \times 10^{-4}$ (0.000134)
Public	$1.83 \times 10^{-6}$ (0.00000183)	$8.6 \times 10^{-1}$ (0.86)	$5 \times 10^{-4}$ (0.0005)	$4.28 \times 10^{-6}$ (0.00000428)

a. Calculated using methodology in PEIS, which assumes linear extrapolation. NAS (1990) cautions against using this methodology when dose is less than 0.1.0E-2 rem.

b. 1 rem = 10 mSv

c. PEIS = Programmatic Environmental Impact Statement ( DOE 1995a)

## **4.3 Accidents**

### **4.3.1 Construction**

Construction of the dry cask storage facility would not present any unique occupational hazards. Standard industrial accidents would be minimized through the implementation of safety codes and standards [e.g., Occupational Safety and Health Administration (OSHA) standards]. Workers would comply with the DOE Order 5480.9, "Construction Safety and Health Program," and applicable OSHA provisions. Further, to avoid exposure to liquid hazards (e.g., hydraulic fluid, lubricating oil, fuels, and ethylene glycol if construction equipment overturned), workers would be trained in implementing spill prevention, control containment, and cleanup measures.

Impacts to groundwater and/or surface water from accidental spills of hazardous construction liquids would be minimized by using rapid spill emergency response actions as described in the ORNL Spill Prevention, Control, Countermeasures, and Contingency Plan (September 1985). Thus, potential impacts on aquatic resources from runoff, sediment transport, leaks, or spills from the facility would be minimal. Any soil contaminated by a spill of hazardous liquid would be collected and disposed of at appropriate ORNL waste disposal facilities. Under the Superfund Amendments and Reauthorization Act of 1986 (SARA), Title III, industrial facilities are required to report releases of "reportable quantities" of hazardous substances [CERCLA- and Emergency Planning and Community Right-to-Know Act (EPCRA)-listed] to state and local emergency response personnel. DOE, LMES, and City of Oak Ridge would mobilize an emergency preparedness plan if a release of hazardous materials (to any environmental medium--air, surface water, groundwater, soils) occurs.

### **4.3.2 Handling and On-Site Transportation of SNF**

The PEIS analyzed several accident scenarios. The accident scenario that would result in the greatest probable risk (risk times probability) to the maximally exposed off-site individual is a fuel assembly breach. This could occur from objects falling on the assembly, cutting into the assembly, or dropping the assembly. This type of accident is expected to occur less frequently than  $1.6 \times 10^{-1}$  (0.16) per year (DOE 1995a, Volume 1, Appendix F-ORR, p. 3.5-63). The dose and associated cancer fatality risk to the highly conservative maximally exposed off-site individual for this type of accident would be  $1.2 \times 10^{-4}$  Sv ( $1.2 \times 10^{-2}$  rem) and  $6 \times 10^{-6}$  (0.000006) cancer fatality risk, respectively. The associated

probabilistic cancer fatality risk from a fuel assembly breach is  $9.6 \times 10^{-7}$  (0.00000096) (i.e., less than a one in a million chance of cancer fatality due to the accident) (DOE 1995a, Volume 1, Appendix F-ORR, p. 3.5-57 and -59).

The accident scenario that would result in the greatest probable risk to workers is a dropped fuel cask. This scenario involves dropping and overturning a fuel cask in an existing storage pool (e.g., the HFIR pool). The probability of this accident is estimated to be less than  $1 \times 10^{-4}$  per year (DOE 1995a, Volume 1, Appendix F-ORR, p. 3.5-63). The dose and associated cancer fatality risk to a worker for a dropped fuel cask was found to be 0.047 Sv (4.7 rem) and  $1.9 \times 10^{-3}$  (0.0019) cancer fatality risk, respectively. The associated probabilistic cancer fatality risk from a dropped fuel cask is  $1.9 \times 10^{-7}$  (0.00000019) (i.e., about a two in ten million chance of dying of cancer due to the accident) (DOE 1995a, Volume 1, Appendix F-ORR, p. 3.5-57 and -59).

To put these values in perspective, the background individual annual exposure of 3.6 mSv/yr (360 mrem/yr) to the general public would be associated with a cancer fatality risk of approximately  $2 \times 10^{-4}$  (0.0002).

#### **4.4 Socioeconomics and Environmental Justice**

The small workforce necessary for construction would be drawn from the ORR labor pool. All other activities would be done by the existing ORNL workforce. There would be no influx of workers associated with the proposed action.

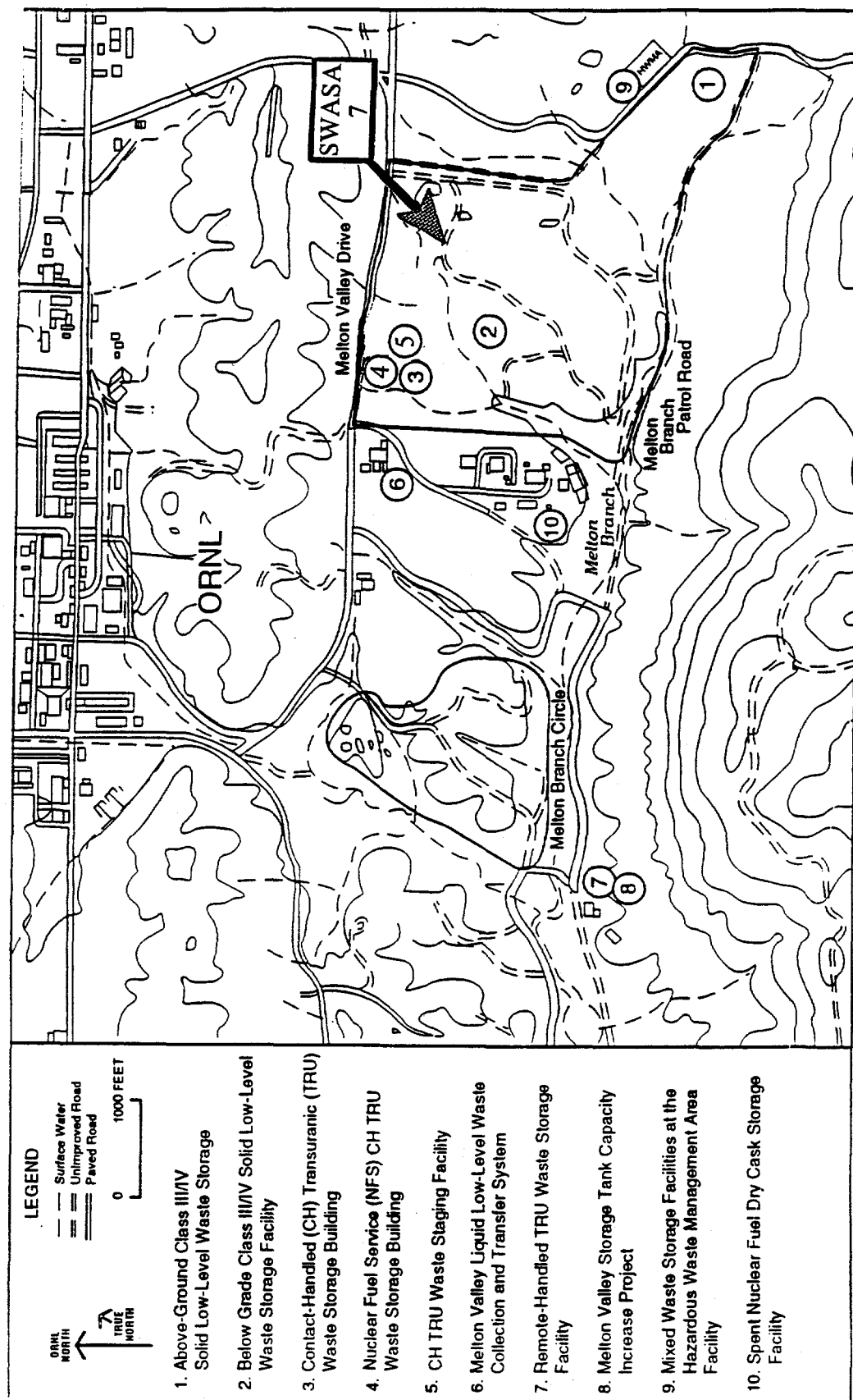
Executive Order 12898 requires federal agencies to achieve environmental justice "to the greatest extent practicable" by identifying and addressing "disproportionately high and adverse human health or environmental effects of its . . . activities on minority populations and low-income populations . . ." No minority or economically disadvantaged populations would be disproportionately affected since the proposed action would have no adverse impacts.

#### **4.5 Cumulative Impacts**

DOE has proposed or approved the construction and operation of other waste management activities in Melton Valley through 1995 (Figure 4.1). National Environmental Policy Act (NEPA) documentation has been completed or is being prepared for each of these proposed actions. The cumulative impacts from the implementation of these actions in Melton Valley are assessed in this section. The following is a listing and short description of these proposed projects, including the proposed action assessed in this document. Project 1

is undergoing environmental review. FONSIIs were issued for Projects 2, 3, 5, and 6. A categorical exclusion was issued for Project 4.

- (1) **Class III/IV solid low-level waste (SLLW) storage facilities** (Sites 1 and 2 on Figure 4.1)--The proposed facilities consist of one above-grade and four below-grade SLLW storage facilities to be constructed and operated in SWSA 7. Construction of these facilities would result in clearing approximately 5.3 ha (13 ac) [1.6 ha (4 ac) for the above-grade facility and 3.6 ha (9 ac) for the four below-grade facilities]. Construction and operation of the below-grade facilities would occur as necessary over approximately 10 years.
- (2) **Contact-handled (CH) and remote-handled (RH) transuranic (TRU) waste storage buildings** (Sites 3, 4, and 7 on Figure 4.1)--Two CH TRU waste storage facilities and one RH TRU waste staging/storage facility have been approved for construction and operation in SWSA 7. These metal buildings will store CH TRU and mixed CH TRU waste. Approximately 1.2 ha (3 ac) will be cleared and leveled for this project. The RH TRU waste storage facility will consist of one reinforced concrete bunker to store casks of RH TRU and RH TRU mixed waste\* generated at ORNL. The building will be in Melton Valley, and approximately 0.4 ha (1 ac) will be cleared. The TRU facilities will be permitted under the Resource Conservation and Recovery Act (RCRA)\*. An approved EA (DOE 1995b) resulted in a FONSI.
- (3) **Nuclear Fuel Services CH TRU storage building** (Site 5 on Figure 4.1)—A metal building has been constructed to store mixed waste transported from the Nuclear Fuel Services facility in Erwin, Tennessee. This facility is located in the northwest corner of SWSA 7. Less than 1.2 ha (3 ac) was cleared. The approved EA for this project (DOE 1992) resulted in a FONSI.
- (4) **Melton Valley liquid low-level waste (LLLW) collection and transfer system upgrade** (site 6 on Figure 4.1)—This project, approved under a NEPA categorical exclusion, is designed to upgrade existing underground LLLW transport lines from the Radiochemical Engineering Center in Melton Valley



**Figure 4.1. Site Locations for Oak Ridge National Laboratory's Proposed Waste Management Projects for Melton Valley through 1995.**  
(Some locations are preliminary sites for proposed facilities)

to existing waste lines in the main ORNL complex located in Bethel Valley. The project also includes the construction of a monitoring and control station for collection of LLLW from Melton Valley facilities and the addition of an ion exchange system in the HFIR building for treatment of HFIR waste. Dewatered and dried spent ion exchange resins (Class II SLLW) would be stored as part of the Class III/IV above-grade inventory. Approximately 1.6 ha (4 ac) of land will be disturbed by construction associated with the upgrade.

- (5) **Melton Valley Storage Tank-Capacity Increase Project (MVST-CIP)** (Site 8 on Figure 4.1)—This project includes construction and operation of eight LLLW storage tanks. These tanks are needed to increase the capacity of ORNL's existing LLLW storage tanks. Approximately 2 ha (5 ac) will be cleared. The final EA for this project (DOE 1995c) resulted in a FONSI.
- (6) **Mixed waste storage facilities** (Site 9 on Figure 4.1)—These facilities are proposed to expand the storage capacity of hazardous mixed waste storage facilities located just to the east of SWSA 7. Approximately 0.1 ha (0.25 acre) of land will be affected by construction of proposed buildings. The final EA for this project (DOE 1994b) resulted in a FONSI.

Approximately 13.0 ha (32.1 ac) of land would be cleared for all these approved or proposed projects addressed in this cumulative impact assessment. Operation of these facilities would result in the continued transport and storage of low-level and TRU wastes and spent nuclear fuel at ORNL. Releases of hazardous material or radioactive isotopes from storage facilities would not be expected under normal operation. The cumulative impacts of these reasonably foreseeable actions are discussed in the following paragraphs.

#### **4.5.1 Groundwater Hydrology**

Construction and operation of the actions in Melton Valley are not expected to result in cumulative impacts to groundwater hydrology and quality. Implementation of groundwater suppression techniques at individual sites could have minimal localized effects on the groundwater table. Lowering of the groundwater table by approximately 0.3 m (1 ft) could occur over small areas. Materials used to backfill pipeline trenches could be more permeable than native soils, creating preferred pathways for groundwater movement. Containment



features incorporated into the design of the facilities would minimize the potential for movement of contaminants from these facilities into groundwater. During construction, accidental releases of construction liquids could occur. However, rapid spill emergency response would minimize impacts to groundwater.

Under the Superfund Amendments and Reauthorization Act of 1986 (SARA), Title III, industrial facilities are required to report releases of "reportable quantities" of hazardous substances [CERCLA- and Emergency Planning and Community Right-to-Know Act (EPCRA)-listed] to state and local emergency response personnel. DOE, LMES, and City of Oak Ridge would mobilize an emergency preparedness plan if a release of hazardous materials (to any environmental media--air, surface water, groundwater, soils) occurs.

#### **4.5.2 Surface Water Hydrology**

Construction of the proposed SNF dry cask storage area and other Melton Valley actions included in this cumulative assessment would result in clearing and grading of approximately 13.0 ha (32.1 ac), which may result in sediment mobilization and transport into nearby surface waters. The potential for eroded material to reach streams and adversely impact water quality increases as more area in the watershed is disturbed. Impacts to surface water are expected to be minimal because (1) most of the proposed facilities are not adjacent to surface waters; (2) many of the streams in the construction areas are intermittent during part of the year; (3) only a portion of the total area would be under construction at any one time; and (4) best management practices (i.e., hay bales and silt fences) would be implemented to reduce impacts.

Operation of numerous production and storage facilities in Melton Valley increases the potential for accidental releases of contaminants to the environment and potential transport of these contaminants into the aquatic environment. However, cleanup of any spills of hazardous materials following the ORNL Spill Prevention, Control, Countermeasures, and Contingency Plan (September 1985) would minimize the potential for impacts to surface waters. Releases of "reportable quantities" of hazardous substances (CERCLA- and EPCRA-listed) would be required to the State (see Section 4.5.1).

Clearing vegetation and replacing it with buildings and/or concrete pads could cause faster and greater runoff of storm water because there would be less natural vegetation and ground surface to allow absorption and longer retention. Natural buffers of more than 30 m (98 ft) between the areas developed and streams such as Melton Branch should be adequate to allow runoff to be slowed and absorbed before reaching the creeks. Retention ponds could

be used to collect runoff and reduce impacts on surface water quality and hydrology if projects are located closer to streams than 30 m (98 ft).

Finally, the ORNL Biological Monitoring and Abatement Program (BMAP), which has reported improvement in water quality in Melton Valley in the last few years, will continue to monitor water quality and aquatic biota there. Thus, any deterioration of water quality would be quickly detected allowing measures to be implemented to correct the problem as necessary.

#### **4.5.3 Wetlands**

Construction has the potential to result in sediment transport and deposition in wetlands. Sediment deposition occurs in wetland areas under natural conditions; however, excessive sediment deposition can have an adverse impact on wetland ecology. In general, without the use of sediment control measures, the effects of construction at several sites or larger areas would be additive. Although there is potential for sediment transport to wetlands from some of the projects proposed for Melton Valley, especially to small headwater wetlands close to construction areas, use of best management practices during construction and operation, such as silt fences, seeding, and water velocity reduction, would minimize sediment transport.

Clearing vegetation and replacing it with buildings and/or concrete pads could cause faster and greater runoff of storm water because there would be less natural vegetation and ground surface to allow absorption and longer retention. Such changes in hydrology might impact headwater wetlands and their plants. If runoff velocity proves to be a problem, use of settling ponds could retard runoff and minimize such impacts.

Wetland surveys have been conducted for each proposed site. All wetlands that occur near any of the proposed sites would be flagged before construction to ensure their protection from impacts due to construction of individual projects. Further, a 15-m (65-ft) buffer around wetlands should adequately reduce potential wetland impacts. These protective measures would also prevent significant cumulative effects. Thus, with careful planning and follow through, the proposed facilities in Melton Valley would not be expected to have separate or cumulative adverse effects on wetlands.

#### **4.5.4 Aquatic Ecology**

The effects of sedimentation in small streams are generally additive and result in habitat degradation or loss and ultimately in changes in community composition of the

aquatic environment (see Section 4.1.1). Disturbance of only a small portion of the overall area at any one time by construction activities, in addition to the use of best management practices, such as those mentioned in Section 4.5.3, during construction and operation at all sites would minimize impacts to surface water quality and, consequently, to aquatic biota. As more land in the watershed is disturbed, the potential for eroded material to reach the stream, to accumulate, and to have an adverse impact on aquatic biota increases.

BMAP surveys have shown an increase in fish and macroinvertebrate populations in Melton Branch in the last few years in response to remedial actions at ORNL. Adequate planning and control measures should ensure that this trend continues and is not reversed by increased sedimentation and habitat alteration. Since BMAP will continue to monitor water quality in Melton Branch, any deterioration of water quality should be detected allowing measures to be implemented to correct the problem as necessary.

#### **4.5.5 Terrestrial Ecology**

Cumulative impacts on local and regional terrestrial ecosystems include the loss of natural vegetation and reductions in wildlife populations due to habitat loss and forest fragmentation. Construction and operation of each facility in Melton Valley would result in a loss of some native forest habitat and associated wildlife. These effects are generally additive.

Forest fragmentation affects some wildlife species (e.g., the ovenbird, yellow-billed cuckoo, wood warblers, red-shouldered hawk) which require large areas of undisturbed forest. To protect forest species that generally do not reproduce in nonwooded habitats, forested areas at least 100 ha (247 ac) or larger are needed (Askins 1995, Robinson et al. 1995). Even species preferring edge (e.g., indigo bunting), nest more successfully in less fragmented landscapes.

Some species that require large forested areas, especially neotropical migratory songbirds, could be adversely affected by increase predation and parasitism from species that live in openings and edges and hunt in surrounding forest. Parasites such as cowbirds, for example, are active within 100 m (328 to 656 ft) of forest edge and can severely affect reproductive success of songbirds in fragmented forests (Askins 1995, Robinson et al. 1995). Extensive forests not only protect forest species, but provide a source of recolonization of more fragmented forests that are too small to be self-sustaining. [Songbird declines also could lead to leaf-feeding insects outbreaks (Askins 1995, Robinson et al. 1995)].

In general, as forest cover is removed from more areas within Melton Valley, smaller populations of species that require large forested areas could occupy the remaining forest.

Other species that use openings and edges of forests and already occupy abundant habitat associated with existing disturbed sites would become even more abundant.

Many species requiring extensive forest might be impacted by forest fragmentation in Melton Valley. One such species, which is known to occur there and for which data are available, is the red-shouldered hawk. The optimal habitat for a pair of red-shouldered hawks is approximately 500 ha (1,200 ac) of primarily forest land, with less than 15% of the total area in clearings smaller than about 4 ha (10 ac). These birds reuse the same area for many years, preferably the same tree, and often the same nest. The hawk often nests near roads and probably would not be affected by nearby traffic. There has been an active nest located in an oak tree in one of the bottomlands in the eastern part of Melton Valley. A buffer zone of about 200-m (650-ft) radius including the nest site and surrounding riparian habitat would probably ensure successful nesting and rearing of young.

Site clearing would create some opportunity for erosion. These areas would need to be planted with native species of vegetation to stabilize soil and minimize erosion, as outlined in Executive Order 11987, "Exotic Organisms," and DOE 5400.1/AI-1, which restrict the introduction of exotic species into natural ecosystems on federally owned land.

The proposed actions in Melton Valley are not expected to have separate or cumulative adverse effects on rare plants. The state-listed endangered lilies growing on SWSA 7 at the eastern end of Melton Valley could be indirectly affected if there were changes in hydrology. However, the wetland and floodplain areas where they are growing would be protected from disturbance, runoff, and siltation. State-listed wildlife populations known to use forest ecosystems such as those affected by these projects are assumed to be affected by additive fragmentation and effects of loss of habitat.

The overall impact on the wildlife habitats of ORR and the surrounding region of the projects proposed for Melton Valley would be relatively small since the entire acreage of the proposed sites is approximately 13 ha (32 ac). About 85% of the land is forested on the approximately 809 ha (2000 ac) of Melton Valley between Highway 95 and the eastern boundary of SWSA 7. Construction for these proposed actions would, therefore, result in less than an additional 1% of cleared forest in this part of Melton Valley.

However, forests of the ORR are representative of ecosystems that are increasingly threatened by human development (Noss et al. 1995). ORR is a uniquely large and continuously forested area compared with the surrounding landscape (Mann et al. in press). The Nature Conservancy has identified the eastern end of Melton Valley as one of three landscape complexes on the ORR of ecological importance because of concentrations of rare species, rare ecological communities, and large blocks of high-quality native vegetation

(Nature Conservancy 1995). Minimizing clearing of forest during construction would help reduce fragmentation.

Construction of the proposed facilities in Melton Valley considered in this evaluation would make a minor additional contribution to the cumulative impacts on ORR vegetation and wildlife due to all recent, current, and proposed actions on ORR. However, these projects in Melton Valley add to progressive fragmentation of forest on ORR which could have a disproportionately negative effect on interior forest populations and migratory bird species in the region.

DOE's recent (e.g., last ten years), currently proposed, and possible future actions, including property sales and numerous construction projects in various areas on ORR, have usually had or would have minor individual impacts because most of the actions affect only a relatively small area. However, some projects, not specifically included in this analysis, would impact large areas [e.g., Parcel A which was recently sold to the city of Oak Ridge, the proposed lease of 405 ha (1,000 ac) east of K-25 to the East Tennessee Economic Council, the proposed Spallation Neutron Source which might take an area of up to 3.2 km x 0.8 km (2 mi x 0.5 mi)]. In total, therefore, the actions in Melton Valley, in addition to all the other on-going and potential actions on the ORR, could have considerable cumulative impact on ORR vegetation and wildlife.

#### 4.5.6 Air Quality

Temporary and localized increases in atmospheric concentrations of carbon monoxide, nitrogen dioxide, volatile organic compounds, and particulate matter would result from exhaust emissions of heavy construction vehicles, diesel generators, and other construction equipment. Because of the small scale of the proposed activities, these emissions would not add appreciably to existing levels of pollutants and would have negligible impacts on ambient air quality.

Fugitive dust would result from excavation and earthwork during construction activities. The impact of constructing any one building would be negligible. However, more than one site may be disturbed at any one time. Therefore, the cumulative impacts of simultaneous construction of several sites were modeled (see Appendix D.2) using the EPA-recommended Industrial Source Complex Short-Term (ISCST) air dispersion model (EPA 1992). All sites were assumed to be under construction at the same time [a total of approximately 14 ha (34 ac) of disturbed area]. The modeling results indicate that PM-10 would increase by 20  $\mu\text{g}/\text{m}^3$ . Exceedance of the National Ambient Air Quality Standards

(Appendix D.2) would not be expected to occur as a result of the proposed activities, even if they were occurring simultaneously (see Appendix D.2) .

Doses resulting from the possible excavation of  $^{90}\text{SrTiO}_3$  contaminated soils (Appendix B.1) have been calculated. Assuming (1) the concentration of  $^{90}\text{SrTiO}_3$  in the soil at the site of the construction activities is 0.037 Bq/g (1 pCi/g) (a reasonable upper-bound estimate of the radioactivity\* at SWSA 5), and (2) the construction activities would increase the annual average atmospheric concentration of soil particles by  $20 \mu\text{g}/\text{m}^3$  (the conservative estimate given above), then the radioactivity of the air would nominally increase by  $7.4 \times 10^{-7} \text{ Bq}/\text{m}^3$  ( $2 \times 10^{-5} \text{ pCi}/\text{m}^3$ ). For comparison, the activity of radon in outdoor air is about 100 pCi/ $\text{m}^3$  (NCRP 1984), or more than  $10^6$  times the estimated increase from  $^{90}\text{SrTiO}_3$  if the proposed activities were all taking place simultaneously. That is, the  $^{90}\text{SrTiO}_3$  would be expected to increase the natural background radioactivity of the air by less than 0.0001%. It should be noted that this is a very conservative estimate, based on the assumptions that all waste management sites would be disturbed simultaneously, that the radioactivity of the suspended soil is the same as that at SWSA 5 (where it is about an order of magnitude higher than typical concentrations in the area), and that no measures would be used to suppress fugitive dust.

#### **4.5.7 Historic and Archaeological Resources**

The only currently known historical sites in Melton Valley is the Jones house site (DuVall and Associates 1992). None of the proposed sites is on this historical site, and therefore, no impacts are expected on archaeological or historical resources in Melton Valley. For all proposed projects, National Historic Preservation Act Section 106 consultation with the State Historic Preservation Officer (SHPO) would be carried out. For the proposed actions that have received consultation from the SHPO, no objections or recommendations were given regarding construction of the proposed projects. Proposed projects awaiting correspondence with the SHPO would follow the SHPO's recommendations to ensure that proper measures are undertaken to protect archeological resources during construction and operation of the proposed facilities.

#### **4.5.8 Health and Safety**

The construction and operation of the proposed or planned actions in Melton Valley could result in additional injuries, illnesses, or radiation exposures. Injuries from

construction and operation equipment are considered to be standard industrial accidents. Workers would comply with OSHA regulations (29 CFR 1926) and ORNL safety provisions to mitigate the incidence of equipment-related injuries or illnesses.

Construction of each of these projects might involve excavation of soils contaminated with  $^{90}\text{SrTiO}_3$ . Radioactivity from  $^{90}\text{SrTiO}_3$  is from beta particles. Radiation exposure could therefore result in external exposures to the skin and internal exposures from inhalation of contaminated, airborne soil particles. Strontium-90 is known to absorb readily into the bloodstream and deposit in the bone. However,  $^{90}\text{SrTiO}_3$  is an insoluble compound and would tend to remain in the respiratory tract if inhaled.

To bound exposures, the same conservative assumptions in the air quality section (Section 4.5.6) are used here. Assuming all the soil is contaminated, external exposures to the skin from the  $^{90}\text{SrTiO}_3$  would result in an annual EDE of approximately  $8.7 \times 10^{-6}$  mSv ( $8.7 \times 10^{-4}$  mrem). This is 0.0002% of the average individual background level. Exposure from inhalation of airborne particulates is based on the conservative air concentration of  $7.4 \times 10^{-7}$  Bq ( $2 \times 10^{-5}$  pCi/m<sup>3</sup>), presented in the air quality assessment (Section 4.5.6). The associated annual EDE from inhalation would be approximately  $2 \times 10^{-5}$  mSv ( $2 \times 10^{-3}$  mrem). This is about 0.0006% of the average annual individual background level of 3.6 mSv (360 mrem). Therefore, using conservative assumptions, such as (1) all soils are contaminated above the average levels found in SWSA 7, and (2) all excavation is conducted simultaneously for all activities in Melton Valley, the impacts on an individual's radiation exposure are negligible. This assessment bounds impacts for any individual excavation activity included in this cumulative impact assessment.

Cumulatively, operational activities in Melton Valley (Figure 4.1) would represent an increase in the radioactive waste\* management activities at ORNL.<sup>1</sup> However, waste operators\* at ORNL would continue to rotate between jobs, comply with DOE Order 5480.11, and meet ALARA goals. Precise changes in exposures due to operations of all the actions are difficult to estimate. The annual dose to waste operations radiation workers would be expected to vary little from the 1991 average measurable exposure of 0.40 mSv/yr (40 mrem/yr) (see Section 3.2.2). This is well below the DOE limit of 50 mSv/yr (5 rem/yr), the ORNL ALARA goal of 6.5 mSv/yr (0.65 rem/yr), and the Energy Systems administrative control level of 15 mSv/yr (1.5 rem/yr). Therefore, there would be no significantly increased radiological risk to workers, and the addition to cumulative impacts on worker health and safety during incident-free operation of this action would be negligible.

Some of the proposed facilities would handle mixed waste, thereby potentially

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<sup>1</sup>Radioactive waste management is assumed to include the management of SNF.

exposing workers to hazardous materials. These facilities would handle only small amounts of hazardous material (e.g., 25 mg/L of cadmium) that would be mixed with a larger inventory of radioactive waste [e.g., in a 208-L (55-gal) drum]. The hazardous waste\* component of individual operations at the proposed facilities would not pose a threat because the quantities would be sufficiently small. Measures taken to control radiological hazards would also generally protect workers from the hazardous constituents in the mixed waste, except for highly volatile chemicals.

Public risk from radiological or hazardous materials would also be negligible because the waste would be well contained and the overall radiological doses to off-site individuals would increase only slightly (probably not measurable). DOE Order 5400.5, "Radiation Protection of the Public and the Environment," limits the EDE that an off-site individual may receive from all exposure pathways and all radionuclides released from ORR during 1 year to no more than 1.0 mSv (100 mrem). In 1993, the maximum predicted EDE from exposure through all pathways was 0.03 mSv (3 mrem), 3% of the DOE Order 5400.5 limit (Kornegay et al. 1994a). Any small increase due to cumulative impacts from the waste storage activities assessed in this section would not be expected to change current experience measurably, which is well below the DOE limit. The cumulative impact on health and safety of the waste operation facilities would be negligible.

The proposed facilities would represent an increase in radioactive waste inventory in the immediate area and would thereby increase the health hazard to the workers and members of the public who may travel near to the area. However, the hazard is passive and only becomes a problem (risk) when the radioactive material becomes mobilized during an incident. Operation of numerous storage facilities in an area increases the potential for accidental releases of contaminants to that immediate area but does not change materially the overall potential for accidents per storage facility. Individual incidents do not change in probability; however, with more facilities, there is a greater likelihood for an effect at the region of greater facility density. Even with all the proposed facilities, impacts on the public health are expected to be small.

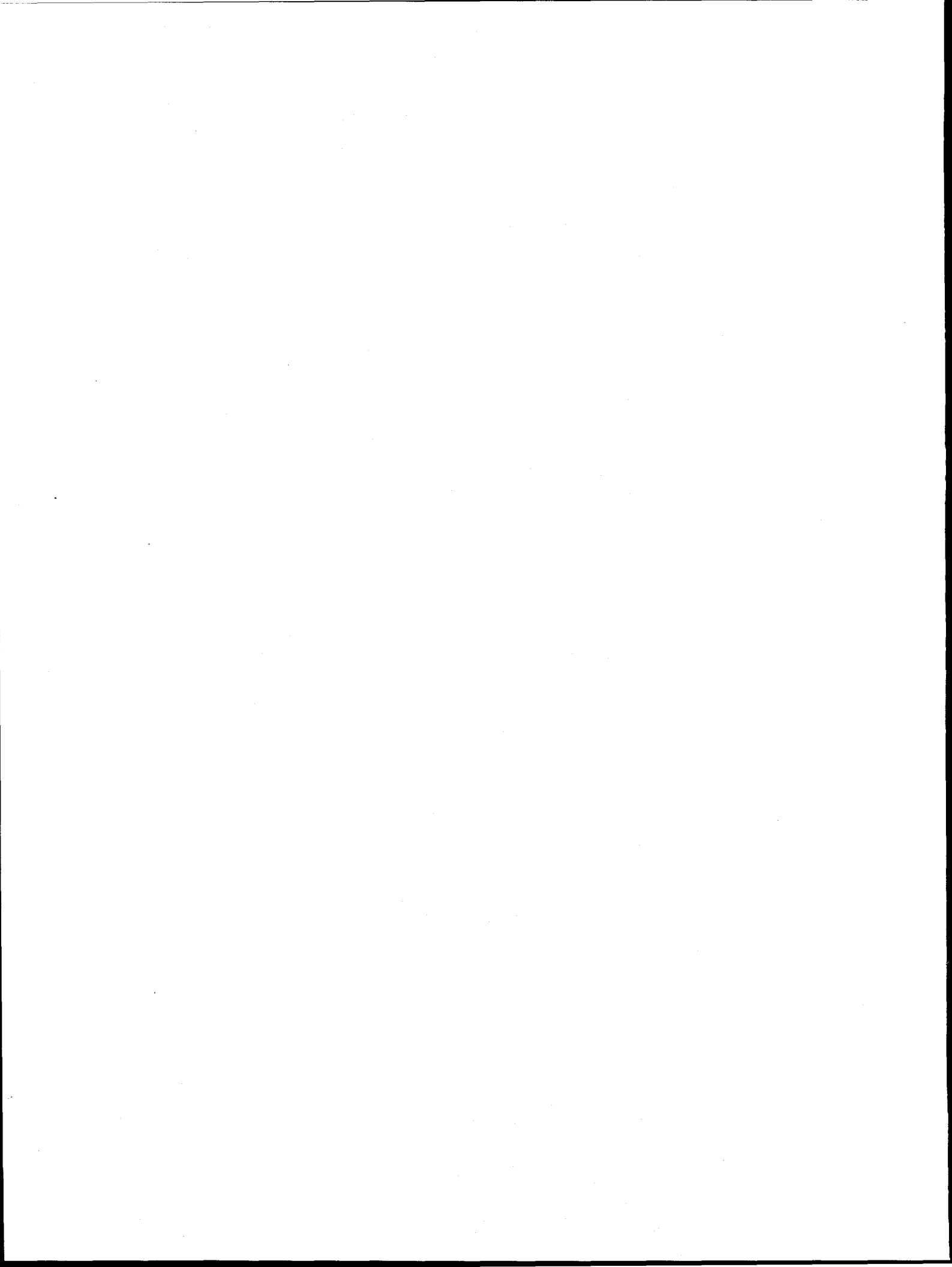
#### **4.5.9 Transportation**

Completed EAs have reported that the potential transportation impacts from both incident-free and accident conditions have been negligible for all proposed Melton Valley facilities.

Operating these proposed facilities in Melton Valley would not greatly alter the transportation risks posed by a particular facility but would increase the overall health hazard



potential to the workers and the public in the immediate area as a result of the increased cumulative quantities of radioactive waste or material being shipped. Even after a postulated accident, the effects would be localized and the actions of emergency response teams would prevent any large population exposures. Increased traffic flow would increase the risk of a vehicular accident, but this fact was considered in this and previous assessments by using conservative traffic volumes and accident rates.



## 5. REGULATORY COMPLIANCE AND AGENCY CONSULTATION

The following additional federal statutes and regulations are applicable to the proposed action: the Clean Air Act and its amendments; RCRA, as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984 which includes requirements for a waste minimization\* program (ORNL 1994); the Clean Water Act (CWA) and its amendments; the Toxic Substances Control Act (TSCA); the Endangered Species Act of 1973; Section 106 of the Historic Preservation Act; OSHA (29 CFR 1910, Subpart G, *Occupational Health and Environmental Controls*, 29 CFR 1910, Subpart I, *Personal Protective Equipment*, 29 CFR 1910, Subpart J, *General Environmental Controls*, 29 CFR 1926, *Safety and Health Standards for Construction*); and 10 CFR 1022, DOE review requirements for floodplains and wetlands. The proposed action would also comply with Tennessee state laws, including the Tennessee Water Quality Control Act (TCA 69-3-108) the Tennessee Burial Law (TCA 39-17-311, TCA 39-17-312), and Tennessee Hazardous Waste Reduction Act of 1990.

Consultation letters are found in Appendix E. Consultation with the United States Fish and Wildlife Service has been completed, as required by the Endangered Species Act of 1973. Appendix C summarizes the status of endangered species, as they apply to the ORR. Consultation with the U.S. Natural Resource Conservation Service has been completed and is being undertaken with the State Historic Preservation Officer.



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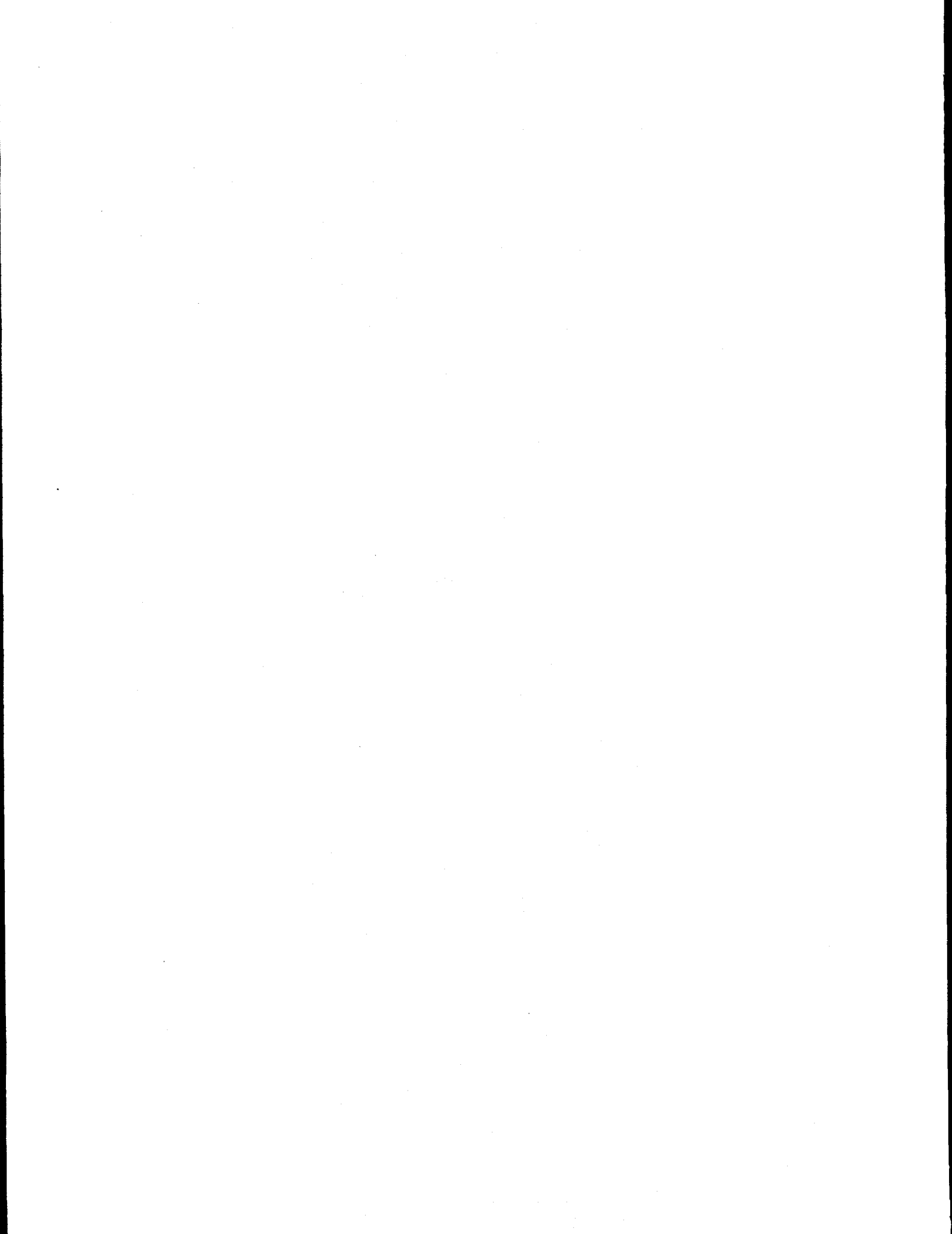


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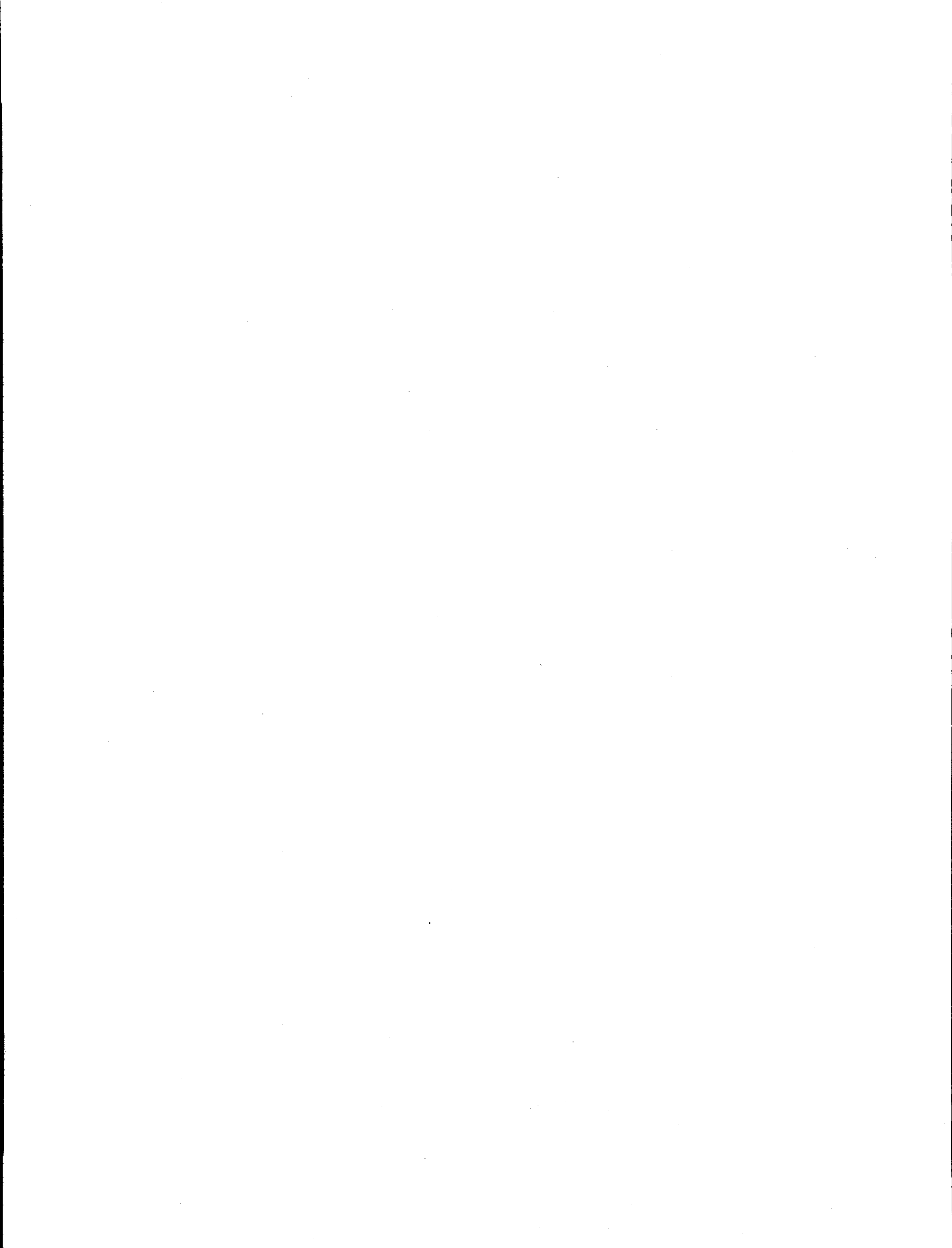
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## **APPENDIX A: GLOSSARY**

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and the role of the accounting department in ensuring the integrity of the financial statements. It also highlights the need for transparency and accountability in the reporting process.

2. The second part of the document outlines the various methods used to collect and analyze data, including surveys, interviews, and focus groups. It emphasizes the importance of using a mix of qualitative and quantitative techniques to gain a comprehensive understanding of the research topic.

3. The third part of the document presents the results of the research, which show a clear trend towards increased customer satisfaction and loyalty. This is attributed to the implementation of the new service standards and the ongoing training of the staff.

4. The fourth part of the document discusses the challenges faced during the research process, such as limited access to certain data sources and the need for additional resources to conduct more in-depth analysis. It also provides suggestions for how these challenges can be overcome in future research.

5. The fifth part of the document concludes the research by summarizing the key findings and their implications for the organization. It stresses the importance of continuing to monitor and improve the service quality to maintain the competitive edge in the market.

## GLOSSARY

**100-year flood**--A flood event of such magnitude it occurs, on average, every 100 years (equates to a 1 percent probability of occurring in any given year).

**accident**--An unplanned sequence of events that results in undesirable consequences.

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

**background radiation**--Radiation from cosmic sources; naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material), and global fallout as it exists in the environment from the testing of nuclear explosive devices.

**bounding analysis**--An evaluation which determines the limits of anticipated impact.

**by-product**--a) Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident, during the process of producing or utilizing special nuclear material, and b) the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material [Atomic Energy Act 11(e)]. By-product material is exempt from regulation under the Resource Conservation and Recovery Act.

**Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)**--A Federal law (also known as "Superfund") that provides a comprehensive framework to deal with past or abandoned hazardous materials. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) provides for liability, compensation, cleanup, and emergency response for hazardous substances released into the environment that could endanger public health, welfare, or the environment, as well as the cleanup of inactive hazardous waste disposal sites. CERCLA has jurisdiction over any release or threatened release of any "hazardous substance" to the environment. Under CERCLA, the definition of "hazardous" is much broader than under the Resource Conservation and Recovery Act, and the hazardous substance need not be a waste. If a site meets the CERCLA requirements for designation, it is ranked along with other "Superfund" sites and listed on the National Priorities List. This ranking and listing is the U.S. Environmental Protection Agency's way of determining which sites have the highest priority for cleanup.

**contamination**--The deposition of unwanted radioactive material on the surfaces of structures, areas, objects, or personnel.

**core**--The central portion of a nuclear reactor containing the fuel elements, moderator, neutron poisons, and support structure.

**curie (Ci)**--The basic unit used to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion disintegrations per second, which is approximately the rate of decay of 1 gram of radium. A curie is also a quantity of any radionuclide that decays at a rate of 37 billion disintegrations per second.

**decommissioning**--The process of removing a facility from operation, followed by decontamination, entombment, dismantlement, or conversion to another use.

**decontamination**--The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environment, such as radioactive contamination from facilities, soil, or equipment by washing, chemical action, mechanical cleaning, or other techniques.

**dose (or radiation dose)**--A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent.

**dry storage**--Storage of spent nuclear fuel in environments where the fuel is not immersed in liquid for the purposes of cooling and/or shielding.

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

**enriched uranium**--Uranium that has greater amounts of the fissionable isotope uranium-235 than occurs naturally. Naturally occurring uranium is 0.72 percent uranium-235.

**hazardous waste**--Under the Resource Conservation and Recovery Act, a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may (a) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. Source, special nuclear material, and by-product\* material, as defined by the Atomic Energy Act, are specifically excluded from the definition of solid waste.

**hot cell/hot cell facility**--A heavily shielded enclosure for handling and processing (by remote means or automatically), or storing highly radioactive materials.



**hydrology**--The study of water, including groundwater, surface water, and rainfall.

**isotope**--One of two or more atoms with the same number of protons, but different numbers of neutrons, in their nuclei. Thus, carbon-12, carbon-13, and carbon-14 are isotopes of the element carbon, the numbers denoting the approximate atomic weights. Isotopes have very nearly the same chemical properties, but often different physical properties (for example, carbon-12 and -13 are stable; carbon-14 is radioactive).

**low-level waste**--Waste that contains radioactivity and is not classified as high-level waste, transuranic waste, or spent nuclear fuel. 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 waste, provided the concentration of transuranic elements is less than 100 nanocuries per gram of waste.

**management (of spent nuclear fuel)**--Emplacing, operating, and administering facilities, transportation systems, and procedures to assure safe and environmentally responsible handling and storage of spent nuclear fuel pending (and in anticipation of) a decision on ultimate disposition.

**mixed waste**--Waste that contains both hazardous waste under the Resource Conservation and Recovery Act and source, special nuclear, or by-product material subject to the Atomic Energy Act of 1954.

**normal operation**--All normal conditions and those abnormal conditions that frequency estimation techniques indicate occur with a frequency greater than 0.1 events per year.

**nuclear fuel**--Materials that are fissionable and can be used in nuclear reactors to make energy.

**operator**--The organization that operates a facility.

**production reactor**--A nuclear reactor that is used to irradiate target material to produce special nuclear material or by-product material.

**proposed critical habitat**--Critical habitat as defined in Section 3(5)(A) of the Endangered Species Act (Pub. L. 93-205, as amended) that has been proposed, but that has not been finalized. When the proposal is finalized, the habitat is termed "designated" critical habitat.

**public**--Anyone outside the DOE site boundary at the time of an accident or during normal operation. With respect to accidents analyzed in this EA, anyone outside the DOE site boundary at the time of an accident.

**radiation (ionizing radiation)**--Alpha particles, beta particles, gamma rays, x-rays, neutrons,

high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as it is used here, does not include nonionizing radiation such as radio- or microwaves, or visible, infrared, or ultraviolet light.

**radiation worker**--A worker who is occupationally exposed to ionizing radiation and receives specialized training and radiation monitoring devices to work in such circumstances.

**radioactive waste**--Waste that is managed for its radioactive content.

**radioactivity**--The property or characteristic of material to spontaneously "disintegrate" with the emission of energy in the form of radiation. The unit of radioactivity is the curie\* (or becquerel).

**radioisotope**--An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation. Approximately 5,000 natural and artificial radioisotopes have been identified.

**radiological survey**--The evaluation of the radiation hazard accompanying the production, use, or existence of radioactive materials under a specific set of conditions. Such evaluation customarily includes a physical survey of the disposition of materials and equipment, measurements or estimates of the levels of radiation that may be involved, and a sufficient knowledge of processes affecting these materials to predict hazards resulting from unexpected or possible changes in materials or equipment.

**radionuclide**--See radioisotope.

**Record of Decision (ROD)**--A public document that records the final decision(s) concerning a proposed action. The Record of Decision is based in whole or in part on information and technical analysis generated either during the Comprehensive Environmental Response, Compensation, and Liability (CERCLA) process or the National Environmental Policy Act (NEPA) process, both of which take into consideration public comments and community concerns.

**research reactor**--A nuclear reactor used for research and development.

**Resource Conservation and Recovery Act (RCRA)**--A Federal law addressing the management of waste. Subtitle C of the law addresses hazardous waste under which a waste must either be "listed" on one of the U.S. Environmental Protection Agency's (EPA's) hazardous waste lists or meet one of EPA's four hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity, as measured using the toxicity characterization leaching procedure (TCLP). Cradle-to-grave management of wastes classified as RCRA hazardous wastes must meet stringent guidelines for environmental protection as required by the law.

These guidelines include regulation of transport, treatment, storage, and disposal of RCRA-defined hazardous waste. Subtitle D of the law addresses the management of nonhazardous, nonradioactive, solid waste such as municipal wastes.

**retrieval**--The process of recovering wastes that have been stored or disposed of on-site so they may be appropriately characterized, treated, and disposed of.

**risk**--Quantitative expression of possible loss that considers both the probability that a hazard causes harm and the consequences of that event.

**segregation**--The process of separating (or keeping separate) individual waste type and/or forms in order to facilitate their cost-effective treatment and storage or disposal.

**solid waste**--Any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities. It does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges, which are point sources subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended, or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended [Public Law 94-580, 1004(27) (Resource Conservation and Recovery Act)].

**special nuclear material**--a) Plutonium, or uranium enriched in the isotope 233 or in the isotope 235, and any other material that the U.S. Nuclear Regulatory Commission, pursuant to the provisions of the Atomic Energy Act of 1954, Section 51, determines to be special nuclear material; or b) any material artificially enriched by any of the foregoing, but does not include source material. Special nuclear material is exempt from regulation under the Resource Conservation and Recovery Act (RCRA).

**spent nuclear fuel (SNF)**--Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated. For the purposes of this EA, spent nuclear fuel also includes uranium/neptunium target materials, blanket subassemblies, pieces of fuel, and debris.

**storage**--The collection and containment of waste or spent nuclear fuel in such a manner as not to constitute disposal of the waste or spent nuclear fuel for the purposes of awaiting treatment or disposal capacity (that is, not short-term accumulation).

**subsurface**--The area below the land surface.

**target**--A tube, rod, or other form containing material that, on being irradiated in a nuclear reactor, would produce a designed end product (that is, uranium-238 produces plutonium-239 and neptunium-237 produces plutonium-238).

**transloading**--Transfer of SNF from an on-site transportation container to an off-site transportation cask.

**ultimate disposition**--The final step in which a material is either processed for some use or disposed of.

**vulnerabilities**--Conditions or weaknesses that may lead to radiation exposure to the public, unnecessary or increased exposure to the workers, or release of radioactive materials to the environment. For example, some DOE facilities have had leakage from spent fuel storage pools, excessive corrosion of fuel causing increased radiation levels in the pool, or degradation of handling systems. Vulnerabilities are also caused by loss of institutional controls, such as cessation of facility funding or reductions in facility maintenance and control.

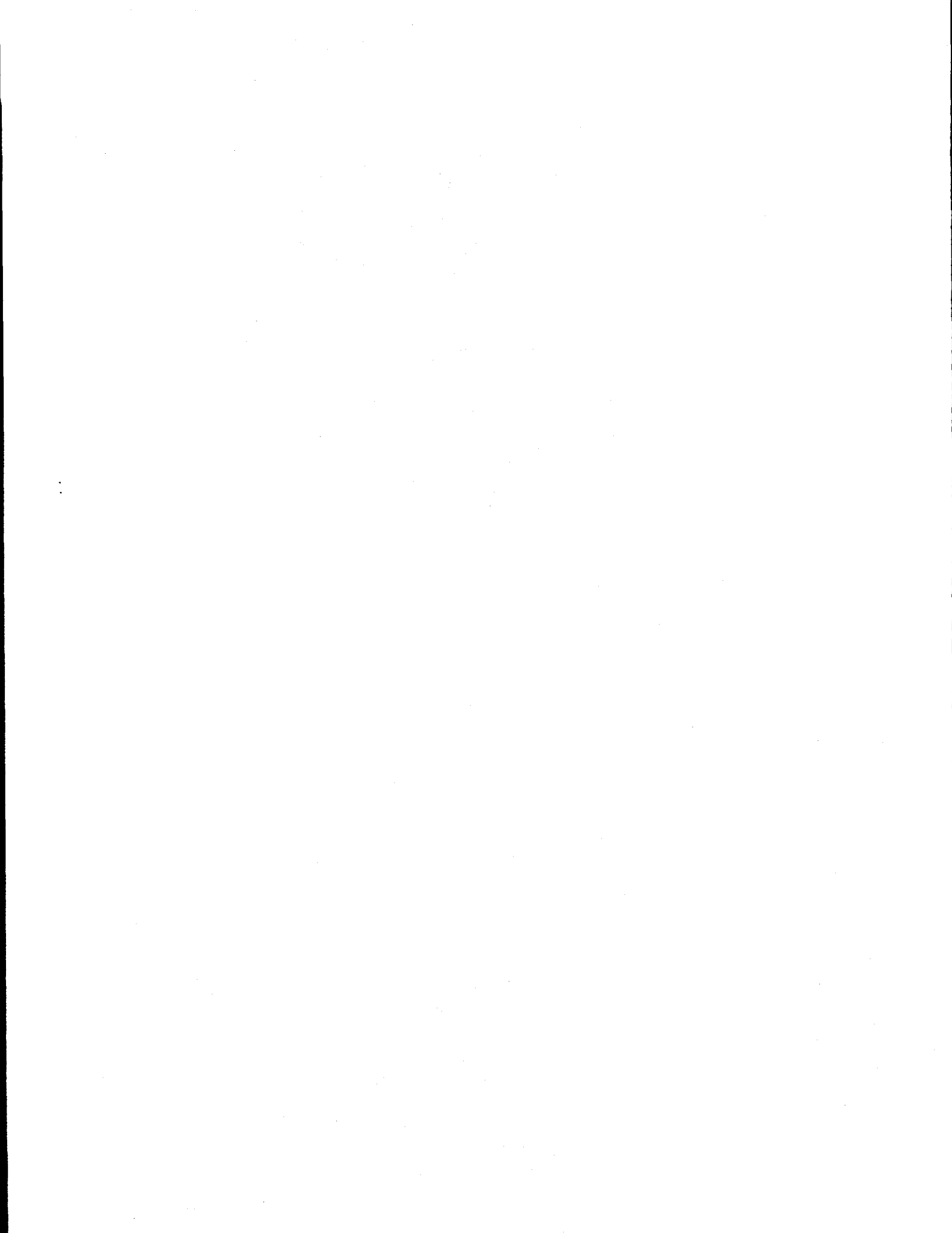
**waste management**--The planning, coordination, and direction of those functions related to generation, handling, treatment, storage, transport, and disposal of waste, as well as associated surveillance and maintenance activities.

**waste minimization**--The minimization or elimination of :

- (1) the production of waste at the sources;
- (2) the mixing of radioactive and nonradioactive hazardous waste; and
- (3) exposures of personnel and the general public to hazardous materials.

**wet storage**--Storage of spent nuclear fuel in a pool of water, generally for the purposes of cooling and/or shielding.

**APPENDIX B: SITE SELECTION CRITERIA FOR DRY CASK  
STORAGE FACILITY**



## **B.1 Evaluation Results of Potential Sites for the Dry Cask Storage Facility**

Seven potential sites were evaluated (Lockheed Martin 1995). One site, SWSA 7, was eliminated because of conflict with the proposed Class III/IV belowground storage facility planned. The other six sites (Figure B-1) were evaluated as follows:

### **(1) SWSA 5**

#### **Opportunities**

- elevated plateau site
- good access via gravel non-public road

#### **Constraints**

- adjacent to life sciences area and Melton Branch
- not directly accessible from HFIR
- possible conflict with ORNL Site Development Plan (SDP)

### **(2) HFIR West**

#### **Opportunities**

- level topography
- excellent access to HFIR
- area accessible via non-public road
- site characterization completed for previous project (HFIR Maintenance Facility)

#### **Constraints**

- close to HFIR parking lot
- conflicts with SDP
- close to Melton Branch and a blue line stream
- may require relocation of trailers (7964 E&F) in SW portion of HFIR area
- contains unsurveyed wetlands

### **(3) Melton Branch**

#### **Opportunities**

- level-to-rolling topography
- area accessible via gravel, non-public road

# CANDIDATE SITES

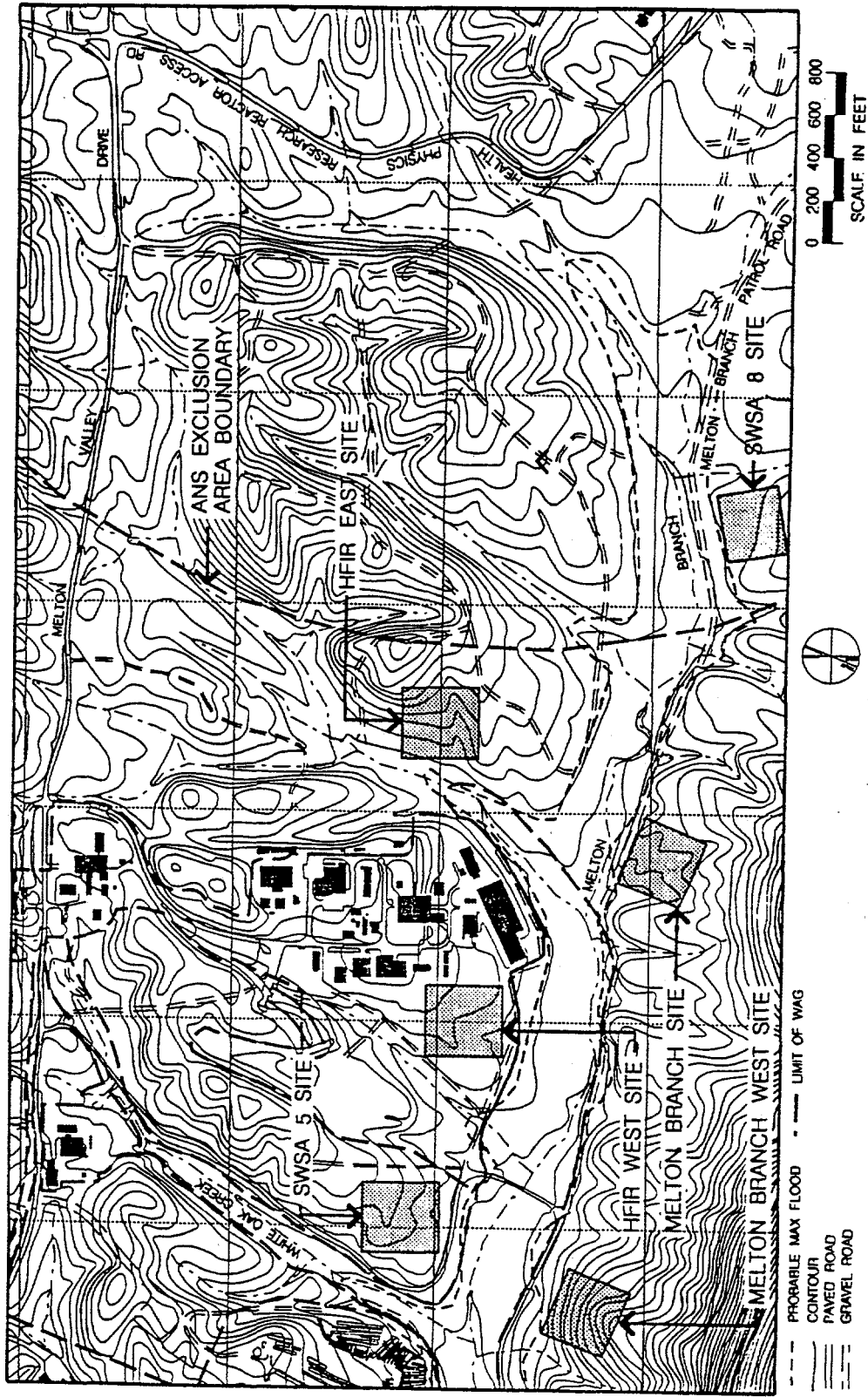


Figure B-1. Candidate Sites Evaluated for the Dry Cask Storage Facility Location



#### Constraints

- requires crossing of Melton Branch
- located near Melton Branch
- adjacent to low/wet area in gravel road

#### (4) HFIR East

##### Opportunities

- excellent access to HFIR
- good expansion capability
- requires only minor road construction
- located within limits of proposed SWSA 7

##### Constraints

- some site grading will be required
- possible conflict with existing patrol road
- proposed road will cross blue line stream

#### (5) SWSA 8

##### Opportunities

- relatively level topography
- located within limits of proposed SWSA 8
- fronts on Melton Branch Circle (gravel road)
- adjacent site has previous site characterization
- location well suited for vendor operation due to outside accessibility

##### Constraints

- requires crossing of Melton Branch
- located adjacent to Melton Branch
- Melton Branch Circle may require upgrading for truck traffic
- farthest candidate site from HFIR
- located inside ANS exclusion area boundary

#### (6) Melton Branch West

##### Opportunities

- frontage along paved road that may be improved under another project
- relatively good access to HFIR

##### Constraints

- steep topography

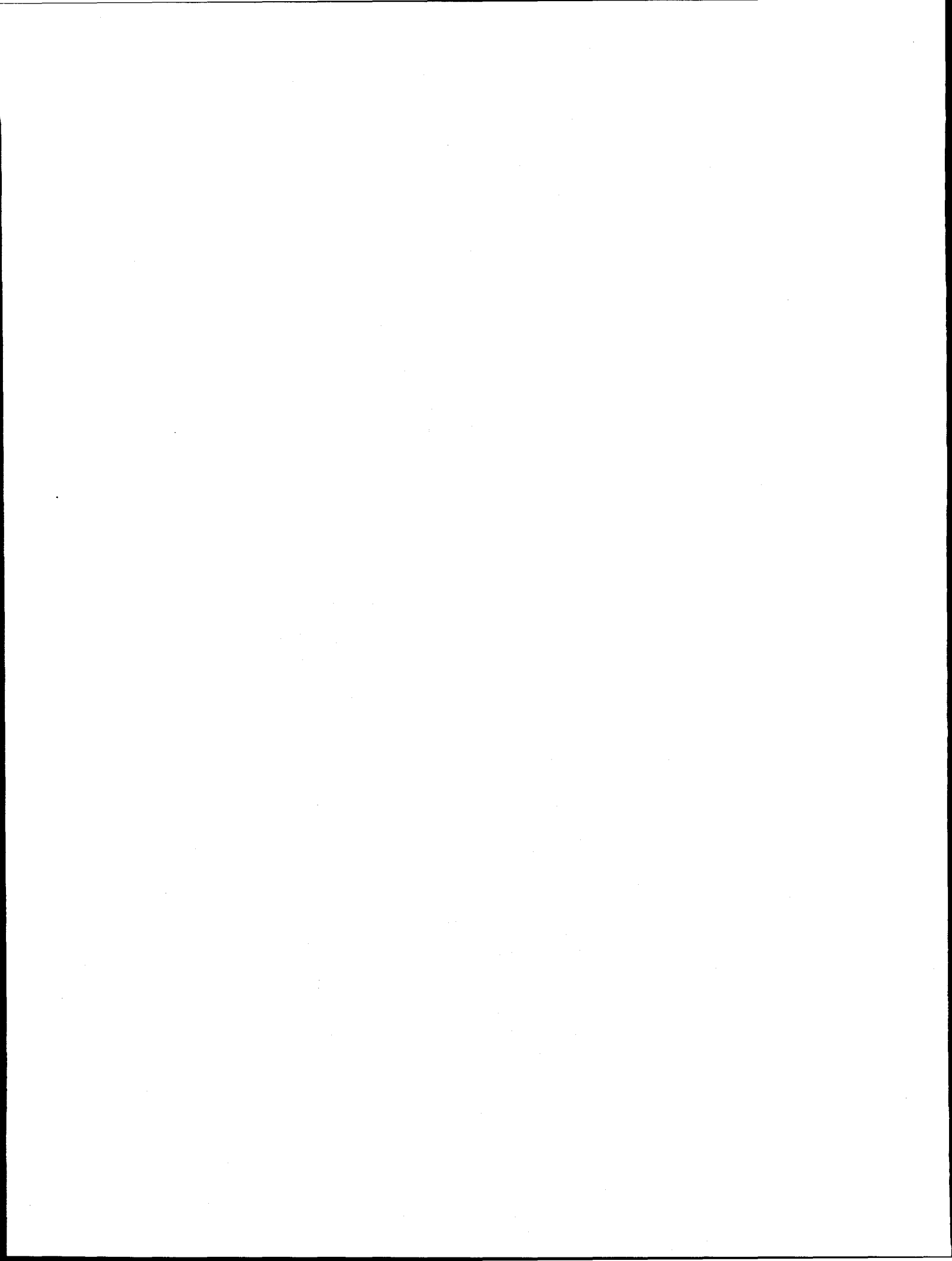
- adjacent to Melton Branch and wetlands
- trucks required to cross Melton Branch

The sites were then ranked, and the one with the highest scores was determined to be the preferred site; the one with the next highest score was determined to be the alternate site (Figure B-2).

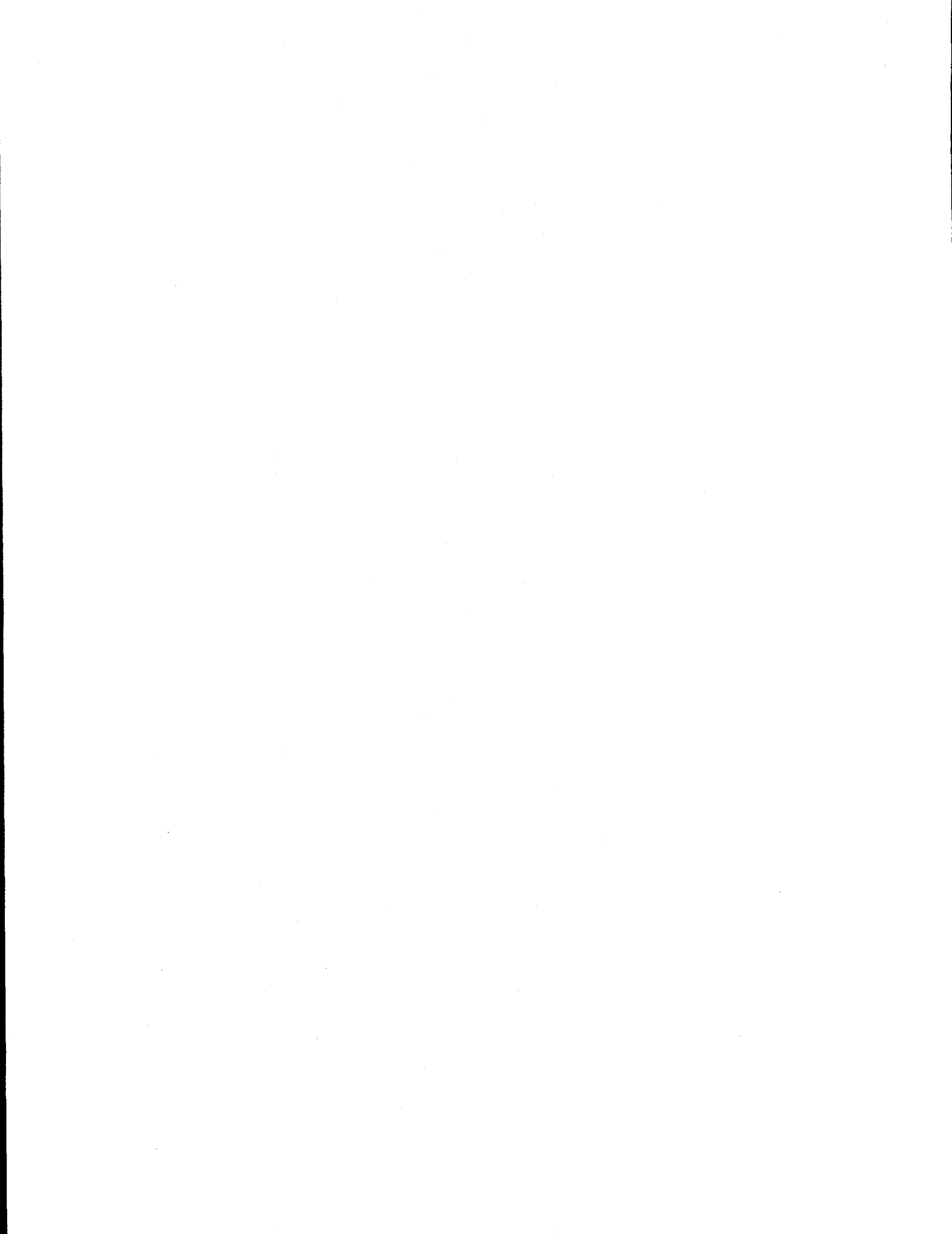
# CANDIDATE SITE EVALUATION FORM

CRITERIA	WEIGHT FACTOR	RATING BY SITE:					
		SWSAS	HFRBW	MB	HFIRES	SWSAS	MBW
<b>FUNCTIONAL SUITABILITY</b>							
Proximity to existing roadways	1	X					
Proximity to HFR	3	X					
Topographic suitability/minimal grading	2	X					
<b>PROGRAMMATIC SUITABILITY</b>							
Conforms to ORNL Site Development Plan	1	X					
Conforms to ORNL security procedures	2	X					
Minimizes impact on existing land use	2	X					
Surveillance and monitoring suitability	3	X					
<b>HEALTH &amp; SAFETY SUITABILITY</b>							
Minimize discharge into streams, groundwater	3	X					
Avoid SWMU's and contaminated sites	3	X					
Locate to allow waste transport via non-public roads	3	X					
<b>ENVIRONMENTAL SUITABILITY</b>							
Minimize ecosystem fragmentation	1	X					
Minimize disturbance of wetlands	3	X					
Minimize impact on threatened/endangered species	3	X					
Minimize impact on historic, cultural, archaeological resources	2	X					
Minimize impact on natural, reference and research areas	2	X					
<b>TOTAL</b>		720	825	640	656	600	596
<b>RANK</b>		2	1	4	3	5	6

Figure B-2. Site Evaluation Form for Candidate Sites Evaluated for the Dry Cask Storage Facility.  
(Source: Lockheed Martin 1995b)



**APPENDIX C: STATUS OF PROTECTED SPECIES ON THE  
OAK RIDGE RESERVATION**



**Table C.1. Status of Protected Species on the Oak Ridge Reservation<sup>a</sup>**

Species		Legal status <sup>b</sup>	
		Federal	State
<b>Plants</b>			
<i>Aureolaria patula</i>	spreading false foxglove	C2	E
<i>Cimicifuga rubifolia</i>	Appalachian bugbane	C2	T
<i>Delphinium exaltatum</i>	tall larkspur	C2	E
<i>Juglans cinerea</i>	butternut	C2	
<i>Cypripedium acaule</i>	pink lady-slipper		E
<i>Liparis loeselii</i>	fen orchid		E
<i>Diervilla lonicera</i>	northern bush-honeysuckle		T
<i>Fothergilla major</i>	mountain witch-alder		T
<i>Hydrastis canadensis</i>	goldenseal		T
<i>Lilium canadense</i>	Canada lily		T
<i>Panax quinquefolius</i>	ginseng		T
<i>Platanthera flava</i> var <i>hebiola</i>	tuberculed rein-orchid		T
<i>Platanthera peramoena</i>	purple fringeless orchid		T
<i>Elodea nuttallii</i>	Nuttall's waterweed		S
<i>Saxifraga careyana</i>	Carey's saxifrage		S
<i>Spiranthes ovalis</i>	lesser lady's tresses		S
<i>Carex gravida</i>	heavy sedge		S
<i>Draba ramosissima</i>	branching whitlow grass		S
<i>Juncus brachycephalus</i>	small-headed sedge		S
<i>Spiranthes lucide</i>	shining ladies' tresses		T
<i>Carex oxylepis</i> var. <i>pubescens</i>	hairy sharp-scaled sedge		S
<i>Rhynchospora colorata</i>	white-topped sedge		S
<i>Ruellia purshiana</i>	Pursh's wild petunia		S
<b>Fish</b>			
<i>Polyodon spathula</i>	paddlefish	C2	
<i>Phoxinus tennesseensis</i>	Tennessee dace		NM

Table C.1, continued

Species		Legal status <sup>b</sup>	
		Federal	State
<b>Amphibians and Reptiles</b>			
<i>Aneides aeneus</i>	green salamander	C2	
<i>Cryptobranchus alleganiensis</i>	hellbender	C2	NM
<i>Hemidactylium scutatum</i>	four-toed salamander		NM
<b>Birds</b>			
<i>Haliaeetus leucocephalus</i> <sup>c</sup>	bald eagle	T	T
<i>Falco peregrinus</i> <sup>c</sup>	peregrine falcon	T	E
<i>Aimophila aestivalis</i> <sup>d</sup>	Bachman's sparrow	C2	E
<i>Ammodramus henslowii</i> <sup>c</sup>	Henslow's sparrow	C2	
<i>Chlidonias niger</i> <sup>c</sup>	black tern	C2	
<i>Dendroica cerulea</i> <sup>d</sup>	cerulean warbler	C2	
<i>Thyromanes bewickii</i>	Bewick's wren	C2	T
<i>Pandion haliaetus</i>	osprey		T
<i>Ammodramus savannarum</i> <sup>d</sup>	grasshopper sparrow		NM
<i>Accipiter striatus</i> <sup>d</sup>	sharp-shinned hawk		NM
<i>Accipiter cooperii</i> <sup>d</sup>	Cooper's hawk		NM
<i>Circus cyaneus</i> <sup>c</sup>	northern harrier		NM
<i>Anhinga anhinga</i> <sup>c</sup>	anhinga		NM
<i>Casmerodius alba</i> <sup>c</sup>	great egret		NM
<i>Contopus borealis</i> <sup>c</sup>	olive-sided flycatcher		NM
<i>Grus canadensis</i> <sup>c</sup>	sandhill crane		NM
<i>Phalacrocorax auritus</i> <sup>c</sup>	double-crested cormorant		NM
<i>Sphyrapicus varius</i> <sup>c</sup>	yellow-bellied sapsucker		NM
<i>Tyto alba</i>	common barn owl		NM
<i>Egretta caerulea</i> <sup>d</sup>	little blue heron		NM
<i>Lanius ludovicianus</i>	loggerhead shrike		NM
<b>Mammals</b>			
<i>Myotis grisescens</i>	gray bat	E	E
<i>Sorex longirostris</i>	southeastern shrew		NM



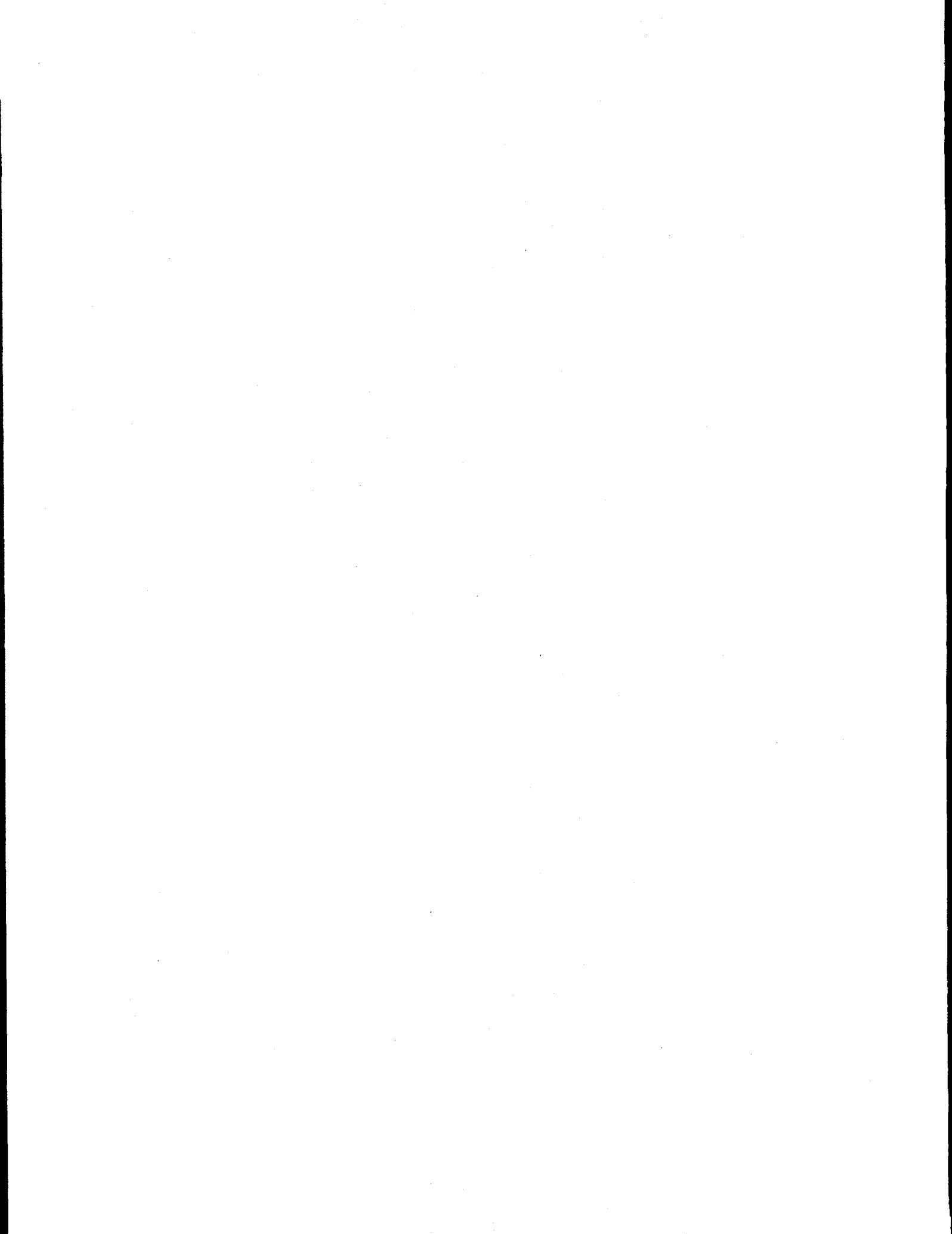
Table C.1, continued

- a. From Parr and Evans (1992), Cunningham et al. (1993), Kroodsma (1987), Pounds et al. (1993), King et al. (1994), and ongoing environmental restoration field surveys.
- b. E = endangered, T = threatened, C1, C2 = candidate, NM = in need of management, S = special concern in Tennessee.
- c. Uncommon visitor or migrant. Does not currently nest on the Oak Ridge Reservation.
- d. Present in summer.

## C.2 REFERENCES

- Cunningham, M. et al. 1993. *Resource Management Plan for the Oak Ridge Reservation Vol. 29: Rare Plants on the Oak Ridge Reservation*, ORNL/NERP-7, Oak Ridge National Laboratory, Oak Ridge, Tenn.
- King, A. L., D. J. Ayl, and C. A. Gabrielsen. 1994. *Environmentally Sensitive Areas Surveys Program Threatened and Endangered Species Survey Progress Report*, ORNL/ES/ER/TM-130, Oak Ridge National Laboratory, Oak Ridge, Tenn.
- Kroodsmma, R. L. 1987. *Resource Management Plan for the Oak Ridge Reservation, Vol. 24: Threatened and Endangered Animal Species*. ORNL/ESH-1/V24, Oak Ridge National Laboratory, Oak Ridge, Tenn.
- Parr, P. D. and J. W. Evans 1992. *Resources Management Plan for the Oak Ridge Reservation, Vol. 27: Wildlife Management Plan*. ORNL/NERP-6, Oak Ridge National Laboratory, Oak Ridge, Tenn.
- Pounds, L. R., P. D. Parr, and M. G. Ryon. 1993. *Resource Management Plan for the Oak Ridge Reservation, Vol. 30: Oak Ridge National Environmental Research Park Natural Areas and Reference Areas—Oak Ridge Reservation Environmentally Sensitive Sites Containing Special Plants, Animals, and Communities*. ORNL/NERP-8, Oak Ridge National Laboratory, Oak Ridge, Tenn.

## **APPENDIX D: TECHNICAL SUPPORT DATA**



## D.1 Radiological Background Data

Beginning in 1994, a radiological survey\* was conducted at SWSA 7 (Figure 4.1) to determine if the land was radiologically contaminated and if so, to what degree. Random sampling was conducted in areas proposed for construction for solid low-level waste storage facilities. Forty-two 3-m × 3-m (10-ft × 10-ft) plots were sampled for gamma and beta radiation. The results of the survey determined that there were no areas of gamma radiation above background. Beta particles were found in all but four of the plots. The particles were found to be  $^{90}\text{SrTiO}_3$ , an insoluble form of  $^{90}\text{Sr}$ . Fifteen-cm (6-in.) depth profiles were conducted at four sampling plots. Contamination was found below the surface but began to taper off before 15 cm (6 in.). The number of particles per plot and disintegrations per minute (dpm) of beta radioactivity were recorded. The minimum, maximum, mean, and median number of contaminated particles per plot and activities per particle are presented in Table 3.1.

A sample was also taken near SWSA 5, where  $^{90}\text{SrTiO}_3$  was historically taken for disposal. (see Figure 2.1, SWSA5 Site). Strontium titanate was found in higher concentrations at that one plot than in SWSA 7. In a 0.3-m × 1.5-m (1-ft × 5-ft) plot, approximately 25 particles were found at the surface, and a total of 85 particles were found in the same area to a depth of 15 cm (6 in.). The mean activity was 1098 dpm per particle. Although there is no statistical support for making conclusions based on one plot, this information gives an indication that the SWSA 5 area may have more contamination than SWSA 7. Furthermore, it is logical to assume that the contamination would be greater in SWSA 5 since the material was disposed of in that area.

**Table D.1 Strontium Titanate Soil Contamination in Solid Waste Storage Area 7**

No. of contaminated particles per plot (surface only)		Activity per particle (per plot)	
		disintegrations per minute (dpm)	Bq (Ci) <sup>a</sup>
min	0	261	4.4 ( $1.2 \times 10^{-10}$ )
max	56	9582	160 ( $4.3 \times 10^{-9}$ )
mean	12	1192	20 ( $5.4 \times 10^{-10}$ )
median	6	1091	18 ( $4.9 \times 10^{-10}$ )

<sup>a</sup>One dpm = 0.0167 Bq; 1 Bq =  $2.7 \times 10^{-11}$  Ci.

Under the provisions of ORNL/M-116/R1, *Health, Safety and Environmental Protection Procedure for Excavating Operations*, the contaminated soils are listed as Category 2 soils. This category allows the excavated soil to be used as backfill, provided the area is not intended for continuous human occupation, but requires that the contaminated backfill be covered with 0.3 m (1 ft) of clean, uncontaminated soil.

## D.2 Air Quality

An average emission factor for total suspended particulate matter of 1.02 g/ha/s (1.2 tons/acre/month) (EPA 1985) was used, and 30% of that amount was assumed to be respirable particulate matter (EPA 1988a). Respirable particulate matter is defined as particles of 10  $\mu\text{m}$  or less in diameter and is therefore abbreviated PM-10. Particles that small can move easily into the lower respiratory tract. National Ambient Air Quality Standards (NAAQS) exist for annual and 24-h averages of PM-10 concentration.

The wind was assumed to be blowing toward the nearest residential area [Shoreline Estates, about 3 km (2 mi) southeast of the proposed above- and below-grade storage areas] at a speed of 1 m/s (2.2 mph). Flat terrain was assumed for this fugitive dust analysis. These assumptions are all conservative. That is, they lead to overestimates of the ambient air concentrations of PM-10.

Two approaches were taken to estimate the maximum 24-h average concentrations of PM-10 resulting from the proposed activities. In the first approach, stable meteorological conditions were assumed. These conditions only occur at night, so the simulated concentrations were multiplied by 0.4 as per EPA (1988b) to arrive at an estimate of the maximum 24-h average to compare with the corresponding NAAQS. In the second approach, neutral stability (which can persist for 24 h) was assumed and the resulting simulated concentrations were taken as the estimate of the maximum 24-h average. The highest of these figures (obtained by the first approach) was multiplied by 0.25 as per EPA (1988b) to arrive at a conservative estimate of annual average concentration of PM-10 that would result from all proposed activities occurring simultaneously. These figures were added to the background concentration, from monitoring data for Loudon County, Tennessee. Emissions from the stack at the ORNL steam plant, a local source that is not accounted for in the Loudon County survey, were also included in the modeling.

The annual average concentration of PM-10 was simulated to increase by 20  $\mu\text{g}/\text{m}^3$ . When added to the background value of 31  $\mu\text{g}/\text{m}^3$ , the result exceeds the NAAQS for annual average PM-10 concentration (50  $\mu\text{g}/\text{m}^3$ ) by 1  $\mu\text{g}/\text{m}^3$ . The maximum increase in PM-10 for a 24-h period was simulated as 80  $\mu\text{g}/\text{m}^3$ . When added to the background value of 61  $\mu\text{g}/\text{m}^3$ ,

the result is still less than the corresponding NAAQS for PM-10 averaged over a 24-h period ( $150 \mu\text{g}/\text{m}^3$ ).

Because of the conservative nature of the modeling, the simulated PM-10 concentrations probably represent an unrealistic situation. Exceedance of the NAAQS would not be expected as a result of the proposed activities, even if they were all occurring simultaneously. However, it is generally recommended that the disturbed areas be sprinkled with water, or other dust suppression measures be implemented, on particularly dusty days to mitigate possible nuisance or health hazards to workers resulting from inhalation of particulate matter.

### D.3 REFERENCES

- EPA (U.S. Environmental Protection Agency) 1985. *Compilation of Air Pollutant Emission Factors, Vol. I: Stationary Point and Area Sources*, 4th ed. EPA Publication AP-42, Research Triangle Park, NC.
- EPA (U.S. Environmental Protection Agency) 1988a. *Gap Filling for PM-10 Emission Factors for Selected Open Area Dust Sources*, EPA-450/4-88-003, Research Triangle Park, NC.
- EPA (U.S. Environmental Protection Agency) 1988b. *Screening Procedures for Estimating the Air Quality Impact of Stationary Sources*, EPA-450/4-88-010. Office of Air Quality Planning and Standards, Research Triangle Park, NC.



## **APPENDIX E: CONSULTATION LETTERS**

104

105

106

107

108

109

110

111

112

113

114

115

116

117

118

119

120

121

122

123

124

125

OAK RIDGE NATIONAL LABORATORY  
MANAGED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.  
FOR THE U.S. DEPARTMENT OF ENERGY

POST OFFICE BOX 2008  
OAK RIDGE, TENNESSEE 37831-6038

March 23, 1993

Linda K. Mann  
Environmental Sciences Division  
Telephone: 615/574-4677  
Telefax: 615/576-8543

Mr. Terry Gupton  
U.S. Soil Conservation Service  
P.O. Box 203  
Kingston, TN 37763

Dear Mr. Gupton:

We are preparing environmental assessments for several waste storage or treatment facilities on the Oak Ridge Reservation. These projects involve building gravel storage pads, below ground storage or pumping structures, pipelines, and upgrading gravel access roads. A map showing the areas of concern is enclosed.

Please let me know if there are prime agricultural lands on any of these sites which might affect our assessment.

Thank you for your help. If you have any questions, please call me at (615) 574-4677.

Sincerely,

*Linda K. Mann*

Linda K. Mann  
Research Associate

LKM:dlid

Enclosures





United States  
Department of  
Agriculture

Soil  
Conservation  
Service

P. O. Box 200  
Kinston, TN 37763  
3/29/93

Ms. Linda K. Mann  
Environmental Sciences Division  
Oak Ridge National Laboratory  
Post Office Box 2008  
Oak Ridge, TN 37831-6308

Dear Ms. Mann:

I have reviewed the soils map for the area that you are making an environmental assessment. The map shows only one soil type that is prime farmland. The soil type is Pope (Po on the map). This soil is located near small drainageways and occurs in narrow bands on either side of the streambeds. These small narrow areas will probably be insignificant to the overall project.

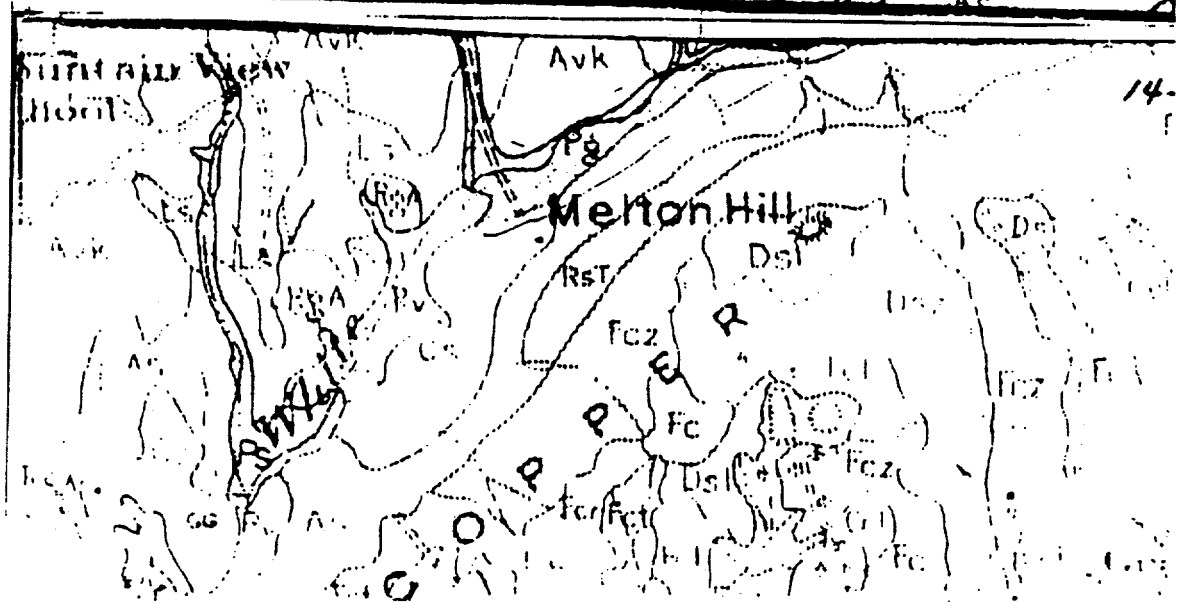
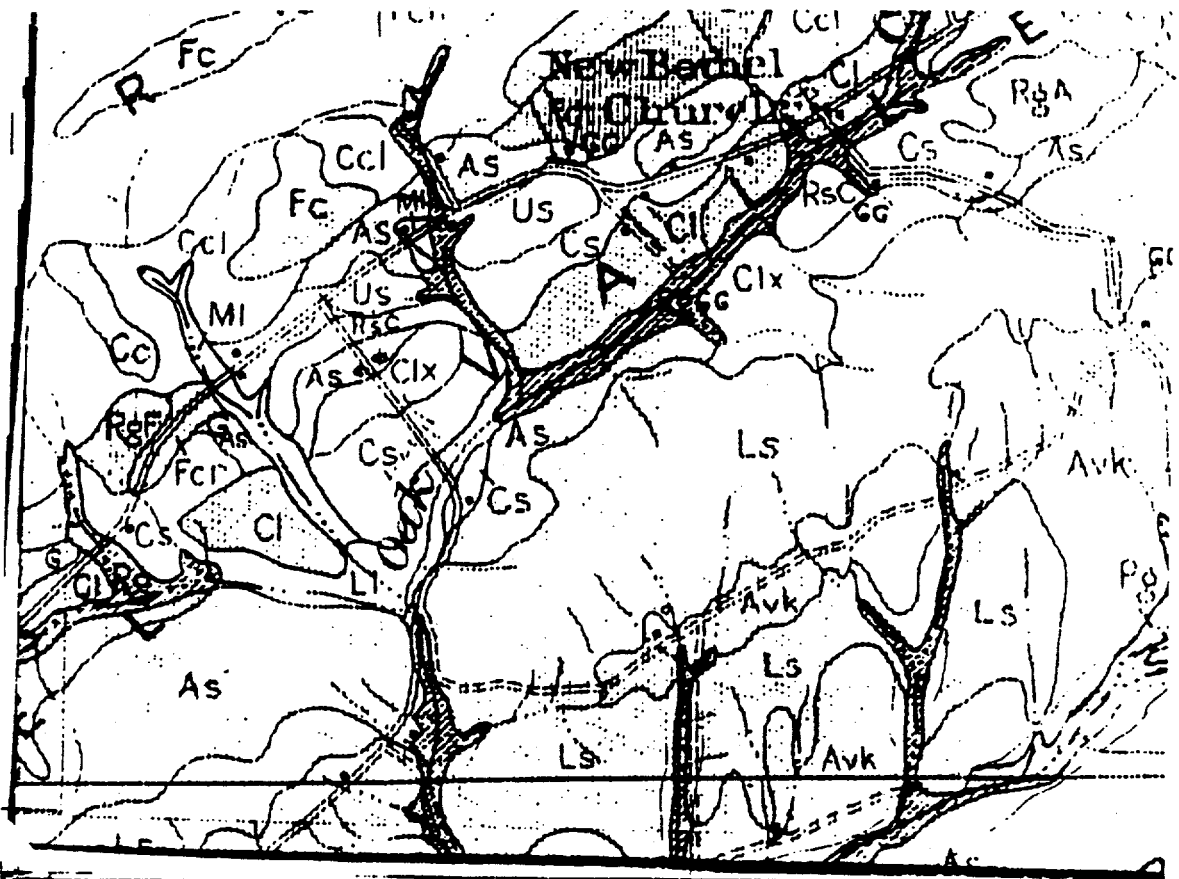
Please let me know if you need more information.

Sincerely,

Terry A. Gupton, District Conservationist

Enclosure

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis without regard to race, color, national origin, religion, sex, marital status, or handicap.





# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

446 Neal Street  
Cookeville, TN 38501

August 8, 1995

Ms. Linda Mann  
Research Associate  
Oak Ridge National Laboratory  
P.O. Box 2008  
Oak Ridge, Tennessee 37831-6038

Dear Ms. Mann:

Thank you for your letter and enclosures of July 10, 1995, regarding the Oak Ridge Reservation in Roane County, Tennessee. The Fish and Wildlife Service (Service) has reviewed the information submitted and offers the following comments.

Information available to the Service indicates that wetlands exist in the vicinity of the proposed project. However, our wetland determination has been made in the absence of a field inspection and does not constitute a wetland delineation for the purposes of Section 404 of the Clean Water Act or the wetland conservation provisions of the Food Security Act. The Corps of Engineers or the Natural Resources Conservation Service should be contacted regarding the presence of regulatory wetlands and the requirements of wetland protection statutes.

According to our records, the following federally listed or proposed endangered or threatened species may occur in the project impact area:

Bald eagle (Haliaeetus leucocephalus) (E)  
Gray bat (Myotis grisescens) (E)

In addition to listed species, there are species that, although not presently listed or proposed, are being considered for listing in the future. Status review (candidate) species that might occur in the vicinity of the proposed project are:

Tall larkspur (Delphinium exaltatum) (SR)

These species are not legally protected under the Endangered Species Act (Act) at this time, and consultation and biological assessment requirements of Section 7 of the Act do not currently apply to them. However, we would appreciate any measures you might implement to avoid impacting them.

You should assess potential impacts and determine if the proposed project may affect the species. A finding of "may affect" could require initiation of formal consultation. We recommend that you submit a copy of your assessment and finding to this office for review and concurrence.

Thank you for the opportunity to comment on this action. If you have any questions, please contact Allen Robison of my staff at 615/528-6481.

Sincerely,

A handwritten signature in dark ink, appearing to read "Douglas B. Winford". The signature is fluid and cursive, with the first name "Douglas" being more prominent.

Douglas B. Winford  
Acting Field Supervisor





## Department of Energy

Oak Ridge Operations  
P.O. Box 2001  
Oak Ridge, Tennessee 37831— 8739  
September 22, 1995

Mr. Joseph Garrison  
Tennessee Historical Commission  
Department of Environment and Conservation  
2941 Lebanon Road  
Nashville, Tennessee 37243-0442

Dear Mr. Garrison:

### **NATIONAL HISTORIC PRESERVATION ACT, SECTION 106 COMPLIANCE: SPENT NUCLEAR FUEL DRY CASK STORAGE FACILITY**

Enclosed is a Project Summary for the subject proposed project. The proposed project would be located at the DOE ORO Oak Ridge National Laboratory in Roane County, Tennessee. DOE ORO has determined that the proposed project would have no effect on any properties included or eligible for inclusion in the National Register of Historic Places. This determination is included with the Project Summary. The proposed project is addressed in the Programmatic Agreement Among the Department of Energy Oak Ridge Operations Office, the Tennessee State Historic Preservation Officer, and the Advisory Council on Historic Preservation Concerning Management of Historical and Cultural Properties at the Oak Ridge Reservation under Sections III.A.1. and III.D. and, therefore, does not require further Section 106 review. However, DOE ORO requests formal documentation of your concurrence with this determination to be used in the National Environmental Policy Act (NEPA) Environmental Assessment for this project.

If you have any questions or need additional information related to this project please call me at (615) 576-9574.

Sincerely,

A handwritten signature in cursive script that reads "Ray T. Moore".

Ray T. Moore  
DOE ORO Cultural Resources  
Management Coordinator

Enclosures

cc:  
See Page 2



TENNESSEE HISTORICAL COMMISSION  
DEPARTMENT OF ENVIRONMENT AND CONSERVATION  
2941 LEBANON ROAD  
NASHVILLE, TN 37243-0442  
(615) 532-1550

September 28, 1995

Mr. Ray Moore  
Environmental Protection  
Post Office Box 2001  
Oak Ridge, Tennessee 37831-8739

RE: DOE, ORNL/SPENT FUEL DRY CASK STORAGE, OAK RIDGE, ROANE COUNTY

Dear Mr. Moore:

The Tennessee State Historic Preservation Office has reviewed the above-referenced undertaking for compliance by the participating federal agency or applicant for federal assistance with Section 106 of the National Historic Preservation Act. The Advisory Council on Historic Preservation has codified procedures implementing Section 106 of the Act at 36 CFR 800 (51 FR 31115, September 2, 1986).

After considering the documentation submitted, it is our opinion that the undertaking will have no effect on National Register of Historic Places listed or eligible properties. This determination is made either because of location, scope and/or nature of the undertaking, and/or because of the size of the area of potential effect; because no listed or eligible properties exist in the area of potential effect; or because the undertaking will not alter any characteristics of an identified eligible or listed property that qualify the property for listing in the National Register or alter such property's location, setting or use. Therefore, this office has no objection to your proceeding with the project.

If you are applying for federal funds, license or permit, you should submit this letter as evidence of compliance with Section 106 to the appropriate federal agency, which, in turn, should contact this office as required by 36 CFR 800. If you represent a federal agency, you should submit a formal determination to this office for comment. You may direct questions or comments to Joe Garrison (615)532-1559. This office appreciates your cooperation.

Sincerely,

A handwritten signature in cursive script, reading "Herbert L. Harper", is positioned above the typed name.

Herbert L. Harper  
Executive Director and  
Deputy State Historic  
Preservation Officer

HLH/jyg



STATE OF TENNESSEE  
DEPARTMENT OF ENVIRONMENT AND CONSERVATION  
DOE OVERSIGHT DIVISION  
761 EMORY VALLEY ROAD  
OAK RIDGE, TENNESSEE 37830-7072

December 21, 1995

Ms. Patricia W. Phillips  
NEPA Compliance Officer  
US Department of Energy  
Oak Ridge Operations Office  
PO Box 2001  
Oak Ridge TN 37831-8620

Dear Ms. Phillips

**Document NEPA Review – Draft Environmental Assessment, DOE/EA-1117, October 1995, "Management of Spent Nuclear Fuel on the Oak Ridge Reservation Oak Ridge, Tennessee."**

The Tennessee Department of Environment and Conservation, DOE Oversight Division (TDEC/DOE-O) has received an Environmental Assessment (EA) concerning the Management of Spent Nuclear Fuel on the Oak Ridge Reservation, Oak Ridge, Tennessee. The subject EA has been reviewed in accordance with the requirements of the National Environmental Policy Act (NEPA) and implementing regulations of 40 CFR 1500-1508 and 10 CFR 1021.

After review and research, the Division concurs with the proposed project preferred alternative except that the State of Tennessee opposes construction of a dry cask storage facility.

In accordance with the Record of Decision for the Department of Energy Programmatic Spent Nuclear Fuel Management Program, spent nuclear fuel from the High Flux Isotope Reactor (HFIR) must be shipped to the Savannah River Site; therefore, a dry cask storage facility should not be needed. The Record of Decision was signed by the Secretary of Energy on May 30, 1995. The Record of Decision selected "Regionalization by Fuel Type (Alternative 4a)" which requires consolidation of "..... existing and newly generated spent nuclear fuel at three existing Department of Energy sites (i.e., the Hanford Site, the Idaho National Engineering Laboratory, and the Savannah River Site) based on the fuel type ..... Consolidation of spent nuclear fuel at these sites will be accomplished on a time-phased basis .....". Even the most unreasonable "time-phased" basis would require shipments of adequate amounts of HFIR spent fuel to keep the reactor operating on a continuous basis.

5. Page 4, Table 1.1 and Page 7, Table 1.2

Reference a. "Sources: DOE 1995, Appendix F" contains outdated SNF inventory figures; therefore, that reference should be deleted.

6. Page 8, Section 1.2.2, Numbers 3 & 4

Provide information on why buildings 4501 High-Level Radiochemical Laboratory, and 3042 the Oak Ridge Research Reactor were excluded as SNF storage facilities beyond the scope of this document.

7. Page 9, Paragraph under third bullet

Please define "timely fashion" in regard to when the dry cask storage facility would be constructed if SNF could not be shipped to SRS or INEL.

8. Page 10, section 2.2 "Proposed Action (Preferred Alternative)," line 28

Insert "HFIR" before reactor operations. Also, a statement should be added that clearly explains that a dry cask storage facility will not be constructed unless absolutely needed for continued operation of the HFIR reactor.

9. Page 10, section 2.2.1 "Dry Cask Storage Facility Construction"

Reference the codes and standards to which the SNF Dry Cask Storage Facility would be constructed.

10. Page 11, line 4

Insert "HFIR" before SNF and delete "or INEL."

11. Page 11, line 33

This line reads "..... before the re-racked pool is full." It should read "..... before the re-racked HFIR pool is full."

12. Page 20, Section 3.1.2.5 Terrestrial Ecology/Land Use, Paragraph 3

Please clarify the phrase "proposed critical habitat."

13. Page 42, Section 4.5.7 Historical and Archeological Resources

Please clarify if archeological and historical surveys have been completed in Melton Valley. Also, provide correspondence from State Historical Preservation Officer stating a position for the proposed project.

**Tennessee Department of Environment and Conservation/DOE Oversight Division**

**Comments on Draft Environmental Assessment, DOE/EA-117, October 1995,  
"Management of Spent Nuclear Fuel (SNF) on the Oak Ridge Reservation Oak Ridge,  
Tennessee."**

**GENERAL COMMENTS**

The alternatives considered in the subject EA, including the construction and operation of a Dry Cask Storage Facility, should identify and consider the impact of all waste streams generated as a result of the spent nuclear fuel management program. In addition, waste minimization possibilities should be explored and identified.

A cost evaluation of each alternative, including estimated costs for construction and operation of a Dry Cask Storage Facility, should be a part of the subject EA.

**SPECIFIC COMMENTS**

1. Page x, line 17

This line reads "it would be affected by the proposed action." It should read "it would not be affected by the proposed action."

2. Page 1, Section 1.1 Purpose and Need for Action, Paragraph 4

Please provide additional detailed information to justify the need for construction of a dry cask SNF storage facility. In addition to other details, explain how long the facility may be needed to enable continued operation of the High Flux Isotope Reactor (HFIR), and why the current eight SNF storage areas at ORNL are not sufficient to implement the Record of Decision for SNF.

3. Page 1, lines 28 through 30

It should be clearly stated that reracking of the High Flux Isotope Reactor (HFIR) pool must be completed in order to allow continued reactor operation until the year 2001 if no spent nuclear fuel (SNF) is moved from the pool.

4. Page 1, line 30

The year-by-year costs of HFIR reracking should be included in the EA to ensure budget requirements for that activity are not overlooked.

Patricia Phillips  
Page Two  
December

Additional comments are attached for your review and consideration in the preparation of a final environmental assessment.

If you have any questions, please contact Dale Rector at (423) 481-0995 or Steve Nisley at (423) 481-0163.

Sincerely

*W A Childers*

For

Earl C. Leming  
Director

Attachment

cc TN Environmental Policy Office  
Local Oversight Committee

em0298.99

**Response to  
Comments From Earl C. Leming  
Tennessee Department of Environment and Conservation, DOE Oversight Division  
December 21, 1995**

Number	Comment	Response
	<b>General Comments</b>	
G1.	<p>The alternatives considered in the subject EA, including the construction and operation of a Dry Cask Storage Facility, should identify and consider the impact of all waste streams generated as a result of the spent nuclear fuel management program.</p> <p>In addition, waste minimization possibilities should be explored and identified.</p>	<p>The proposed action is to implement regional storage of SNF. Wastes generated from this action would be minimized by implementation of the ORNL Pollution Prevention Program as mandated by DOE Order 5400.1. Waste minimization is a significant effort in the Oak Ridge operations. Extensive effort is devoted to minimization of waste in the repackaging of SNF.</p>
G2.	<p>A cost evaluation of each alternative, including estimated costs for construction and operation of a Dry Cask Storage Facility, should be a part of the subject EA.</p>	<p>Cost evaluation is an ongoing programmatic action. However, cost evaluation is not required for environmental decision making and will not be evaluated in this EA.</p>
	<b>Specific Comments</b>	
S1.	<p>Page x, line 17 This line reads "it would be affected by the proposed action." It should read "it would not be affected by the proposed action."</p>	<p>This change has been incorporated into the text on Page xi.</p>
S2.	<p>Page 1, Section 1.1 Purpose and Need for Action ¶ 4 Please provide additional detailed information to justify the need for construction of a dry cask SNF storage facility.</p> <p>In addition to other details, explain how long the facility may be needed to enable continued operation of the High Flux Isotope Reactor (HFIR), and why the current eight SNF storage areas at ORNL are not sufficient to implement the Record of Decision for SNF.</p>	<p>The EA has been revised to clarify that the construction of the Dry Cask Storage Facility is a contingency to ensure adequate on-site storage capacity for SNF should off-site shipments be blocked in the future. These changes were made in the Summary (Page ix); Section 1.1 (Pages 1 and 3); and Section 2.2 (Page 11).</p> <p>The dry cask storage facility will not be needed if shipments of HFIR SNF are not interrupted. HFIR SNF can only be stored on site in the HFIR pool.</p>
S3.	<p>Page 1, lines 28 - 30 It should be clearly stated that racking of the High Flux Isotope Reactor (HFIR) pool must be completed in order to allow continued reaction operation until the year 2001 if no spent nuclear fuel (SNF) is moved from the pool.</p>	<p>Section 1.1 (Page 1) has been revised to emphasize the importance of reracking.</p>

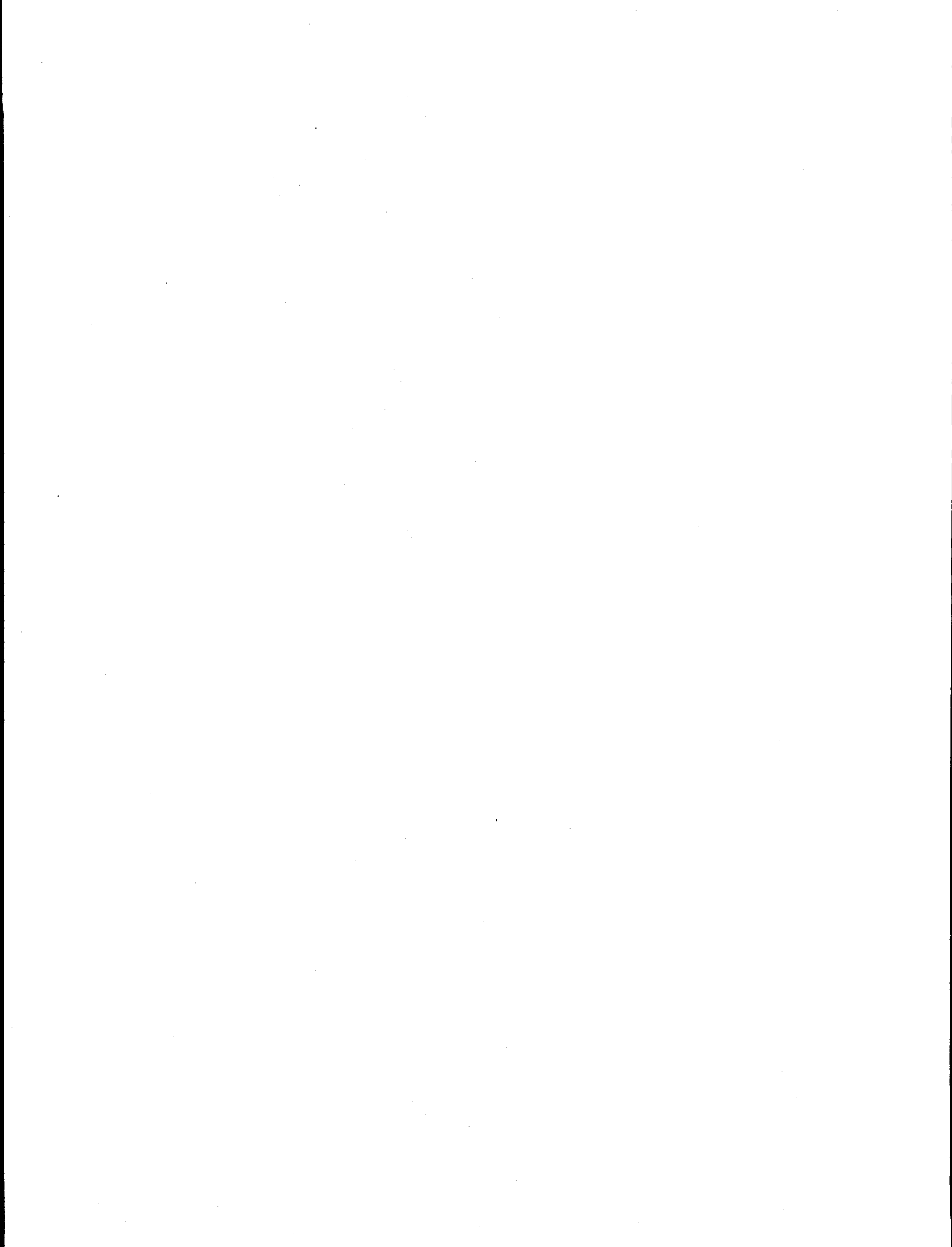
Response to Comments, page 2

S4.	Page 1, line 30 The year-by-year costs of HFIR reracking should be included in the EA to ensure budget requirements for that activity are not overlooked.	This is a programmatic cost for the HFIR Program that is continuing to evolve and is therefore not appropriate for inclusion in the EA.
S5.	Page 4, Table 1.1 and Page 7, Table 1.2 Reference a. "Sources: DOE 1995, Appendix F" contains outdated SNF inventory figures; therefore, that reference should be deleted.	This reference is part of the source information and needs to stay referenced in the EA.
S6.	Page 8, Section 1.2.2 Numbers 3 & 4 Provide information on why buildings 4501 High-Level Radiochemical Laboratory, and 3042 the Oak Ridge Research Reactor were excluded as SNF storage facilities beyond the scope of this document.	Section 1.2.2 (Page 7) has been revised to emphasize that SNF no longer exists in these buildings.
S7.	Page 9, Paragraph under third bullet Please define "timely fashion" in regard to when the dry cask storage facility would be constructed if SNF could be shipped to SRS or INEL.	Section 1.3 (Page 9) has been revised to define "timely fashion."
S8.	Page 10, Section 2.2 "Proposed Action (Preferred Alternative)" Line 28 Insert "HFIR" before reactor operations.  Also, a statement should be added that clearly explains that a dry cask storage facility will not be constructed unless absolutely needed for continued operation of the HFIR reactor.	The text in Section 2.2 (Pages 11 and 12) has been revised and a statement added concerning the dry cask storage facility.
S9.	Page 10, Section 2.2.1 "Dry Cask Storage Facility Construction" Reference the codes and standards to which the SNF Dry Cask Storage Facility would be constructed.	Applicable codes and standards for the design of the Dry Cask Storage Facility would be addressed at the time of facility design.
S10.	Page 11, Line 4 Insert "HFIR" before SNF and,  delete "or INEL."	This would be incorrect since SNF from facilities other than HFIR have contributed to the SNF inventory in Oak Ridge.  Both SRS and INEL are potential sites for ORNL SNF shipments; therefore, the reference to INEL should not be deleted.



Response to Comments, page 3

S11.	Page 11, Line 33 This line read "... before the reracked pool is full." It should read "... before the reracked HFIR pool is full.	The text has been revised (Page 14).
S12.	Page 20, Section 3.1.2.5 Terrestrial Ecology/Land Use, Paragraph 3 Please clarify the phrase "proposed critical habitat."	The term "proposed critical habitat"* has been defined in the Glossary (Page A-3).
S13.	Page 42, Section 4.5.7 Historical and Archeological Resources Please clarify if archeological and historical surveys have been completed in Melton Valley.  Also, provide correspondence from State Historical Preservation Officer stating a position for the proposed project.	The text has been revised on Page 46. Archaeological surveys have been completed for the site and the consultation letter from SHPO has been included in Appendix E.



# **FINDING OF NO SIGNIFICANT IMPACT**

## **Management of Spent Nuclear Fuel on the Oak Ridge Reservation Oak Ridge, Tennessee**

**AGENCY:** U.S. DEPARTMENT OF ENERGY

**ACTION:** FINDING OF NO SIGNIFICANT IMPACT

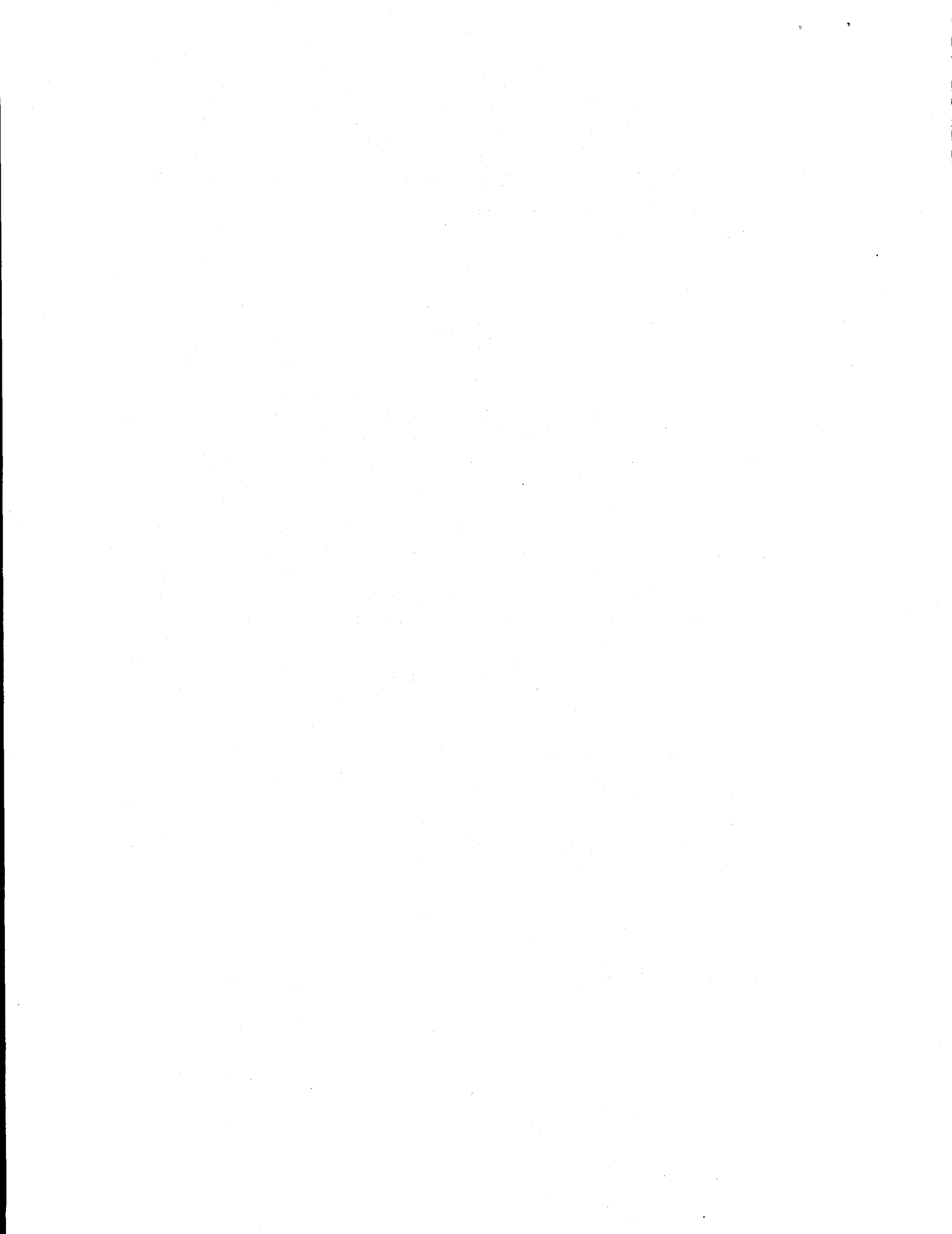
**SUMMARY:** The U.S. Department of Energy (DOE) has completed an environmental assessment (DOE/EA-1117) of the proposed management of spent nuclear fuel (SNF) on the DOE Oak Ridge Reservation (ORR). On June 1, 1995, the DOE issued a Record of Decision (ROD) [60 *Federal Register* 28680] based on the analyses presented in a programmatic environmental impact statement (PEIS) for the Department-wide management of SNF. To implement the ROD, ORR SNF would be retrieved from storage; transferred by truck to a hot-cell facility, if segregation by fuel type and/or repackaging is required; loaded into containers/transport casks that meet regulatory requirements; and shipped via truck to off-site storage at either the Savannah River Site or the Idaho National Engineering Laboratory. The proposed action may also include construction and maintenance of a SNF dry cask storage facility on the ORR to enable reactor operations to continue in the event of an interruption of offsite SNF shipments. Based on the results of the analysis reported in the EA, DOE has determined that the proposed action is not a major Federal action that would significantly affect the quality of the human environment within the context of the National Environmental Policy Act of 1969 (NEPA). Therefore, preparation of an environmental impact statement (EIS) is not necessary, and DOE is issuing this Finding of No Significant Impact (FONSI).

**PUBLIC AVAILABILITY OF EA AND FONSI:** The EA and FONSI may be reviewed at and copies of the documents obtained from:

U.S. Department of Energy  
Public Reading Room  
55 Jefferson Circle  
Oak Ridge, Tennessee 37830  
Phone: (423) 241-4780.

**INFORMATION ON THE NEPA PROCESS:** For further information on the NEPA process, contact:

Patricia W. Phillips  
NEPA Compliance Officer  
U.S. Department of Energy  
P. O. Box 2001  
Oak Ridge, Tennessee 37831  
Phone: (423) 576-4200.



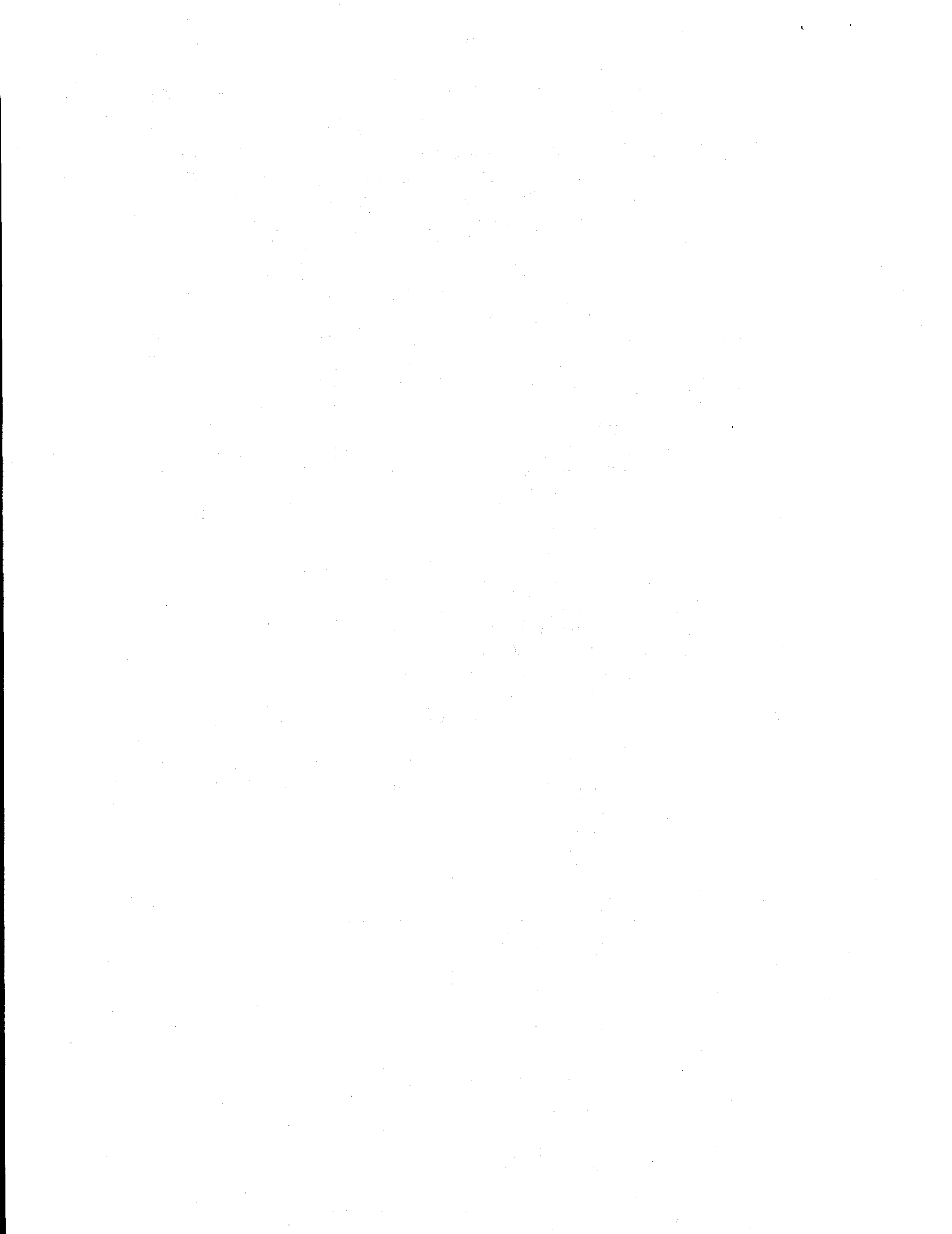
**BACKGROUND:** On June 1, 1995, the U.S. Department of Energy (DOE) issued a Record of Decision (ROD) [60 *Federal Register* 28680] based on the analyses presented in a programmatic environmental impact statement (PEIS) for the Department-wide management of spent nuclear fuel (SNF). In the ROD, DOE selected "regionalized storage of SNF by fuel type" as the preferred alternative. Implementation of the preferred alternative would require that aluminum-clad SNF from the DOE complex be transported for storage at the DOE Savannah River Site in South Carolina and non-aluminum-clad SNF, except for production reactor fuel from Hanford, be transported for storage at the DOE Idaho National Engineering Laboratory, pending final disposition.

The proposed action is the management of SNF on the DOE Oak Ridge Reservation (ORR) to implement the preferred alternative of regional storage. To implement the ROD, ORR SNF would be retrieved from storage; transferred by truck to a hot-cell facility, if segregation by fuel type and/or repackaging is required; loaded into containers/transport casks that meet regulatory requirements; and shipped via truck to off-site storage at either the Savannah River Site or the Idaho National Engineering Laboratory. Transport from Oak Ridge to off-site storage and impacts at off-site storage locations were evaluated in the PEIS; thus, they are not part of the proposed action addressed in this EA. The proposed action may also include construction and operation of a dry cask SNF storage facility on the ORR to enable reactor operations to continue in the event of an interruption of off-site SNF shipment.

**ALTERNATIVES:** A no-action alternative was evaluated. If no action is taken, neither construction of a dry cask storage facility nor shipment of SNF from the ORR would occur. SNF would remain in present storage locations on the ORR. Because of limited storage space, operations on the ORR that generate SNF would have to cease, including operation of the High Flux Isotope Reactor, which produces radioisotopes for medical applications.

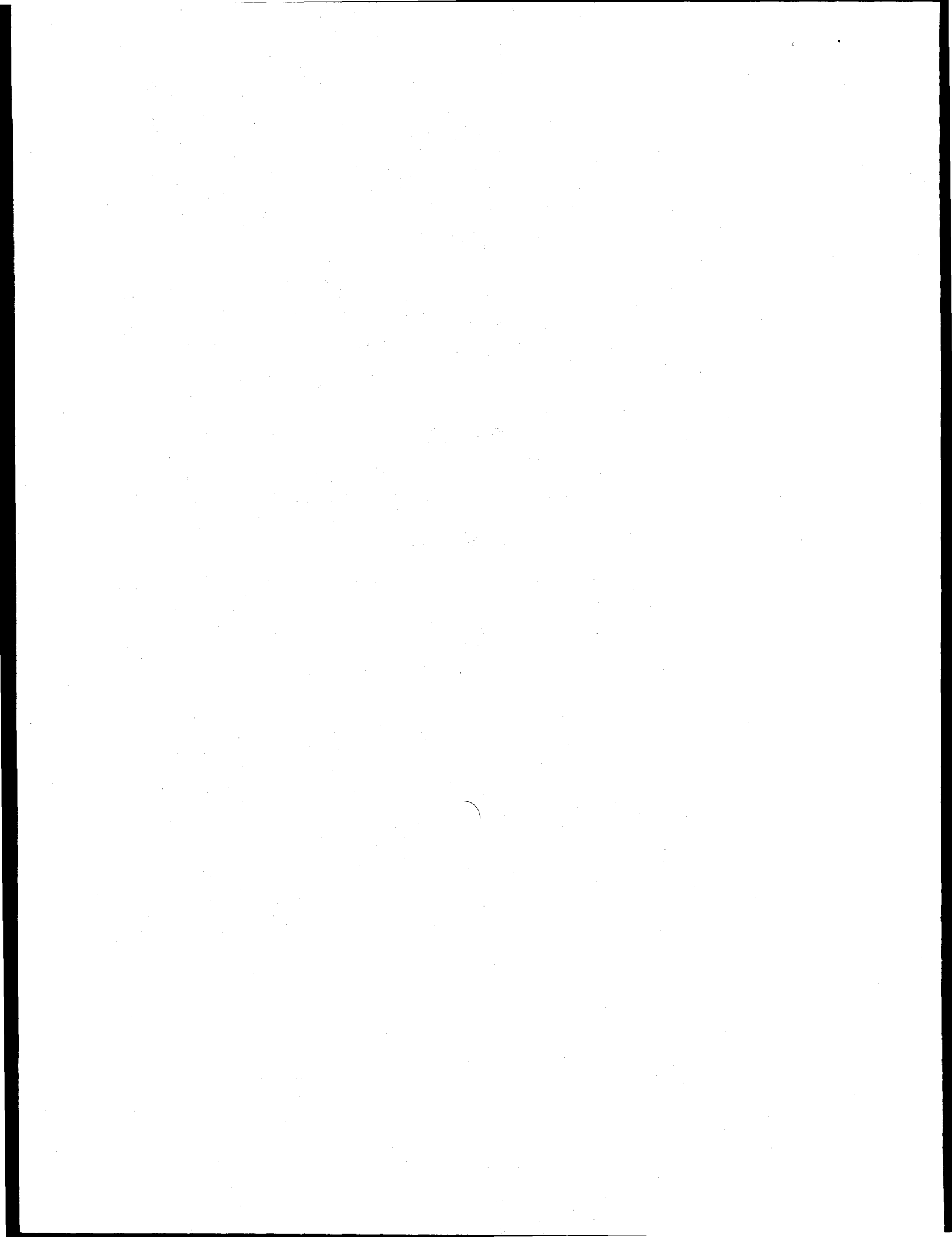
**ENVIRONMENTAL IMPACTS:** Impact analyses resulted in the following findings:

- Up to 3 acres of land would be cleared at the site of the dry cask storage facility. This loss of less than 0.05% of the pine forest on the ORR would reduce a minimal amount of wildlife habitat, but would contribute to cumulative impacts resulting from forest loss as other projects on the ORR remove similar habitat. The relative loss of habitat from the proposed action is quite small.
- No federal- and state- listed, threatened, or endangered species of plants or animals, and critical habitat would be affected by land disturbance, construction, and transport operations.
- Exposure to radioactivity during on-site transportation of SNF associated with segregating, repackaging, and storage activities would result in  $1.36 \times 10^{-4}$  (0.000136) fatal cancers in workers and  $4.28 \times 10^{-6}$  (0.00000428) fatal cancers in the general public. These risks are less than one-tenth of the DOE annual limit for occupational radiological exposure, which would result in a risk of  $2 \times 10^{-3}$  (0.002) fatal cancers, and the cancer



fatality risk associated with annual exposure to background radiation, which is approximately  $2 \times 10^{-4}$  (0.0002).

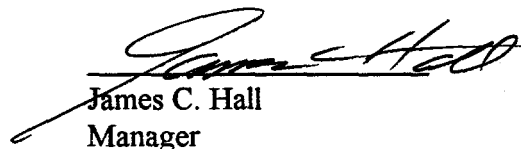
- Stored SNF at the dry cask storage facility would result in annual worker radiological doses less than DOE's limit of 5 rem and as-low-as-reasonably-achievable level of 0.025 Mev/h (2.5 mrem/h). Public doses would be negligible.
- Accidents involving handling the SNF would result in a cancer fatality risk to the maximally exposed individual (public) and to the worker of  $9.6 \times 10^{-7}$  and  $1.9 \times 10^{-7}$  (0.00000096 and 0.00000019), respectively. This risk is quite small in comparison with general population cancer risk of  $2 \times 10^{-4}$  (0.0002) fatalities from exposure to background radiation.
- Clean Air Act-regulated pollutant emissions generated during handling and onsite transport would include small quantities of fugitive dust, sulfur dioxide, nitrogen oxides, unburned hydrocarbons, and carbon monoxide from vehicle exhaust emissions, and from earth disturbance during construction of a dry cask storage facility as well as truck traffic. These emissions would temporarily increase onsite pollutant concentrations, but this effect would be temporary, and offsite pollutant concentrations would not be affected because of dispersal in the atmosphere as distance increases from the source.
- Because there would be no effluents discharged during the proposed action, there would be no direct impacts to water resources. Indirect effects of erosion and sedimentation to streams during earth disturbance for construction of a dry cask storage facility would be minimized by the implementation of Best Management Practices, such as the use of straw barriers and silt fences.
- There are no archaeological and historic sites, prime farmlands, wetlands, or floodplains at or near the proposed site for the dry cask facility. Handling and transport of SNF on the ORR would not affect any of these resources.
- The current pool of ORR workers would provide labor for the proposed action. Therefore, the local employment and economy would not be affected.
- The nearest minority and economically disadvantaged population is located in the city of Oak Ridge, approximately 8 miles from ORNL facilities. Because impacts of the proposed action would be concentrated at ORNL facilities and no offsite impacts are expected, there would be no environmental justice issues associated with the proposed action.





**DETERMINATION:** Based on the findings of the environmental assessment and Finding of No Significant Impact, DOE has determined that the proposed management of spent nuclear fuel on the Oak Ridge Reservation does not constitute a major Federal action that would significantly affect the quality of the human environment within the context of the National Environmental Policy Act. Therefore, preparation of an environmental impact statement is not required.

Issued at Oak Ridge, Tennessee, this \_\_\_\_ day of \_\_\_\_ 1996.



James C. Hall

Manager

U.S. Department of Energy

Oak Ridge Operations Office

Oak Ridge, Tennessee

