
52-4

"Tritium Supply
& Recycling"



Final Programmatic Environmental Impact Statement (PEIS) for Tritium Supply and Recycling

TABLE OF CONTENTS

<u>COVER SHEET</u>
<u>List of Figures</u>
<u>List of Tables</u>
<u>Acronyms</u>
<u>EXECUTIVE SUMMARY</u>
<u>Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling</u>
<u>SUMMARY</u>
<u>CHAPTER 1: INTRODUCTION</u>
<u>1.1 The Tritium Supply and Recycling Proposal</u>
<u>1.2 Compliance with the National Environmental Policy Act for Tritium Supply an</u>
<u>1.3 Time Period Considered in Analysis</u>
<u>1.4 Background</u>
<u>1.5 Other National Environmental Policy Act Reviews</u>
<u>1.6 Program Changes</u>
<u>1.7 Public Participation</u>
<u>1.8 Organization of the Programmatic Environmental Impact Statement</u>
<u>1.9 Preparation of the Programmatic Environmental Impact Statement</u>
<u>CHAPTER 2: PURPOSE OF AND NEED FOR THE DEPARTMENT OF ENERGY'S ACTION</u>
<u>2.1 Purpose of and Need for the Department of Energy's Action</u>
<u>CHAPTER 3: TRITIUM SUPPLY AND RECYCLING ALTERNATIVES</u>
<u>3.1 Development of Tritium Supply and Recycling Alternatives</u>
<u>3.2 Tritium Supply and Recycling Alternatives</u>
<u>3.3 Candidate Sites</u>
<u>3.4 Tritium Supply Technologies and Recycling</u>
<u>3.5 Pollution Prevention and Waste Minimization</u>
<u>3.6 Comparison of Tritium Supply and Recycling Alternatives</u>
<u>3.7 Agency Preferred Alternative</u>
<u>CHAPTER 4: AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS</u>
<u>4.1 Environmental Resource Methodologies</u>
<u>4.2 Idaho National Engineering Laboratory</u>
<u>4.3 Nevada Test Site</u>
<u>4.4 Oak Ridge Reservation</u>
<u>4.5 Pantex Plant</u>
<u>4.6 Savannah River Site</u>
<u>4.7 Intersite Transport of Tritium Supply and Recycling Materials</u>
<u>4.8 Potential Impacts From Tritium Supply Options</u>
<u>4.9 Cumulative Impacts</u>
<u>4.10 Commercial Light Water Reactor Alternative and/or Contingency</u>
<u>4.11 Producing Tritium at an Earlier Date</u>
<u>4.12 Unavoidable Adverse Environmental Impacts</u>
<u>4.13 Relationship Between Local Short-Term Uses of the Environment and the Maint</u>
<u>4.14 Irreversible and Irrecoverable Commitments of Resources</u>
<u>4.15 Facility Transition</u>
<u>4.16 Environmental Justice in Minority and Low-Income Populations</u>
<u>CHAPTER 5: ENVIRONMENTAL, OCCUPATIONAL SAFETY & HEALTH PERMITS AND COMPLIANCE REC</u>
<u>5.1 Introduction and Purpose</u>
<u>5.2 Background</u>
<u>5.3 Environmental Statutes, Orders, and Agreements</u>
<u>5.4 Federal and State Environmental Enforcement</u>
<u>5.5 Compliance with Occupational Safety and Health Requirements</u>
<u>CHAPTER 6: REFERENCES</u>
<u>CHAPTER 7: LIST OF PREPARERS</u>

CHAPTER 8: LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THIS STATEMENT ARE BEING PROVIDED

CHAPTER 9: GLOSSARY

CHAPTER 10: INDEX

Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling
DOE/EIS-0161 Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling

CHAPTER 1: ISSUE CATEGORIES

CHAPTER 2: COMMENT DOCUMENTS

CHAPTER 3: COMMENT SUMMARIES AND RESPONSES





Final Programmatic Environmental Impact Statement (PEIS) for Tritium Supply and Rec

DOE/EIS-0161

Final Programmatic
Environmental Impact Statement
for Tritium Supply and Recycling

Executive Summary

United States Department of Energy
Office of Reconfiguration

October 1995

Department of Energy
Washington, DC 20585
October 19, 1995

Dear Interested Party:

The Final Programmatic Environmental Impact Statement (PEIS) for Tritium Supply and Recycling has now been completed. Tritium is an essential component of every warhead in the current and projected United States nuclear weapons stockpile. Tritium decays at a rate of 5.5 percent per year and must be replaced periodically as long as the Nation relies on a nuclear deterrent. In accordance with the Atomic Energy Act of 1954, as amended, the Department of Energy is responsible for developing and maintaining the capability to produce nuclear materials such as tritium. Currently, the Department does not have the capability to produce tritium in the required amounts.

The Tritium Supply and Recycling PEIS evaluates the siting, construction, and operation of tritium supply technology alternatives and recycling facilities at each of five candidate sites. The PEIS also evaluates the use of a commercial reactor for producing tritium.

On October 10, 1995, the Department announced its preferred alternative, a dual-track strategy under which the Department would begin work on two promising production options: use of an existing commercial light water reactor and construction of a linear accelerator. The Savannah River Site in South Carolina has been identified as the preferred site for an accelerator, should one be constructed. Details on this preferred alternative can be found in the Executive Summary and in section 3.7 of Volume I of the PEIS. A Record of Decision will follow in late November.

The Department of Energy appreciates your continued participation in this Program.

Sincerely,

Stephen M. Sohinki, Director
Office of Reconfiguration





List of Figures

- Figure S-1 Current and Former Nuclear Weapons Complex Sites.
- Figure S-2 Tritium Supply and Recycling Alternatives.
- Figure 1.4-1 Current and Former Nuclear Weapons Complex Sites.
- Figure 1.4.1-1 Nuclear Weapons Stockpile Memorandum Process.
- Figure 1.4.2-1 Evolution of the Reconfiguration Program, 1991-1995.
- Figure 1.7.2-1 Public Hearing Locations and Dates, 1995.
- Figure 2.1-1 Estimated Tritium Inventory and Reserve Requirements.
- Figure 3.2-1 Tritium Supply and Recycling Alternatives.
- Figure 3.3.1-1 Site Selection Process.
- Figure 3.4.1-1 Tritium Supply and Recycling Complex.
- Figure 3.4.2.1-1 Heavy Water Reactor Facility (Typical).
- Figure 3.4.2.2-1 Modular High Temperature Gas-Cooled Reactor Facility (Typical).
- Figure 3.4.2.3-1 Advanced Light Water Reactor Facility (Typical).
- Figure 3.4.2.4-1 Accelerator Production of Tritium Facility Site Layout (Typical).
- Figure 3.4.3.1-1 New Tritium Recycling Facility (Typical).
- Figure 3.4.3.2-1 Tritium Recycling Facilities Upgrades at Savannah River Site (Gene
- Figure 4.2-1 Idaho National Engineering Laboratory, Idaho, and Region.
- Figure 4.2.1-1 Primary Facilities and Proposed Tritium Supply Site at Idaho National Engineering Laboratory.
- Figure 4.2.2.1-1 Generalized Land Use at Idaho National Engineering Laboratory and
- Figure 4.2.2.4-1 Surface Water Features at Idaho National Engineering Laboratory.
- Figure 4.2.2.4-2 Generalized Groundwater Flow and Groundwater Contamination in Idaho National Engineering Laboratory Area.
- Figure 4.2.2.5-1 Major Fault Systems and Historic Earthquakes in Idaho National Eng Laboratory Region.
- Figure 4.2.2.5-2 Seismic Zone Map of the United States.
- Figure 4.2.2.6-1 Distribution of Plant Communities at Idaho National Engineering La
- Figure 4.2.2.8-1 Economy for Idaho National Engineering Laboratory Regional Economi
- Figure 4.2.2.8-2 Population and Housing for Idaho National Engineering Laboratory R Influence [Page 1 of 2].
- Figure 4.2.2.8-2 Population and Housing for Idaho National Engineering Laboratory R

Influence [Page 2 of 2].

- Figure 4.2.2.8-3 1992 Local Government Public Finance for Idaho National Engineering Laboratory Region of Influence.
- Figure 4.2.3.8-1 Total Project-Related Employment (Direct and Indirect) and Percent Over No Action from Tritium Supply Technologies and Recycling for National Engineering Laboratory Regional Economic Area.
- Figure 4.2.3.8-2 Unemployment Rate, Per Capita Income, and Percentage Increase from Supply Technologies and Recycling for Idaho National Engineering Laboratory Regional Economic Area.
- Figure 4.2.3.8-3 Population and Housing Percentage Increase Over No Action During Peak Construction from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence, 2005.
- Figure 4.2.3.8-4 Population and Housing Percentage Increase Over No Action at Full Operation from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence, 2010.
- Figure 4.2.3.8-5 City and County Total Revenues and Expenditures Percentage Increase Over No Action During Peak Construction from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence.
- Figure 4.2.3.8-6 County and City Total Revenues and Expenditures Percentage Increase Over No Action at Full Operation from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence, 2010.
- Figure 4.2.3.8-7 School District Total Revenues and Expenditures Percentage Increase Over No Action During Peak Construction from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence.
- Figure 4.2.3.8-8 School District Total Revenues and Expenditures Percentage Increase Over No Action at Full Operation from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence, 2010.
- Figure 4.2.3.9-1 High Consequence Accident-Cancer Fatalities Complementary Cumulative Distribution Functions for Tritium Supply and Recycling Severe Accident for Idaho National Engineering Laboratory.
- Figure 4.3-1 Nevada Test Site, Nevada, and Region.
- Figure 4.3.1-1 Primary Facilities, Proposed Tritium Supply Site, and Testing Areas at Nevada Test Site.
- Figure 4.3.2.1-1 Generalized Land Use at Nevada Test Site and Vicinity.
- Figure 4.3.2.4-1 Groundwater Hydrologic Units at Nevada Test Site and Vicinity.
- Figure 4.3.2.5-1 Major Fault Systems and Historic Earthquakes in Nevada Test Site Region.
- Figure 4.3.2.6-1 Distribution of Plant Communities at Nevada Test Site.
- Figure 4.3.2.6-2 Distribution of Desert Tortoise at Nevada Test Site.
- Figure 4.3.2.8-1 Economy for Nevada Test Site Regional Economic Area.
- Figure 4.3.2.8-2 Population and Housing for Nevada Test Site Region of Influence.
- Figure 4.3.2.8-3 1992 Local Government Public Finance for Nevada Test Site Region of Influence.
- Figure 4.3.3.8-1 Total Project-Related Employment (Direct and Indirect) and Percent Over No Action from Tritium Supply Technologies and Recycling for Nevada Test Site Regional Economic Area.

over No Action from Tritium Supply Technologies and Recycling for Test Site Regional Economic Area.

Figure 4.3.3.8-2 Unemployment Rate, Per Capita Income, and Percentage Increase over from Tritium Supply Technologies and Recycling for Nevada Test Site Economic Area.

Figure 4.3.3.8-3 Total Population and Housing Percentage Increase over No Action During Construction from Tritium Supply Technologies and Recycling for Nevada Test Site Region of Influence, 2005.

Figure 4.3.3.8-4 Total Population and Housing Percentage Increase over No Action at Operation from Tritium Supply Technologies and Recycling for Nevada Test Site Region of Influence, 2010.

Figure 4.3.3.8-5 County, City, and School District Total Revenues and Expenditures Increase over No Action During Peak Construction from Tritium Supply Technologies and Recycling for Nevada Test Site Region of Influence.

Figure 4.3.3.8-6 County, City, and School District Total Revenues and Expenditures Increase over No Action at Full Operation from Tritium Supply Technologies and Recycling for Nevada Test Site Region of Influence, 2010.

Figure 4.3.3.9-1 High Consequence Accident-Cancer Fatalities Complementary Cumulative Distribution Functions for Tritium Supply and Recycling Severe Accident at Nevada Test Site.

Figure 4.4-1 Oak Ridge Reservation, Tennessee, and Region.

Figure 4.4.1-1 Primary Facilities and Proposed Tritium Supply Site at Oak Ridge Reservation.

Figure 4.4.2.1-1 Generalized Land Use at Oak Ridge Reservation and Vicinity.

Figure 4.4.2.1-2 Future Land Use at Oak Ridge Reservation, Oak Ridge, Tennessee.

Figure 4.4.2.4-1 Surface Water Features at Oak Ridge Reservation.

Figure 4.4.2.6-1 Distribution of Plant Communities at Oak Ridge Reservation.

Figure 4.4.2.8-1 Economy for Oak Ridge Reservation Regional Economic Area.

Figure 4.4.2.8-2 Population and Housing for Oak Ridge Reservation Region of Influence.

Figure 4.4.2.8-3 1992 Local Government Public Finance for Oak Ridge Reservation Region of Influence.

Figure 4.4.3.8-1 Total Project-Related Employment (Direct and Indirect) and Percent Increase Over No Action from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Regional Economic Area.

Figure 4.4.3.8-2 Unemployment Rate, Per Capita Income, and Percentage Increase Over No Action from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Regional Economic Area.

Figure 4.4.3.8-3 Total Population and Housing Percentage Increase Over No Action During Construction from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Region of Influence, 2005.

Figure 4.4.3.8-4 Total Population and Housing Percentage Increase Over No Action at Operation from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Region of Influence, 2010.

Figure 4.4.3.8-5 County, City, and School District Total Revenues and Expenditures Increase Over No Action During Peak Construction from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Region of Influence.

Technologies and Recycling for Oak Ridge Reservation Region of Inf

- Figure 4.4.3.8-6 County, City, and School District Total Revenues and Expenditures Increase Over No Action at Full Operation from Tritium Supply Tech Recycling for Oak Ridge Reservation Region of Influence, 2010.
- Figure 4.4.3.9-1 High Consequence Accident-Cancer Fatalities Complementary Cumulati Distribution Functions for Tritium Supply and Recycling Severe Acc Ridge Reservation.
- Figure 4.5-1 Pantex Plant, Texas, and Region.
- Figure 4.5.1-1 Primary Facilities, Proposed Tritium Supply Sites, and Testing Areas Plant.
- Figure 4.5.2.1-1 Generalized Land Use at Pantex Plant and Vicinity.
- Figure 4.5.2.1-2 Future Land Use at Pantex Plant.
- Figure 4.5.2.1-3 Designated Industrial Sites at Pantex Plant.
- Figure 4.5.2.4-1 Potentiometric Surface of the Ogallala Aquifer at Pantex Plant.
- Figure 4.5.2.8-1 Economy for Pantex Plant Regional Economic Area.
- Figure 4.5.2.8-2 Population and Housing for Pantex Plant Region of Influence.
- Figure 4.5.2.8-3 1992 Local Government Public Finance for Pantex Plant Region of In
- Figure 4.5.3.8-1 Total Project-Related Employment (Direct and Indirect) and Percent Over No Action from Tritium Supply Technologies and Recycling for Plant Regional Economic Area.
- Figure 4.5.3.8-2 Unemployment Rate, Per Capita Income, and Percentage Increase Over No Action from Tritium Supply Technologies and Recycling for Pante Regional Economic Area.
- Figure 4.5.3.8-3 Total Population and Housing Percentage Increase over No Action Du Construction from Tritium Supply Technologies and Recycling for Pa Region of Influence, 2005.
- Figure 4.5.3.8-4 Total Population and Housing Percentage Increase over No Action at Operation from Tritium Supply Technologies and Recycling for Pante Region of Influence, 2010.
- Figure 4.5.3.8-5 County and City Total Revenues and Expenditures Percentage Increas No Action During Peak Construction from Tritium Supply Technologie Recycling for Pantex Plant Region of Influence, 2005.
- Figure 4.5.3.8-6 County and City Total Revenues and Expenditures Percentage Increas No Action at Full Operation from Tritium Supply Technologies and R Pantex Plant Region of Influence, 2010.
- Figure 4.5.3.8-7 School District Total Revenues and Expenditures Percentage Increas No Action During Peak Construction from Tritium Supply Technologie Recycling for Pantex Plant, 2005.
- Figure 4.5.3.8-8 School District Total Revenues and Expenditures Percentage Increas No Action at Full Operation from Tritium Supply Technologies and R Pantex Plant, 2010.
- Figure 4.5.3.9-1 High Consequence Accident-Cancer Fatalities Complementary Cumulati Distribution Functions for Tritium Supply and Recycling Severe Acc Pantex Plant.

- Figure 4.6-1 Savannah River Site, South Carolina, and Region.
- Figure 4.6.1-1 Primary Facilities and Proposed Tritium Supply Site at Savannah River
- Figure 4.6.2.1-1 Generalized Land Use at Savannah River Site and Vicinity.
- Figure 4.6.2.4-1 Surface Water Features and Groundwater Contamination Areas at Savannah River Site.
- Figure 4.6.2.6-1 Distribution of Plant Communities at Savannah River Site.
- Figure 4.6.2.8-1 Economy for Savannah River Site Regional Economic Area.
- Figure 4.6.2.8-2 Population and Housing for Savannah River Site Region of Influence
- Figure 4.6.2.8-3 1992 Local Government Public Finance for Savannah River Site Region of Influence.
- Figure 4.6.3.8-1 Total Project-Related Employment (Direct and Indirect) and Percent Over No Action from Tritium Supply Technologies with Recycling Upgrade for Savannah River Site Regional Economic Area.
- Figure 4.6.3.8-2 Unemployment Rate, Per Capita Income, and Percentage Increase Over No Action from Tritium Supply Technologies and Recycling Upgrade for Savannah River Site Regional Economic Area.
- Figure 4.6.3.8-3 Total Employment, Unemployment Rate, and Per Capita Income for No and Tritium Recycling Phaseout for Savannah River Site Regional Economic Area, 2010.
- Figure 4.6.3.8-4 Total Population and Housing Percentage Increase Over No Action During Peak Construction from Tritium Supply Technologies and Recycling Upgrade for Savannah River Site Region of Influence, 2005.
- Figure 4.6.3.8-5 Total Population and Housing Percentage Increase Over No Action at Full Operation from Tritium Supply Technologies and Recycling Upgrade for Savannah River Site Region of Influence, 2010.
- Figure 4.6.3.8-6 Total Population and Housing Percentage Decrease Under No Action from Tritium Recycling Phaseout for Savannah River Site Region of Influence, 2010.
- Figure 4.6.3.8-7 County and City Total Revenues and Expenditures Percentage Decrease Under No Action for the Tritium Recycling Phaseout for Savannah River Site Region of Influence, 2010.
- Figure 4.6.3.8-8 County and City Revenues and Expenditures Percentage Increase Over No Action During Peak Construction from Tritium Supply Technologies and Recycling Upgrade for Savannah River Site Region of Influence, 2005.
- Figure 4.6.3.8-9 County and City Revenues and Expenditures Percentage Increase Over No Action at Full Operation from Tritium Supply Technologies and Recycling Upgrade for Savannah River Site Region of Influence, 2010.
- Figure 4.6.3.8-10 School District Total Revenues and Expenditures Percentage Increase Over No Action During Peak Construction from Tritium Supply Technologies and Recycling Upgrade for Savannah River Site Region of Influence, 2005.
- Figure 4.6.3.8-11 School District Total Revenues and Expenditures Percentage Increase Over No Action at Full Operation from Tritium Supply Technologies and Recycling Upgrade for Savannah River Site Region of Influence, 2010.
- Figure 4.6.3.8-12 School District Total Revenues and Expenditures Percentage Decrease Under No Action from the Tritium Recycling Phaseout for Savannah River Site Region of Influence, 2010.

of Influence, 2010.

Figure 4.6.3.9-1 High Consequence Accident-Cancer Fatalities Complementary Cumulative Distribution Functions for Tritium Supply and Recycling Severe Accident Savannah River Site.

Figure 4.8.3.1-1 Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility Plan

Figure 4.8.3.1-2 Manufacturing Building Layout Plan.

Figure 4.10-1 Commercial Nuclear Power Plants Within Eleven Energy-Demand Regions of the United States.

Figure 4.10-2 Commercial Nuclear Power Plants with Design Electrical Rating Greater than 1,100 Megawatts Electric Within Eleven Energy-Demand Regions of the United States.

Figure 4.16-1 Minority Population Distribution for Idaho National Engineering Laboratory and Surrounding Area.

Figure 4.16-2 Low-Income Distribution by Poverty Status for Idaho National Engineering Laboratory and Surrounding Area.

Figure 4.16-3 Minority Population Distribution for Nevada Test Site and Surrounding Area

Figure 4.16-4 Low-Income Distribution by Poverty Status for Nevada Test Site and Surrounding Area.

Figure 4.16-5 Minority Population Distribution for Oak Ridge Reservation and Surrounding Area.

Figure 4.16-6 Low-Income Distribution by Poverty Status for Oak Ridge Reservation and Surrounding Area.

Figure 4.16-7 Minority Population Distribution for Pantex Plant and Surrounding Area

Figure 4.16-8 Low-Income Distribution by Poverty Status for Pantex Plant and Surrounding Area.

Figure 4.16-9 Minority Population Distribution for Savannah River Site and Surrounding Area

Figure 4.16-10 Low-Income Distribution by Poverty Status for Savannah River Site and Surrounding Area.

Figure A.2.1.1-1 Heavy Water Reactor Tritium Production Process.

Figure A.2.1.1-2 Heavy Water Reactor Facility (Typical).

Figure A.2.1.1-3 Heavy Water Reactor Waste Management System (Dry Site).

Figure A.2.1.1-4 Heavy Water Reactor Waste Management System (Wet Site).

Figure A.2.1.2-1 Modular High Temperature Gas-Cooled Reactor Tritium Production Process

Figure A.2.1.2-2 Modular High Temperature Gas-Cooled Reactor Facility (Typical).

Figure A.2.1.2-3 Modular High Temperature Gas-Cooled Reactor Waste Management System (Dry Site).

Figure A.2.1.2-4 Modular High Temperature Gas-Cooled Reactor Waste Management System (Wet Site).

Figure A.2.1.3-1 Advanced Light Water Reactor Tritium Production Process.

Figure A.2.1.3-2 Advanced Light Water Reactor Facility (Typical).

Figure A.2.1.3-3 Advanced Light Water Reactor Waste Management System (Dry Site).

Figure A.2.1.3-4 Advanced Light Water Reactor Waste Management System (Wet Site).

Figure A.2.1.4-1 Accelerator Production of Tritium Facility Functional Layout.

Figure A.2.1.4-2 Accelerator Production of Tritium Facility Site Layout (Typical).

Figure A.2.1.4-3 Accelerator Production of Tritium/Helium-3 Target System.

Figure A.2.1.4-4 Accelerator Production of Tritium/Spallation-Induced Lithium Conve Target System (Exploded).

Figure A.2.1.4-5 Flow Diagram for Accelerator Production of Tritium/Helium-3 Target

Figure A.2.1.4-6 Flow Diagram for Accelerator Production of Tritium/Spallation-Indu Lithium Conversion Target.

Figure A.2.2.1-1 New Tritium Recycling Facility (Typical).

Figure A.2.2.1-2 New Tritium Recycling Facility Processes.

Figure A.2.2.1-3 New Tritium Recycling Waste Management System Process (Dry Site).

Figure A.2.2.1-4 New Tritium Recycling Waste Management System Process (Wet Site).

Figure A.2.2.2-1 Tritium Recycling Facilities Upgrades at Savannah River Site (Generalized).

Figure A.2.2.2-2 Upgraded Tritium Recycling Facilities Processes.

Figure A.2.2.2-3 Upgraded Tritium Recycling Facilities Waste Management System.

Figure B.1.3.2-1 Wind Distribution at Idaho National Engineering Laboratory, 1986 (33-foot level).

Figure B.1.3.2-2 Ambient Air Quality Monitoring Network at Idaho National Engineeri Laboratory.

Figure B.1.3.3-1 Wind Distribution at Nevada Test Site, 1990 (33-foot level).

Figure B.1.3.4-1 Wind Distribution at Oak Ridge Reservation, 1990 (98-foot level).

Figure B.1.3.4-2 Ambient Air Quality Monitoring Network at Oak Ridge Reservation, Y-12 Plant.

Figure B.1.3.5-1 Wind Distribution at Pantex Plant, 1989 (33-foot level).

Figure B.1.3.6-1 Wind Distribution at Savannah River Site, 1985 (200-foot level).

Figure B.1.3.6-2 Ambient Air Quality Monitoring and Meteorological Stations at Sava River Site.

Figure E.2.4-1 Location of Maximum Receptors at Idaho National Engineering Laborato

Figure E.2.5-1 Location of Maximum Receptors at Nevada Test Site.

Figure E.2.6-1 Location of Maximum Receptors at Oak Ridge Reservation.

Figure E.2.7-1 Location of Maximum Receptors at Pantex Plant.

Figure E.2.8-1 Location of Maximum Receptors at Savannah River Site.

Figure F.2.1.1-1 High Consequence Accident-Cancer Fatality Frequency Distribution F for the Heavy Water Reactor.

Figure F.2.1.2-1 High Consequence Accident-Cancer Fatality Frequency Distribution F for the Modular High Temperature Gas-Cooled Reactor

Figure F.2.1.3.1-1 High Consequence Accident-Cancer Fatality Frequency Distribution for the Advanced Boiling Water Reactor.

Figure F.2.1.3.2-1 AP600 Advanced Light Water Reactor High Consequence Accident-Can Fatalities Complementary Cumulative Distribution Functions.

Figure F.2.1.3.2-1 High Consequence Accident-Cancer Fatality Frequency Distribution for the CE System 80+ Reactor.

Figure F.2.1.3.3-1 High Consequence Accident-Cancer Fatality Frequency Distribution for the AP600 Reactor.

Figure F.2.1.3.4-1 Simplified Boiling Water Reactor Cancer Fatalities Complementary Cumulative Distribution Functions for High Consequence Accidents

Figure F.2.1.4.2-1 High Consequence Accident-Cancer Fatality Frequency Distribution for the Full Size Accelerator Production of Tritium with Helium-

Figure F.2.1.4.3-1 High Consequence Accident-Cancer Fatality Frequency Distribution for the Full APT with Spallation-Induced Lithium Conversion Targ

Figure F.2.1.5.2-1 High Consequence Accident-Cancer Fatality Frequency Distribution for the Multipurpose Reactor Fuel Fabrication Facility.

Figure F.2.1.5.3-1 High Consequence Accident-Cancer Fatality Frequency Distribution for the Disassembly and Conversion Facility.

Figure F.2.1.6-1 High Consequence Accident-Cancer Fatality Frequency Distribution F for Tritium Extraction.

Figure F.2.3-1 Tritium Recycling Facility Cancer Fatalities Complementary Cumulative Distribution Functions for High Consequence Accident.

Figure F.3.1-1 Design-Basis Accident for Typical Reactor at Idaho National Engineer Laboratory (ground surface exposure-113 mrem per year).

Figure F.3.2-1 Design-Basis Accident for Typical Reactor at Nevada Test Site (ground surface exposure-78 mrem per year).

Figure F.3.3-1 Design-Basis Accident for Typical Reactor at Oak Ridge Reservation (ground surface exposure-67 mrem per year).

Figure F.3.4-1 Design-Basis Accident for Typical Reactor at Pantex Plant, Texas (ground surface exposure-107 mrem per year).

Figure F.3.5-1 Design-Basis Accident for Typical Reactor at Savannah River Site (ground surface exposure-76 mrem per year).

Figure H.2.1-1 Spent Nuclear Fuel Management at Idaho National Engineering Laborato

Figure H.2.1-2 High-Level Waste Management at Idaho National Engineering Laboratory

Figure H.2.1-3 Transuranic Waste Management at Idaho National Engineering Laborator

Figure H.2.1-4 Low-Level Waste Management at Idaho National Engineering Laboratory.

Figure H.2.1-5 Mixed Waste Management at Idaho National Engineering Laboratory.

Figure H.2.5-1 High-Level Waste Management Plan at Savannah River Site.

Figure H.2.5-2 Transuranic Waste Management Plan at Savannah River Site.

Figure H.2.5-3 F- and H-Areas Effluent Treatment Facility Waste Management Plan at Savannah River Site.

Figure H.2.5-4 Saltstone (Low-Level Waste) Disposal Plan at Savannah River Site.

Figure H.2.5-5 Low-Level Waste Management Plan at Savannah River Site.

Figure H.2.5-6 Mixed Waste Management Plan at Savannah River Site.

Figure H.2.5-7 Hazardous Waste Management Plan at Savannah River Site.

Figure H.2.5-8 Nonhazardous Solid Waste Management Plan at Savannah River Site.





List of Tables

Table 3.3.2-1	Current Missions at Idaho National Engineering Laboratory
Table 3.3.3-1	Current Missions at Nevada Test Site
Table 3.3.4-1	Current Missions at Oak Ridge Reservation
Table 3.3.5-1	Current Missions at Pantex Plant
Table 3.3.6-1	Current Missions at Savannah River Site
Table 3.4.2.1-1	Heavy Water Reactor Construction Requirements
Table 3.4.2.1-2	Heavy Water Reactor Operation Requirements
Table 3.4.2.1-3	Heavy Water Reactor Estimated Spent Nuclear Fuel and Waste Volumes
Table 3.4.2.2-1	Modular High Temperature Gas-Cooled Reactor Construction Requirements
Table 3.4.2.2-2	Modular High Temperature Gas-Cooled Reactor Operation Requirements
Table 3.4.2.2-3	Modular High Temperature Gas-Cooled Reactor Estimated Spent Nuclear Waste Volumes
Table 3.4.2.3-1	Advanced Light Water Reactor Construction Requirements
Table 3.4.2.3-2	Advanced Light Water Reactor Operation Requirements
Table 3.4.2.3-3	Advanced Light Water Reactor (Large) Estimated Spent Nuclear Fuel a Volumes
Table 3.4.2.3-4	Advanced Light Water Reactor (Small) Estimated Spent Nuclear Fuel a Volumes
Table 3.4.2.4-1	Accelerator Production of Tritium Construction Requirements
Table 3.4.2.4-2	Accelerator Production of Tritium Operation Requirements
Table 3.4.2.4-3	Accelerator Production of Tritium (Full) Estimated Waste Volumes
Table 3.4.2.4-4	Accelerator Production of Tritium (Phased) Estimated Waste Volumes
Table 3.4.2.4-5	Accelerator Production of Tritium Power Plant Construction Requirement
Table 3.4.2.4-6	Accelerator Production of Tritium Power Plant Operation Requirement
Table 3.4.3.1-1	New Tritium Recycling Facility Construction Requirements
Table 3.4.3.1-2	New Tritium Recycling Facility Operation Requirements
Table 3.4.3.1-3	New Tritium Recycling Facility Estimated Waste Volumes
Table 3.4.3.2-1	Upgraded Tritium Recycling Facilities Construction Requirements
Table 3.4.3.2-2	Upgraded Tritium Recycling Facilities Operation Requirements
Table 3.4.3.2-3	Upgraded Tritium Recycling Facilities (Unconsolidated-With Building Waste Volumes

Table 3.4.3.2-4	Upgraded Tritium Recycling Facilities (Consolidated-Without Buildin Waste Volumes
Table 3.4.3.3-1	Extraction Facility for Commercial Light Water Reactor Construction Requirements
Table 3.4.3.3-2	Extraction Facility for Commercial Light Water Reactor Operation Re
Table 3.4.3.3-3	Extraction Facility for Commercial Light Water Reactor Waste Volume
Table 3.4.3.3-4	Target Fabrication Facility for Commercial Light Water Reactor Cons Requirements
Table 3.4.3.3-5	Target Fabrication for Commercial Light Water Reactor Operation Req
Table 3.4.3.3-6	Target Fabrication for Commercial Light Water Reactor Waste Volumes
Table 3.6-1	Summary Comparison of Environmental Impacts of Tritium Supply and Recyc Alternatives
Table 3.6-2	Summary Comparison of Environmental Impacts of the Commercial Light Wat Reactor Alternative
Table 4.2.2.2-1	Baseline Characteristics for Idaho National Engineering Laboratory
Table 4.2.2.2-2	Subregional Power Pool Electrical Summary for Idaho National Engine Laboratory
Table 4.2.2.3-1	Comparison of Baseline Ambient Air Concentrations with Most Stringe Applicable Regulations and Guidelines at Idaho National Engineering 1989-1991
Table 4.2.2.4-1	Summary of Surface Water Quality Monitoring Data for Big Lost River National Engineering Laboratory, 1985
Table 4.2.2.4-2	Groundwater Quality Monitoring Data at Idaho National Engineering L 1990-1991
Table 4.2.2.5-1	The Modified Mercalli Scale of 1931, with Approximate Correlations Scale and Maximum Ground Acceleration
Table 4.2.2.6-1	Federal and State-Listed Threatened, Endangered, and Other Special Species That May Be Found On the Site or In the Vicinity of the Pro Supply Site at Idaho National Engineering Laboratory
Table 4.2.2.9-1	Sources of Radiation Exposure to Individuals in the Vicinity, Unrel National Engineering Laboratory Operations, 1992
Table 4.2.2.9-2	Doses to the General Public from Normal Operations at Idaho Nationa Engineering Laboratory, 1992 (committed effective dose equivalent)
Table 4.2.2.9-3	Doses to the Worker Onsite from Normal Operations at Idaho National Engineering Laboratory, 1992 (committed effective dose equivalent)
Table 4.2.2.10-1	Spent Nuclear Fuel and Waste Management at Idaho National Engineer Laboratory
Table 4.2.3.1-1	Potential Changes to Land Use Resulting from Tritium Supply Technol Recycling at Idaho National Engineering Laboratory
Table 4.2.3.2-1	Modifications to Site Infrastructure for Tritium Supply Technologie at Idaho National Engineering Laboratory

Table 4.2.3.2-2	Impacts on Subregional Electrical Power Pool from Tritium Supply Te and Recycling at Idaho National Engineering Laboratory
Table 4.2.3.3-1	Estimated Cumulative Concentrations of Pollutants Resulting from Tr Technologies and Recycling Including No Action at Idaho National En Laboratory
Table 4.2.3.4-1	Potential Changes to Water Resources Resulting from Tritium Supply and Recycling at Idaho National Engineering Laboratory
Table 4.2.3.6-1	Potential Impacts to Biotic Resources During Construction and Opera from Tritium Supply Technologies and Recycling at Idaho National En Laboratory
Table 4.2.3.9-1	Potential Radiological Impacts to the Public and Workers Resulting Operation of Tritium Supply Technologies and Recycling at Idaho Nat Engineering Laboratory
Table 4.2.3.9-2	Potential Hazardous Chemical Impacts to the Public and Workers Resu Normal Operation at Idaho National Engineering Laboratory
Table 4.2.3.9-3	Tritium Supply Technologies and Recycling High Consequence/Low Prob Radioactive Release Accidents and Consequences at Idaho National En Laboratory
Table 4.2.3.9-4	Tritium Supply Technologies and Recycling Low-to-Moderate Consequen High Probability Radioactive Release Accidents and Consequences at National Engineering Laboratory
Table 4.2.3.10-1	Projected Spent Nuclear Fuel and Waste Management for No Action at National Engineering Laboratory
Table 4.2.3.10-2	Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes fo Supply Technologies and Recycling at Idaho National Engineering La
Table 4.2.3.10-3	Potential Spent Nuclear Fuel and Waste Management Impacts from Tri Supply Technologies and Recycling at Idaho National Engineering La
Table 4.3.2.2-1	Baseline Characteristics for Nevada Test Site
Table 4.3.2.2-2	Subregional Power Pool Electrical Summary for Nevada Test Site
Table 4.3.2.3-1	Comparison of Baseline Ambient Air Concentrations with Most Stringe Applicable Regulations and Guidelines at Nevada Test Site, 1990-199
Table 4.3.2.4-1	Groundwater Quality Monitoring Data at Nevada Test Site, 1991-1992
Table 4.3.2.6-1	Federal and State-Listed Threatened, Endangered, and Other Special Species That May Be Found On the Site or In the Vicinity of the Pro Supply Site at Nevada Test Site
Table 4.3.2.9-1	Sources of Radiation Exposure to Individuals in the Vicinity, Unrel Test Site Operations
Table 4.3.2.9-2	Doses to the General Public from Normal Operation at Nevada Test Si (committed effective dose equivalent)
Table 4.3.2.9-3	Doses to the Worker Onsite from Normal Operation at Nevada Test Sit (committed effective dose equivalent)
Table 4.3.2.10-1	Waste Management at Nevada Test Site
Table 4.3.3.1-1	Potential Changes to Land Use Resulting from Tritium Supply Technol Recycling at Nevada Test Site

Table 4.3.3.2-1	Modifications to Site Infrastructure for Tritium Supply Technologie at Nevada Test Site
Table 4.3.3.2-2	Impacts on Subregional Electrical Power Pool from Tritium Supply Te and Recycling at Nevada Test Site
Table 4.3.3.3-1	Estimated Cumulative Concentrations of Pollutants Resulting from Tr Technologies and Recycling Including No Action at Nevada Test Site
Table 4.3.3.4-1	Potential Changes to Water Resources Resulting from Tritium Supply and Recycling at Nevada Test Site
Table 4.3.3.6-1	Potential Impacts to Biotic Resources Resulting During Construction from Tritium Supply Technologies and Recycling at Nevada Test Site
Table 4.3.3.9-1	Potential Radiological Impacts to the Public and Workers Resulting Operation of Tritium Supply Technologies and Recycling at Nevada Te
Table 4.3.3.9-2	Potential Hazardous Chemical Impacts to the Public and Workers Resu Normal Operation at Nevada Test Site
Table 4.3.3.9-3	Tritium Supply Technologies and Recycling High Consequence/Low Prob Radioactive Release Accidents and Consequences at Nevada Test Site
Table 4.3.3.9-4	Tritium Supply Technologies and Recycling Low-to-Moderate Consequen Probability Radioactive Release Accidents and Consequences at Nevad
Table 4.3.3.10-1	Projected Waste Management Under No Action at Nevada Test Site
Table 4.3.3.10-2	Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes fo Supply Technologies and Recycling at Nevada Test Site
Table 4.3.3.10-3	Potential Spent Nuclear Fuel and Waste Management Impacts from the Supply Technologies and Recycling at Nevada Test Site
Table 4.4.2.2-1	Baseline Characteristics for Oak Ridge Reservation
Table 4.4.2.2-2	Subregional Power Pool Electrical Summary for Oak Ridge Reservation
Table 4.4.2.3-1	Comparison of Baseline Ambient Air Concentrations with Most Stringe Applicable Regulations and Guidelines at Oak Ridge Reservation, 199
Table 4.4.2.4-1	Summary of Clinch River Surface Water Quality Monitoring at Oak Rid Reservation, 1991
Table 4.4.2.4-2	Groundwater Quality Monitoring Data at Oak Ridge Reservation, 1991
Table 4.4.2.6-1	Federal and State-Listed Threatened, Endangered, and Other Special Species That May Be Found On the Site or In the Vicinity of Propose Supply Site at Oak Ridge Reservation
Table 4.4.2.9-1	Sources of Radiation Exposure to Individuals in the Vicinity, Unrel Ridge Reservation Operations
Table 4.4.2.9-2	Doses to the General Public from Normal Operation at Oak Ridge Rese 1992 (committed effective dose equivalent)
Table 4.4.2.9-3	Doses to the Worker Onsite from Normal Operation at Oak Ridge Reser 1992 (committed effective dose equivalent)
Table 4.4.2.10-1	Spent Nuclear Fuel and Waste Management at Y-12 Plant
Table 4.4.2.10-2	Spent Nuclear Fuel and Waste Management at Oak Ridge National Labo

Table 4.4.2.10-3 Waste Management at K-25 Site

Table 4.4.3.1-1 Potential Changes to Land Use Resulting from Tritium Supply Technol Recycling at Oak Ridge Reservation

Table 4.4.3.2-1 Modifications to Site Infrastructure for Tritium Supply Technologie at Oak Ridge Reservation

Table 4.4.3.2-2 Impacts on Subregional Electrical Power Pool from Tritium Supply Te and Recycling at Oak Ridge Reservation

Table 4.4.3.3-1 Estimated Cumulative Concentrations of Pollutants Resulting from Tr Technologies and Recycling Including No Action at Oak Ridge Reserva

Table 4.4.3.4-1 Potential Changes to Water Resources Resulting from Tritium Supply and Recycling at Oak Ridge Reservation

Table 4.4.3.6-1 Potential Impacts to Biotic Resources During Construction and Opera from Tritium Supply Technologies and Recycling at Oak Ridge Reserva

Table 4.4.3.9-1 Potential Radiological Impacts to the Public and Workers Resulting Operation of Tritium Supply Technologies and Recycling at Oak Ridge

Table 4.4.3.9-2 Potential Hazardous Chemical Impacts to the Public and Workers Resu Normal Operations at Oak Ridge Reservation

Table 4.4.3.9-3 Tritium Supply Technologies and Recycling High Consequence/Low Prob Radioactive Release Accidents and Consequences at Oak Ridge Reserva

Table 4.4.3.9-4 Tritium Supply Technologies and Recycling Low-to-Moderate Consequen Probability Radioactive Release Accidents and Consequences at Oak R Reservation

Table 4.4.3.10-1 Projected Spent Nuclear Fuel and Waste Management for No Action at Reservation

Table 4.4.3.10-2 Estimated Generated Annual Spent Nuclear Fuel and Waste Volumes fo Supply Technologies and Recycling at Oak Ridge Reservation

Table 4.4.3.10-3 Potential Spent Nuclear Fuel and Waste Management Impacts from Tri Supply Technologies and Recycling at Oak Ridge Reservation

Table 4.5.2.2-1 Baseline Characteristics for Pantex Plant

Table 4.5.2.2-2 Subregional Power Pool Electrical Summary for Pantex Plant

Table 4.5.2.3-1 Comparison of Baseline Ambient Air Concentrations with Most Stringe Applicable Regulations and Guidelines at Pantex Plant, 1991

Table 4.5.2.4-1 Summary of Surface Water Quality Monitoring Data for Playa 1 at Pan 1991

Table 4.5.2.4-2 Groundwater Quality Monitoring Data for the Ogallala Aquifer Wells Plant, 1990

Table 4.5.2.4-3 Groundwater Quality Monitoring for the Perched Zone Wells at Pantex 1990

Table 4.5.2.6-1 Federal and State-Listed Threatened, Endangered, and Other Special Species That May be Found On the Site or In the Vicinity of Propose Supply Site on Pantex Plant

Table 4.5.2.9-1 Sources of Radiation Exposure to Individuals in the Vicinity, Unrel

Plant Operations

Table 4.5.2.9-2	Doses to the General Public from Normal Operation at Pantex Plant, (committed effective dose equivalent)
Table 4.5.2.9-3	Doses to the Worker Onsite from Normal Operation at Pantex Plant, (committed effective dose equivalent)
Table 4.5.2.10-1	Waste Management at Pantex Plant
Table 4.5.3.1-1	Potential Changes to Land Use Resulting from Tritium Supply Technol Recycling at Pantex Plant
Table 4.5.3.2-1	Modifications to Site Infrastructure for Tritium Supply Technologie at Pantex Plant
Table 4.5.3.2-2	Impacts on Subregional Electrical Power Pool from Tritium Supply Te and Recycling at Pantex Plant
Table 4.5.3.3-1	Estimated Cumulative Concentrations of Pollutants Resulting from Tr Technologies and Recycling Including No Action at Pantex Plant
Table 4.5.3.4-1	Potential Changes to Water Resources Resulting from Tritium Supply and Recycling at Pantex Plant
Table 4.5.3.6-1	Potential Impacts to Biotic Resources During Construction and Opera from Tritium Supply Technologies and Recycling at Pantex Plant
Table 4.5.3.9-1	Potential Radiological Impacts to the Public and Workers Resulting Operation of Tritium Supply Technologies and Recycling at Pantex Pl
Table 4.5.3.9-2	Potential Hazardous Chemical Impacts to the Public and Workers Resu Normal Operation at Pantex Plant
Table 4.5.3.9-3	Tritium Supply Technologies and Recycling High Consequence/Low Prob Radioactive Release Accidents and Consequences at Pantex Plant
Table 4.5.3.9-4	Tritium Supply Technologies and Recycling Low to Moderate Consequen Radioactive Release Accidents and Consequences at Pantex Plant
Table 4.5.3.10-1	Projected Waste Management for No Action at Pantex Plant, 1992
Table 4.5.3.10-2	Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes fo Supply Technologies and Recycling at Pantex Plant
Table 4.5.3.10-3	Potential Spent Nuclear Fuel and Waste Management Impacts from Tri Supply Technologies and Recycling at Pantex Plant
Table 4.6.2.2-1	Baseline Characteristics for Savannah River Site
Table 4.6.2.2-2	Subregional Power Pool Electrical Summary for Savannah River Site
Table 4.6.2.3-1	Comparison of Baseline Ambient Air Concentrations with Most Stringe Applicable Regulations and Guidelines at Savannah River Site, 1985-
Table 4.6.2.4-1	Summary of Surface Water Quality Monitoring Data for the Savannah R Savannah River Site, 1991
Table 4.6.2.4-2	Groundwater Quality Monitoring Data at Savannah River Site, 1991
Table 4.6.2.6-1	Federal and State-Listed Threatened, Endangered, and Other Special Species That May Be Found On the Site or In the Vicinity of the Pro Supply Site at Savannah River Site

Table 4.6.2.9-1	Sources of Radiation Exposure to Individuals in the Vicinity, Unrel Savannah River Site Operations, 1992
Table 4.6.2.9-2	Doses to the General Public from Normal Operations at Savannah Rive 1992 (committed effective dose equivalent)
Table 4.6.2.9-3	Doses to the Worker Onsite from Normal Operations at Savannah River 1992 (committed effective dose equivalent)
Table 4.6.2.10-1	Spent Nuclear Fuel and Waste Management at Savannah River Site
Table 4.6.3.1-1	Potential Changes to Land Use Resulting from Tritium Supply Technol Recycling at Savannah River Site
Table 4.6.3.2-1	Modifications to Site Infrastructure for Tritium Supply Technologie Phaseout at Savannah River Site
Table 4.6.3.2-2	Impacts on the Subregional Electrical Power Pool from Tritium Suppl Technologies at Savannah River Site
Table 4.6.3.3-1	Estimated Cumulative Concentrations of Pollutants Resulting from Tr Supply Technologies and Upgraded Recycling Including No Action at S River Site
Table 4.6.3.4-1	Potential Changes to Water Resources Resulting from Tritium Supply and Recycling at Savannah River Site
Table 4.6.3.6-1	Potential Impacts to Biotic Resources Resulting from Tritium Supply and Recycling During Construction and Operation at Savannah River S
Table 4.6.3.9-1	Potential Radiological Impacts to the Public and Workers Resulting Operation of Tritium Supply Technologies and Recycling at Savannah
Table 4.6.3.9-2	Potential Hazardous Chemical Impacts to the Public and Workers Resu Normal Operation at Savannah River Site
Table 4.6.3.9-3	Radioactive Release Accidents and Consequences for Existing No Acti Recycling Operations at Savannah River Site
Table 4.6.3.9-4	Tritium Supply Technologies and Recycling High Consequence/Low Prob Radioactive Release Accidents and Consequences at Savannah River Si
Table 4.6.3.9-5	Tritium Supply Technologies and Recycling Low-to-Moderate Consequen Probability Radioactive Release Accidents and Consequences at Savan Site
Table 4.6.3.10-1	Projected Spent Nuclear Fuel and Waste Management for No Action at River Site
Table 4.6.3.10-2	Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes fo Supply Technologies and Recycling at Savannah River Site
Table 4.6.3.10-3	Potential Spent Nuclear Fuel and Waste Management Impacts from Tri Supply Technologies and Recycling at Savannah River Site
Table 4.7.1.1-1	Transportation Modes and Comparison Ratings for the Candidate Sites
Table 4.7.2.2-1	Comparison of Relative Mileage Risk
Table 4.7.2.2-2	Accident Impacts from Transporting Low-Level Waste from Pantex Plan Nevada Test Site
Table 4.8.3.1-1	Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility Ke Parameters

Table 4.8.3.1-2	Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility Co Requirements
Table 4.8.3.1-3	Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility Op Requirements
Table 4.8.3.1-4	Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility Wa Volumes
Table 4.8.3.1-5	Pit Disassembly/Conversion Facility Key Design Parameters
Table 4.8.3.1-6	Pit Disassembly/Conversion Facility Construction Requirements
Table 4.8.3.1-7	Pit Disassembly/Conversion Facility Operation Requirements
Table 4.8.3.1-8	Pit Disassembly/Conversion Facility Waste Volumes
Table 4.8.3.1-9	Mixed-Oxide Fuel Fabrication Worker and Population Impacts of High Consequence Accidents
Table 4.8.3.1-10	Mixed-Oxide Fuel Fabrication Worker and Population Impacts of Low Consequence/High Probability Accidents
Table 4.8.3.2-1	Increase of Radioactive Materials for the Mixed-Oxide Fueled Light Reactor
Table 4.8.3.3-1	Multipurpose Modular High Temperature Gas-Cooled Reactor Estimated Construction Material/Resource Requirements
Table 4.8.3.3-2	Multipurpose Modular High Temperature Gas-Cooled Reactor Estimated Utility Requirements
Table 4.10.3.1-1	Estimated Total Construction Materials/Resources Consumption to Co Nuclear Power Plant
Table 4.10.3.1-2	Estimated Peak Year Construction Air Emissions From Activities to Nuclear Power Plant
Table 4.10.3.1-3	Estimated Construction Workers Needed by Year to Complete a Nuclea Plant
Table 4.10.3.1-4	Estimated Construction Waste Generated to Complete a Nuclear Power
Table 4.10.3.1-1	Generic Commercial Light Water Reactor Operational Parameters
Table 4.10.3.1-2	Commercial Light Water Reactor Operational Parameter Changes From Production
Table 4.10.3.2-3	Radiological Consequences of Transportation Accidents Shipping Tri Rods
Table 4.16-1	Selected Demographic Characteristics for Idaho National Engineering La Region-of-Influence
Table 4.16-2	Selected Demographic Characteristics for Nevada Test Site Region-of-In
Table 4.16-3	Selected Demographic Characteristics for Oak Ridge Reservation Region-Influence
Table 4.16-4	Selected Demographic Characteristics for Pantex Plant Region-of-Influe
Table 4.16-5	Selected Demographic Characteristics for Savannah River Site Region-of Influence

Table 5.3-1 Federal Environmental Statutes, Regulations, and Orders

Table 5.3-2 Selected Department of Energy Environment, Safety, and Health Orders

Table 5.3-3 Department of Energy Agreements with Federal and State Environmental Regulatory Agencies

Table 5.3-4 State Environmental Statutes, Regulations, and Orders

Table 5.5-1 Estimated Number of Construction Worker Fatalities by Technology

Table A.2.1.1-1 Heavy Water Reactor Construction Material/Resource Requirements

Table A.2.1.1-2 Heavy Water Reactor Operation Utility Requirements

Table A.2.1.1-3 Heavy Water Reactor Annual Chemical Requirements

Table A.2.1.1-4 Heavy Water Reactor Estimated Spent Nuclear Fuel and Waste Volumes

Table A.2.1.2-1 Modular High Temperature Gas-Cooled Reactor Construction Material/Resource Requirements

Table A.2.1.2-2 Modular High Temperature Gas-Cooled Reactor Operation Utility Requirements

Table A.2.1.2-3 Modular High Temperature Gas-Cooled Reactor Annual Chemical Requirements

Table A.2.1.2-4 Modular High Temperature Gas-Cooled Reactor Estimated Spent Nuclear and Waste Volumes

Table A.2.1.3-1 Advanced Light Water Reactor Construction Material/Resource Requirements

Table A.2.1.3-2 Advanced Light Water Reactor Operation Utility Requirements

Table A.2.1.3-3 Advanced Light Water Reactor Annual Chemical Requirements

Table A.2.1.3-4 Advanced Light Water Reactor (Large) Estimated Spent Nuclear Fuel and Waste Volumes

Table A.2.1.3-5 Advanced Light Water Reactor (Small) Estimated Spent Nuclear Fuel and Waste Volumes

Table A.2.1.4-1 Accelerator Production of Tritium Construction Material/Resource Requirements

Table A.2.1.4-2 Accelerator Production of Tritium Operation Utility Requirements

Table A.2.1.4-3 Accelerator Production of Tritium Annual Chemical Requirements

Table A.2.1.4-4 Accelerator Production of Tritium (Helium-3 Target) Estimated Waste Volumes

Table A.2.1.4-5 Accelerator Production of Tritium (Spallation-Induced Lithium Conve Target) Estimated Waste Volumes

Table A.2.1.4-6 Phased Accelerator Production of Tritium (Helium-3 Target Only) Estimated Waste Volumes

Table A.2.2.1-1 New Tritium Recycling Facility Construction Material/Resource Requirements

Table A.2.2.1-2 New Tritium Recycling Facility Operation Utility Requirements

Table A.2.2.1-3 New Tritium Recycling Facility Annual Chemical Requirements

Table A.2.2.1-4 New Tritium Recycling Facility Estimated Waste Volumes

Table A.2.2.2-1 Upgraded Tritium Recycling Facilities Construction Material/Resource Requirements

Table A.2.2.2-2 Upgraded Tritium Recycling Facilities Operation Utility Requirement

Table A.2.2.2-3 Upgraded Tritium Recycling Facilities Annual Chemical Requirements

Table A.2.2.2-4 Upgraded Tritium Recycling Facilities Estimated Waste Volumes

Table B.1.3.1-1 Ambient Air Quality Standards Applicable to the Candidate Sites

Table B.1.3.1-2 Maximum Allowable Prevention of Significant Deterioration Concentration Increments for the Candidate Sites

Table B.1.3.1-3 Pollutant Emissions from Natural Gas-Fired Turbines

Table B.1.3.2-1 Ambient Air Quality at Idaho National Engineering Laboratory

Table B.1.3.2-2 Source Emission Inventory for Idaho National Engineering Laboratory

Table B.1.3.2-3 Prevention of Significant Deterioration Sources and Concentration Increment Consumed at Idaho National Engineering Laboratory Boundary and Near Class I Area

Table B.1.3.2-4 Emission Rates and Maximum Site Boundary Concentration of Toxic/Hazardous Air Pollutants at Idaho National Engineering Laboratory, 1989

Table B.1.3.2-5 Estimated Ambient Concentration of Criteria Pollutants from Baseline at Idaho National Engineering Laboratory, 1991

Table B.1.3.3-1 Ambient Air Quality Data for Nevada Test Site, 1990

Table B.1.3.3-2 Source Emission Inventory for Nevada Test Site, 1992

Table B.1.3.3-3 Estimated Ambient Concentration of Criteria Pollutants from Existing Sources at Nevada Test Site, 1990

Table B.1.3.4-1 Ambient Air Quality Data for Oak Ridge Reservation, 1990

Table B.1.3.4-2 Source Emission Inventory for Oak Ridge Reservation, 1990-1992

Table B.1.3.4-3 Emission Rates and Maximum Site Boundary Concentration of Toxic/Hazardous Air Pollutants at Oak Ridge Reservation, 1992

Table B.1.3.4-4 Estimated Ambient Concentration of Criteria Pollutants from Existing Sources at Oak Ridge Reservation, 1992

Table B.1.3.5-1 Ambient Air Quality Data for Pantex Plant, 1986-1991

Table B.1.3.5-2 Source Emission Inventory for Pantex Plant, 1991

Table B.1.3.5-3 Emission Rates and Maximum Site Boundary Concentration of Toxic/Hazardous Air Pollutants at Pantex Plant, 1991

Table B.1.3.5-4 Estimated Ambient Concentration of Pollutants from Existing Sources at Pantex Plant, 1991

Table B.1.3.6-1 Ambient Air Quality Data for Savannah River Site, 1985

Table B.1.3.6-2	Source Emission Inventory for Savannah River Site, 1987
Table B.1.3.6-3	Emission Rates and Maximum Site Boundary Concentration of Toxic/Haz Air Pollutants at Savannah River Site, 1990
Table B.1.3.6-4	Estimated Ambient Concentration of Criteria Pollutants from Existin at Savannah River Site, 1987
Table B.1.4-1	Potential Air Emissions Resulting from Tritium Supply Technologies an Recycling at Idaho National Engineering Laboratory (tons/year)
Table B.1.4-2	Potential Air Emissions Resulting from Tritium Supply Technologies an Recycling at Nevada Test Site (tons/year)
Table B.1.4-3	Potential Air Emissions Resulting from Tritium Supply Technologies an Recycling at Oak Ridge Reservation (tons/year)
Table B.1.4-4	Potential Air Emissions Resulting from Tritium Supply Technologies an Recycling at Pantex Plant (tons/year)
Table B.1.4-5	Potential Air Emissions Resulting from Tritium Supply Technologies an Upgraded Recycling at Savannah River Site (tons/year)
Table B.2.2.1-1	City of Oak Ridge Maximum Allowable Noise Limits Applicable to Oak Ridge Reservation
Table B.2.2.2-1	Aiken County Maximum Allowable Noise Levels
Table C-1	Scientific Names of Common Nonthreatened and Nonendangered Plant and Animal Species Referred to in the Text
Table C-2	Federal- and State-Listed Threatened, Endangered, and Other Special Statu Species That May Be Found On the Site or In the Vicinity of Idaho Nationa Engineering Laboratory
Table C-3	Federal- and State-Listed Threatened, Endangered, and Other Special Statu Species That May Be Found On the Site or In the Vicinity of Nevada Test S
Table C-4	Federal- and State-Listed Threatened, Endangered, and Other Special Statu Species That May Be Found On the Site or In the Vicinity of Oak Ridge Reservation
Table C-5	Federal- and State-Listed Threatened, Endangered, and Other Special Statu Species That May Be Found On the Site or In the Vicinity of Pantex Plant
Table C-6	Federal- and State-Listed Threatened, Endangered, and Other Special Statu Species That May Be Found On the Site or In the Vicinity of Savannah River Site
Table D.2.1-1	Historical and Projected Site Employment
Table D.2.1-2	Counties Representing the Candidate Sites' Regional Economic Areas
Table D.2.1-3	Assumptions for Regional Economic Area
Table D.2.1-4	Parameters Used by the Model Idaho National Engineering Laboratory Example
Table D.3-1	Distribution of Employees by Place of Residence for Idaho National Engineering Laboratory, 1991
Table D.3-2	Employment and Local Economy Statistics for Idaho National Engineering Laboratory Regional Economic Area, 1970-2020

Table D.3-3 Changes to Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies for Idaho National Engineering Laboratory Regional Economic Area

Table D.3-3a Changes to Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Idaho National Engineering Laboratory Regional Economic Area

Table D.3-4 Changes to Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Regional Economic Area

Table D.3-4a Changes to Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Idaho National Engineering Laboratory Regional Economic Area

Table D.3-5 Population for Idaho National Engineering Laboratory Region of Influence 1970-2020

Table D.3-6 Changes to Population During Peak Construction (2005 (2003 for Phased A and Full Operation (2010) from Tritium Supply Technologies for Idaho National Engineering Laboratory Region of Influence

Table D.3-6a Changes to Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Accelerator Production of Tritium Power and Multipurpose Reactor for Idaho National Engineering Laboratory Region of Influence

Table D.3-7 Changes to Population During Peak Construction (2005 (2003 for Phased A and Full Operation (2010) from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence

Table D.3-7a Changes to Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Accelerator Production of Tritium Power and Multipurpose Reactor for Idaho National Engineering Laboratory Region of Influence

Table D.3-8 Total Housing Units for Idaho National Engineering Laboratory Region of Influence, 1970-2020

Table D.3-9 Changes in Housing Demand During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies for Idaho National Engineering Laboratory Region of Influence

Table D.3-9a Changes in Housing Demand During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Idaho National Engineering Laboratory Region of Influence

Table D.3-10 Changes in Housing Demand During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence

Table D.3-10a Changes in Housing Demand During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Idaho National Engineering Laboratory Region of Influence

Table D.3-11 County and City Revenues and Expenditures for Idaho National Engineering Laboratory Region of Influence

Laboratory Region of Influence, 1992

- Table D.3-12 School District Revenues and Expenditures for Idaho National Engineering Laboratory Region of Influence, 1992
- Table D.3-13 Changes in County and City Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Tritium Supply Technologies for Idaho National Engineering Laboratory Region of Influence
- Table D.3-13a Changes in County and City Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Idaho National Engineering Laboratory Region of Influence
- Table D.3-14 Changes to County and City Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Tritium Supply Technologies for Idaho National Engineering Laboratory Region of Influence
- Table D.3-14a Changes to County and City Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Idaho National Engineering Laboratory Region of Influence
- Table D.3-15 Changes to School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Tritium Supply Technologies for Idaho National Engineering Laboratory Region of Influence
- Table D.3-15a Changes to School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Idaho National Engineering Laboratory Region of Influence
- Table D.3-16 Changes to School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Tritium Supply Technologies for Idaho National Engineering Laboratory Region of Influence
- Table D.3-16a Changes to School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Idaho National Engineering Laboratory Region of Influence
- Table D.3-17 Changes to County and City Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence
- Table D.3-17a Changes to County and City Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Idaho National Engineering Laboratory Region of Influence
- Table D.3-18 Changes to County and City Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence
- Table D.3-18a Changes to County and City Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Idaho National Engineering Laboratory Region of Influence
- Table D.3-19 Changes to School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from

Tritium Supply Technologies and Recycling for Idaho National Engineering
Laboratory Region of Influence

- Table D.3-19a Changes to School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Idaho National Engineering Laboratory Region of Influence
- Table D.3-20 Changes in School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence
- Table D.3-20a Changes in School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Idaho National Engineering Laboratory Region of Influence
- Table D.3-21 Distribution of Employees by Place of Residence for Nevada Test Site, 1991
- Table D.3-22 Employment and Local Economy Statistics for Nevada Test Site Regional Economic Area, 1970-2020
- Table D.3-23 Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies for Nevada Test Site Regional Economic Area
- Table D.3-23a Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Nevada Test Site Regional Economic Area
- Table D.3-24 Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies and Recycling for Nevada Test Site Regional Economic Area
- Table D.3-24a Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Nevada Test Site Regional Economic Area
- Table D.3-25 Population for Nevada Test Site Region of Influence, 1970-2020
- Table D.3-26 Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Tritium Supply Technologies for Nevada Test Site Region of Influence
- Table D.3-26a Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Nevada Test Site Region of Influence
- Table D.3-27 Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Tritium Supply Technologies and Recycling for Nevada Test Site Region of Influence
- Table D.3-27a Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Nevada Test Site Region of Influence
- Table D.3-28 Total Housing Units for Nevada Test Site Region of Influence, 1970-2020
- Table D.3-29 Changes in Housing Demands During Peak Construction (2005 (2003 for

Phased APT)) and Full Operation (2010) from Tritium Supply Technologies
Nevada Test Site Region of Influence

Table D.3-29a Changes in Housing Demands During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Nevada Test Site Region of Influence

Table D.3-30 Changes in Housing Demands During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies and Recycling for Nevada Test Site Region of Influence

Table D.3-30a Changes in Housing Demands During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Nevada Test Site Region of Influence

Table D.3-31 County and City Revenues and Expenditures for Nevada Test Site Region of Influence 1992

Table D.3-32 School District Revenues and Expenditures for Nevada Test Site Region of Influence, 1992

Table D.3-33 Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Tritium Supply Technologies for Nevada Test Site Region of Influence

Table D.3-33a Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Nevada Test Site Region of Influence

Table D.3-34 Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Tritium Supply Technologies for Nevada Test Site Region of Influence

Table D.3-34a Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Nevada Test Site Region of Influence

Table D.3-35 Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Tritium Supply Technologies and Recycling for Nevada Test Site Region of Influence

Table D.3-35a Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Nevada Test Site Region of Influence

Table D.3-36 Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Tritium Supply Technologies and Recycling for Nevada Test Site Region of Influence

Table D.3-36a Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Nevada Test Site Region of Influence

Table D.3-37 Distribution of Employees by Place of Residence for Oak Ridge Reservation 1990

- Table D.3-38 Employment and Local Economy Statistics for Oak Ridge Reservation Regional Economic Area, 1970-2020
- Table D.3-39 Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies for Oak Ridge Reservation Regional Economic Area
- Table D.3-39a Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Oak Ridge Reservation Regional Economic Area
- Table D.3-40 Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Regional Economic Area
- Table D.3-40a Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Oak Ridge Reservation Regional Economic Area
- Table D.3-41 Population for Oak Ridge Reservation Region of Influence, 1970-2020
- Table D.3-42 Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Tritium Supply Technologies for Oak Ridge Reservation Region of Influence
- Table D.3-42a Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Oak Ridge Reservation Region of Influence
- Table D.3-43 Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Region of Influence
- Table D.3-43a Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Oak Ridge Reservation Region of Influence
- Table D.3-44 Total Housing Units for Oak Ridge Reservation Region of Influence, 1970-2020
- Table D.3-45 Changes in Housing Demands During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies for Oak Ridge Reservation Region of Influence
- Table D.3-45a Changes in Housing Demands During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Oak Ridge Reservation Region of Influence
- Table D.3-46 Changes in Housing Demands During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Region of Influence
- Table D.3-46a Changes in Housing Demands During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Oak Ridge Reservation Region of Influence
- Table D.3-47 County and City Revenues and Expenditures for Oak Ridge Reservation Region of Influence, 1992

- Table D.3-48 Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 Phased APT)) from Tritium Supply Technologies for Oak Ridge Reservation Region of Influence
- Table D.3-48a Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Oak Ridge Reservation Region of Influence
- Table D.3-49 Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Tritium Supply Technologies for Oak Ridge Reservation Region of Influence
- Table D.3-49a Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Oak Ridge Reservation Region of Influence
- Table D.3-50 Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 Phased APT)) from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Region of Influence
- Table D.3-50a Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Oak Ridge Reservation Region of Influence
- Table D.3-51 Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Region of Influence
- Table D.3-51a Changes in County, City, and School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Oak Ridge Reservation Region of Influence
- Table D.3-52 Distribution of Employees by Place of Residence for Pantex Plant, 1991
- Table D.3-53 Employment and Local Economy Statistics for Pantex Plant Regional Economic Area, 1970-2020
- Table D.3-54 Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies for Pantex Plant Regional Economic Area
- Table D.3-54a Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Pantex Plant Regional Economic Area
- Table D.3-55 Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies and Recycling for Pantex Plant Regional Economic Area
- Table D.3-55a Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Pantex Plant Regional Economic Area

Table D.3-56 Population for Pantex Plant Region of Influence, 1970-2020

Table D.3-57 Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Tritium Supply Technologies for Pantex Region of Influence

Table D.3-57a Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Pantex Plant Region of Influence

Table D.3-58 Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Tritium Supply Technologies and Recycling for Pantex Plant Region of Influence

Table D.3-58a Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Pantex Plant Region of Influence

Table D.3-59 Total Housing Units for Pantex Plant Region of Influence, 1970-2020

Table D.3-60 Changes to Housing Demands During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies for Pantex Plant Region of Influence

Table D.3-60a Changes to Housing Demands During Peak Construction (2005 (2003 for P APT)) and Full Operation (2010) from Accelerator Production of Tritium Plant and Multipurpose Reactor for Pantex Plant Region of Influence

Table D.3-61 Changes in Housing Demands During Peak Construction (2005 (2003 for Ph APT)) and Full Operation (2010) from Tritium Supply Technologies and Recycling for Pantex Plant Region of Influence

Table D.3-61a Changes in Housing Demands During Peak Construction (2005 (2003 for P APT)) and Full Operation (2010) from Accelerator Production of Tritium Plant and Multipurpose Reactor for Pantex Plant Region of Influence

Table D.3-62 County and City Revenues and Expenditures for Pantex Plant Region of Influence, 1992

Table D.3-63 School District Revenues and Expenditures for Pantex Plant Region of Influence, 1992

Table D.3-64 Changes in County and City Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Tritium Supply Technologies for Pantex Plant Region of Influence

Table D.3-64a Changes in County and City Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Pantex Plant Region of Influence

Table D.3-65 Changes in County and City Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Tritium Supply Technologies for Pantex Plant Region of Influence

Table D.3-65a Changes in County and City Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Pantex Plant Region of Influence

Table D.3-66 Changes in School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Tritium Supply Technologies for Pantex Plant Region of Influence

- Table D.3-66a Changes in School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Pantex Plant Region of Influence
- Table D.3-67 Changes in School District Total Revenues and Expenditures Over/Under Action at Full Operation (2010) from Tritium Supply Technologies for Pantex Plant Region of Influence
- Table D.3-67a Changes in School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Pantex Plant Region of Influence
- Table D.3-68 Changes in County and City Total Revenues and Expenditures Over/Under Action During Peak Construction (2005 (2003 for Phased APT)) from Tritium Supply Technologies and Recycling for Pantex Plant Region of Influence
- Table D.3-68a Changes in County and City Total Revenues and Expenditures Over/Under Action During Peak Construction (2005 (2003 for Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Pantex Plant Region of Influence
- Table D.3-69 Changes in County and City Total Revenues and Expenditures Over/Under Action at Full Operation (2010) from Tritium Supply Technologies and Recycling for Pantex Plant Region of Influence
- Table D.3-69a Changes in County and City Total Revenues and Expenditures Over/Under Action at Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Pantex Plant Region of Influence
- Table D.3-70 Changes in School District Total Revenues and Expenditures Over/Under Action During Peak Construction (2005 (2003 for Phased APT)) from Tritium Supply Technologies and Recycling for Pantex Plant Region of Influence
- Table D.3-70a Changes in School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Pantex Plant Region of Influence
- Table D.3-71 Changes in School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Tritium Supply Technologies and Recycling for Pantex Plant Region of Influence
- Table D.3-71a Changes in School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor for Pantex Plant Region of Influence
- Table D.3-72 Distribution of Employees by Place of Residence for Savannah River Site 1991
- Table D.3-73 Employment and Local Economy Statistics for Savannah River Site Regional Economic Area, 1970-2020
- Table D.3-74 Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 Phased APT)) and Full Operation (2010) from Tritium Supply Technologies and Recycling Upgrade and Phaseout for Savannah River Site Regional Economic Area
- Table D.3-74a Changes in Total Employment, Unemployment Rate, and Per Capita Income During Peak Construction (2005 (2003 Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor Upgrade and Phaseout for Savannah River Site Regional Economic Area

Table D.3-75 Population for Savannah River Site Region of Influence, 1970-2020

Table D.3-76 Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Tritium Supply Technologies and Recycli Upgrade and Phaseout for Savannah River Site Region of Influence

Table D.3-76a Changes in Population During Peak Construction (2005 (2003 for Phased and Full Operation (2010) from Accelerator Production of Tritium Powe and Multipurpose Reactor Upgrade and Phaseout for Savannah River Site Region of Influence

Table D.3-77 Total Housing Units for Savannah River Site Region of Influence, 1970-2020

Table D.3-78 Changes in Housing Demands During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Tritium Supply Technologies and Recycling Upgrade and Phaseout for Savannah River Site Region of Influence

Table D.3-78a Changes in Housing Demands During Peak Construction (2005 (2003 for Phased APT)) and Full Operation (2010) from Accelerator Production of Tritium Power Plant and Multipurpose Reactor Upgrade and Phaseout for Savannah River Site Region of Influence

Table D.3-79 County and City Revenues and Expenditures for Savannah River Site Regi of Influence, 1992

Table D.3-80 School District Revenues and Expenditures for Savannah River Site Regi of Influence, 1992

Table D.3-81 Changes in County and City Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Tritium Supply Technologies and Recycling Upgrade for Savannah River S Region of Influence

Table D.3-81a Changes in County and City Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reacto Upgrade for Savannah River Site Region of Influence

Table D.3-82 Changes to County and City Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Tritium Supply Technologies an Recycling Upgrade and Phaseout for Savannah River Site Region of Influe

Table D.3-82a Changes to County and City Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Accelerator Production of Tri Power Plant and Multipurpose Reactor Upgrade and Phaseout for Savanna River Site Region of Influence

Table D.3-83 Changes in School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Tritium Supply Technologies and Recycling Upgrade for Savannah River S Region of Influence

Table D.3-83a Changes in School District Total Revenues and Expenditures Over/Under No Action During Peak Construction (2005 (2003 for Phased APT)) from Accelerator Production of Tritium Power Plant and Multipurpose Reacto Upgrade for Savannah River Site Region of Influence

Table D.3-84 Changes in School District Total Revenues and Expenditures Over/Under No Action at Full Operation (2010) from Tritium Supply Technologies an Recycling Upgrade and Phaseout for Savannah River Site Region of Influe

Table D.3-84a Changes in School District Total Revenues and Expenditures Over/Under

No Action at Full Operation (2010) from Accelerator Production of Tri
Power Plant and Multipurpose Reactor Upgrade and Phaseout for Savanna
River Site Region of Influence

Table E.2.1.2-1 Lifetime Risks per 100,000 Persons Exposed to a Single Exposure
of 10 Rem

Table E.2.2.2-1 GENII Exposure Parameters to Plumes and Soil Contamination

Table E.2.2.2-2 GENII Usage Parameters for Consumption of Terrestrial Food

Table E.2.2.2-3 GENII Usage Parameters for Consumption of Animal Products

Table E.2.2.2-4 GENII Usage Parameters for Aquatic Activities

Table E.2.3-1 Estimated Annual In-Plant Worker Doses and Resulting Health Effects f
Various Tritium Supply Technologies and Recycling Facilities

Table E.2.3.1-1 Annual Radioactive Releases During Normal Operation from Heavy Wate
Reactor (curies)

Table E.2.3.2-1 Annual Atmospheric Radioactive Releases from Modular High Temperatu
Gas-Cooled Reactor (curies)

Table E.2.3.3.1-1 Annual Liquid and Atmospheric Radioactive Releases from Large Adv
Light Water Reactor (Advanced Boiling Water Reactor) (curies)

Table E.2.3.3.1-2 Annual Liquid and Atmospheric Radioactive Releases from Large Adv
Light Water Reactor (CE System 80+ Reactor) (curies)

Table E.2.3.3.2-1 Annual Liquid and Atmospheric Radioactive Releases from Small Adv
Light Water Reactor (Simplified Boiling Water Reactor) (curies)

Table E.2.3.3.2-2 Annual Liquid and Atmospheric Radioactive Releases from Small Adv
Light Water Reactor (AP600 Reactor) (curies)

Table E.2.3.4-1 Annual Atmospheric Releases from Accelerator Production of Tritium
During Normal Operation (curies)

Table E.2.3.5-1 Annual Atmospheric Releases of Tritium from Various Tritium Target
Extraction Facilities for Tritium Supply Technologies (curies)

Table E.2.4-1 Release Point Characteristics, Direction, Distance, and Chi/Q at Idah
National Engineering Laboratory Boundary

Table E.2.4-2 Direction, Distance, and Meteorological Dispersion to Various Maximum
Individual Receptors at Idaho National Engineering Laboratory Site Bo

Table E.2.4.1-1 Annual Atmospheric Radioactive Releases from Normal Operation of No
at Idaho National Engineering Laboratory (curies)

Table E.2.4.1-2 Doses and Resulting Health Effect to the Maximally Exposed Individu
Resulting from Normal Operation at Idaho National Engineering Labor

Table E.2.4.1-3 Doses and Resulting Health Effect to the Population Within 50 Miles
Resulting from Normal Operation at Idaho National Engineering Labor

Table E.2.5-1 Release Point Characteristics, Direction, Distance, and Chi/Q at Neva
Test Site Boundary

Table E.2.5-2 Direction, Distance, and Meteorological Dispersion to Various Maximum
Individual Receptors at Nevada Test Site Boundary

Table E.2.5.1-1 Estimated Annual Atmospheric Radioactive Releases from Normal Opera

of No Action at Nevada Test Site (curies)

Table E.2.5.1-2 Doses and Resulting Health Effect to the Maximally Exposed Individu Resulting from Normal Operation at Nevada Test Site

Table E.2.5.1-3 Doses and Resulting Health Effect to the Population Within 50 Miles Resulting from Normal Operation at Nevada Test Site

Table E.2.6-1 Release Point Characteristics, Direction, Distance, and Chi/Q at Oak Reservation Boundary

Table E.2.6-2 Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at Oak Ridge Reservation Site Boundary

Table E.2.6.1-1 Annual Atmospheric Radioactive Releases from Normal Operation of No at Oak Ridge Reservation (curies)

Table E.2.6.1-2 Doses and Resulting Health Effect to the Maximally Exposed Individu from Atmospheric Releases Associated with Normal Operation at Oak R Reservation

Table E.2.6.1-3 Doses and Resulting Health Effect to the Population Within 50 Miles of Oak Ridge Reservation from Atmospheric Releases Associated with Normal Operation

Table E.2.6.1-4 Annual Liquid Releases from Normal Operation of No Action at Oak Ri Reservation (curies)

Table E.2.6.1-5 Doses and Resulting Health Effect to the Maximally Exposed Individu at Oak Ridge Reservation from Liquid Releases Associated with Norma Operation

Table E.2.6.1-6 Doses and Resulting Health Effects to the Population Downstream of Releases Associated with Normal Operation at Oak Ridge Reservation

Table E.2.7-1 Release Point Characteristics, Direction, Distance and Chi/Q at Pante Boundary

Table E.2.7-2 Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at the Pantex Site Boundary

Table E.2.7.1-1 Estimated Annual Atmospheric Radioactive Releases from Normal Opera of No Action at Pantex Plant (curies)

Table E.2.7.1-2 Doses and Resulting Health Effect to the Maximally Exposed Individu Resulting from Normal Operation at Pantex Plant

Table E.2.7.1-3 Doses and Resulting Health Effect to the Population Within 50 Miles Resulting from Normal Operation of Pantex Plant

Table E.2.8-1 Release Point Characteristics, Direction, Distance, and Chi/Q at Sava River Site Boundary

Table E.2.8-2 Direction, Distance, and Meteorological Dispersion to Various Maximum Individual Receptors at Savannah River Site Boundary

Table E.2.8.1-1 Annual Atmospheric Radioactive Releases from Normal Operation of No Action at Savannah River Site (curies)

Table E.2.8.1-2 Annual Atmospheric Radioactive Releases from Waste Management Facil During Normal Operation of No Action at Savannah River Site (curies)

Table E.2.8.1-3 Doses and Resulting Health Effect to Maximally Exposed Individual f Atmospheric Releases Associated with Normal Operation at Savannah

River Site

- Table E.2.8.1-4 Doses and Resulting Health Effect to the Population Within 50 Miles Savannah River Site from Atmospheric Releases Associated with Normal Operation
- Table E.2.8.1-5 Annual Liquid Radioactive Releases from Normal Operation of No Action at Savannah River Site (curies)
- Table E.2.8.1-6 Doses and Resulting Health Effect to the Maximally Exposed Member of Public from Liquid Releases Associated with Normal Operation at Savannah River Site
- Table E.2.8.1-7 Doses and Resulting Health Effect to the Population from Liquid Releases Associated with Normal Operation Downstream of Savannah River Site
- Table E.3.2-1 Chemical Toxicity Profiles
- Table E.3.3-1 Regulated Exposure Limits
- Table E.3.4-1 Risk Assessments from Exposure to Hazardous Chemicals from No Action Operation at Idaho National Engineering Laboratory
- Table E.3.4-2 Risk Assessments from Exposure to Hazardous Chemicals from Heavy Water Reactor Operation at Idaho National Engineering Laboratory
- Table E.3.4-3 Risk Assessments from Exposure to Hazardous Chemicals from Modular High Temperature Gas-Cooled Reactor Operation at Idaho National Engineering Laboratory
- Table E.3.4-4 Risk Assessments from Exposure to Hazardous Chemicals from Advanced Light Water Reactor Operation at Idaho National Engineering Laboratory
- Table E.3.4-5 Risk Assessments from Exposure to Hazardous Chemicals from Accelerator Production of Tritium Operation at Idaho National Engineering Laboratory
- Table E.3.4-6 Risk Assessments from Exposure to Hazardous Chemicals from Tritium Recycling Operation at Idaho National Engineering Laboratory
- Table E.3.4-7 Risk Assessments from Exposure to Hazardous Chemicals at Idaho National Engineering Laboratory-Summary Hazard Index and Total Cancer Risk
- Table E.3.4-8 Risk Assessments from Exposure to Hazardous Chemicals from No Action Operation at Nevada Test Site
- Table E.3.4-9 Risk Assessments from Exposure to Hazardous Chemicals from Heavy Water Reactor Operation at Nevada Test Site
- Table E.3.4-10 Risk Assessments from Exposure to Hazardous Chemicals Modular High Temperature Gas-Cooled Reactor Operation at Nevada Test Site
- Table E.3.4-11 Risk Assessments from Exposure to Hazardous Chemicals from Advanced Light Water Reactor Operation at Nevada Test Site
- Table E.3.4-12 Risk Assessments from Exposure to Hazardous Chemicals from Accelerator Production of Tritium Operation at Nevada Test Site
- Table E.3.4-13 Risk Assessments from Exposure to Hazardous Chemicals from Tritium Recycling Operation at Nevada Test Site
- Table E.3.4-14 Risk Assessments from Exposure to Hazardous Chemicals at Nevada Test Site- Summary Hazard Index and Total Cancer Risk
- Table E.3.4-15 Risk Assessments from Exposure to Hazardous Chemicals from No Action

Operation at Oak Ridge Reservation

Table E.3.4-16	Risk Assessments from Exposure to Hazardous Chemicals from Heavy Water Reactor Operation at Oak Ridge Reservation
Table E.3.4-17	Risk Assessments from Exposure to Hazardous Chemicals from Modular High Temperature Gas-Cooled Reactor Operation at Oak Ridge Reservati
Table E.3.4-18	Risk Assessments from Exposure to Hazardous Chemicals from Advanced Light Water Reactor Operation at Oak Ridge Reservation
Table E.3.4-19	Risk Assessments from Exposure to Hazardous Chemicals from Accelerat Production of Tritium Operation at Oak Ridge Reservation
Table E.3.4-20	Risk Assessments from Exposure to Hazardous Chemicals from Tritium Recycling Operation at Oak Ridge Reservation
Table E.3.4-21	Risk Assessments from Exposure to Hazardous Chemicals at Oak Ridge Reservation-Summary Hazard Index and Total Cancer Risk
Table E.3.4-22	Risk Assessments from Exposure to Hazardous Chemicals from No Action Operation at Pantex Plant
Table E.3.4-23	Risk Assessments from Exposure to Hazardous Chemicals from Heavy Water Reactor Operation at Pantex Plant
Table E.3.4-24	Risk Assessments from Exposure to Hazardous Chemicals from Modular High Temperature Gas-Cooled Reactor Operation at Pantex Plant
Table E.3.4-25	Risk Assessments from Exposure to Hazardous Chemicals from Advanced Light Water Reactor Operation at Pantex Plant
Table E.3.4-26	Risk Assessments from Exposure to Hazardous Chemicals from Accelerat Production of Tritium Operation at Pantex Plant
Table E.3.4-27	Risk Assessments from Exposure to Hazardous Chemicals from Tritium Recycling Operation at Pantex Plant
Table E.3.4-28	Risk Assessments from Exposure to Hazardous Chemicals at Pantex Plant-Summary Hazard Index and Total Cancer Risk
Table E.3.4-29	Risk Assessments from Exposure to Hazardous Chemicals from No Action Operation at Savannah River Site
Table E.3.4-30	Risk Assessments from Exposure to Hazardous Chemicals from Heavy Water Reactor Operation at Savannah River Site
Table E.3.4-31	Risk Assessments from Exposure to Hazardous Chemicals from Modular High Temperature Gas-Cooled Reactor Operation at Savannah River Site
Table E.3.4-32	Risk Assessments from Exposure to Hazardous Chemicals from Advanced Light Water Reactor at Savannah River Site
Table E.3.4-33	Risk Assessments from Exposure to Hazardous Chemicals from Accelerat Production of Tritium Operation at Savannah River Site
Table E.3.4-34	Risk Assessments from Exposure to Hazardous Chemicals from Tritium Recycling Upgrade Operation at Savannah River Site
Table E.3.4-35	Risk Assessments from Exposure to Hazardous Chemicals from Tritium Recycling Phaseout Function at Savannah River Site
Table E.3.4-36	Risk Assessments from Exposure to Hazardous Chemicals at Savannah River Site-Summary Hazard Index and Total Cancer Risk

Table F.2.1.1-1	Heavy Water Reactor High Consequence Accident Source Terms
Table F.2.1.1-2	Heavy Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory-Public Consequences
Table F.2.1.1-3	Heavy Water Reactor High Consequence Accidents at Nevada Test Site-Public Consequences
Table F.2.1.1-4	Heavy Water Reactor High Consequence Accidents at Oak Ridge Reservation-Public Consequences
Table F.2.1.1-5	Heavy Water Reactor High Consequence Accidents at Pantex Plant-Public Consequences
Table F.2.1.1-6	Heavy Water Reactor High Consequence Accidents at Savannah River Site-Public Consequences
Table F.2.1.1-7	Heavy Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory-Worker Consequences
Table F.2.1.1-8	Heavy Water Reactor High Consequence Accidents at Nevada Test Site-Worker Consequences
Table F.2.1.1-9	Heavy Water Reactor High Consequence Accidents at Oak Ridge Reservation-Worker Consequences
Table F.2.1.1-10	Heavy Water Reactor High Consequence Accidents at Pantex Plant-Worker Consequences
Table F.2.1.1-11	Heavy Water Reactor High Consequence Accidents at Savannah River Site-Worker Consequences
Table F.2.1.2-1	Modular High Temperature Gas-Cooled Reactor High Consequence Accident Source Terms
Table F.2.1.2-2	Modular High Temperature Gas-Cooled Reactor High Consequence Accident at Idaho National Engineering Laboratory-Public Consequences
Table F.2.1.2-3	Modular High Temperature Gas-Cooled Reactor High Consequence Accident at Nevada Test Site-Public Consequences
Table F.2.1.2-4	Modular High Temperature Gas-Cooled Reactor High Consequence Accident at Oak Ridge Reservation-Public Consequences
Table F.2.1.2-5	Modular High Temperature Gas-Cooled Reactor High Consequence Accident at Pantex Plant-Public Consequences
Table F.2.1.2-6	Modular High Temperature Gas-Cooled Reactor High Consequence Accident at Savannah River Site-Public Consequences
Table F.2.1.2-7	Modular High Temperature Gas-Cooled Reactor High Consequence Accident at Idaho National Engineering Laboratory-Worker Consequences
Table F.2.1.2-8	Modular High Temperature Gas-Cooled Reactor High Consequence Accident at Nevada Test Site-Worker Consequences
Table F.2.1.2-9	Modular High Temperature Gas-Cooled Reactor High Consequence Accident at Oak Ridge Reservation-Worker Consequences
Table F.2.1.2-10	Modular High Temperature Gas-Cooled Reactor High Consequence Accident at Pantex Plant-Worker Consequences
Table F.2.1.2-11	Modular High Temperature Gas-Cooled Reactor High Consequence Accident

at Savannah River Site-Worker Consequences

Table F.2.1.3.1-1	Advanced Boiling Water Reactor High Consequence Accident Source Terms
Table F.2.1.3.1-2	Advanced Boiling Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory-Public Consequences
Table F.2.1.3.1-3	Advanced Boiling Water Reactor High Consequence Accidents at Nevada Test Site-Public Consequences
Table F.2.1.3.1-4	Advanced Boiling Water Reactor High Consequence Accidents at Oak Ridge Reservation-Public Consequences
Table F.2.1.3.1-5	Advanced Boiling Water Reactor High Consequence Accidents at Pantex Plant-Public Consequence
Table F.2.1.3.1-6	Advanced Boiling Water Reactor High Consequence Accidents at Savannah River Site-Public Consequences
Table F.2.1.3.1-7	Advanced Boiling Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory-Worker Consequences
Table F.2.1.3.1-8	Advanced Boiling Water Reactor High Consequence Accidents at Nevada Test Site-Worker Consequences
Table F.2.1.3.1-9	Advanced Boiling Water Reactor High Consequence Accidents at Oak Ridge Reservation-Worker Consequences
Table F.2.1.3.1-10	Advanced Boiling Water Reactor High Consequence Accidents at Pantex Plant-Worker Consequences
Table F.2.1.3.1-11	Advanced Boiling Water Reactor High Consequence Accidents at Savannah River Site-Worker Consequences
Table F.2.1.3.2-1	CE System 80+ Advanced Light Water Reactor High Consequence Accident Source Terms
Table F.2.1.3.2-2	CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory-Public Consequences
Table F.2.1.3.2-3	CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Nevada Test Site-Public Consequences
Table F.2.1.3.2-4	CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Oak Ridge Reservation-Public Consequences
Table F.2.1.3.2-5	CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Pantex Plant-Public Consequences
Table F.2.1.3.2-6	CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Savannah River Site-Public Consequences
Table F.2.1.3.2-7	CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory-Worker Consequences
Table F.2.1.3.2-8	CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Nevada Test Site-Worker Consequences
Table F.2.1.3.2-9	CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Oak Ridge Reservation-Worker Consequences
Table F.2.1.3.2-10	CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Pantex Plant-Worker Consequences

Table F.2.1.3.2-11	CE System 80+ Advanced Light Water Reactor High Consequence Accidents at Savannah River Site-Worker Consequences
Table F.2.1.3.3-1	AP600 Advanced Light Water Reactor High Consequence Accident Source Terms
Table F.2.1.3.3-2	AP600 Advanced Light Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory-Public Consequences
Table F.2.1.3.3-3	AP600 Advanced Light Water Reactor High Consequence Accidents at Nevada Test Site-Public Consequences
Table F.2.1.3.3-4	AP600 Advanced Light Water Reactor High Consequence Accidents at Oak Ridge Reservation-Public Consequences
Table F.2.1.3.3-5	AP600 Advanced Light Water Reactor High Consequence Accidents at Pantex Plant-Public Consequences
Table F.2.1.3.3-6	AP600 Advanced Light Water Reactor High Consequence Accidents at Savannah River Site-Public Consequences
Table F.2.1.3.3-7	AP600 Advanced Light Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory-Worker Consequences
Table F.2.1.3.3-8	AP600 Advanced Light Water Reactor High Consequence Accidents at Nevada Test Site-Worker Consequences
Table F.2.1.3.3-9	AP600 Advanced Light Water Reactor High Consequence Accidents at Oak Ridge Reservation-Worker Consequences
Table F.2.1.3.3-10	AP600 Advanced Light Water Reactor High Consequence Accidents at Pantex Plant-Worker Consequences
Table F.2.1.3.3-11	AP600 Advanced Light Water Reactor High Consequence Accidents at Savannah River Site-Worker Consequences
Table F.2.1.3.4-1	Simplified Boiling Water Reactor High Consequence Accident Source Terms
Table F.2.1.3.4-2	Simplified Boiling Water Reactor High Consequence Accidents at Idaho National Engineering Laboratory-Public Consequences
Table F.2.1.3.4-3	Simplified Boiling Water Reactor High Consequence Accidents at Ne Test Site-Public Consequences
Table F.2.1.3.4-4	Simplified Boiling Water Reactor High Consequence Accidents at Oak Ridge Reservation-Public Consequences
Table F.2.1.3.4-5	Simplified Boiling Water Reactor High Consequence Accidents at Pantex Plant-Public Consequences
Table F.2.1.3.4-6	Simplified Boiling Water Reactor High Consequence Accidents at Savannah River Site-Public Consequences
Table F.2.1.3.4-7	Simplified Boiling Water Reactor High Consequence Accidents at Id National Engineering Laboratory-Worker Consequences
Table F.2.1.3.4-8	Simplified Boiling Water Reactor High Consequence Accidents at Nevada Test Site-Worker Consequences
Table F.2.1.3.4-9	Simplified Boiling Water Reactor High Consequence Accidents at Oak Ridge Reservation-Worker Consequences

Table F.2.1.3.4-10	Simplified Boiling Water Reactor High Consequence Accidents at Pantex Plant-Worker Consequences
Table F.2.1.3.4-11	Simplified Boiling Water Reactor High Consequence Accidents at Savannah River Site-Worker Consequences
Table F.2.1.4.2-1	Source Term for Full Accelerator Production of Tritium with Helium-3 Target System High Consequence Accidents
Table F.2.1.4.2-2	Source Term for Phased Accelerator Production of Tritium with Helium-3 Target System High Consequence Accidents
Table F.2.1.4.2-3	Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Idaho National Engineering Laboratory-Public Consequences
Table F.2.1.4.2-4	Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Nevada Test Site-Public Consequences
Table F.2.1.4.2-5	Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Oak Ridge Reservation-Public Consequences
Table F.2.1.4.2-6	Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Pantex Plant-Public Consequences
Table F.2.1.4.2-7	Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Savannah River Site-Public Consequences
Table F.2.1.4.2-8	Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Idaho National Engineering Laboratory-Worker Consequences
Table F.2.1.4.2-9	Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Nevada Test Site-Worker Consequences
Table F.2.1.4.2-10	Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Oak Ridge Reservation-Worker Consequences
Table F.2.1.4.2-11	Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Pantex Plant-Worker Consequences
Table F.2.1.4.2-12	Full Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accidents at Savannah River Site-Worker Consequences
Table F.2.1.4.2-13	Phased Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accident-Public Consequences
Table F.2.1.4.2-14	Phased Accelerator Production of Tritium with the Helium-3 Target System High Consequence Accident-Worker Consequences
Table F.2.1.4.3-1	Source Term for Full Accelerator Production of Tritium with Spallation Lithium Conversion Target System High Consequence Accident
Table F.2.1.4.3-2	Full Accelerator Production of Tritium with the Spallation-Induced Conversion Target System High Consequence Accidents at Idaho National Engineering Laboratory-Public Consequences
Table F.2.1.4.3-3	Full Accelerator Production of Tritium with the Spallation-Induced Conversion Target System High Consequence Accidents at Nevada Test Site-Public Consequences

Table F.2.1.4.3-4	Full Accelerator Production of Tritium with the Spallation-Induce Lithium Conversion Target System High Consequence Accidents at Oa Reservation-Public Consequences
Table F.2.1.4.3-5	Full Accelerator Production of Tritium with the Spallation-Induce Lithium Conversion Target System High Consequence Accidents at Pa Plant-Public Consequences
Table F.2.1.4.3-6	Full Accelerator Production of Tritium with the Spallation-Induce Conversion Target System High Consequence Accidents at Savannah River Site-Public Consequences
Table F.2.1.4.3-7	Full Accelerator Production of Tritium with the Spallation-Induce Conversion Target System High Consequence Accidents at Idaho Nati Engineering Laboratory-Worker Consequences
Table F.2.1.4.3-8	Full Accelerator Production of Tritium with the Spallation-Induce Conversion Target System High Consequence Accidents at Nevada Test Site-Worker Consequences
Table F.2.1.4.3-9	Full Accelerator Production of Tritium with the Spallation-Induce Conversion Target System High Consequence Accidents at Oak Ridge Reservation-Worker Consequences
Table F.2.1.4.3-10	Full Accelerator Production of Tritium with the Spallation-Induc Conversion Target System High Consequence Accidents at Pantex Plant-Worker Consequences
Table F.2.1.4.3-11	Full Accelerator Production of Tritium with the Spallation-Induc Conversion Target System High Consequence Accidents at Savannah River Site-Worker Consequences
Table F.2.1.5.2-1	Multipurpose Reactor Fuel Fabrication High Consequence Accident S Terms
Table F.2.1.5.2-2	Isotopic Distribution for a Plutonium Release
Table F.2.1.5.2-3	Multipurpose Reactor Fuel Fabrication High Consequence Accidents National Engineering Laboratory-Public Consequences
Table F.2.1.5.2-4	Multipurpose Reactor Fuel Fabrication High Consequence Accidents Nevada Test Site-Public Consequences
Table F.2.1.5.2-5	Multipurpose Reactor Fuel Fabrication High Consequence Accidents Oak Ridge Reservation-Public Consequences
Table F.2.1.5.2-6	Multipurpose Reactor Fuel Fabrication High Consequence Accidents Pantex Plant-Public Consequences
Table F.2.1.5.2-7	Multipurpose Reactor Fuel Fabrication High Consequence Accidents Savannah River Site-Public Consequences
Table F.2.1.5.2-8	Multipurpose Reactor Fuel Fabrication High Consequence Accidents Idaho National Engineering Laboratory-Worker Consequences
Table F.2.1.5.2-9	Multipurpose Reactor Fuel Fabrication High Consequence Accidents Nevada Test Site-Worker Consequences
Table F.2.1.5.2-10	Multipurpose Reactor Fuel Fabrication High Consequence Accidents Oak Ridge Reservation-Worker Consequences
Table F.2.1.5.2-11	Multipurpose Reactor Fuel Fabrication High Consequence Accidents Pantex Plant-Worker Consequences

Table F.2.1.5.2-12	Multipurpose Reactor Fuel Fabrication High Consequence Accidents Savannah River Site-Worker Consequences
Table F.2.1.5.3-1	Pit Disassembly and Conversion High Consequence Accident Source Terms
Table F.2.1.5.3-2	Pit Disassembly and Conversion High Consequence Accidents at Idaho National Engineering Laboratory-Public Consequences
Table F.2.1.5.3-3	Pit Disassembly and Conversion High Consequence Accidents at Nevada Test Site-Public Consequences
Table F.2.1.5.3-4	Pit Disassembly and Conversion High Consequence Accidents at Oak Ridge Reservation-Public Consequences
Table F.2.1.5.3-5	Pit Disassembly and Conversion High Consequence Accidents at Pantex Plant-Public Consequences
Table F.2.1.5.3-6	Pit Disassembly and Conversion High Consequence Accidents at Savannah River Site-Public Consequences
Table F.2.1.5.3-7	Pit Disassembly and Conversion High Consequence Accidents at Idaho National Engineering Laboratory-Worker Consequences
Table F.2.1.5.3-8	Pit Disassembly and Conversion High Consequence Accidents at Nevada Test Site-Worker Consequences
Table F.2.1.5.3-9	Pit Disassembly and Conversion High Consequence Accidents at Oak Ridge Reservation-Worker Consequences
Table F.2.1.5.3-10	Pit Disassembly and Conversion High Consequence Accidents at Pantex Plant -Worker Consequences
Table F.2.1.5.3-11	Pit Disassembly and Conversion High Consequence Accidents at Savannah River Site-Worker Consequences
Table F.2.1.6-1	Tritium Target Extraction Facility High Consequence Accident -Public Consequences
Table F.2.1.6-2	Tritium Target Extraction Facility High Consequence Accident -Worker Consequences
Table F.2.2.1-1	Source Term for Heavy Water Reactor Charge/Discharge Accident
Table F.2.2.1-2	Heavy Water Reactor Charge/Discharge Accident-Public Consequences
Table F.2.2.1-3	Heavy Water Reactor Charge/Discharge Accident-Worker Consequences
Table F.2.2.2-1	Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accident Source Terms
Table F.2.2.2-2	Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory-Public Consequences
Table F.2.2.2-3	Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Nevada Test Site-Public Consequences
Table F.2.2.2-4	Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Oak Ridge Reservation-Public Consequences
Table F.2.2.2-5	Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Pantex Plant-Public Consequences

Table F.2.2.2-6	Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Savannah River Site-Public Consequences
Table F.2.2.2-7	Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory-Work Consequences
Table F.2.2.2-8	Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Nevada Test Site-Worker Consequences
Table F.2.2.2-9	Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Oak Ridge Reservation-Worker Consequences
Table F.2.2.2-10	Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Pantex Plant-Worker Consequences
Table F.2.2.2-11	Modular High Temperature Gas-Cooled Reactor Low-to-Moderate Consequence Accidents at Savannah River Site-Worker Consequences
Table F.2.2.3.1-1	AP600 Low-to-Moderate Consequence Accident Source Terms
Table F.2.2.3.1-2	AP600 Reactor Low-to-Moderate Consequence Accidents at Idaho Nati Engineering Laboratory-Public Consequences
Table F.2.2.3.1-3	AP600 Reactor Low-to-Moderate Consequence Accidents at Nevada Test Site-Public Consequences
Table F.2.2.3.1-4	AP600 Reactor Low-to-Moderate Consequence Accidents at Oak Ridge Reservation-Public Consequences
Table F.2.2.3.1-5	AP600 Reactor Low-to-Moderate Consequence Accidents at Pantex Plant-Public Consequences
Table F.2.2.3.1-6	AP600 Reactor Low-to-Moderate Consequence Accidents at Savannah River Site-Public Consequences
Table F.2.2.3.1-7	AP600 Reactor Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory-Worker Consequences
Table F.2.2.3.1-8	AP600 Reactor Low-to-Moderate Consequence Accidents at Nevada Test Site-Worker Consequences
Table F.2.2.3.1-9	AP600 Reactor Low-to-Moderate Consequence Accidents at Oak Ridge Reservation-Worker Consequences
Table F.2.2.3.1-10	AP600 Reactor Low-to-Moderate Consequence Accidents at Pantex Plant-Worker Consequences
Table F.2.2.3.1-11	AP600 Reactor Low-to-Moderate Consequence Accidents at Savannah River Site-Worker Consequences
Table F.2.2.3.2-1	Simplified Boiling Water Reactor Low-to-Moderate Consequence Acci Source Terms
Table F.2.2.3.2-2	Simplified Boiling Water Reactor Low-to-Moderate Consequence Acci at Idaho National Engineering Laboratory-Public Consequences
Table F.2.2.3.2-3	Simplified Boiling Water Reactor Low-to-Moderate Consequence Acci at Nevada Test Site-Public Consequences
Table F.2.2.3.2-4	Simplified Boiling Water Reactor Low-to-Moderate Consequence Acci at Oak Ridge Reservation-Public Consequences
Table F.2.2.3.2-5	Simplified Boiling Water Reactor Low-to-Moderate Consequence Acci

at Pantex Plant-Public Consequences

Table F.2.2.3.2-6	Simplified Boiling Water Reactor Low-to-Moderate Consequence Acci at Savannah River Site-Public Consequences
Table F.2.2.3.2-7	Simplified Boiling Water Reactor Low-to-Moderate Consequence Acci at Idaho National Engineering Laboratory-Worker Consequences
Table F.2.2.3.2-8	Simplified Boiling Water Reactor Low-to-Moderate Consequence Acci at Nevada Test Site-Worker Consequences
Table F.2.2.3.2-9	Simplified Boiling Water Reactor Low-to-Moderate Consequence Acci at Oak Ridge Reservation-Worker Consequences
Table F.2.2.3.2-10	Simplified Boiling Water Reactor Low-to-Moderate Consequence Acc at Pantex Plant-Worker Consequences
Table F.2.2.3.2-11	Simplified Boiling Water Reactor Low-to-Moderate Consequence Acc at Savannah River Site-Worker Consequences
Table F.2.2.3.3-1	Advanced Boiling Water Reactor Low-to-Moderate Consequence Accide Source Terms
Table F.2.2.3.3-2	Advanced Boiling Water Reactor Low-to-Moderate Consequence Accide at Idaho National Engineering Laboratory-Public Consequences
Table F.2.2.3.3-3	Advanced Boiling Water Reactor Low-to-Moderate Consequence Accide at Nevada Test Site-Public Consequences
Table F.2.2.3.3-4	Advanced Boiling Water Reactor Low-to-Moderate Consequence Accide at Oak Ridge Reservation-Public Consequences
Table F.2.2.3.3-5	Advanced Boiling Water Reactor Low-to-Moderate Consequence Accide at Pantex Plant-Public Consequences
Table F.2.2.3.3-6	Advanced Boiling Water Reactor Low-to-Moderate Consequence Accide at Savannah River Site-Public Consequences
Table F.2.2.3.3-7	Advanced Boiling Water Reactor Low-to-Moderate Consequence Accide at Idaho National Engineering Laboratory-Worker Consequences
Table F.2.2.3.3-8	Advanced Boiling Water Reactor Low-to-Moderate Consequence Accide at Nevada Test Site-Worker Consequences
Table F.2.2.3.3-9	Advanced Boiling Water Reactor Low-to-Moderate Consequence Accide at Oak Ridge Reservation-Worker Consequences
Table F.2.2.3.3-10	Simplified Boiling Water Reactor Low-to-Moderate Consequence Acc at Pantex Plant-Worker Consequences
Table F.2.2.3.3-11	Simplified Boiling Water Reactor Low-to-Moderate Consequence Acc at Savannah River Site-Worker Consequences
Table F.2.2.5.2-1	Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accident Source Terms
Table F.2.2.5.2-2	Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory-Public Consequ
Table F.2.2.5.2-3	Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Nevada Test Site-Public Consequences
Table F.2.2.5.2-4	Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Oak Ridge Reservation-Public Consequences

Table F.2.2.5.2-5	Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Pantex Plant-Public Consequences
Table F.2.2.5.2-6	Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Savannah River Site-Public Consequences
Table F.2.2.5.2-7	Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Idaho National Engineering Laboratory-Worker Consequ
Table F.2.2.5.2-8	Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Nevada Test Site-Worker Consequences
Table F.2.2.5.2-9	Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequence Accidents at Oak Ridge Reservation-Worker Consequences
Table F.2.2.5.2-10	Mixed Oxide Fuel Fabrication Low-to-Moderate Consequence Acciden Pantex Plant-Worker Consequences
Table F.2.2.5.2-11	Multipurpose Reactor Fuel Fabrication Low-to-Moderate Consequenc Accidents at Savannah River Site-Worker Consequences
Table F.2.2.5.3-1	Pit Disassembly and Conversion Low-to-Moderate Consequence Accide Source Terms
Table F.2.2.5.3-2	Pit Disassembly and Conversion Low-to-Moderate Consequence Accide at Idaho National Engineering Laboratory -Public Consequences
Table F.2.2.5.3-3	Pit Disassembly and Conversion Low-to-Moderate Consequence Accide at Nevada Test Site-Public Consequences
Table F.2.2.5.3-4	Pit Disassembly and Conversion Low-to-Moderate Consequence Accide at Oak Ridge Reservation-Public Consequences
Table F.2.2.5.3-5	Pit Disassembly and Conversion Low-to-Moderate Consequence Accide at Pantex Plant-Public Consequences
Table F.2.2.5.3-6	Pit Disassembly and Conversion Low-to-Moderate Consequence Accide at Savannah River Site-Public Consequences
Table F.2.2.5.3-7	Pit Disassembly and Conversion Low-to-Moderate Consequence Accide at Idaho National Engineering Laboratory -Worker Consequences
Table F.2.2.5.3-8	Pit Disassembly and Conversion Low-to-Moderate Consequence Accide at Nevada Test Site-Worker Consequences
Table F.2.2.5.3-9	Pit Disassembly and Conversion Low-to-Moderate Consequence Accide at Oak Ridge Reservation-Worker Consequences
Table F.2.2.5.3-10	Pit Disassembly and Conversion Low-to-Moderate Consequence Accid at Pantex Plant-Worker Consequences
Table F.2.2.5.3-11	Pit Disassembly and Conversion Low-to-Moderate Consequence Accid at Savannah River Site-Worker Consequences
Table F.2.2.6-1	Tritium Target Extraction Facility Bounding Low-to-Moderate Consequ Accident-Public Consequences
Table F.2.2.6-2	Tritium Target Extraction Facility Bounding Low-to-Moderate Consequ Accident-Worker Consequences
Table F.2.3-1	Tritium Recycling Facility High Consequence Accident-Public Consequences

Table F.2.3-2	Tritium Recycling Facility High Consequence Accident-Worker Consequences
Table F.2.4-1	Tritium Recycling Facility Hydride Bed Rupture Accident-Public Consequences
Table F.2.4-2	Tritium Recycling Facility Hydride Bed Rupture Accident-Worker Consequences
Table G.6-1	Five-Year Summary of Traffic To/From Proposed Tritium Supply and Recycling Sites
Table G.6-2	Hazardous Materials Shipments for Proposed Tritium Supply Technologies and Recycling Sites, 1991
Table G.6-3	Air Mileage Between Selected Sites
Table G.7-1	Representative Vessel and Steam Generator Size
Table H.1.1.-1	Spent Nuclear Fuel and Waste Categories
Table H.1.5-1	Low-Level Waste Disposal Land Usage Factors
Table H.2.1-1	High-Level Waste at Idaho National Engineering Laboratory
Table H.2.1-2	High-Level Waste Treatment Capability at Idaho National Engineering Laboratory
Table H.2.1-3	High-Level Waste Storage at Idaho National Engineering Laboratory
Table H.2.1-4	Mixed Transuranic Waste at Idaho National Engineering Laboratory
Table H.2.1-5	Transuranic and Mixed Transuranic Waste Treatment Capability at Idaho National Engineering Laboratory
Table H.2.1-6	Transuranic and Mixed Transuranic Waste Storage at Idaho National Engineering Laboratory
Table H.2.1-7	Mixed Low-Level Waste Streams at Idaho National Engineering Laboratory
Table H.2.1-8	Mixed Low-Level Waste and Low-Level Waste Treatment Capability at Idaho National Engineering Laboratory
Table H.2.1-9	Low-Level Waste and Mixed Low-Level Waste Storage at Idaho National Engineering Laboratory
Table H.2.2-1	Mixed Transuranic Waste Storage at Nevada Test Site
Table H.2.2-2	Low-Level and Mixed Low-Level Waste Storage and Disposal Capacity at Nevada Test Site
Table H.2.2-3	Mixed Low-Level Waste Streams at Nevada Test Site
Table H.2.2-4	Mixed Low-Level Waste and Low-Level Waste Treatment Capability at Nevada Test Site
Table H.2.3-1	Low-Level and Mixed Low-Level Waste Treatment Capability at Y-12
Table H.2.3-2	Low-Level and Mixed Low-Level Waste Storage Capability at Y-12
Table H.2.3-3	Mixed Low-Level Waste at Y-12
Table H.2.3-4	Hazardous Waste Treatment Capability at Y-12

Table H.2.3-5 Hazardous Waste Storage Capability at Y-12

Table H.2.3-6 Inventory of Reactor-Irradiated Nuclear Material at Oak Ridge Reserva

Table H.2.3-7 Mixed Transuranic Waste at Oak Ridge National Laboratory

Table H.2.3-8 Transuranic and Mixed Transuranic Waste Storage Capability at Oak Rid
National Laboratory

Table H.2.3-9 Low-Level and Mixed Low-Level Waste Treatment Capability at Oak Ridge
National Laboratory

Table H.2.3-10 Low-Level and Mixed Low-Level Waste Storage Capability at Oak Ridge
National Laboratory

Table H.2.3-11 Low-Level Waste Disposal Units at Oak Ridge National Laboratory

Table H.2.3-12 Mixed Low-Level Waste at Oak Ridge National Laboratory

Table H.2.3-13 Hazardous Waste Treatment Capability at Oak Ridge National Laborator

Table H.2.3-14 Hazardous Waste Storage Capability at Oak Ridge National Laboratory

Table H.2.3-15 Low-Level, Mixed Low-Level, and Hazardous Waste Treatment Capability
at K-25 Site

Table H.2.3-16 Low Level, Mixed Low-Level, and Hazardous Waste Storage Capability
at K-25 Site

Table H.2.3-17 Low-Level Waste Storage Capability at K-25 Site

Table H.2.3-18 Mixed Low-Level Waste at K-25 Site

Table H.2.4-1 Waste Treatment Capability at Pantex Plant

Table H.2.4-2 Waste Storage Capability at Pantex Plant

Table H.2.4-3 Low-Level Waste Streams at Pantex Plant

Table H.2.4-4 Low-Level Waste Inventory at Pantex Plant

Table H.2.4-5 Mixed Low-Level Waste Streams at Pantex Plant

Table H.2.4-6 Mixed Low-Level Waste Inventory at Pantex Plant

Table H.2.4-7 Hazardous Waste Streams at Pantex Plant

Table H.2.4-8 Hazardous Waste Inventory at Pantex Plant

Table H.2.5-1 High-Level Wastes at Savannah River Site

Table H.2.5-2 High-Level Waste Treatment Capability at Savannah River Site

Table H.2.5-3 High-Level Waste Storage at Savannah River Site

Table H.2.5-4 Mixed Transuranic Waste at Savannah River Site

Table H.2.5-5 Transuranic and Mixed Transuranic Waste Treatment Capability at
Savannah River Site

Table H.2.5-6 Transuranic and Mixed Transuranic Waste Storage at Savannah
River Site

Table H.2.5-7 Low-Level and Mixed Low-Level Wastes at Savannah River Site

Table H.2.5-8 Low-Level and Mixed Low-Level Waste Treatment Capability at Savannah River Site

Table H.2.5-9 Low-Level and Mixed Low-Level Waste Storage at Savannah River Site

Table H.2.5-10 Waste Disposal at Savannah River Site

Table I.1-1 Comparison of Tritium Supply and Recycling Alternatives

Table I.1-2 Summary Comparison of Environmental Impacts of the Commercial Light Water Reactor Alternative

Table 1.1-1 Hearing Attendance and Comment Summaries	1-1
Table 1.1-2 Document and Comment Submission Overview	1-1
Table 1.3-1 Issue Categories	1-6
Table 1.3-2 Index of Attendance at Public Hearings	1-7
Table 1.3-3 Index of Commentors, Private Individuals	1-22
Table 1.3-4 Index of Commentors, Organizations	1-31
Table 1.3-5 Comment Document and Summary Locator	1-36
Table 1.3-6 Comments Sorted by Summary Code	1-61





Table of Contents

List of Figures

List of Tables

Acronyms

INTRODUCTION

TRITIUM SUPPLY AND RECYCLING PROPOSAL

AGENCY PREFERRED ALTERNATIVE

PURPOSE OF AND NEED FOR THE DEPARTMENT OF ENERGY'S ACTION

CHANGES FROM THE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

TRITIUM SUPPLY AND RECYCLING

Technologies

Heavy Water Reactor

Modular High Temperature Gas-Cooled Reactor

Advanced Light Water Reactor

Accelerator Production of Tritium

Commercial Light Water Reactor

Tritium Recycling

New Recycling Facilities

Upgrade of Recycling Facilities at Savannah River Site

SITES

Commercial Light Water Reactor

Idaho National Engineering Laboratory

Nevada Test Site

Oak Ridge Reservation

Pantex Plant

Savannah River Site

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Purchase of Tritium from Foreign Sources

Redesign of Weapons to Require Less or No Tritium

Use of Existing Department of Energy Reactors or Accelerators

Alternative Sites

REDUCED TRITIUM REQUIREMENTS

ENVIRONMENTAL RESOURCE IMPACT METHODS

Land Resources

Land Use

Visual Resources

Site Infrastructure

Air Quality and Acoustics

Water Resources

Surface Water

Groundwater

Geology and Soils

Biotic Resources

Terrestrial Resources

Wetlands

- Aquatic Resources
- Threatened and Endangered Species
- Cultural and Paleontological Resources
 - Prehistoric and Historic Resources
 - Native American Resources
 - Paleontological Resources
- Socioeconomics
- Radiation and Hazardous Chemical Environment
- Waste Management
- Intersite Transportation
- Environmental Justice

ENVIRONMENTAL IMPACTS

- Visual Resources
- Air Quality and Acoustics
- Floodplains
- Geology and Soils
- Terrestrial Resources
- Cultural and Paleontological Resources
- Other Socioeconomic Issues

MULTIPURPOSE ("TRIPLE PLAY") REACTOR

- Advanced Light Water Reactor
- Modular High Temperature Gas-Cooled Reactor

Commercial Light Water Reactor

- Core Changes
- Personnel Requirements
- Effluent
- Waste
- Spent Nuclear Fuel
- Worker Radiation Exposure
- Radiological Impacts
 - Normal Operations
- Transportation/Handling

QUALITATIVE COMPARISON

- Site Infrastructure
- Human Health
- Generated Wastes
 - Spent Fuel Generation
 - Low-Level Waste

List of Figures

- Figure ES-1 Current and Former Nuclear Weapons Complex Sites
- Figure ES-2 Tritium Supply and Recycling Alternatives
- Figure ES-3 Nuclear Weapons Stockpile Plan Process
- Figure ES-4 Estimated Tritium Inventory and Reserve Requirements
- Figure ES-5 Heavy Water Reactor Facility (Typical)
- Figure ES-6 Modular High Temperature Gas-Cooled Reactor Facility (Typical)
- Figure ES-7 Advanced Light Water Reactor Facility (Typical)
- Figure ES-8 Accelerator Production of Tritium Facility Site Layout (Typical)
- Figure ES-9 New Tritium Recycling Facility (Typical)
- Figure ES-10 Tritium Recycling Facilities Upgrades at Savannah River Site (General)

List of Tables

Table ES-1 Summary Comparison of Environmental Impacts of Tritium Supply Technologies and Recycling

Table ES-2 Summary Comparison of Environmental Impacts of Commercial Light Water Reactor Alternative

Acronyms

APT	Accelerator Production of Tritium
ALWR	Advanced Light Water Reactor
CEQ	Council on Environmental Quality
DOE	Department of Energy
DP	DOE Office of the Assistant Secretary for Defense Programs
ES&H	environment, safety and health
HLW	high-level waste
HWR	Heavy Water Reactor
INEL	Idaho National Engineering Laboratory
IP	implementation plan
LLW	low-level waste
MHTGR	Modular High Temperature Gas-Cooled Reactor
NEPA	National Environmental Policy Act of 1969
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NTS	Nevada Test Site
ORR	Oak Ridge Reservation
PEIS	programmatic environmental impact statement
ROD	Record of Decision
SRS	Savannah River Site
TRU	transuranic

EXECUTIVE SUMMARY

INTRODUCTION

In January 1991, the Secretary of Energy announced that the Department of Energy (D Office of the Assistant Secretary for Defense Programs (DP) would prepare a program environmental impact statement (PEIS) examining alternatives for the reconfiguration of the Nation's Nuclear Weapons Complex (Complex) (figure ES-1). The framework for the Reconfiguration PEIS was described in the January 1991 Nuclear Weapons Complex Reconfiguration Study, a detailed examination of alternatives for the future Complex. Because the significant changes in the world since January 1991, especially with regard to projected future requirements for the United States nuclear weapons stockpile, the framework described in the Nuclear Weapons Reconfiguration Study does not exist today. Therefore, the Department separated the Reconfiguration PEIS into two PEISs: a PEIS Tritium Supply and Recycling; and a Stockpile Stewardship and Management PEIS. The Supply and Recycling Proposal is analyzed in this PEIS. The Stockpile Stewardship and Management Proposal is currently being analyzed in a separate PEIS being prepared by

Another issue, which was once part of reconfiguration, was the storage of all weapons-usable fissile materials, primarily highly enriched uranium and plutonium. In early 1994 the Secretary established a Department-wide program for developing recommendations and for directing implementation of decisions concerning disposition of nuclear materials. This program was recognized in the FY 1995 Defense Authorization which directed that an office be established for this purpose.

A determination was made that a PEIS was needed to support the decision-making for disposition of surplus weapons-usable fissile materials. Since long-term storage is closely related (connected) to disposition, the long-term storage analysis that had part of the Reconfiguration PEIS was moved into the program for Long-Term Storage a Disposition of Weapons-Usable Fissile Materials. As a result, a third PEIS, the Long Storage and Disposition of Weapons-Usable Fissile Materials PEIS, is being prepared to analyze alternatives for the long-term storage of all weapons-usable fissile materials primarily highly-enriched uranium and plutonium. That PEIS will also address the disposition of plutonium declared surplus to national defense needs by the President. The EIS for the disposition of surplus highly enriched uranium is also being prepared.

Tritium Supply and Recycling Proposal

DOE proposes to provide tritium supply and recycling facilities for the Complex. Tritium, a man-made radioactive isotope of hydrogen, is an essential component of every warhead in the current and projected U.S. nuclear weapons stockpile. These warheads depend on tritium to perform as designed. Tritium decays at a rate of 5.5 percent per year and must be replaced periodically as long as the Nation relies on a nuclear deterrent. Currently, the Complex does not have the capability to produce the required amounts of tritium, and projections require that new tritium be available by approximately 2011. The Tritium Supply and Recycling Programmatic Environmental Impact Statement evaluates the siting, construction, and operation of tritium supply technology alternatives and recycling facilities at each of five candidate sites: the Idaho National Engineering Laboratory (INEL), the Nevada Test Site (NTS), the Oak Ridge Reservation (ORR), the Pantex Plant, and the Savannah River Site (SRS). The PEIS assesses the environmental impacts of all reasonable alternatives discussed in the following section, including No Action.

Tritium supply deals with the production of new tritium in either a reactor or an accelerator (by irradiating target materials with neutrons) and the subsequent extraction of the tritium in pure form for its use in nuclear weapons. Tritium recycling consists of recovering residual tritium from weapons components, purifying it, and refilling weapons components with both recovered and new tritium when it becomes available.

Figure (Page ES-2)

Figure ES-1. - Current and Former Nuclear Weapons Complex Sites

Under the No Action alternative, DOE would not establish a new tritium supply capability. The current inventory of tritium would decay and DOE would not meet stockpile requirements for tritium. This would be contrary to DOE's mission as specified by the Atomic Energy Act of 1954, as amended. Alternatives for new tritium supply and recycling facilities consist of four different tritium supply technologies and five locations as shown in Figure ES-2. The four technologies proposed to provide a new supply of tritium are Water Reactor (HWR), Modular High Temperature Gas-Cooled Reactor (MHTGR), Advanced Water Reactor (ALWR), and Accelerator Production of Tritium (APT). Both Large (1,300 MWe) and Small (600 MWe) options for the ALWR are evaluated as well as a phased approach for the APT. The use of an existing commercial light water reactor that would be used for irradiation services or purchased and converted for tritium production is also included as an alternative for long-term tritium supply.

Tritium Supply and Recycling Proposal:

- . Provide the long-term, assured supply of Tritium.
- . Safely and reliably fulfill all future national defense requirements for tritium.
- . Protect the health of workers, the general public, and the environment.

Additionally, the PEIS for Tritium Supply and Recycling includes an assessment of the

environmental impacts associated with using one or more commercial light water reactors for tritium production as a contingency in the event of a national emergency. Specific commercial reactors are not identified in the PEIS.

This PEIS also addresses the environmental impacts of an ALWR or modular gas-cooled reactor used as a multipurpose reactor. A commercial reactor could also be used as a multipurpose reactor. Throughout the PEIS, references to and discussion of impacts of a multipurpose ALWR are also applicable to a multipurpose commercial reactor. A multipurpose ("triple play") reactor is defined as one capable of producing tritium, "burning" plutonium, and generating revenues through the sale of electric power. The multipurpose ALWR would operate the same as the uranium-fueled tritium production ALWR. Therefore, the environmental impacts from operation of a multipurpose ALWR would be expected to be similar to those from the tritium production ALWR. However, a plutonium Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would be needed to produce the mixed-oxide fuel rods for the ALWR multipurpose reactor and would be the major contributor to potential environmental impacts greater than those for a uranium-fueled tritium production ALWR for this scenario. For a modular gas-cooled multipurpose reactor, twice as many reactor modules would be needed both to meet tritium requirements and to burn plutonium. A plutonium Pit Disassembly/Conversion/Fuel Fabrication Facility also would be needed. Thus, the potential environmental impacts for a multipurpose gas-cooled reactor are expected to be substantially greater than a uranium-fueled tritium production gas-cooled reactor.

The PEIS evaluates alternative tritium supply technologies against a baseline tritium requirement (i.e., a specific quantity of tritium, the exact amount of which is classified). Understanding the concept of the baseline tritium requirement is crucial to understanding the alternatives and the analysis in the PEIS. The baseline tritium requirement is the amount necessary to support the 1994 Nuclear Weapons Stockpile Plan, which is based on a START II stockpile level of approximately 3,500 accountable weapons. In the PEIS, the baseline tritium requirement is approximately 3/8ths the tritium requirement that was analyzed in the New Production Reactor Draft EIS published in 1991. This is the tritium requirement "baseline" which the tritium supply technologies must support, and against which they are assessed.

This baseline tritium requirement is made up of two specific components: (1) a steady-state tritium requirement to make up for tritium lost through natural decay; (2) a surge tritium requirement to replace any tritium which might be used in the event the Nation ever dipped into, or lost, its tritium reserve. The sizing of the surge capacity is based on the requirement set forth in the Nuclear Weapons Stockpile Plan to reconstitute the entire reserve in a 5-year period. The steady-state component accounts for approximately 50 percent of the baseline tritium requirement, while the surge accounts for the remaining 50 percent. Tritium supply technologies being evaluated must be able to support the steady-state tritium requirement (a specific quantity of tritium every year) and make up for any lost tritium reserves.

Figure (Page ES-4)

Figure ES-2.- Tritium Supply and Recycling Alternatives

Time Frame of Proposed Action:

- . 1999 to 2009 - Construction
- . 2010 - Initial Operation
- . 2010 to 2050 - Full Operation

The Tritium Supply and Recycling Proposal will proceed in three phases. The first phase involves preparing information to support programmatic decisions on siting and technology. This includes preparing this PEIS and the associated Record of Decision (ROD). The second phase includes the following programmatic decisions:

- . Whether to build new tritium supply and new or upgraded tritium recycling facilities;

- . Where to locate new tritium supply and recycling facilities; and
- . Which technologies to employ for tritium supply.

During the second phase, DOE would develop detailed designs and meet project-specific National Environmental Policy Act of 1969 (NEPA) requirements which would focus on the facility would be placed and construction and operation impacts. The third phase involve constructing, testing, and certifying the selected tritium supply and recycling facilities, leading to full operation. Present planning requires the tritium facility be fully operational by the year 2010 with new tritium available for use approximately year later. The PEIS also includes analyses of providing tritium at an earlier date (approximately 2005) to support a higher stockpile level.

Following the PEIS, DOE will develop a schedule for implementing the ROD decision. schedule will be subject to change and include reassessments required by congressional authorizations and appropriations. Although the individual schedules of any activity or projects may overlap, the current uncertainty associated with any given activity project requires that assumptions be made regarding the time periods used in the PE analyses.

Because of the uncertainties associated with the scheduling of the second and third phases, the PEIS assumes an environmental baseline period for construction between 2000 and 2009, and an operational period, beginning in approximately 2010, of 40 years. As the design life of the tritium supply and recycling facilities has not yet been determined by engineering studies, the assumption of an operational period of approximately 40 years is consistent with the operating periods used in prior DOE NEPA documents for similar new facilities. Project-level tiered NEPA documents would identify in detail specific construction and operational periods for each project implemented.

AGENCY PREFERRED ALTERNATIVE

The Council on Environmental Quality (CEQ) Regulations require an agency to identify preferred alternative(s) in the Final Environmental Impact Statement (40 CFR 1502.14). The preferred alternative is the alternative which the agency believes would fulfill statutory mission, giving consideration to environmental, economic, technical, and social factors. Consequently, to identify a preferred alternative, the Department has developed information on potential environmental impacts, costs, technical risks, and schedule risks for the alternatives under consideration.

This PEIS provides information on the environmental impacts. Cost, schedule, and technical analyses have also been prepared, and are summarized in the Tritium Supply Recycling Technical Reference Report which is available in the appropriate DOE Read Rooms for public review.

Based upon the analysis presented in the documents identified above, the Department preferred alternative is a acquisition strategy that assures tritium production for the nuclear weapons stockpile rapidly, cost effectively, and safely. The preferred strategy is to begin work on the two most promising production alternatives: (1) purchase an existing commercial light water reactor or irradiation services with an option to purchase the reactor for conversion to a defense facility; (2) design, build, and test critical components of an accelerator system for tritium production. Within a three year period, the Department would select one of the alternatives to serve as the primary source of tritium. The other alternative, if feasible, would be developed as a back-up tritium source.

Savannah River Site has been designated as the preferred site for an accelerator, should one be built. The preferred alternative for tritium recycling and extraction activity is to remain at the Savannah River Site with appropriate consolidation and upgrading of current facilities, and construction of a new extraction facility.

Purpose of and Need For the department of energy's action

Since nuclear weapons came into existence in 1945, a nuclear deterrent has been a cornerstone of the Nation's defense policy and national security. The President reinforced this principle in his July 3, 1993, radio address to the Nation. Tritium was used in the design process to enhance the yield of nuclear weapons and allow for the production of smaller or more powerful warheads to satisfy the needs of modern delivery systems. As a result, the United States' strategic nuclear systems are based on designs that use tritium. Therefore, the Nation requires a reliable tritium supply source. Tritium has a relatively short radioactive half-life of 12.3 years. Because of this relatively rapid radioactive decay, tritium must be replenished periodically in nuclear weapons to ensure that they will function as designed. Over the past 40 years, DOE has built and operated reactors to produce tritium and other nuclear materials for weapons purposes. Today only one of these reactors is operational, and no tritium has been produced since 1988.

Pursuant to the Atomic Energy Act of 1954, as amended, DOE is responsible for developing and maintaining the capability to produce nuclear materials such as tritium, which is required for the defense of the United States. The primary use of tritium is for maintaining the Nation's stockpile of nuclear weapons as directed by the President's Nuclear Weapons Stockpile Plan. Figure ES-3 depicts the Nuclear Weapons Stockpile Plan process.

Tritium, with a 12.3-year half-life, decays at the rate of approximately 5 percent per year and is necessary for all nuclear weapons that remain in the stockpile.

The Nuclear Weapons Stockpile Plan is normally forwarded annually from the Secretary of the Departments of Energy and Defense via the National Security Council to the President for approval. The Nuclear Weapons Stockpile Plan reflects the size and composition of the stockpile needed to defend the United States and provides an assessment of DOE's ability to support the proposed stockpile. Many factors are considered in the development of the Nuclear Weapons Stockpile Plan, including the status of the currently approved stockpiles, arms control negotiations and treaties, Congressional constraints, and the status of nuclear material production and fabrication facilities. Revisions of the Nuclear Weapons Stockpile Plan could be issued when any of the factors indicate the need to change requirements established in the annual document. The most current Nuclear Weapons Stockpile Plan, which was approved by President Clinton on March 7, 1994, authorizes weapons production and retirement through fiscal year 1999. The analysis in this PEIS is based on the requirements of the 1994 Nuclear Weapons Stockpile Plan which is based on START II stockpile levels (approximately 3,500 accountable weapons). The 1994 Nuclear Weapons Stockpile Plan represents the latest official guidance for tritium requirements. The Nuclear Weapons Stockpile Plan for 1995 has not yet been issued. Appendix CA, which is classified, contains quantitative projections for tritium requirements based on the Nuclear Weapons Stockpile Plan, and details of the transportation analysis.

Even with a reduced nuclear weapons stockpile and no identified requirements for new nuclear weapons production in the foreseeable future, an assured long-term tritium and recycling capability will be required. Presently, no source of new tritium is available. The effectiveness of the U.S. nuclear deterrent capability depends not only on the Nation's current stockpile of nuclear weapons or those it can produce, but also on its ability to reliably and safely provide the tritium needed to support these weapons.

Until a new tritium supply source is operational, DOE will continue to support tritium requirements by recycling tritium from weapons retired from the Nation's nuclear weapons stockpile. However, because tritium decays relatively quickly, recycling can only meet tritium demands for a limited time. Current projections, derived from classified projections of future stockpile scenarios, indicate that recycled tritium will adequately support the Nation's nuclear weapons stockpile until approximately 2011 (figure ES-3). After that time, without a new tritium supply source, it would be necessary to utilize the strategic reserve of tritium in order to maintain the readiness of the nuclear weapons stockpile. The strategic reserve of tritium contains a quantity of tritium to maintain readiness in emergencies and contingencies. In such a scenario, if the strategic tritium reserve is depleted, the nuclear deterrent capability would degrade because the weapons in the stockpile would not be capable of functioning as designed. Eventually, the nuclear

deterrent would be lost. The proposed tritium supply and recycling facilities would provide the capability to produce tritium safely and reliably in order to meet the Nation's defense requirements well into the 21st century while also complying with environment, safety, and health (ES&H) standards.

DOE has analyzed the activities that must take place in order to bring a new tritium supply source into operation. The analysis indicates that it could take approximate years to research, develop, design, construct, and test a new tritium supply source new tritium production can begin. Thus, in order to have reasonable confidence that Nation will be able to maintain an effective nuclear deterrent, prudent management dictates that DOE proceed with the proposed action now. In addition, DOE was required to meet a statutory deadline of March 1, 1995, to issue a PEIS addressing tritium supply alternatives (Public Law 103-160, section 3145). That deadline was met by the issuance of a Draft PEIS for Tritium Supply and Recycling in February 1995. Following public hearings, comments received have been considered in preparing this Final PEIS which was submitted to Congress to close out DOE's obligation with respect to the intent of Public Law 103-160, Section 3145.

Changes from the Draft Programmatic Environmental Impact Statement

The 60-day public comment period for the Draft PEIS began on March 17, 1995, and ended on May 15, 1995. However, comments were accepted as late as June 23, 1995. During the period, public hearings were held in Las Vegas, NV; Washington, DC; Pocatello, ID; Oa Ridge, TN; North Augusta, SC; and Amarillo, TX. Two hearings were held at each location. In addition, the public was encouraged to provide comments via mail, fax, electronic bulletin board (Internet), and telephone (tollfree 800-number). During public review of the Draft PEIS a majority of the comments regarded concerns that alternatives and/or candidate sites were not given the correct amount of consideration on factors including cost and technical feasibility. Although these concerns made up the majority of the comments, many others involved the resources analyzed, NEPA and regulatory issues, and Federal policies as they related to the PEIS. The major issues identified by commentors included the following:

The electrical requirements of the various alternatives, particularly the APT, and potential for the MHTGR and ALWR to produce electricity;

The impacts of the alternatives on groundwater, including the potential for aquifer depletion and contamination and the consideration of the use of treated wastewater for cooling;

The socioeconomic impacts, both positive and negative, of locating or failing to locate a facility at one of the candidate sites;

Figure (Page ES-8)

Figure ES-3. - Nuclear Weapons Stockpile Plan Process

Figure (Page ES-9)

Figure ES-4. - Estimated Tritium Inventory and Reserve Requirements.

The generation, storage, and disposal of radioactive and hazardous wastes (including spent nuclear fuel) and the associated risks;

The impacts of the alternatives on human health (both from radiation and hazardous chemicals) and how these risks were determined and evaluated;

The relationship of this PEIS to other DOE documents and programs, particularly the Waste Management PEIS and the Fissile Materials Disposition Program, and the need to make decisions based on all associated programs and activities concurrently;

The need for decisions to be based on many different factors, including environment, cost, and safety concerns;

The failure of DOE to consider a no tritium or zero stockpile alternative, and the

negative national and international implications of building a new tritium supply facility; and

The need for DOE to consider a commercial reactor alternative in greater detail.

Additionally, as a result of public comments, DOE published on August 25, 1995 a Notice in the Federal Register (60 FR 44327) to include the purchase of irradiation services commercial reactor as a reasonable alternative. The Draft PEIS considered this an unreasonable alternative because of the long-standing policy of the United States that civilian nuclear facilities should not be utilized for military purpose and nonproliferation concerns. Nonetheless, the Draft PEIS included an evaluation of the environmental impacts of irradiation services using an existing commercial reactor to make tritium. Because of public comments on the Notice, public review of the Draft and further consideration of nonproliferation issues, purchase of irradiation services was evaluated in the PEIS as a reasonable alternative. During the extended comment period there were two major issues of concern raised:

License and regulatory implication; and

Non-proliferation concerns.

Revisions in the Final PEIS include additional discussion and analysis in the following areas: severe accidents and design-basis accidents for all tritium supply technologies; site-specific environmental impacts of a dedicated power plant for the Accelerator Production of Tritium (APT); revisions to water resources sections; site-specific analysis of the multi-purpose reactor that could produce tritium, burn plutonium as fuel, and produce electricity; and the commercial reactor alternative, specifically the purchase of an existing reactor and the purchase of irradiation services for DOE target rods to produce tritium. Each of these areas will be discussed in more detail below.

Analyses of an ALWR design-basis accident were reevaluated as a result of public comments questioning the apparent severity and frequency of the accident consequences shown in the Draft PEIS. Additional analyses were performed to accurately estimate the impacts of a more reasonable design-basis accident and these results have been included in the PEIS.

The analyses of impacts of severe reactor accidents were also revised. The Draft PEIS presented the impacts of a single severe accident for each of the reactor technologies. Since accident consequences vary greatly depending on the selected accident frequency value, a spectrum of severe accidents with a range of frequencies was used to perform a more representative analysis for each technology. The new analyses presented reflect probable effects of a set of accidents for each reactor rather than the single accident scenario.

Public comments also suggested that a disparity existed between the reactor and APT accident analyses, thereby creating a bias in favor of the APT. The Final PEIS now includes an APT severe accident with loss of confinement. The new accident analysis includes a more severe initiating event, a lower frequency, and a higher consequence than the analysis presented in the Draft PEIS.

The Final PEIS has been modified to include a qualitative discussion of impacts to involved workers (workers assigned to the facility and located in close proximity to the facility as a result of the proposed action) and quantitative impacts to noninvolved workers (workers collocated at the site independent of the proposed action). For involved workers, impacts were addressed qualitatively, explaining the significant risk for exposure and fatality and that mitigative features would be provided in the design and operation to minimize worker impacts from accidents.

For the noninvolved worker, the impacts were represented by the exposure of a hypothetical worker at several prescribed distances from the accident (but within the site boundary). These impacts were described in terms of dose (rems), increases in the likelihood of cancer fatalities, and risk of cancer for the maximally exposed noninvolved worker.

Another significant change in the document is a more detailed description of potent impacts of a dedicated power plant for the APT. The section has been revised to include site-specific impacts for the gas-fired power plant.

Based on public comments received at the hearings, two revisions were incorporated into the water resources sections for NTS and Pantex. For NTS, the Final PEIS incorporates more accurate recharge rates and information regarding the potential project use of the aquifer to present a more accurate impact on groundwater resources.

For Pantex, the Final PEIS includes the use of reclaimed sanitary wastewater source Hollywood Road Wastewater Treatment Plant and the Pantex Plant Wastewater Treatment for tritium supply cooling water.

A more detailed analysis of the multi-purpose reactor has been included in the Final PEIS. Since the multi-purpose reactor would use plutonium fuel, an analysis of the construction impacts of a Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility to support multi-purpose ALWR has been incorporated in the site-specific analysis for each of the candidate sites. Impacts of just the pit disassembly/conversion part of the facility included for the multi-purpose MHTGR since this technology already includes a fuel fabrication component. For the operation of a multi-purpose reactor, additional data regarding the impacts on atmospheric emissions, liquid emissions, water requirements, socioeconomics, human health (for both normal operations and accidents), waste management and intersite transportation has been included in the site-specific analysis.

Analysis and a discussion of potential impacts have been expanded and included in the Final PEIS on the alternative of DOE purchasing an existing operating commercial reactor, an incomplete reactor and converting it to production of tritium for defense purposes. Also included in the Final PEIS is an analysis of the alternative of DOE purchasing irradiation services from one or more commercial light water reactors for the production of tritium using DOE targets.

TRITIUM SUPPLY AND RECYCLING

The tritium supply technologies and site alternatives are described below. For each alternative except those being considered for SRS, a new tritium recycling facility either be collocated with the new supply facilities or DOE could use the existing tritium recycling facilities at SRS after upgrade. For the alternatives at SRS, DOE would use existing recycling facilities at SRS, which would be upgraded to support the tritium mission.

Technologies

Of the tritium supply technologies considered by DOE for the production of tritium in the Final PEIS, only the HWR has tritium production operating experience. The MHTGR and light water reactor (upon which the ALWR is based) technologies have been used in electricity production but lack tritium production experience and development of tritium technology. The APT technology, which has an operating history in research and development programs, also has no tritium production experience and only recent development of targets.

Since both the MHTGR and the ALWR were originally developed to produce electricity as such have steam turbines as an integral part of their designs, the Final PEIS evaluates environmental effects of both of these technologies with turbines included. The actual sale of steam or generation of electricity by DOE would be covered in the site-specific NEPA documents if either of these technologies is chosen. The general impact of the transmission lines necessary to carry this generated electricity are discussed. In addition, the general impacts of constructing and operating a dedicated power plant (either coal or natural gas burning) to provide the required power for the APT are presented. As both the MHTGR and the ALWR technologies could also be used for the disposition of plutonium, the general impacts of operating these two technologies with plutonium-uranium fuel is presented in the Final PEIS.

Heavy Water Reactor. The HWR would be a low pressure, low temperature reactor whose purpose would be to produce tritium. The HWR would use heavy water as the reactor coolant and moderator. Because of the low temperature of the exit coolant, a power conversion system designed to produce electrical power as an option would not be feasible. In addition to the reactor, the HWR complex would consist of several support buildings and other facilities required for the supply and extraction of tritium.

The HWR complex would cover approximately 260 acres and the entire area would be surrounded by a security fence. The main reactor would be about 10 stories high and other associated buildings would range from one story to three stories in height. The cooling towers vary in height, depending on the type of cooling towers utilized. The cooling tower which serves as a holding pond for the cooling towers, would cover approximately 2 acres. In this PEIS, dry sites such as INEL, NTS, and Pantex which lack plentiful surface water sources would use mechanical draft dry cooling towers while wet sites such as ORR with abundant surface water resources would use natural draft wet cooling towers.

Range of Selected Construction Requirements for Tritium Supply Technologies:

- . Electrical Energy Demand:
40,000 to 120,000 MWh per year
- . Land Use:
173 to 360 acres
- . Total Number of Construction Workers:
2,200 to 3,500
- . Water Consumption:
41,700,000 to 200,000,000 gallons
- . Steel Consumption
45,000 to 68,000 tons

The conceptual design of the HWR complex includes a fuel and target fabrication facility to assemble fuel and target rods that are used in the reactor core; a tritium target processing facility to extract and collect tritium from irradiated targets; an intermediate fuel storage building to store used target and fuel rods; a general services building for administrative purposes; and a security infrastructure to control access to the complex. Figure ES-5 shows a representative drawing of an HWR complex with mechanical draft cooling towers for illustrative purposes only. The number and arrangement of buildings and support areas are descriptive only and can change significantly as design progresses. The fuel and target fabrication facility would be a steel or concrete structure designed to control the spread of contamination within the building and prevent the uncontrolled release of radioactive material. The target processing facility would consist of two attached structures: a process building and a support building. The process building would include the laboratory and other activities associated with handling tritium. The support building contains offices, maintenance areas, and nonradioactive ventilation systems.

The design of the HWR would incorporate numerous safety features including: an emergency power facility to house diesel generators or gas turbines for short-term emergency power to support safety related loads in the event of temporary failure of the offsite power supply; a reactor containment building to limit any operational or accidental release of radioactive material; an emergency core cooling system to make up coolant for heat removal in the event of a loss of coolant or a loss of pumping; an emergency shutdown system with shutdown rods independent of the reactor control rods; a neutron poison system to inject neutron absorbing material into the moderator tank; and a backup system to remove heat from the reactor if the primary coolant fails to circulate.

Construction of the HWR would take somewhat less than 8 years and require approximately 2,320 workers during the peak construction period. Once constructed, approximately 1

years would be needed for system checkout of the reactor prior to actual tritium production. Operation of the HWR would require approximately 930 workers.

Modular High Temperature Gas-Cooled Reactor. The MHTGR would be a high temperature, moderate pressure reactor whose primary purpose would be to produce tritium. The MH would use helium gas as a core coolant and graphite as a moderator. Because of the temperature of the exit coolant, a power conversion facility designed to produce electricity is an integral part of the design and is included in the analysis. In addition, the reactor building and the power conversion building, the MHTGR complex would consist of several buildings and other facilities required for the supply and extraction of tritium.

The MHTGR complex would cover approximately 360 acres and the entire area would be surrounded by a security fence. The MHTGR would consist of three 350 MWt reactor vessels housed in adjacent, below-ground, reinforced-concrete silos. The silos would extend approximately 160 feet below-grade and each reactor vessel would be about 22 feet in diameter and 75 feet high. Each reactor vessel would contain a reactor core, reflector, and associated supports. A shutdown cooling heat exchanger and a shutdown cooling circulator would be located at the bottom of the vessels. Support buildings and other associated facilities within the MHTGR complex would range in height from one to thirty stories. Two cooling towers would be needed and their height would vary, depending on the type of cooling towers that are utilized. In this PEIS dry sites (INEL, NTS, and Paducah) would use mechanical draft dry cooling towers and wet sites (ORR and SRS) would use natural draft wet cooling towers.

Figure (Page ES-13)

Figure ES-5. - Heavy Water Reactor Facility (Typical).

The design of the MHTGR complex would include a fuel and target fabrication facility, tritium target processing building, helium storage buildings, waste treatment facility, spent fuel storage facility, a general services building, a security infrastructure, power conversion facility consisting of three turbine-generators and associated electrical control equipment. Figure ES-6 shows a representative drawing of a MHTGR complex with mechanical draft cooling towers shown for illustrative purposes only. The number and arrangement of buildings and support areas are descriptive only and can change significantly as design progresses. The design of the MHTGR would incorporate numerous features that include: an emergency power facility to house diesel generators or gas turbines for short-term emergency power to support safety related loads in the event of a temporary failure of the offsite power supply; a below-grade design, which serves as a barrier to external hazards (aircraft, turbine blades, and tornado-generated debris); reduces seismic-induced stress on the reactors, and provides radiological shielding; below-grade containment structure made of reinforced concrete; an emergency core cooling system; and an emergency shutdown system with safety rods independent of the reactor control rods.

Construction of the MHTGR would take about 9 years and require approximately 2,210 workers during the peak construction period. One to 2 years would be needed after construction system checkout of the reactor prior to actual tritium production. Operation of the MHTGR would require approximately 910 workers.

A modular gas-cooled reactor like the MHTGR would also be capable of performing the "triple play" missions of producing tritium, burning plutonium, and generating electricity. To burn plutonium in a gas-cooled reactor, a plutonium Pit Disassembly/Conversion/Plutonium-Oxide Fuel Fabrication Facility would be needed. Additionally, because tritium production decreases significantly in a plutonium-fueled gas-cooled reactor, twice as many reactor modules would be necessary in order to produce the steady-state tritium requirements. This doubling of reactor modules would be the major contributor to potential environmental impacts for this scenario. The PEIS contains an assessment of these potential environmental impacts.

Advanced Light Water Reactor. The ALWR would be a high temperature, high pressure reactor whose primary purpose would be to produce tritium. There are two options for the present ALWR technology: a Large ALWR (1,300 MWe) and a Small ALWR (600 MWe). The large and

options would be chosen from the following four candidates: a large or small pressurized water reactor; or a large or small boiling water reactor. All ALWR options would use (regular) water as the reactor coolant and moderator. Like the MHTGR, a power conversion facility (steam turbine) is an integral part of the design for the ALWR because of the high temperature of the exit coolant and is included in the analysis. In addition to the reactor building, the ALWR complex would consist of several support buildings and other facilities for the supply and extraction of tritium.

The ALWR complex would cover approximately 350 acres and the entire area would be surrounded by a security fence. The main reactor building would be approximately 10 stories high. The other associated buildings would range from one to three stories height. The differences between the large and small options are primarily in the power output of the reactors. Both of the small reactors are rated at 600 MWe, while the large options are rated at 1,300 MWe. The physical sizes of the large and small options for the technologies are generally the same.

In addition to the reactor, the ALWR complex would include an interim spent fuel storage building, a waste treatment facility, a tritium target processing facility, warehouse and a power conversion facility. Unlike the other technologies, the ALWR would not have a fuel fabrication facility since fuel rods would be obtained from offsite sources. Figure ES-7 shows a representative drawing of an ALWR complex with a natural draft cooling tower shown for illustrative purposes only. The number and arrangements of buildings and areas are descriptive only and can change significantly as design progresses. The target processing facility would consist of the following two attached structures: processing building and a support building. The process building would include the extraction processes, laboratory, and other activities associated with handling tritium. The support building would contain offices, maintenance areas, and nonradioactive ventilation systems. The type of cooling tower used depends upon where the ALWR would be located. In this PEIS, dry sites (INEL, NTS, and Pantex) would use mechanical draft cooling towers and wet sites (ORR and SRS) would use natural draft wet cooling towers.

Figure (Page ES-15)

Figure ES-6. - Modular High Temperature Gas-Cooled Reactor Facility (Typical).

Figure (Page ES-16)

Figure ES-7. - Advanced Light Water Reactor Facility (Typical).

The design of the ALWR would incorporate numerous safety features such as: an emergency power facility to house diesel generators or gas turbines for short-term emergency power to support safety-related loads in the event of temporary failure of the offsite power supply; a reactor containment building to limit any release of radioactivity; an emergency core cooling system to make up coolant in the event of a loss of coolant or a loss of pumping; an emergency shutdown system; and a neutron poison system to inject neutron-absorbing material into the reactor vessel.

Construction of the ALWR would take about 6 years and require approximately 3,500 workers for the Large ALWR and 2,200 workers for the Small ALWR during the peak construction period. Once constructed, 1 to 2 years would be needed for system checkout of the reactor prior to actual tritium production. Operation of the Large and Small ALWR would require approximately 830 and 500 workers, respectively.

An ALWR would also be capable of performing the "triple play" missions of producing tritium, burning plutonium, and generating electricity. The multi-purpose ALWR would operate essentially the same as a uranium-fueled tritium production ALWR. Therefore, environmental impacts from operation of a multi-purpose ALWR would be expected to be unchanged from the tritium production ALWR. To burn plutonium in an ALWR, a plutonium Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would be needed to produce the mixed-oxide fuel rods for the ALWR, and would be the major contributor to potential environmental impacts for this scenario. The PEIS contains an assessment of these potential environmental impacts.

Range of Selected Operation Requirements for Tritium Supply Technologies:

- . Electrical Energy Demand:
260,000 to 740,000 MWh per year
- . Land Use:
173 to 360 acres
- . Total Number of Operation Workers:
500 to 930
- . Water Consumption:
0.03 to 16 billion gallons per year
- . Spent Nuclear Fuel Generation:
0 to 80 cubic yards per year

Accelerator Production of Tritium. The APT would be a linear accelerator whose primary purpose would be to produce tritium. The APT accelerates a proton beam in a long tunnel one of two target/blanket assemblies located in separate target stations. There are target/blanket concepts being considered in the conceptual design of the Full APT: helium-3 target and the spallation-induced lithium conversion target.

The APT complex would cover approximately 173 acres and the entire area would be surrounded by a security fence. The accelerator, 3,940 feet in length, would be housed in a tunnel buried 40 to 50 feet underground for radiation shielding. The design of the radio frequency power system and its distribution network is similar to that of existing accelerators. The tunnel would be sealed and evacuated during operation but would vent to the atmosphere during shutdown period. The full size facility would consist of 10 cooling towers and 13 substations located above ground along the full length of the underground accelerator. The APT facility would require a peak electrical load of approximately 355 MWe to produce the 3/8 goal tritium quantity and 355 MWe to produce the steady-state tritium requirement. Additionally, there would be two cooling towers for the target/blanket beam stop located next to the target building. The cooling towers and substations would be approximately one to two stories in height.

The preconceptual design of the APT complex includes: a target building that would contain either the helium-3 or the spallation-induced lithium conversion target chambers located in a subterranean structure at the same level as the accelerator; a tritium process facility to extract tritium from the targets; a klystron remanufacturing and maintenance facility; waste treatment buildings to treat all generated wastes; and various administration, operation, and maintenance facilities. Figure ES-8 shows a representative drawing of an APT complex. The number and arrangement of buildings and subterranean areas are illustrative and can change significantly as design progresses.

The design of the APT would incorporate numerous safety features to include: an emergency power facility to house diesel generators or gas turbines for short-term emergency to support safety related loads in the event of temporary failure of the offsite power supply; multiple sensors and diagnostics which would determine if the accelerator beam is out of acceptable limits in terms of position, energy, size, etc.; redundant cooling systems for all heat-removal systems; and an automatic beam shutoff in the event of loss of cooling, a misaligned beam, or abnormal radiation levels.

Construction of the APT would take about 5 years and require approximately 2,760 workers during the peak construction period. Additional construction area for equipment and materials would not be required since there would be sufficient unencumbered space within the APT boundaries. Once constructed, 1 to 2 years would be needed for system checkout of the accelerator prior to actual tritium production. Operation of the APT would require approximately 624 workers.

If desired, a phased construction of the APT could also occur. Under this scenario, initial construction of the APT would result in a facility that could produce the steady-state requirement of tritium (approximately 50 percent of baseline case). Expansion

of the facility could be possible at a later date in order to increase tritium production to the baseline requirements if necessary. The helium-3 target is the primary target for the Phased APT option.

Commercial Light Water Reactor. The purchase by DOE of an existing operating or partially completed commercial power reactor is an alternative to meet the stockpile tritium requirement. Production of tritium using irradiation services contracted from commercial power reactor(s) (with the option to purchase the reactor) is also an alternative. Commercial light water reactors use both pressurized water and boiling water technologies. The two types, pressurized water reactors are more readily adaptable to the requirements of tritium production by DOE tritium target rod irradiation because they utilize boron poison rods which could be replaced by tritium target rods.

Commercial pressurized water reactors are high-temperature, high-pressure reactors that use ordinary light water as the coolant and moderator and are capable of generating large amounts of electricity through a steam turbine generator. The range of electrical production for these plants is approximately 390 million kWh per year to 6,900 million kWh per year using an assumed annual capacity factor of 62 percent. A typical commercial water reactor facility includes the reactor building, spent fuel storage facilities, cooling towers, a switchyard for the transmission of generated electricity, maintenance buildings, administrative buildings, and security facilities. Acreage for existing operating commercial light water reactor facilities varies in size from a low of 84 to a high of 30,000 acres.

The designs of typical commercial reactors incorporate numerous safety features including: a reactor containment building to limit any release of radioactivity; an emergency core cooling system for heat removal in the event of a loss of coolant or loss of pumping; an emergency shutdown system with safety rods independent of the reactor control rods; and a backup system to remove heat from the reactor if the primary coolant fails to circulate.

The representative drawing for the ALWR complex (figure ES-7) would be similar to a commercial light water reactor complex except that tritium target fabrication and processing facilities would not be typical facilities. If a partially completed reactor were purchased, these facilities could potentially be constructed along with the final construction of the reactor.

Figure (Page ES-19)

Figure ES-8. - Accelerator Production of Tritium Facility Site Layout (Typical).

A commercial reactor would also be capable of performing the "triple play" missions: producing tritium, burning plutonium, and generating electricity. The multi-purpose commercial reactor would operate essentially the same as a uranium-fueled tritium production commercial reactor. Therefore, the environmental impacts from operation of a multi-purpose commercial reactor would be expected to be unchanged from the tritium production commercial reactor. To burn plutonium in a commercial reactor, a plutonium Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would be needed to produce the mixed-oxide fuel rods for the commercial reactor, and would be the major contributor to potential environmental impacts for this scenario. The PEIS contains a generic assessment of these potential environmental impacts.

Tritium Recycling

The primary mission of the tritium recycling facility is to process and recycle tritium for use in nuclear weapons. This mission includes the steps necessary to empty reservoirs (small pressure vessels containing tritium installed in nuclear weapons), recover tritium, provide new gas mixtures according to specifications, and reclaim usable reservoirs. Additionally, the tritium recycling facility would perform a full range of analytical, physical, and environmental tests to ensure that the quality and integrity of all reservoirs are maintained throughout their operational life. It would also provide for appropriate waste management, including storage, treatment, and disposal of tritiated wastes.

The tritium recycling facility would receive tritium in reservoirs returned from DO other activities, or as new tritium from the extraction facility that is associated the tritium supply facility. The reservoirs would be unpacked from their shipping containers in the auxiliary building and taken to the tritium processing building for temporary storage. They would then be emptied and the contained gases would be processed to separate the hydrogen isotopes from other gases, primarily helium-3 (a stable isotope resulting from the radioactive decay of tritium). Prior to being placed into reservoirs the tritium would undergo a purification process. The empty reservoir bottles would be sent to the tritium auxiliary building to be reclaimed. If reclamation is not possible the bottles would be disposed of as LLW. Otherwise, they would be refurbished and sent to the tritium processing building to be filled.

Reservoirs that have been filled with tritium and sealed would be transferred to the auxiliary building for finishing, where they would be decontaminated, leak tested, inspected, marked, measured for tritium content, and, if required, combined with various parts necessary for final assembly. The reservoirs would then be placed in storage needed for limited life component exchange, or sent to the assembly and disassembly facility for use in new weapons.

Some reservoirs would be placed in the weapon surveillance program. The tritium recycling facility would include testing capability for production, surveillance, a research and development reservoirs. In general, tests on reservoirs filled with tritium would be performed in the tritium processing building, while tests on other bottles or parts of bottles would be performed in the auxiliary building.

Tritium recycling could be collocated with tritium supply, or be done in existing facilities at SRS. At SRS, an upgrade of the existing recycling facilities would be implemented rather than construction of a new facility. Discussed below are the options for new or upgraded recycling facilities.

New Recycling Facilities. If the tritium supply and recycling facilities are located at any site other than SRS, new recycling facilities would have to be constructed (figure ES-9). The tritium recycling facility would be housed in two major buildings and in several support facilities. The first building, the tritium processing building, would be a hardened facility designed with systems to contain tritium releases should the need occur. The second building, the auxiliary building, would house nontritium and very small amounts of working tritium. These buildings would be located within a 202-acre area.

Figure (Page ES-21)

Figure ES-9.- New Tritium Recycling Facility (Typical)

Upgrade of Recycling Facilities at Savannah River Site. If the tritium supply facilities are located at SRS or at one of the other sites without a collocated recycling facility, the existing tritium recycling facilities would be upgraded. The upgrade, presented here, called the unconsolidated upgrade, would result in no buildings being closed and consolidation of tritium handling activities. Buildings 232-H, 232-1H, 234-H, 238-H, 249-H (figure ES-10), would be upgraded to meet DOE Order 5480.28, Natural Phenomenon Hazards Mitigation. These upgrades would involve adding wall and cross bracings to existing beams, strengthening some exterior walls, and reinforcing existing building frames. Additionally, Building 232-H would require an anchor for the service area roof slab as well as an upgrade to the Radiation Control and Monitoring System. Building 232-H would require upgrades to its reservoir storage encased safes which are used to protect filled reservoirs during high winds and earthquakes. No additional acreage would be required for these upgrades, and no upgrade modifications would be required for buildings 233-H (Replacement Tritium Facility), 235-H, 236-H, or 720-H.

As a potential mitigation measure, a consolidation of tritium activities into fewer buildings to minimize tritium emissions and waste is also possible. In this upgrade

called the consolidated upgrade, Building 232-H would be closed and its functions transferred to buildings 233-H and 234-H. As discussed above, upgrades would then be to buildings 232-1H, 234-H, 238-H, and 249-H. Additionally, Building 233-H would require modifications in order to accept activities transferred from Building 232-H.

SITES

Commercial Light Water Reactor

The commercial light water reactor alternative does not include a specific site for analysis in the PEIS. Therefore, any one of the existing operating commercial nuclear reactors or partially completed reactors is a potential candidate site for the tritium supply mission. Currently, 109 commercial nuclear power plants are located at 71 of 32 of the contiguous states. Of these, 53 sites are located east of the Mississippi River. No commercial nuclear power plants are located in Alaska or Hawaii. Approximately one-half of these 71 sites contain two or three nuclear units per site.

Typically, commercial nuclear power plant sites and the surrounding area are flat-to-rolling countryside in wooded or agricultural areas. More than 50 percent of sites have 50-mile population densities of less than 200 persons per square mile and 80 percent have 50-mile densities of less than 500 persons per square mile.

Site areas range from 84 acres to 30,000 acres. Twenty-eight site areas range from 1,000 acres and an additional 12 sites are in the 1,000 to 2,000-acre range. Thus, a 60 percent of the plant sites encompass 500 to 2,000 acres. The larger land-use areas are associated with plant cooling systems that include reservoirs, artificial lakes, and buffer areas.

Idaho National Engineering Laboratory

In 1949, INEL was established in the southeastern Idaho desert 50 miles west of Idaho Falls. Situated on approximately 570,000 acres in four counties, the site is used to build, and operate nuclear facilities. INEL is one of DOE's primary centers for research and development activities on reactor performance, materials testing, environmental monitoring, waste processing, and breeder reactor development and serves as a naval reactor training site. The collection of reactors at INEL is the world's largest, varying from research and testing to power and ship propulsion reactors. Over the years, 52 research and test reactors at INEL have been used to test fuel and target design, reactor systems, and overall safety. Currently, there are four reactors in use, three of which are in continuous operation.

In addition to nuclear reactor research, other INEL facilities support reactor operation processing and storage of high-level waste (HLW) and low-level waste (LLW); and storage of LLW and transuranic (TRU) waste generated by defense program activities. Until 1992 spent reactor fuels were reprocessed at the Idaho Chemical Processing Plant but this was terminated by DOE. Therefore, INEL has no current defense program missions.

Figure (Page ES-23)

Figure ES-10. - Tritium Recycling Facilities Upgrades at Savannah River Site (Generalized).

Nevada Test Site

In 1950, NTS was established in southern Nevada 65 miles northwest of Las Vegas, on approximately 864,000 acres of land. NTS is operated by several management and operation contractors under the direction of the Nevada Operations Office. The site is a remote secure facility for conducting underground testing of nuclear weapons and evaluating effects of nuclear weapons on military communications, electronics, satellites, sensors and other materials. Approximately one-third of the land is used for nuclear weapon

testing, one-third is reserved for future missions, and one-third is used for research development and other facility requirements. In October 1992, the underground nuclear testing was halted, yet the site maintains the capability and infrastructure necessary to resume testing if authorized by the President. The infrastructure to continue research development, and testing is being maintained (albeit at lower levels).

Facilities at NTS include nuclear device assembly, diagnostic canister assembly, hazardous liquid spill, and the Radioactive Waste Management Site. In addition, DOE is evaluating Yucca Mountain, an area on the border of the site, as a potential repository for spent nuclear fuel and high-level radioactive waste.

Oak Ridge Reservation

ORR was established in 1942 as part of the World War II Manhattan Project. The site located 20 miles west of Knoxville on approximately 35,000 acres, includes three major facilities: Oak Ridge National Laboratory; Y-12 Plant (Y-12); and the K-25 site (the former Oak Ridge Gaseous Diffusion Plant). Oak Ridge National Laboratory missions include basic and applied scientific research and technology development. Y-12 engages in national security activities and manufacturing outreach to U.S. industry. The K-25 serves as an operations center for environmental restoration and waste management programs.

Y-12 is the primary location for defense program missions. Activities at Y-12 include dismantling of nuclear weapons components returned from the Nation's stockpile, maintaining nuclear production capability (primarily uranium and lithium) and stock support, storing special nuclear materials, and providing special manufacturing support for DOE programs. Operational space at Y-12 is being downsized in response to the reduced workloads.

Pantex Plant

Pantex is located 17 miles northeast of Amarillo, TX, on approximately 10,000 acres. The site served as a conventional bomb plant during World War II. After the war, the site was sold to Texas Technological College (Texas Tech) but was repurchased by the Army in 1946 at the request of the Atomic Energy Commission. Pantex served as a nuclear weapons production facility and over the years absorbed the weapons modification functions of the Clarksville, TN (1965) and Medina, TX (1966) plants. In 1975, Pantex absorbed the functions of the decommissioned Burlington Plant in Iowa.

Today, Pantex functions include the fabrication of chemical explosives; nuclear weapons assembly, disassembly, testing, quality assurance, repair, and disposal of nonnuclear components; and development work in support of design laboratories. Due to recent reductions in the Nation's stockpile, Pantex has developed the interim capability for sealed pit storage of nuclear materials. Pantex is the only DOE facility that can perform the final assembly of a nuclear weapon for the DOD stockpile. At present, weapons disassembly and component storage dominate activity at the plant.

Savannah River Site

In 1950, SRS was established 12 miles south of Aiken, SC, on approximately 198,000 acres. The major nuclear facilities at SRS have included fuel and target fabrication facilities; nuclear material production reactors; chemical separation plants used for recovery of plutonium and plutonium isotopes; a uranium fuel reprocessing area; and the Savannah Technology Center, which provides process support.

SRS is the Nation's primary facility for tritium recycling operations, which provide tritium for weapons in the nuclear stockpile. Recycled tritium is delivered to Pantex for weapons assembly and directly to DOD to replace expired tritium reserves. In the past, SRS produced tritium but only tritium recycling operations continue at the Replacement Facility. Other activities at SRS include interim storage of plutonium, waste management, and environmental monitoring and restoration.

Alternatives Considered But Eliminated From Detailed Study

By law, DOE is required to support the Nuclear Weapons Stockpile Plan. To do this, must maintain a nuclear weapons production, maintenance, and surveillance capacity consistent with the President's Stockpile Plan. For the proposed action, the following alternatives were considered but eliminated from detailed study for the reasons stated below.

Purchase of Tritium From Foreign Sources

DOE has considered the purchase of tritium from other sources, including foreign nations. Conceptually, the purchase of tritium from foreign governments could provide a small fraction of the tritium requirement. However, while there is no national policy against the purchase of defense materials from foreign sources, DOE has determined that the uncertainties associated with obtaining tritium from foreign sources render this alternative unreasonable for an assured long-term supply.

Redesign of Weapons to Require Less or No Tritium

The nuclear warheads in the enduring stockpile were designed and built in an era when tritium supply was assured, when underground nuclear testing was being conducted, and military needs required that the warheads be optimized in terms of weight and volume. Replacing these warheads with new ones that would use little or no tritium for the reason of reducing overall tritium demand would be infeasible and unreasonable. With underground nuclear testing to verify their safety and reliability, new warhead designs cannot deviate very far from current designs that require the use of tritium. Even without underground testing to facilitate new designs and a fully operational production capability, it would still take many years to build enough warheads to replace the enduring stockpile. Therefore, replacing the enduring stockpile of warheads with new designs would most likely take longer and could cost more than constructing and operating a new tritium supply facility. Because neither the President nor the Congress has approved that the government embark on a costly and expansive design, testing, and construction program solely to eliminate tritium requirements, weapons redesign to use less or no tritium is not a reasonable short or long-term alternative.

Use of Existing Department of Energy Reactors or Accelerators

DOE (and its predecessor agencies) has designed, constructed, and operated many nuclear reactors over the past 50 years. The majority of these reactors were designed to assist in the development of nuclear research and safety standards development. DOE has also constructed nuclear reactors to produce the materials required to support the production and maintenance of nuclear weapons and has constructed nuclear reactors in support of the Naval Propulsion Program.

Among the first experimental reactors were the Water Boiler at Los Alamos National Laboratory and CP-3 at Argonne National Laboratory, which were completed in 1944. Since then, numerous experimental and research reactors were constructed for a variety of purposes, including material tests, new reactor concepts, and safety experiments. Of the four DOE research reactors are currently operational: the High Flux Isotope Reactor (HFIR); the High Flux Beam Reactor at Brookhaven National Laboratory; and the Experimental Breeder Reactor-II and the Advanced Test Reactor at INEL. In addition, there are several power/critical facilities supporting medical research (at Brookhaven) and supporting reactor core configuration research (at Argonne National Laboratory-West at INEL). These facilities are large enough to produce the amount of tritium required to support projected stockpile requirements. All are fully or partially committed to existing programs, and were constructed in the early 1960s, rendering their design life relatively unsuitable for the timeframe required for a new, assured, long-term tritium supply facility.

Of the existing DOE reactors that are currently not being operated, only one has the potential to produce tritium.

potential for producing any significant quantities of tritium: the Fast Flux Test Facility at the Hanford Site. This facility was designed and constructed to perform material research for the national liquid-metal breeder reactor program. This small (440-megawatt thermal (MWT)) experimental reactor, based on liquid-metal reactor technology, could, after substantial core and cooling system modifications, as well as target technology development, have the potential to supply a significant percentage of the steady state tritium requirement. The Fast Flux Test Facility, however, was designed in the late 1970s and began operation in 1980. The Fast Flux Test Facility is currently defueled. A technical study to extend the life of the Fast Flux Test Facility to 10 years past design 20-year lifetime has been completed. While technically possible to expand the lifetime, in the year 2010 the facility would be at the end of even the extended life. Relying on the ability to further modify and operate the Fast Flux Test Facility well into the middle of the next century is not a reasonable alternative.

DOE also constructed and operated more than a dozen nuclear reactors for production of nuclear materials at SRS and the Hanford Site, starting with the early part of the Manhattan Project during World War II. None of these reactors is currently operating. Of those reactors specifically designed to produce nuclear materials for the nuclear weapons program, the K-Reactor at SRS is the only remaining reactor which could be returned to operation. It is currently in a "cold stand-by state" and has not been operated since 1988. The reactor was shut down for major environmental, safety, and upgrades, to comply with today's stringent standards. DOE discontinued the K-Reactor Restart Program when the reduced need for tritium to support a smaller stockpile of the need for tritium. In this context, reliance upon the ability to upgrade and operate well into the middle of the next century a first generation reactor designed in the 1950s is not a reasonable alternative for new, long-term, assured tritium supply.

DOE has been a world leader in the design and construction of particle accelerators and currently operates six national facilities. Of the existing research accelerators, capable of producing significant quantities of tritium. The existing DOE research accelerators are all of the pulsed design and are only capable of producing low power accelerator beams in the 800 kilowatt (kW) range. A production accelerator facility utilizing continuous wave operation, would be required to deliver a high power proton beam of 100 megawatts (MW) for tritium production. None of the existing research accelerators could be reasonably upgraded to meet the long-term, assured tritium requirement.

Alternative Sites

The process of determining these reasonable tritium supply alternative sites has been evolutionary, starting with the engineering studies and criteria developed by the National Production Reactor program, then utilizing additional criteria and considerations of the Reconfiguration Program, information related to changing missions at DOE sites, and from public scoping.

During the preparation of the PEIS, the Department has continued to assess other alternative sites. In fact, once the APT was added as a potential tritium supply technology, an assessment was conducted to determine if the Los Alamos National Laboratory, which operates a linear accelerator and is the home of significant accelerator expertise, would be a reasonable site for a tritium producing accelerator.

The APT conceptual designs for tritium supply have established that evaporative cooling towers would be used to dissipate the heat generated in the tritium target assembly in the accelerator facility. These APT cooling water requirements are significantly greater than the current regulated allotment of water for Los Alamos National Laboratory and increasing the allotment to support the APT water requirement would be impractical, and in any event beyond DOE's control.

It may be possible that an APT could use non-evaporative cooling towers, which would greatly reduce the water requirements. However, there is sufficient technical uncertainty regarding the feasibility and practicality of using non-evaporative cooling towers with continuous wave APT to render this option unacceptable as a source for the Nation's supply of tritium. The other five sites being analyzed in this PEIS could reasonably support the water requirements of the APT using evaporative cooling towers and, thus,

would not incur the technical uncertainty and risk of Los Alamos National Laboratory. Thus, DOE has concluded that Los Alamos National Laboratory is not a reasonable site for an accelerator to produce tritium.

REDUCED TRITIUM REQUIREMENTS

The need for new tritium supply is based on the 1994 Nuclear Weapons Stockpile Plan projects a need for new tritium by approximately 2011 based on a START II level stockpile size of approximately 3,500 accountable weapons. A smaller than STARTII stockpile would extend the need date for new tritium beyond approximately 2011. If the need for tritium were significantly later than 2011, the Department would not have a proposal for new tritium supply, and would not be preparing a PEIS for Tritium Supply and Recycling.

ENVIRONMENTAL RESOURCE IMPACT METHODS

The following is a brief description of the impact assessment approach used in the process for addressing potential impacts of the tritium supply and recycling action.

Land Resources

Land Use. Land use impacts are assessed based on the extent and type of land that would be affected, and potential direct impacts resulting from the conversion or the incompatibility of land use changes with special status and protected lands.

Visual Resources. Visual impacts are assessed based on whether changes in existing facilities or construction of new facilities would appear uncharacteristic in each site's visual setting and, if so, how noticeable the changes would be.

Site Infrastructure

Changes to site infrastructure are assessed by overlaying the support requirements of respective tritium supply technologies and recycling facilities upon the projected infrastructure capacities. These assessments focus upon power requirements, road and rail interfaces, and fuel requirements. The basis for the PEIS assessment is the supply and demand projections of the U.S. electric utilities published annually by the North American Electric Reliability Council.

Air Quality and Acoustics

The assessment of potential impacts to air quality is based upon comparison of proposed project effects with applicable state, local, or national ambient air quality standards or the potential exceedance of Prevention of Significant Deterioration increments. The more stringent of the standards serve as the comparison criteria. The comparison of project toxic pollutants includes guidelines or standards adopted or proposed by each state.

Acoustic impacts are assessed qualitatively on the basis of the potential degree of change in noise levels at sensitive receptors with respect to ambient conditions.

Water Resources

Surface Water. The surface water impacts are assessed based on water consumption and wastewater discharge for both construction and operation phases. Changes in the annual flows of surface water resulting from proposed withdrawals and discharges are determined. The existing water supply is evaluated to determine if sufficient quantities are available to support an increased demand by comparing projected increases with the capacity of the supplier and existing water rights, agreements, or allocations. The assessment of water quality impacts from wastewater (sanitary and process) and stormwater runoff qualitatively addresses potential impacts to the receiving waters.

Floodplains impacts are assessed based on whether any of the proposed tritium supply technologies and recycling facilities are located within a floodplain. Where possible, the proposed location is compared with the 500-year floodplain.

Groundwater. Groundwater resource impacts are assessed based on the effects on aquifer groundwater usage, and groundwater quality within the regions. Total groundwater use at the facility and projections of future usage are added to project water requirement to determine the short and long-term impacts associated with construction and operation dewatering withdrawals. Impacts of groundwater withdrawals on existing contaminant plumes because of construction and facility operation are assessed.

Geology and Soils

Impacts to the geological environment are assessed based on the destruction of or disturbance to unique geological features and subsidence caused by groundwater withdrawal, landslide, or shifting. Potential seismic impacts are assessed based on the location of capable faults and the history of the seismicity of the site areas. Soil types at the proposed project sites are described and the capability of supporting construction at the proposed structures assessed.

Biotic Resources

Potential impacts are assessed based on the degree to which various habitats or species could be affected by the project. Where possible, impacts are evaluated with respect to Federal and state protection regulations and standards.

Terrestrial Resources. Impacts to wildlife are based on plant community loss, which is associated with animal habitat. Also evaluated is the disturbance, displacement, or loss of wildlife. Based on expected releases and the results of past studies, impacts of radionuclides on site biota were not evaluated.

Wetlands. Impacts are assessed based on the nearness of wetlands to project areas and the knowledge that standard construction erosion and sedimentation control measures will be implemented. Impacts from increased flows are assessed based on a comparison of expected discharge rates with present stream flow rates.

Aquatic Resources. Impacts as a result of sedimentation, increased flows, and effluent discharges are assessed in the same manner as wetlands. Impacts as a result of impingement and entrainment are assessed based on comparison of stream flow and intake volumes.

Threatened and Endangered Species. A list of species potentially present at each site is developed using information obtained from the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and appropriate state agencies, along with site environmental and engineering data, is used to assess whether the various technologies would impact a plant or animal.

Cultural and Paleontological Resources

Prehistoric and Historic Resources. Impacts are assessed by considering whether the proposed action could substantially add to existing disturbance of resources in the adversely affect National Register of Historic Places (NRHP) eligible resources, or loss of or destruction to important prehistoric resources.

Native American Resources. Impacts are assessed by considering whether the proposed has the potential to affect sites important for their position in the Native American physical universe or belief system, or the possibility of reducing access to traditional use areas or sacred sites.

Paleontological Resources. Impact assessments for paleontological resources are based on the numbers and kinds of resources that could be affected as well as the quality of preservation in a given deposit.

Socioeconomics

The assessment of impacts on local and regional socioeconomic conditions and factors include population, employment, economy, housing, public finance, and transportation. The impact assessment is based on the degree to which changes in employment and population affect the local economy, housing market, public finance, and transportation. The changes to these factors are projected to the year 2030 because it is assumed that after 2030 the impacts associated with the alternatives are negligibly different from the 2030 conditions.

Radiation and Hazardous Chemical Environment

The health effects are determined for each technology by identifying the types and quantities of material to which one is exposed, estimating doses, and then calculating resultant health effects. The impacts on human health for workers and the public during normal operation and postulated accidents from various alternatives are assessed. Models such as GENII and MACCS for airborne and liquid radioactive releases; CHEM-PLUS for explosions; and SLAB for hazardous chemical releases were used to project impacts. Atmospheric dispersion modeling performed for the air quality section is also utilized in the evaluation of impacts to workers from radiological and hazardous chemicals.

Experience from past and current operations that are similar to future operation is used to estimate the radiological health impacts to workers. Models are used to estimate worker chemical exposure dose since no individual exposure data are available. Public health impacts could result from exposure to radioactive or hazardous chemical materials released during operation. Modeling is used to estimate the type and amount of materials released and the associated radiological and chemical doses. These doses are converted to health effects using appropriate health risk estimators.

The relative consequences of postulated accidents in the evaluation of each alternative are assessed. The accident analysis involves less detail than a formal Probabilistic Assessment and only addresses bounding accidents (high consequence, low probability) and a representative spectrum of possible operational accidents (low consequence but high probability of occurrence). The technical approach for the selection of accidents is consistent with the DOE Office of NEPA Oversight Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements Guidance (May 1993), which recommends consideration of two major categories of accidents: within design basis accidents and beyond design basis accidents.

Risk is defined as the mathematical product of the probability and consequence of an accident. Both probabilities and consequences are presented in the PEIS. The risk-contributing scenarios consider both design-basis and severe accidents. The scenarios

accidents consider the types of facilities.

Waste Management

The analysis addresses the waste types and waste volumes projected to be generated the various supply technologies and recycling facilities at each site. Impacts are assessed in the context of site practices for treatment, storage, and disposal plus applicable regulatory settings.

Pantex is the only site under consideration that does not have existing onsite low-waste disposal; the number of additional shipments required to transport low-level from Pantex to a DOE low-level waste disposal facility is estimated. The risk associated with additional shipments is also addressed.

Intersite Transportation

The intersite transportation assessment was based on the transport mode, weight of material, curies, proximity dose rates (transport index), type of package, number of shipments, and/or distance. Health impacts from the transportation of tritium, highly-enriched uranium, plutonium, heavy water, and LLW are presented. Radiological health risks attributed to transport of tritium target rods from commercial reactor transport of highly-enriched uranium to potential HWR and MHTGR tritium supply site transport of plutonium pits to support the multipurpose MHTGR and ALWR, and the transport of low-level waste from Pantex to NTS are also addressed.

Environmental Justice

The environmental justice analysis addressed selected demographic characteristics of region-of-influence (50-miles) for each of the five candidate sites. The analysis identified census tracts where people of color comprise 50 percent (simple majority) of the total population in the census tract, or where people of color comprise less than 50 percent but greater than 25 percent of the total population in the census tract. The analysis also identified low-income communities where 25 percent or more of the population is characterized as living in poverty (yearly income of less than \$8,076 family of two). Impacts are assessed based on the analysis presented for each resource area for each tritium supply technology at each site. No disproportionately high and adverse human health or environmental effects on minority and low-income populations were identified.

Environmental IMPACTS

In accordance with Council on Environmental Quality (CEQ) regulations, the environmental consequences discussions provide the analytical detail for comparisons of environmental impacts associated with the various tritium supply technologies and recycling facilities.

Tables ES-1 and ES-2, at the end of this summary, present a summary comparison of environmental impacts of the tritium supply and recycling alternatives. Impacts associated with collocation of a tritium supply and recycling alternative in table are evaluated for every site except SRS. At SRS, impacts are evaluated for a tritium supply with upgraded recycling and a tritium upgrade. In addition, impacts associated with tritium supply alone alternatives are evaluated for all the candidate sites except SRS. The tritium upgrade is part of the supply alone alternatives at the other four candidate sites (INEL, NTS, ORR, and Pantex) and the commercial reactor alternative. For the supply alone alternatives and the commercial reactor alternative, there would be minor impacts associated with upgrading the facilities at SRS.

For comparison purposes, environmental concentrations of emissions and other potential environmental effects are presented with appropriate regulatory standards or guidelines.

However, the compliance with regulatory standards is not an assessment of the signi or severity of the environmental impact for NEPA purposes. The purpose of the analy environmental consequences is to identify the potential for environmental impacts. PEIS for Tritium Supply and Recycling (Volume I) discusses in detail the environmen assessment methods used and the factors considered in assessing environmental impac

To satisfy the requirements of the NEPA, No Action is presented for comparison with action alternatives. Under No Action (2010), DOE would not establish a new tritium capability, the current inventory of tritium would decay, and DOE would not meet cu projections of stockpile requirements of tritium. Sites would continue waste manage programs to meet the legal requirements and commitments in formal agreements and wo proceed with cleanup activities. Production facilities and support roles at specifi sites, however, would be downsized or eliminated in accordance with the reduced wor projected for the year 2010 and beyond.

To minimize repetition and be as concise as possible, the comparison of alternative tablesES-1 and ES-2 concentrate on the areas in which the public has expressed considerable interest and on programmatic factors important to DOE decisionmaking. ingly, the following resources are compared in tableES-1:

Land resources;

Site infrastructure;

Water resources (surface water and Groundwater);

Biotic resources (wetlands, aquatic resources, and threatened and endangered specie and/or species of concern);

Socioeconomics (employment during construction and operation and unemployment durin operation);

Radiological and hazardous chemical impacts during normal operations;

Radiological impacts-accidents;

Waste management; and

Intersite transportation.

For the other resource areas summarized below, the environmental impacts do not var significantly from site to site or technology to technology.

Visual Resources. Visual impacts may occur at NTS, ORR, or SRS. There would be no i to visual resources at INEL or Pantex. The use of a wet cooling system at ORR or SR produce some visible cooling tower plumes during certain weatherconditions.

Air Quality and Acoustics. Construction activities would result in exceedance of 24 PM10 and TSP standards. At all sites, air pollutant concentrations would increase d operation but would be within standards, and noise levels would increase during bot construction and operation.

Floodplains. No construction would take place in areas designated as 100-year flood at any site, or in areas designated as 500-year flood plains at INEL. NTS, ORR, Pan and SRS would require 500-year floodplain assessments.

Geology and Soils. There would be no impacts associated with geological conditions no impacts to soils except for the disturbed areas.

Terrestrial Resources. The impacts to terrestrial resources would vary by the area disturbed during construction, and some salt drift impacts are possible with wet coastal systems.

Cultural and Paleontological Resources. Some NRHP-eligible resources may occur with proposed site; Native American resources may be affected by land disturbance and aerial visual intrusions; and some paleontological resources may be affected by construction excavations deeper than 50 feet.

Other Socioeconomic Issues. Unemployment would decrease slightly in the economic study area at all sites during construction. Population and housing demand would increase slightly in the economic study area during construction and operation, as would per capita income. Revenues and expenditures for most region-of-influence counties, cities, and school districts would increase during construction and operation. Traffic conditions would worsen slightly during construction and operation on main access routes to the sites.

MULTIPURPOSE ("TRIPLE PLAY") REACTOR

The Department's Office of Fissile Materials Disposition is preparing a PEIS addressing the issue of how to dispose of plutonium that is excess to nuclear weapons requirements. Among the alternatives to be analyzed in the Long-Term Storage and Disposition of Weapons-Usable Fissile Materials PEIS is the use of plutonium as a fuel in existing modified, or new nuclear reactors.

The nuclear reactors evaluated for tritium production in the Tritium Supply and Recycle PEIS utilize uranium as the fuel source, and the analysis in this PEIS is based on that design. Nonetheless, it is technically feasible to also use plutonium or plutonium-uranium oxide (mixed-oxide) fuel for a tritium production reactor. Congress and commercial entities have expressed interest in developing a multipurpose ("triple play" reactor that could produce tritium, "burn" plutonium, and generate revenues through sale of electric power. Only the commercial reactor, ALWR, and MHTGR would be capable of performing the triple play missions; the potential environmental impacts from these triple play reactors are summarized below. The discussion for the multipurpose ALWR applies to the multipurpose commercial reactor.

Advanced Light Water Reactor. If an ALWR were used to burn plutonium, the major contributions to potential environmental impacts would be from a new plutonium Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility. Such a facility could disturb up to 129 acres of land, and require a peak construction force of 550 during the peak year of the 6-year construction period.

During operation, this facility would require approximately 10 percent as much water as a large ALWR at a dry site, and would employ as many workers as the ALWR. Radiological exposures to workers during normal operation would be kept as low as reasonably achievable, and would not be expected to exceed 50 mrem per worker per year. If all workers were exposed to such a dose, a highly conservative assumption, 0.52 latent cancer fatalities (less than one) would be expected over the 40 year operation life of the facility. The goal for the facility for public radiation exposure would be not to exceed 1.0 mrem effective dose equivalent per year.

Safety analysis reports have not been prepared for this facility. However, bounding accident scenarios have been identified from safety analysis reports for similar plutonium processing facilities. Criticality accidents, explosions, and fires could occur in such a facility, and release of radiation to the environment. The use of plutonium in an ALWR would not significantly affect the consequences of radioactivity releases from severe accidents, though there would be some small changes in the source term release spectrum and frequency.

Using a mixed-oxide fuel in an ALWR would have no major effect on reactor operation; therefore, impacts would not be expected to change significantly from those associated with a uranium-fueled ALWR.

with utilizing a uranium fueled reactor. This is based on a study conducted by the the Final Generic Environmental Statement on the Use of Recycled Plutonium in Mixed Fuel in Light Water Reactors (August, 1976).

Modular High Temperature Gas-Cooled Reactor. To burn plutonium in a modular gas-cooled reactor, a plutonium Pit Disassembly/Conversion Facility would also be needed, and environmental impacts from such a facility are expected to be approximately the same as those described for the similar facility to support a multipurpose ALWR. In a plutonium fueled gas-cooled reactor, however, tritium production decreases significantly. Thus twice as many reactor modules would be necessary in order to produce the steady-state tritium requirements. This doubling of reactor modules would be the major contributor to potential environmental impacts for this scenario.

Overall, building twice as many reactor modules could double most environmental impacts. Some construction impacts (land distributed, construction duration, and peak construction workforce) might be less than double because of economies of scale and shared support infrastructure. Depending upon the particular site, some impacts could be significant.

During operation of twice as many reactor modules, water requirements could increase 100 percent. Impacts to groundwater would not change significantly from those expected for the three module MHTGR at those sites that would use groundwater resources. The expected workforce increase would approximately double any socioeconomic impacts and radiation doses to workers. Radiation exposure to the public from normal operation might also double. The use of plutonium in a MHTGR would not significantly affect severe accident consequences because fuel failures are not expected in any severe accident. Spent fuel generation would also double with the addition of twice as many reactor modules.

COMMERCIAL LIGHT WATER REACTOR

The purchase by DOE of an existing operating or partially completed commercial power reactor is a reasonable alternative being evaluated to meet the stockpile tritium requirement mission. Production of tritium using irradiation services contracted from commercial power reactors is also being evaluated as a reasonable alternative and a potential contingency measure to meet the projected tritium requirements for the Nation's nuclear weapons stockpile in the event of a national emergency. The reactors employed for domestic electric power generation in the United States are conventional light water reactors that use ordinary water as moderator and coolant. The potential environmental impacts of the commercial light water reactor alternative are summarized below.

The option to purchase an operating commercial power reactor or finish construction of a partially complete commercial reactor to support the stockpile tritium requirement would have similar impacts. The reactor technologies and characteristics would be the same. However, some additional land use impacts may occur to incorporate security infrastructure and other requirements which would be needed for a DOE-owned and -operated tritium production facility. The potential land use impacts would result from new buffer zone requirements, new fencing, security buildings, and road access restrictions or construction of new roads.

The environmental impacts of completing construction of an unfinished commercial nuclear power plant would be relative to the extent that the potential power plant has been completed by the utility. For construction impact analysis, a range of reactor completion (45 percent to 85 percent) was used. Environmental impacts from the upgrade of existing site infrastructure to support renewed construction activities would be minimal. Completing construction of a nuclear reactor would result in impacts from air emissions, increased worker numbers, and waste generation and management. Air emissions would be temporary and would not be expected to significantly affect air quality in the project area. The increase in construction workers would have potential impact on the local economy and area population, housing, and local services. Because a majority of the nuclear power plant infrastructure and the power plant itself have already been completed using a much larger overall workforce and peak workforce, socioeconomic impacts are expected to be minor.

Construction activities are expected to generate construction debris and other hazardous and nonhazardous wastes. Typical hazardous wastes generated during the completion of construction phase would include paints, solvents, acids, oils, and degreasers. Additional environmental impacts from management and disposal of these wastes would not be expected.

The commercial reactor alternatives for producing tritium would result in additional environmental impacts from the changes in the reactor operational characteristics and the introduction of DOE target rods. Impacts would likely result from core changes, personnel requirements, effluents, waste, spent fuel, radiation exposure, and transportation/handling.

Core Changes. Production of tritium in a commercial light water reactor would require physical changes to the reactor core, which could range from replacement of burnable poison elements with DOE target elements to the replacement of fuel rods with DOE target assemblies. Core changes could alter the accident basis and would modify the source term. The estimated additional core tritium content in curies per reactor at the end of the irradiation period would be 3.2×10^7 for a single reactor. Because of the reduced burnup in the reactor core, the total fission products in each fuel rod would decrease.

Personnel Requirements. An estimated 72 additional personnel would be needed for a typical commercial nuclear power facility. The additional personnel would represent an increase of approximately 9 percent for a single reactor. The number of personnel would be smaller for each commercial reactor site if multiple reactors were used.

Effluent. Because of the addition of DOE target rods, airborne and water-borne effluents would be expected to change (particularly for tritium). Estimates for expected increases of gaseous tritium effluent range from 5,740 Ci per year for a single reactor to 3,000 Ci per year in the multiple reactor scenario. Estimated increases of liquid tritium effluent range from 1,460 Ci per year for a single reactor to 935 Ci per year per reactor in the multiple reactor scenario.

Waste. Additional activities associated with the handling, processing, and shipping of target assemblies would be expected to increase waste generation rates at the commercial reactor site. An estimated 164 yd³ per year of LLW per reactor would be expected. This would be approximately a 50-percent increase for a typical plant. No increase in mixed waste generation would be anticipated. Depending on the selected site, expansion of existing or construction of new facilities may be required.

Spent Nuclear Fuel. More frequent refueling operations and the segmenting of fuel assemblies could result in an increase in spent nuclear fuel volumes. With the single reactor case, 137 additional spent fuel assemblies (40 yd³, assuming 8 ft³/assembly) would be generated each year. This amounts to approximately 58 metric tons of heavy metal additional fuel assemblies represent more than a 3-fold increase over the average of 18 assemblies (24 metric tons of heavy metal) for a typical pressurized commercial light water reactor. The change to 12-month refueling cycles with full core discharge would accelerate the consumption of available spent nuclear fuel pool storage and would require earlier use of additional storage alternatives such as dry storage at some commercial reactor sites.

Worker Radiation Exposure. New DOE target assembly process activities and, in some cases, more frequent refueling-type operations would be expected to increase radiation exposure for some categories of workers. Estimates for expected increases of exposure for reactor personnel range from 19 person-rem per reactor for maintenance workers to less than 1 person-rem for supervisory personnel. In the multiple reactor scenario, no additional refueling personnel would be required; therefore, no additional worker exposure would be expected. The increase in person-rem per reactor for all personnel ranges from 24 for maintenance workers to 1 for supervisory personnel.

Radiological Impacts

Normal Operations. The impact from adding tritium targets to a commercial reactor w vary depending on the reactor type, reactor site location, and the number of sites involved in the tritium production mission. The maximum impacts at a given site wou occur if all of the tritium were produced at that site. The impacts would lessen at given site if multiple sites are used.

Considering that the arithmetic mean annual radiation dose to people who lived with 50-mile radius of a commercial nuclear power plant in 1991 was about 1.2 person-rem and 0.95 person-rem from airborne and liquid releases, respectively) and the median less than 0.2 person-rem (NUREG/CR-2850), impacts of normal operation from tritium production are expected to be less than the NESHAPS 10 mrem limit for atmospheric r and less than the drinking water limit of 4mrem. It is estimated that the changes i radioactive releases associated with the production of tritium in a single reactor result in an annual dose increase of 0.51 person-rem to the 50-mile population. Thi would result in a calculated increase of 0.10 fatal cancer in this population as th result of 40years of reactor operation. There would be a slightly larger increase i total number of fatal cancers in the several population groups for the multiple rea scenario compared with the single reactor, but the calculated risk to an individual of the public would be less because of the larger number of people exposed.

Detailed impact analysis would be performed after the reactor/site combination(s) h selected. If the results of the impacts analysis indicates exceedances of either NE and/or drinking water limits, the reactor's radioactive waste management system wou revised to reduce the effluent to acceptable limits.

Transportation/Handling. Assuming that an inventory of 500target rods would be accu for shipment at one time in NRC-approved fuel assembly shipping casks, and one cask transport truck, approximately 12 shipments per year would occur. The curie content truck would be approximately 2.7×10^6 . The upper bound radiological consequences of accident during transportation from a single site to SRS might incur an additional 240person-rem per year.

QUALITATIVE COMPARISON

To aid the reader in understanding the differences in environmental impacts among t alternatives (particularly the tritium supply technology alternatives i.e., HWR, MH ALWR, and commercial light water reactor), this section presents a brief, qualitati summary comparison of the alternatives. Tables ES-1 and ES-2 which follow this sect present quantitative comparisons of greater detail.

For some of the resource areas evaluated in the PEIS, the analyses indicate that th no major differences in the environmental impacts among the tritium supply technolo site alternatives. Resource areas where no major differences exist, or where potent environmental impacts are small, are: land resources, air quality, water resources, geology and soils, biotic resources, and socioeconomics. For these resource areas, general conclusion is particularly true when comparing the operational impacts of t tritium supply facilities. For construction, this general conclusion is also partic true when comparing among the various types of new tritium supply facilities (e.g., MHTGR, ALWR, and APT).

However, when comparing the potential impacts of constructing a new tritium supply facility against the alternative of using an existing commercial reactor (purchase irradiation services or purchase and conversion of an existing commercial reactor), environmental impacts of the latter are clearly less because the facility already exists, and, thus, there are minimal construction-related environmental impacts. Fo

tritium recycling, this also applies when comparing the existing tritium recycling facilities at SRS against constructing a new tritium recycling facility at another

For other resource areas evaluated in the PEIS, the analyses indicate that there are notable environmental impact differences. Resource areas where notable differences are: site infrastructure (electrical requirements), human health (from radiological impacts due to accidents), and wastes generated. Each of these resource areas is discussed in greater detail below.

Site Infrastructure. Infrastructure and electrical capacity exist at each of the alternative sites to adequately support any of the tritium supply technology alternatives. Nonetheless, because the ALWR and MHTGR technologies could generate electricity while also producing tritium, these technologies could have a positive environmental impact by delaying the need to build some electrical generating facilities in the future. The PEIS acknowledges, and qualitatively discusses, these potential environmental impacts. The APT, and to a significantly lesser degree the HWR, would be energy consumers. The PEIS assesses the environmental impacts of providing power to energy consumers. Thus, in terms of environmental impacts, there could be approximately 1,800 MWe of difference (i.e., ALWR generating 1,300 MWe versus an APT consuming 500 MWe) between the tritium supply technologies. For commercial reactors that already exist and produce electrical power, there would be no change to the existing electrical infrastructure.

Human Health. There are differences among the tritium supply technology and site alternatives regarding the potential human health impacts from accidents. The potential consequences are directly related to the amount of radioactivity released and the population density near the facility. For each of the tritium supply technology alternatives, the probability of severe accidents occurring is extremely small, on the order of once every millions of years at most. Based upon the PEIS analyses of the technologies, the ALWR could cause the largest potential impacts to human health from severe accidents, while the MHTGR would have the smallest potential impacts. Because the APT does not utilize fissile materials, and there is no significant decay heat, there are virtually no radiological consequences from any APT accidents.

Consequently, the APT would have the fewest potential impacts to human health from accidents. The commercial reactor alternatives do not acquire any substantial risks assuming a tritium-production mission.

Regarding the site alternatives, in the event of an accident at sites with small populations (INEL, NTS, and to a lesser extent Pantex), there would be fewer potential human health impacts. Because ORR and SRS have larger populations within 50 miles of the proposed facilities, these two sites have greater potential human health impacts than the other sites. Because there are virtually no radiological consequences from any APT accidents, there are no grounds for discrimination among sites in the case of the APT. It is, in essence, site neutral with respect to potential impacts to human health.

Generated Wastes

Spent Fuel Generation. All of the tritium supply reactor technologies would generate spent fuel. While the MHTGR would generate the greatest volume of spent fuel (because of its graphite moderator), the residual heavy metal content of spent fuel from the ALWR would be the greatest. Reactors providing irradiation services would not generate additional spent fuel over and above what they would otherwise generate during their planned lifetime, assuming that multiple reactors are used and the operating scenarios do not change fuel cycles. However, if only a single reactor were used (irradiation services purchased and converted), additional spent fuel would likely be generated because the reactor's refueling cycle would be shortened. The APT is not a reactor and would not generate spent fuel.

Low-level Waste. None of the alternatives would generate unacceptably large amounts low-level waste. However, of the alternatives, the HWR would create the most low-level waste in 1 year (almost 5 times as much as any other reactor alternative). The APT would generate the least amount of low-level waste annually. In producing tritium, the commercial reactor alternatives would generate additional low-level waste, but this amount would be less than the new reactor alternatives. With regard to sites, except Pantex, all sites have the ability to handle and dispose of low-level nuclear waste site. Low-level nuclear waste generated at Pantex would need to be shipped to another for disposal.

Table ES-1.-Summary Comparison of Environmental Impacts of Tritium Supply Technology Recycling [Page 1 of 32]

INEL	NTS	ORR
Land Resources		
Under No Action there would be no impacts to land use or visual resources.	Under No Action there would be no impacts to land use or visual resources.	Under No Action there would be no impacts to land use or visual resources.
Land Resources-Collocated Tritium		
The land disturbance by technology:	The land disturbance by technology:	The land disturbance by technology:
HWR: 260 acres MHGTR: 360 acres ALWR: 350 acres APT: 173 acres Recycling: 202 acres	HWR: 260 acres MHGTR: 360 acres ALWR: 350 acres APT: 173 acres Recycling: 202 acres	HWR: 260 acres MHGTR: 360 acres ALWR: 350 acres APT: 173 acres Recycling: 202 acres
Site Infrastructure		
Under No Action the peak electrical load requirement would reduce by 51 MWe. Annual energy consumption would remain the same.	Under No Action the peak electrical load requirement would reduce by 7 MWe. Annual energy consumption would remain the same.	Under No Action the peak electrical load requirement would reduce by 1,304 MWe. Annual energy consumption would be 11,641,800 MWh year.
Site Infrastructure-Collocated Tritium		
The increase in the current site electrical requirement (MWe) for each technology:	The increase in the current site electrical requirement (MWe) for each technology:	The change in current capacity (MWe) for each technology:
HWR: 34 MHGTR: 11 Large ALWR: 105 Small ALWR: 40 Full APT: 515	HWR: 78 MHGTR: 55 Large ALWR: 149 Small ALWR: 84 Full APT: 559	HWR: 1,237 less MHGTR: 1,252 less Large ALWR: 1,192 Small ALWR: 1,236 Full APT: 738 less

Phased APT: 320

Phased APT: 364

Phased APT: 933 1

Site Infrastructure-Collocated

The percent of the power
pool capacity margin:The percent of the power
pool capacity margin:The percent of th
pool capacity marHWR: 0.62
MHTGR: 0.45
Large ALWR: 1.14
Small ALWR: 0.67
Full APT: 4.15
Phased APT: 2.72HWR: 0.72
MHTGR: 0.53
Large ALWR: 1.32
Small ALWR: 0.77
Full APT: 4.79
Phased APT: 3.14HWR: 1.47
MHTGR: 1.14
Large ALWR: 2.46
Small ALWR: 1.50
Full APT: 12.44
Phased APT: 8.15

Site Infrastructure-Tr

The tritium supply alone would reduce the peak load requirement above by 16MWe for
Water Resource

Under No Action there would be no impacts to water resources.

Water Resources-Collocated Tr

Surface water would not be used during construction.
(MGY) and corresponding percentage.

increase by techn

-

-

HWR: 23 (1 percen
MHTGR: 19 (1 perc
Large ALWR: 35 (2
Small ALWR: 22 (1
APT: 10 (<1 perce

Water Resources-Collocated Tr

The construction groundwater use (MGY) by technology affected by construction or us
used during construction.HWR: 23
MHTGR: 19
Large ALWR: 35
Small ALWR: 22
APT: 10HWR: 23
MHTGR: 19
Large ALWR: 35
Small ALWR: 22
APT: 10

-

The total percent of groundwater use increase during construction by technology:No

HWR: 1
MHTGR: 1
Large ALWR: 2
Small ALWR: 1
Full APT: <1
Phased APT: <1HWR: 3
MHTGR: 3
Large ALWR: 5
Small ALWR: 3
Full APT: 1
Phased APT: 1Surface water would not be used during operation. The operation surface water
use (MGY) and corresponding percentage increase by technology:

-

-

HWR: 5,914 (320 p
MHTGR: 4,014
(217 percent)

Large ALWR:16,014
(866 percent)
Small ALWR:7,214
(390 percent)
Full APT: 1,214
(66 percent)
Phased APT: 784
(42 percent)

Water Resources-Collocated Tr

No blowdown discharges to surface water.
(MGY) to surface waters by technology:

-

-

HWR: 2,314
MHTGR: 1,618
Large ALWR: 6,202
Small ALWR: 2,818
Full APT: 250
Phased APT: 178

Groundwater requirements
(MGY) and corresponding
percentage increase during
operation by technology:

Groundwater requirements
(MGY) and corresponding
percentage increase during
operation by technology:

Groundwater would
used for operatio

HWR: 62 (3 percent)
MHTGR: 44 (2 percent)
Large ALWR: 104
(5 percent)
Small ALWR: 64 (3 percent)
Full APT: 1,214 (61 percent)
Phased APT: 784
(39 percent)

HWR: 62 (9 percent)
MHTGR: 44 (7 percent)
Large ALWR: 104
(16 percent)
Small ALWR: 64 (10 percent)
Full APT: 1,214 (181 percent)
Phased APT: 784
(117 percent)

-

Total groundwater use
increase for HWR,
MHTGR, and ALWR
would be <1 percent of the
INEL groundwater allotment; for the APT approximately 11 percent.

The HWR, MHTGR,
ALWR, and APT would not
adversely affect aquifer
water levels.

-

Water Resources-Trit

The groundwater requirement would be 1.5 MGY. No groundwater would be used. The
Total surface water wastewater requirement
less than for collocation requirement would be 1.5MGY less
during construction and 14MGY less during
operation for all technolo-
gies. No surface water
would be used.

1.5MGY less than for col-
location during c
operation for all technolo-
gies. No surface water
would be used.

than for collocat
location during c
and 37 MGY less d
operation for all
gies.

Biotic Resource

Under No Action there
would be no impacts to
biotic resources.

Under No Action there
would be no impacts to
biotic resources.

Under No Action t
would be no impac
biotic resources.

Biotic Resources-Collocated Tr

Wetlands and aquatic resources would not be affected.

Wetlands and aquatic resources would not be affected.

Without appropriation measures, in stream flow from tional discharges affect wetland an plant communities

No Federal-listed threatened or endangered species would be affected during construction or operation, but several Federal candidates or state-listed species may be affected.

One Federal-listed threatened species, the desert tortoise, could be affected during construction and operation. Several Federal candidate or state-listed species may be affected.

No Federal-listed threatened or endangered species would be affected during construction or operation, but several Federal candidates or state-listed species may be affected.

Biotic Resources-Collocated Tr

The ferruginous hawk could lose foraging habitat equal to the amount of land disturbed for each technology during construction and operation. The Townsend's western big-eared bat may roost and forage throughout the disturbed area during construction and forage at stormwater retention ponds during operation.

The ferruginous hawk could lose foraging habitat equal to the amount of land disturbed for each technology during construction and operation. The loggerhead shrike could lose foraging and breeding habitats as well. Neither species should be adversely affected due to the large extent of nearby suitable habitat.

Four state-listed species could lose potent and foraging habitat equal to the amount of land for each technology, however this type is abundant in the Tennessee dace and bender, both of which could be affected during construction.

Socioeconomics

Under No Action INEL employment decreased by 1,000 persons between 1990 and 1994 to 10,100 persons, and will remain at this level through 2020.

Under No Action NTS employment decreased by 1,170 persons between 1990 and 1994 to 6,850 persons, and will remain at this level through 2020.

Under No Action O employment decreased by 300 persons between 1990 and 1994 to 15,000 persons, and it will remain at this level through 2020.

Under No Action employment in the regional economic area is expected to grow by less than 1 percent annually through 2009 and then decrease by less than 1 percent annually through 2020.

Under No Action employment in the regional economic area is expected to grow by less than 1 percent annually through 2009 and then continue to increase by less than 1 percent annually through 2020.

Under No Action employment in the regional economic area is expected to grow by less than 1 percent annually through 2009 and then decrease by less than 1 percent annually through 2020.

Socioeconomics

Under No Action unemployment is expected to be at 6.4 percent between 2001 and 2020. Per capita income is expected to increase from

Under No Action unemployment is expected to be at 5 percent between 2001 and 2020. Per capita income is expected to increase from

Under No Action unemployment is expected to be at 6.2 percent between 2001 and 2020. Per capita income is expected to increase from

\$17,800 to \$20,900.

Under No Action the average annual population and housing increase is expected to be less than 1percent through 2010.

Under No Action the average annual population and housing increase is expected to be less than 1percent through 2010.

Under No Action total revenues and expenditures for ROI counties, cities, and school districts is expected to increase by an annual average of less than 1percent from 2001 to 2020.

\$23,600 to \$25,100.

Under No Action the average annual population and housing increase is expected to be 1percent through 2020.

Population is expected to reach 207,300 in 2010 and 215,200 in 2020. Population is expected to reach 1,020,900 in 2010 and 1,103,500 in 2020.

Under No Action total revenues and expenditures for ROI counties, cities, and school districts is expected to increase by an annual average of less than 1percent to 5 percent between 2001 and 2005, and by 1 to 2 percent between 2005 and 2010. Between 2010 and 2020, annual increases of less than 1 percent are expected.

\$17,900 to \$20,70

Under No Action t average annual po and housing incre expected to be 1p through 2009 and 1percent between 2020.

Population is exp reach 561,000 in 586,000 in 2020.

Under No Action t revenues and expe for ROI counties, school districts to increase by an average of approx 1percent or less 2020.

Socioeconomics-Collocated Tri

The increase in employment during peak construction in the regional economic area by technology:

HWR: 7,500
MHTGR: 7,200
ALWR: 10,800
APT: 8,750

The increase in employment during full operation in the regional economic area by technology:

HWR: 4,900
MHTGR: 4,900
ALWR: 4,700
APT: 4,100

The decrease in unemploy-ment during full operation in the regional economic area by technology:

HWR: 1.8 percent
MHTGR: 1.8 percent
ALWR: 1.7 percent

The increase in employment during peak construction in the regional economic area by technology:

HWR: 9,500
MHTGR: 9,100
ALWR: 13,700
APT: 11,100

The increase in employment during full operation in the regional economic area by technology:

HWR: 5,500
MHTGR: 5,500
ALWR: 5,200
APT: 4,600

The decrease in unemploy-ment during full operation in the regional economic area by technology:

HWR: 0.7 percent
MHTGR: 0.7 percent
ALWR: 0.6 percent

The increase in e during peak const the regional econ by technology:

HWR: 8,300
MHTGR: 8,000
ALWR: 12,000
APT: 9,700

The increase in e during full opera regional economic technology:

HWR: 5,200
MHTGR: 5,100
ALWR: 4,900
APT: 4,300

The decrease in u ment during full in the regional e area by technolog

HWR: 0.6 percent
MHTGR: 0.6 percent
ALWR: 0.6 percent

APT: 1.5 percent

APT: 0.6 percent

APT: 0.5 percent

Radiological and Hazardous Chemical Impacts

Under No Action, the dose to the maximally exposed member of the public for emissions of radiation from 1 year of operation is 6.0×10^{-3} mrem. The risk of fatal cancer from 40 years of operation is 1.2×10^{-7} .

Under No Action, the dose to the maximally exposed member of the public for emissions of radiation from 1 year of operation is 0.04mrem. The risk of fatal cancer from 40 years of operation is 8.1×10^{-7} .

Under No Action, to the maximally exposed member of the public for emissions of radiation from 1 year of operation is 3.9mrem from atmospheric release and 14 mrem from liquid release. The risk of fatal cancer from operation is 7.8×10^{-4} , respectively.

Radiological and Hazardous Chemical Impacts

The population dose of 0.037 person-rem from total site operations in 2030 would result in 7.4×10^{-4} fatal cancer over 40 years of operation.

The population dose of 8.2×10^{-3} person-rem from total site operations in 2030 would result in 1.6×10^{-4} fatal cancer over 40 years of operation.

The population dose of 0.037 person-rem from total site operations in 2030 would result in 1.1 fatal cancer over 40 years of operation.

Under No Action the average annual dose to a site worker is 30 mrem with a risk of fatal cancer of 4.8×10^{-4} from 40 years of operation. The annual dose of 220 person-rem to total site workforce would result in 3.5 fatal cancers over 40 years of operation.

Under No Action the average annual dose to a site worker is 5 mrem with a risk of fatal cancer of 7.8×10^{-5} from 40 years of operation. The annual dose of 3 person-rem to total site workforce would result in 0.048 fatal cancer over 40 years of operation.

Under No Action the average annual dose to a site worker is 17 mrem with a risk of fatal cancer of 2.8×10^{-4} from 40 years of operation. The annual dose of 320 person-rem to total site workforce would result in 5.1 fatal cancers over 40 years of operation.

Radiological and Hazardous Chemical Impacts

Under No Action for emission of hazardous chemicals, the chemical Hazard Index (HI) is 1.7×10^{-4} with no cancer risk to the maximally exposed member of the public. The site worker HI is 0.021 with no cancer risk.

Under No Action for emission of hazardous chemicals, the chemical HI is 0 with no cancer risk to the maximally exposed member of the public or site worker.

Under No Action for emission of hazardous chemicals, the chemical HI is 0.36 with no cancer risk to the maximally exposed member of the public or site worker. The site worker HI is 0.021 with no cancer risk.

Radiological and Hazardous Chemical Impacts During Norm

The annual dose in mrem to the maximally exposed member of the public from total site operations and the associated (risk of fatal cancer) from 40 years of operation by technology:

HWR: 0.29 (5.9×10^{-6})
MHTGR: 0.19 (3.8×10^{-6})
Large and Small ALWR:
0.36 (7.3×10^{-6})
APT (He-3): 0.11 (2.3×10^{-6})
APT (SILC): 0.16 (3.3×10^{-6})

No liquid releases.

The annual dose in mrem to the maximally exposed member of the public from total site operations and the associated (risk of fatal cancer) from 40 years of operation by technology:

HWR: 0.31 (6.2×10^{-6})
MHTGR: 0.21 (4.1×10^{-6})
Large and Small ALWR:
0.40 (8.0×10^{-6})
APT (He-3): 0.13 (2.6×10^{-6})
APT (SILC): 0.18 (3.6×10^{-6})

No liquid releases.

The annual dose i the maximally exp member of the pub total site operat associated (risk cancer) from 40 y operation by tech

HWR: 7.1 ($1.4 \times 10^{-}$
MHTGR: 5.7 (1.1×1
Large ALWR: 8.8 (
Small ALWR: 7.6 (
APT (He-3): 4.3 (
APT (SILC): 5.0 (
-

The annual dose i the maximally exp member of the pub total site operat 14 mrem from liqu releases for each ogy. The associat fatal cancer from operation would b for all technolog for the ALWRs (2.

The 50-mile population dose in person-rem from total site operations in 2030 and (fatal cancers) from 40years of operation by technology:

The 50-mile population dose in person-rem from total site operations in 2030 and (fatal cancers) from 40years of operation by technology:

The 50-mile popul dose in person-re total site operat and (fatal cancer 40years of operat technology:

Radiological and Hazardous Chemical Impacts During Norm

HWR: 53 (1.1)
MHTGR: 37 (0.73)
Large ALWR: 73 (1.5)
Small ALWR: 71 (1.4)
APT (He-3): 23 (0.45)
APT (SILC): 32 (0.64)

The average annual dose in mrem to a site worker and (fatal cancer risk) from 40years of operation that

HWR: 0.20 (4.0×10^{-3})
MHTGR: 0.13 (2.6×10^{-3})
Large ALWR: 0.24 (4.9×10^{-3})
Small ALWR: 0.25 (5.1×10^{-3})
APT (He-3): 0.08 (1.6×10^{-3})
APT (SILC): 0.11 (2.3×10^{-3})

The average annual dose in mrem to a site worker and (fatal cancer risk) from 40years of operation that

HWR: 82 (1.6)
MHTGR: 76 (1.5)
Large ALWR: 90 (1
Small ALWR: 87 (1
APT (He-3): 68 (1
APT (SILC): 73 (1

The average annua mrem to a site wo (fatal cancer ris 40years of operat

are associated with total site performance by technology:

HWR: 33 (5.2×10^{-4})
MHTGR: 31 (5.0×10^{-4})
Large ALWR: 49 (7.9×10^{-4})
Small ALWR: 41 (6.6×10^{-4})
APT (He-3): 33 (5.2×10^{-4})
APT (SILC): 33 (5.2×10^{-4})

The annual dose in person-rem to the total site workforce and (fatal cancers) from 40 years of operation by technology:

HWR: 261 (4.2)
MHTGR: 250 (4.0)
Large ALWR: 392 (6.3)
Small ALWR: 322 (5.2)
APT (He-3): 260 (4.2)
APT (SILC): 262 (4.2)

All radiological doses to the public and site workers are within regulatory limits.

are associated with total site performance by technology:

HWR: 34 (5.4×10^{-4})
MHTGR: 26 (4.2×10^{-4})
Large ALWR: 140 (2.3×10^{-3})
Small ALWR: 92 (1.5×10^{-3})
APT (He-3): 34 (5.5×10^{-4})
APT (SILC): 36 (5.7×10^{-4})

The annual dose in person-rem to the total site workforce and (fatal cancers) from 40 years of operation by technology:

HWR: 44 (0.70)
MHTGR: 33 (0.53)
Large ALWR: 180 (2.8)
Small ALWR: 100 (1.7)
APT (He-3): 43 (0.69)
APT (SILC): 45 (0.72)

All radiological doses to the public and site workers are within regulatory limits.

are associated with total site performance by technology:

HWR: 19 (3.0×10^{-4})
MHTGR: 18 (2.9×10^{-4})
Large ALWR: 26 (4)
Small ALWR: 22 (3)
APT (He-3): 18 (3)
APT (SILC): 19 (3)

The annual dose in person-rem to the total site workforce and (fatal cancers) from 40 years of operation by technology:

HWR: 360 (5.8)
MHTGR: 350 (5.6)
Large ALWR: 490 (6.3)
Small ALWR: 420 (5.2)
APT (He-3): 360 (4.2)
APT (SILC): 362 (4.2)

All radiological doses to the public and site workers are within regulatory limits.

Radiological and Hazardous Chemical Impacts During Normal Operations

For chemicals, the HI for the maximally exposed member of the public and site worker by technology:

Public
HWR: 2.1×10^{-4}
MHTGR: 1.8×10^{-4}
Large and Small ALWR: 6.3×10^{-4}
APT (for either target system): 1.8×10^{-4}
Cancer Risk: 0

Worker
HWR: 0.031
MHTGR: 0.021
Large and Small ALWR: 0.13
APT (for either target system): 0.021
Cancer Risk: 0

All values are within regulatory limits.

For chemicals, the HI for the maximally exposed member of the public and site worker by technology:

Public
HWR: 6.3×10^{-6}
MHTGR: 2.2×10^{-7}
Large and Small ALWR: 7.7×10^{-5}
APT (for either target system): 1.8×10^{-7}
Cancer Risk: 0

Worker
HWR: 3.2×10^{-3}
MHTGR: 3.4×10^{-5}
Large and Small ALWR: 0.038
APT (for either target system): 3.4×10^{-5}
Cancer Risk: 0

All values are within regulatory limits.

For chemicals, the HI for the maximally exposed member of the public and site worker by technology:

Public
HWR: 0.36
MHTGR: 0.36
Large and Small ALWR: 0.38
APT (for either target system): 0.36
Cancer Risk: 0

Worker
HWR: 0.27
MHTGR: 0.32
Large and Small ALWR: 0.35
APT (for either target system): 0.26
Cancer Risk: 0

All values are within regulatory limits.

Radiological and Hazardous Chemical Impacts Du

The annual dose in mrem to the maximally exposed member of the public from total site operations and the associated (risk of fatal cancer) from 40 years of operation by technology:

HWR: 0.18 (3.7×10^{-6})
 MHTGR: 0.08 (1.6×10^{-6})
 Large and Small ALWR:
 0.25 (5.1×10^{-6})
 APT (He-3): 0.0048 (1.0×10^{-7})
 APT (SILC): 0.05 (1.1×10^{-6})

No liquid release.

The annual dose in mrem to the maximally exposed member of the public from total site operations and the associated (risk of fatal cancer) from 40 years of operation by technology:

HWR: 0.19 (3.8×10^{-6})
 MHTGR: 0.09 (1.7×10^{-6})
 Large and Small ALWR:
 0.28 (5.6×10^{-6})
 APT (He-3): 0.01 (2.0×10^{-7})
 APT (SILC): 0.06 (1.2×10^{-6})

No liquid release.

The annual dose i the maximally exp member of the pub total site operat associated (risk cancer) from 40 y operation by tech

HWR: 4.3 (8.4×10^{-6})
 MHTGR: 2.9 (5.4×10^{-6})
 Large ALWR: 6.0 (1.2×10^{-5})
 Small ALWR: 4.8 (9.6×10^{-6})
 APT (He-3): 1.5 (3.0×10^{-7})
 APT (SILC): 2.2 (4.4×10^{-6})

The annual dose t maximally exposed of the public fro operations includ nology would be 1 from liquid relea associated risk o from 40 years of would be 2.7×10^{-4}

Radiological and Hazardous Chemical Impacts Du

The 50-mile population dose in person-rem from total site operations in 2030 and (fatal cancers) over 40 years of operation by technology:

HWR: 31 (0.66)
 MHTGR: 15 (0.29)
 Large ALWR: 51 (1.1)
 Small ALWR: 49 (0.96)
 APT (He-3): 1.0 (0.01)
 APT (SILC): 10 (0.2)

The average annual dose in mrem to a site worker and (fatal cancer risk) from 40 years of operation that are associated with total site performance, including the following technology:

HWR: 34 (5.4×10^{-4})

The 50-mile population dose in person-rem from total site operations in 2030 and (fatal cancers) over 40 years of operation by technology:

HWR: 0.13 (2.6×10^{-3})
 MHTGR: 0.06 (1.2×10^{-3})
 Large ALWR: 0.17 (3.5×10^{-3})
 Small ALWR: 0.18 (3.7×10^{-3})
 APT (He-3): 0.01 (2.0×10^{-4})
 APT (SILC): 0.04 (9.0×10^{-4})

The average annual dose in mrem to a site worker and (fatal cancer risk) from 40 years of operation that are associated with total site performance, including the following technology:

HWR: 47 (7.5×10^{-4})

The 50-mile popul dose in person-re total site operat and (fatal cancer 40 years of operat technology:

HWR: 71 (1.4)
 MHTGR: 65 (1.3)
 Large ALWR: 79 (1.6)
 Small ALWR: 76 (1.5)
 APT (He-3): 57 (1.1)
 APT (SILC): 62 (1.2)

The average annua mrem to a site wo (fatal cancer ris 40 years of operat are associated wi performance, incl following technol

HWR: 19 (3.0×10^{-4})

MHTGR: 33 (5.3×10^{-4})
 Large ALWR: 52 (8.3×10^{-4})
 Small ALWR: 43 (6.9×10^{-4})
 APT (He-3): 34 (5.4×10^{-4})
 APT (SILC): 34 (5.5×10^{-4})

The annual dose in person-rem to the total site workforce and (fatal cancers) over 40 years of operation by technology:

HWR: 260 (4.2)
 MHTGR: 250 (4.0)
 Large ALWR: 390 (6.3)
 Small ALWR: 320 (5.2)
 APT (He-3): 258 (4.1)
 APT (SILC): 261 (4.2)

MHTGR: 37 (6.0×10^{-4})
 Large ALWR: 220 (3.5×10^{-3})
 Small ALWR: 130 (2.2×10^{-3})
 APT (He-3): 48 (7.7×10^{-4})
 APT (SILC): 51 (8.2×10^{-4})

The annual dose in person-rem to the total site workforce and (fatal cancers) over 40 years of operation by technology:

HWR: 42 (0.67)
 MHTGR: 31 (0.50)
 Large ALWR: 180 (2.8)
 Small ALWR: 98 (1.7)
 APT (He-3): 41 (0.66)
 APT (SILC): 44 (0.70)

MHTGR: 19 (3.0×10^{-4})
 Large ALWR: 26 (4)
 Small ALWR: 23 (3)
 APT 19 (for either system): (3.0×10^{-4})

The annual dose in person-rem to the total site workforce and (fatal cancers) over 40 years of operation by technology:

HWR: 360 (5.8)
 MHTGR: 350 (5.6)
 Large ALWR: 490 (8.3)
 Small ALWR: 420 (7.0)
 APT (He-3): 360 (6.0)
 APT (SILC): 362 (6.0)

Radiological and Hazardous Chemical Impacts Due to Operations

All radiological doses to the public and site workers are within regulatory limits.

For collocation, relative percent reductions of the HI to the maximally exposed member of the public and site worker by technology:

Public
 HWR: 0.3
 MHTGR: 0.03
 ALWR: 0.01
 APT: 0.03
 Cancer Risk: 0
 Worker
 HWR: 0.02
 MHTGR: 0.2
 ALWR: 0.04
 APT: 0.2
 Cancer Risk: 0

All values are within regulatory limits.

All radiological doses to the public and site workers are within regulatory limits.

For collocation, relative percent reductions of the HI to the maximally exposed member of the public and site worker by technology:

Public
 HWR: 1.4
 MHTGR: 41
 ALWR: 0.12
 APT: 51
 Cancer Risk: 0
 Worker
 HWR: 0.5
 MHTGR: 50
 ALWR: 0.04
 APT: 50
 Cancer Risk: 0

All values are within regulatory limits.

All radiological doses to the public and site workers are within regulatory limits.

For collocation, relative percent reductions of the HI to the maximally exposed member of the public and site worker by technology:

Public
 HWR: 0.01
 MHTGR: 0.01
 ALWR: 0.01
 APT: 0.01
 Cancer Risk: 0
 Worker
 HWR: 0.015
 MHTGR: 0.013
 ALWR: 0.011
 APT: 0.015
 Cancer Risk: 0

All values are within regulatory limits.

Radiological Impacts from Accide

The estimated cancer risk and if an accident occurred, the increase in the likelihood of cancer fatality to the maximally exposed individual at site boundary for the low-to-moderate consequence/high probability tritium supply technology accident would be:

Cancer Risk (per year)
HWR: 8.1×10^{-9}
MHTGR: 1.3×10^{-10}
Large ALWR: 5.0×10^{-11}
Small ALWR: 6.8×10^{-11}
APT: negligible
Cancer Fatalities
HWR: 8.1×10^{-6}
MHTGR: 5.1×10^{-9}
Large ALWR: 5.0×10^{-6}
Small ALWR: 6.8×10^{-6}
APT: negligible

The estimated cancer risk and if an accident occurred, the increase in the likelihood of cancer fatality to the maximally exposed individual at site boundary for the low-to-moderate consequence/high probability tritium supply technology accident would be:

Cancer Risk (per year)
HWR: 4.2×10^{-9}
MHTGR: 5.5×10^{-11}
Large ALWR: 2.2×10^{-11}
Small ALWR: 3.0×10^{-11}
APT: negligible
Cancer Fatalities
HWR: 4.2×10^{-6}
MHTGR: 2.2×10^{-9}
Large ALWR: 2.2×10^{-6}
Small ALWR: 3.0×10^{-6}
APT: negligible

The estimated can and if an acciden the increase in t hood of cancer fa maximally exposed ual at site bound low-to-moderate c quence/high proba tritium supply te accident would be

Cancer Risk (per
HWR: 6.8×10^{-8}
MHTGR: 1.1×10^{-9}
Large ALWR: 4.3×1
Small ALWR: 5.8×1
APT: negligible
Cancer Fatalities
HWR: 6.8×10^{-5}
MHTGR: 4.4×10^{-8}
Large ALWR: 4.3×1
Small ALWR: 5.8×1
APT: negligible

Radiological Impacts from Accide

The estimated cancer risk (fatalities per year) and if the accident occurred, total cancer fatalities for population residing within 50miles for a low-to-moderate consequence/high probability accident of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 7.4×10^{-5}
MHTGR: 5.0×10^{-7}
Large ALWR: 3.8×10^{-7}
Small ALWR: 6.2×10^{-7}
APT: negligible
Cancer Fatality
HWR: 0.074
MHTGR: 2.0×10^{-5}
Large ALWR: 0.038
Small ALWR: 0.062
APT: negligible

The estimated cancer risk (fatalities per year) and if the accident occurred, total cancer fatalities for population residing within 50miles for a low-to-moderate consequence/high probability accident of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 1.2×10^{-6}
MHTGR: 1.7×10^{-8}
Large ALWR: 7.3×10^{-9}
Small ALWR: 1.0×10^{-8}
APT: negligible
Cancer Fatality
HWR: 1.2×10^{-3}
MHTGR: 6.8×10^{-7}
Large ALWR: 7.3×10^{-4}
Small ALWR: 1.0×10^{-3}
APT: negligible

The estimated can (fatalities per y the accident occu cancer fatalities tion residing wit 50miles for a low moderate conse- quence/high proba accident of a tri technology would

Cancer Risk (per
HWR: 7.5×10^{-4}
MHTGR: 1.1×10^{-5}
Large ALWR: 4.6×1
Small ALWR: 6.4×1
APT: negligible
Cancer Fatality
HWR: 0.75
MHTGR: 4.3×10^{-4}
Large ALWR: 0.46
Small ALWR: 0.64
APT: negligible

Radiological Impacts from Accide

The estimated cancer risk

The estimated cancer risk

The estimated can

and if the accident occurred, the increase in the likelihood of cancer fatality to a worker located 1,000 meters from the release for a low-to-moderate consequence/high probability accident of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 1.1×10^{-7}
MHTGR: 3.3×10^{-9}
Large ALWR: 1.0×10^{-9}
Small ALWR: 1.3×10^{-9}
APT: negligible
Cancer Fatality
HWR: 1.1×10^{-4}
MHTGR: 1.3×10^{-7}
Large ALWR: 1.0×10^{-4}
Small ALWR: 1.3×10^{-4}
APT: negligible

and if the accident occurred, the increase in the likelihood of cancer fatality to a worker located 1,000 meters from the release for a low-to-moderate consequence/high probability accident of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 2.8×10^{-8}
MHTGR: 8.3×10^{-10}
Large ALWR: 3.1×10^{-10}
Small ALWR: 3.9×10^{-10}
APT: negligible
Cancer Fatality
HWR: 2.8×10^{-5}
MHTGR: 3.3×10^{-8}
Large ALWR: 3.1×10^{-5}
Small ALWR: 3.9×10^{-5}
APT: negligible

and if the accident occurred, the increase in the likelihood of cancer fatality to a worker located 1,000 meters from the release for a low-to-moderate consequence/high probability accident of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 1.6×10^{-7}
MHTGR: 4.8×10^{-9}
Large ALWR: 1.6×10^{-9}
Small ALWR: 2.1×10^{-9}
APT: negligible
Cancer Fatality
HWR: 1.6×10^{-4}
MHTGR: 1.9×10^{-7}
Large ALWR: 1.6×10^{-4}
Small ALWR: 2.1×10^{-4}
APT: negligible

Radiological Impacts from Accidents

The estimated cancer risk and if the accident occurred, the increase in the likelihood of cancer fatality to the maximally exposed individual at the site boundary for the high consequence/low probability accidents of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 6.5×10^{-9}
MHTGR: 9.4×10^{-10}
Large ALWR: 3.5×10^{-10}
Small ALWR: 3.6×10^{-10}
APT(He-3): 4.4×10^{-15}
APT (SILC): 9.2×10^{-14}
Cancer Fatality
HWR: 7.1×10^{-4}
MHTGR: 5.9×10^{-5}
Large ALWR: 2.3×10^{-3}
Small ALWR: 2.3×10^{-3}
APT(He-3): 6.2×10^{-9}
APT (SILC): 1.3×10^{-7}

The estimated cancer risk and if the accident occurred, the increase in the likelihood of cancer fatality to the maximally exposed individual at the site boundary for the high consequence/low probability accidents of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 1.8×10^{-8}
MHTGR: 2.7×10^{-9}
Large ALWR: 8.3×10^{-10}
Small ALWR: 9.8×10^{-10}
APT(He-3): 1.2×10^{-14}
APT (SILC): 2.3×10^{-13}
Cancer Fatality
HWR: 2.0×10^{-3}
MHTGR: 1.7×10^{-4}
Large ALWR: 5.5×10^{-3}
Small ALWR: 6.3×10^{-3}
APT(He-3): 1.7×10^{-8}
APT (SILC): 3.3×10^{-7}

The estimated cancer risk and if the accident occurred, the increase in the likelihood of cancer fatality to the maximally exposed individual at the site boundary for the high consequence/low probability accidents of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 1.4×10^{-7}
MHTGR: 2.4×10^{-8}
Large ALWR: 3.1×10^{-9}
Small ALWR: 6.6×10^{-9}
APT(He-3): 9.5×10^{-15}
APT (SILC): 1.6×10^{-14}
Cancer Fatality
HWR: 0.015
MHTGR: 1.5×10^{-3}
Large ALWR: 0.02
Small ALWR: 0.042
APT(He-3): 1.3×10^{-9}
APT (SILC): 2.2×10^{-7}

Radiological Impacts from Accidents

The estimated cancer risk (fatalities per year) and if the accident occurred, the

The estimated cancer risk (fatalities per year) and if the accident occurred, the

The estimated cancer risk (fatalities per year) and if the accident occurred, the

total cancer fatalities for the population residing within 50 miles for high consequence/low probability accidents of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 1.4×10^{-5}
MHTGR: 2.9×10^{-6}
Large ALWR: 5.5×10^{-8}
Small ALWR: 6.4×10^{-7}
APT(He-3): 7.4×10^{-12}
APT (SILC): 6.7×10^{-11}
Cancer Fatality
HWR: 1.6
MHTGR: 0.18
Large ALWR: 0.36
Small ALWR: 4.1
APT(He-3): 1.0×10^{-5}
APT (SILC): 9.4×10^{-5}

total cancer fatalities for the population residing within 50 miles for high consequence/low probability accidents of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 1.4×10^{-6}
MHTGR: 2.8×10^{-7}
Large ALWR: 5.3×10^{-9}
Small ALWR: 6.1×10^{-8}
APT(He-3): 7.0×10^{-13}
APT (SILC): 6.4×10^{-12}
Cancer Fatality
HWR: 0.15
MHTGR: 0.017
Large ALWR: 0.035
Small ALWR: 0.39
APT(He-3): 9.9×10^{-7}
APT (SILC): 9.0×10^{-6}

total cancer fatalities for the population residing within 50 miles for high consequence/low probability accidents of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 1.2×10^{-4}
MHTGR: 2.3×10^{-5}
Large ALWR: 9.4×10^{-1}
Small ALWR: 5.1×10^{-1}
APT(He-3): 6.8×10^{-1}
APT (SILC): 7.4×10^{-1}
Cancer Fatality
HWR: 13
MHTGR: 1.4
Large ALWR: 6.2
Small ALWR: 33
APT(He-3): 9.6×10^{-1}
APT (SILC): 1.0×10^{-1}

Radiological Impacts from Accidents

The estimated cancer risk to a worker located 1,000 meters from the release and if the accident occurred, the increase in the likelihood of cancer fatality for a high consequence/low probability accidents of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 3.2×10^{-7}
MHTGR: 1.1×10^{-7}
Large ALWR: 5.0×10^{-9}
Small ALWR: 1.5×10^{-8}
APT(He-3): 4.4×10^{-13}
APT (SILC): 6.7×10^{-12}
Cancer Fatality
HWR: 0.034
MHTGR: 6.7×10^{-3}
Large ALWR: 0.033
Small ALWR: 0.094
APT(He-3): 6.1×10^{-7}
APT (SILC): 9.4×10^{-6}

The impact of tritium extraction and recycling are presented in appendix I.

The estimated cancer risk to a worker located 1,000 meters from the release and if the accident occurred, the increase in the likelihood of cancer fatality for a high consequence/low probability accidents of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 2.8×10^{-7}
MHTGR: 8.1×10^{-8}
Large ALWR: 4.5×10^{-9}
Small ALWR: 1.4×10^{-8}
APT(He-3): 3.2×10^{-13}
APT (SILC): 4.8×10^{-12}
Cancer Fatality
HWR: 0.031
MHTGR: 5.0×10^{-3}
Large ALWR: 0.03
Small ALWR: 0.087
APT(He-3): 4.5×10^{-7}
APT (SILC): 6.7×10^{-6}

The impact of tritium extraction and recycling are presented in appendix I.

The estimated cancer risk to a worker located 1,000 meters from the release and if the accident occurred, the increase in the likelihood of cancer fatality for a high consequence/low probability accidents of a tritium supply technology would be:

Cancer Risk (per year)
HWR: 3.2×10^{-7}
MHTGR: 1.1×10^{-7}
Large ALWR: 4.9×10^{-1}
Small ALWR: 1.6×10^{-1}
APT(He-3): 4.3×10^{-1}
APT (SILC): 6.2×10^{-1}
Cancer Fatality
HWR: 0.035
MHTGR: 7.1×10^{-3}
Large ALWR: 0.032
Small ALWR: 0.1
APT(He-3): 6.0×10^{-1}
APT (SILC): 8.7×10^{-1}

The impact of tritium extraction and recycling are presented in appendix I.

Waste Management

Under No Action, INEL would continue to manage spent nuclear fuel and the following waste types: high-level, TRU, low-level, mixed TRU and low-level, hazardous, and nonhazardous.

Under No Action, NTS would continue to manage the following waste types: TRU, low-level, mixed TRU and low-level, hazardous, and nonhazardous.

Under No Action, would continue to manage spent nuclear fuel and the following waste types: TRU, low-level, mixed TRU and low-level, hazardous, and nonhazardous.

Waste Management-Collocated Treatment and Storage

Spent nuclear fuel would be generated by all technologies, except APT.

Spent nuclear fuel would be generated by all technologies, except APT.

Spent nuclear fuel would be generated by all technologies, except APT.

New spent nuclear fuel storage facilities would be required. For tritium recycling phaseout at SRS, there would be no change.

New spent nuclear fuel storage facilities would be required. For tritium recycling phaseout at SRS, there would be no change.

New spent nuclear fuel storage facilities would be required. For tritium recycling phaseout at SRS, there would be no change.

Liquid LLW would be generated by all technologies except APT, in the following quantities:

Liquid LLW would be generated for all technologies except APT, in the following quantities:

Liquid LLW generation would increase for all technologies except APT, in the following quantities:

HWR: 2,100,000 GPY
MHTGR: 525,000 GPY
Large ALWR:
5,000,000 GPY
Small ALWR: 790,000 GPY

HWR: 2,100,000 GPY
MHTGR: 525,000 GPY
Large ALWR:
5,000,000 GPY
Small ALWR: 790,000 GPY

HWR: 2,100,000 GPY
MHTGR: 525,000 GPY
Large ALWR:
5,000,000 GPY
Small ALWR: 790,000 GPY

Existing/planned treatment facility may be adequate for all technologies, except the Large ALWR, which would require a new treatment facility.

New treatment facilities would be required. For tritium recycling phaseout at SRS, there would be no change.

New treatment facilities would be required. For tritium recycling phaseout at SRS, there would be no change.

Solid LLW generation would increase and require additional onsite LLW disposal area.

Solid LLW generation would increase and require additional onsite LLW disposal area.

Solid LLW generation would increase and require additional onsite LLW disposal area.

Waste Management-Collocated Treatment and Storage

The increase over No Action

The increase over No Action

The increase over No Action

(5,100 yd³ per year) and the additional LLW disposal area would be:

facility. For tritium recycling phaseout at SRS, there would be no change.

HWR: 5,550 yd³
(0.6 acres)
MHTGR: 1,650 yd³
(0.2 acres)
Large ALWR: 1,060 yd³
(0.2 acres)
Small ALWR: 1,010 yd³
(0.1 acres)
APT: 894 yd³
(0.1 acres)

-

(42,400 yd³ per year) and the additional LLW disposal area would be:

HWR: 5,550 yd³
(0.6 acres)
MHTGR: 1,650 yd³
(0.2 acres)
Large ALWR: 1,060 yd³
(0.2 acres)
Small ALWR: 1,010 yd³
(0.1 acres)
APT: 894 yd³
(0.1 acres)

-

(9,300 yd³ per year) and the additional LLW disposal area would be:

HWR: 5,550 yd³
(1.2 acres)
MHTGR: 1,650 yd³
(0.35 acres)
Large ALWR: 1,060 yd³
(0.4 acres)
Small ALWR: 1,010 yd³
(0.2 acres)
APT: 894 yd³
(0.2 acres)

-

For tritium recycling phaseout, 350 yd³ per year decrease in solid LLW at SRS. LLW disposal facility life extended.

For tritium recycling phaseout, 350 yd³ per year decrease in solid LLW at SRS. LLW disposal facility life extended.

For tritium recycling phaseout, 350 yd³ decrease in solid LLW at SRS. LLW disposal facility life extended.

Small quantity (6 GPY) of liquid mixed LLW from recycling facility would be generated. Existing/planned treatment facilities would be adequate.

Small quantity (6 GPY) of liquid mixed LLW from recycling facility would be generated. Organic mixed waste treatment capability would be required.

Small quantity (6 GPY) of liquid mixed LLW from recycling facility would be generated. Existing/planned treatment facilities would be adequate.

For tritium recycling phaseout at SRS, 6 GPY of liquid mixed LLW would no longer be generated.

For tritium recycling phaseout at SRS, 6 GPY of liquid mixed LLW would no longer be generated.

For tritium recycling phaseout at SRS, liquid mixed LLW would no longer be generated.

Waste Management-Collocated Treatment and Storage

Solid mixed LLW generation increase over No Action (655 yd³ per year) would be:

HWR: 122 yd³
MHTGR: 3 yd³
Large ALWR: 8 yd³
Small ALWR: 8 yd³
APT: 9 yd³

HWR may require new or

Solid mixed LLW generation increase over No Action (5,460 yd³ per year) would be:

HWR: 122 yd³
MHTGR: 3 yd³
Large ALWR: 8 yd³
Small ALWR: 8 yd³
APT: 9 yd³

Organic mixed waste

Solid mixed LLW generation increase over No Action (11,100 yd³ per year) would be:

HWR: 122 yd³
MHTGR: 3 yd³
Large ALWR: 8 yd³
Small ALWR: 8 yd³
APT: 9 yd³

Existing/planned

expanded treatment and storage facilities.

treatment capability would be required.

facilities would be adequate.

For tritium recycling phaseout, 2 yd³ per year decrease in solid mixed LLW at SRS.

For tritium recycling phaseout, 2 yd³ per year decrease in solid mixed LLW at SRS.

For tritium recycling phaseout, 2 yd³ per year decrease in solid mixed LLW at SRS.

Solid hazardous waste generation increase over No Action (308 yd³ per year) would be:

Solid hazardous waste generation increase over No Action (20 yd³ per year) would be:

Solid hazardous waste generation increase over No Action (1,150 yd³ per year) would be:

HWR: 41 yd³
MHTGR: 101 yd³
Large ALWR: 36 yd³
Small ALWR: 36 yd³
APT: 4 yd³

HWR: 41 yd³
MHTGR: 101 yd³
Large ALWR: 36 yd³
Small ALWR: 36 yd³
APT: 4 yd³

HWR: 41 yd³
MHTGR: 101 yd³
Large ALWR: 36 yd³
Small ALWR: 36 yd³
APT: 4 yd³

Waste Management-Collocated Tr

Use of existing/planned hazardous waste facilities may be feasible.

Additional hazardous waste storage facilities may be required except for APT. APT may require expansion of existing/planned hazardous waste storage facilities.

Existing/planned waste facilities would be adequate.

For tritium recycling phaseout, 1 yd³ per year decrease in hazardous waste at SRS. Decrease in offsite hazardous waste shipments.

For tritium recycling phaseout, 1 yd³ per year decrease in hazardous waste at SRS. Decrease in offsite hazardous waste shipments.

For tritium recycling phaseout, 1 yd³ per year decrease in hazardous waste at SRS. Decrease in offsite hazardous waste shipments.

Liquid sanitary waste would be generated:

Liquid sanitary waste would be generated:

Liquid sanitary waste would be generated:
No Action (483 MG)

HWR: 62.3 MGY
MHTGR: 44.3 MGY
Large ALWR: 104 MGY
Small ALWR: 64.3 MGY
APT: 260 MGY

HWR: 62.3 MGY
MHTGR: 44.3 MGY
Large ALWR: 104 MGY
Small ALWR: 64.3 MGY
APT: 260 MGY

HWR: 2,380 MGY
MHTGR: 1,660 MGY
Large ALWR: 6,320 MGY
Small ALWR: 2,880 MGY
APT: 269 MGY

New treatment facilities would be required.

New treatment facilities would be required.

New treatment facilities would be required.

For tritium recycling phaseout, 32 MGY decrease in liquid sanitary waste at SRS. Decrease would occur over time as recycling facilities

For tritium recycling phaseout, 32 MGY decrease in liquid sanitary waste at SRS. Decrease would occur over time as recycling facilities

For tritium recycling phaseout, 32 MGY decrease in liquid sanitary waste at SRS. Decrease would occur over time as recycling facilities

ities are transitioned.

ities are transitioned.

ities are transit

Waste Management-Collocated Tr

Solid sanitary waste genera-
tion would increase over No
Action (68,000 yd3 per year):

Solid sanitary waste genera-
tion would increase over No
Action (7,000 yd3 per year):

Solid sanitary wa
tion would increa
Action (77,000 yd

HWR: 15,000 yd3
MHTGR: 14,800 yd3
Large ALWR: 14,300 yd3
Small ALWR: 11,600 yd3
APT: 8,640 yd3

HWR: 15,000 yd3
MHTGR: 14,800 yd3
Large ALWR: 14,300 yd3
Small ALWR: 11,600 yd3
APT: 8,640 yd3

HWR: 15,000 yd3
MHTGR: 14,800 yd3
Large ALWR: 14,30
Small ALWR: 11,60
APT: 8,640 yd3

Onsite landfill design life
would be reduced or require
expansion.

Onsite landfill design life
would be reduced or require
expansion.

Onsite landfill d
would be reduced
expansion.

For tritium recycling
phaseout at SRS, 7,800 yd3
per year decrease in solid
sanitary waste at SRS.
Decrease would occur over
time as recycling facilities
are transitioned. Landfill
life would be extended.

For tritium recycling
phaseout at SRS, 7,800 yd3
per year decrease in solid
sanitary waste at SRS.
Decrease would occur over
time as recycling facilities
are transitioned. Landfill
life would be extended.

For tritium recyc
phaseout at SRS,
per year decrease
sanitary waste at
Decrease would oc
time as recycling
are transitioned.
life would be ext

For tritium recycling
phaseout at SRS, 6,800 yd3
per year decrease in other
solid nonhazardous waste at
SRS. Decrease in shipments
to offsite recyclers.

For tritium recycling
phaseout at SRS, 6,800 yd3
per year decrease in other
solid nonhazardous waste at
SRS. Decrease in shipments
to offsite recyclers.

For tritium recyc
phaseout at SRS,
per year decrease
solid nonhazardou
SRS. Decrease in
to offsite recycl

Waste Management-Tri

No change to the impacts
for spent nuclear fuel.
For tritium recycling
upgrade at SRS there would
be no change.

No change to the impacts
for spent nuclear fuel.
For tritium recycling
upgrade at SRS there would
be no change.

No change to the
for spent nuclear
For tritium recyc
upgrade at SRS th
be no change.

Waste Management-Tri

No change to the impacts
for liquid LLW.
For tritium recycling
upgrade at SRS there would
be no change.

No change to the impacts
for liquid LLW.
For tritium recycling
upgrade at SRS there would
be no change.

No change to the
for liquid LLW.
For tritium recyc
upgrade at SRS th
be no change.

The increase in solid LLW
generation over No Action
(5,100 yd3 per year) and the
additional onsite LLW

The increase in solid LLW
generation over No Action
(42,400 yd3 per year) and
the additional onsite LLW

The increase in s
generation over N
(9,300 yd3 per ye
additional onsite

disposal area:

HWR: 5,200 yd3
(0.6 acres)
MHTGR: 1,300 yd3
(0.2 acres)
Large ALWR: 710 yd3
(0.2 acres)
Small ALWR: 660 yd3
(0.08 acres)
APT: 544 yd3
(0.07 acres)

For tritium recycling
upgrade at SRS there would
be no change.

Liquid mixed LLW would
no longer be generated.

For tritium recycling
upgrade at SRS there would
be no change.

Solid mixed LLW genera-
tion would increase over No
Action (655 yd3 per year):

HWR: 120 yd3
MHTGR: 1 yd3
Large ALWR: 6 yd3
Small ALWR: 6 yd3
APT: 7 yd3

Impacts would remain the
same as collocated tritium
supply and recycling.
For tritium recycling
upgrade at SRS there would
be no change.

Hazardous waste generation
would increase over No
Action (308 yd3 per year):

HWR: 40 yd3

disposal area:

HWR: 5,200 yd3
(0.6 acres)
MHTGR: 1,300 yd3
(0.15 acres)
Large ALWR: 710 yd3
(0.2 acres)
Small ALWR: 660 yd3
(0.09 acres)
APT: 544 yd3
(0.07 acres)

For tritium recycling
upgrade at SRS there would
be no change.

Liquid mixed LLW would
no longer be generated.

For tritium recycling
upgrade at SRS there would
be no change.

Solid mixed LLW genera-
tion would increase over No
Action (5,460 yd3 per year):

HWR: 120 yd3
MHTGR: 1 yd3
Large ALWR: 6 yd3
Small ALWR: 6 yd3
APT: 7 yd3

Impacts would remain the
same as collocated tritium
supply and recycling.
For tritium recycling
upgrade at SRS there would
be no change.

Hazardous waste generation
would increase over No
Action (20 yd3 per year):

HWR: 40 yd3

disposal area:

HWR: 5,200 yd3
(1.1 acres)
MHTGR: 1,300 yd3
(0.3 acres)
Large ALWR: 710 y
(0.3 acres)
Small ALWR: 660 y
(0.2 acres)
APT: 544 yd3
(0.1 acres)

For tritium recyc
upgrade at SRS th
be no change.

Liquid mixed LLW
no longer be gene

For tritium recyc
upgrade at SRS th
be no change.

Waste Management-Tri

Solid mixed LLW g
would increase ov
Action (11,100 yd

HWR: 120 yd3
MHTGR: 1 yd3
Large ALWR: 6 yd3
Small ALWR: 6 yd3
APT: 7 yd3

Impacts would rem
same as collocate
supply and recycl
For tritium recyc
upgrade at SRS th
be no change.

Hazardous waste g
would increase ov
Action (1,150 yd3

HWR: 40 yd3

MHTGR: 100 yd3
Large ALWR: 35 yd3
Small ALWR: 35 yd3
APT: 3 yd3

MHTGR: 100 yd3
Large ALWR: 35 yd3
Small ALWR: 35 yd3
APT: 3 yd3

MHTGR: 100 yd3
Large ALWR: 35 yd
Small ALWR: 35 yd
APT: 3 yd3

Use of existing/planned hazardous waste facilities may be feasible.

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For tritium recycling upgrade at SRS there would be no change.

Additional hazardous waste storage facilities may be required except for APT. APT may require expansion of existing/planned hazardous waste storage facilities.

For tritium recycling upgrade at SRS there would be no change.

Existing/planned waste facilities adequate.

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For tritium recyc upgrade at SRS th be no change.

Waste Management-Tri

Liquid sanitary waste generation would increase:

Liquid sanitary waste generation would increase:

Liquid sanitary w
ation would incre
No Action (483 MG

HWR: 48 MGY
MHTGR: 30 MGY
Large ALWR: 90 MGY
Small ALWR: 50 MGY
APT: 245 MGY

HWR: 48 MGY
MHTGR: 30 MGY
Large ALWR: 90 MGY
Small ALWR: 50 MGY
APT: 245 MGY

HWR: 2,350 MGY
MHTGR: 1,630 MGY
Large ALWR: 6,290
Small ALWR: 2,850
APT: 245 MGY

Impacts would remain the same as collocated tritium supply and recycling.

Impacts would remain the same as collocated tritium supply and recycling.

Impacts would rem
same as collocate
supply and recyc

For tritium recycling upgrade at SRS there would be no change.

For tritium recycling upgrade at SRS there would be no change.

For tritium recyc upgrade at SRS th be no change.

Solid sanitary waste generation would increase over No Action (68,000 yd3 per year):

Solid sanitary waste generation would increase over No Action (7,000 yd3 per year):

Solid sanitary wa
tion would increa
Action (77,000 yd

HWR: 7,600 yd3
MHTGR: 7,400 yd3
Large ALWR: 6,900 yd3
Small ALWR: 4,200 yd3
APT: 1,240 yd3

HWR: 7,600 yd3
MHTGR: 7,400 yd3
Large ALWR: 6,900 yd3
Small ALWR: 4,200 yd3
APT: 1,240 yd3

HWR: 7,600 yd3
MHTGR: 7,400 yd3
Large ALWR: 6,900
Small ALWR: 4,200
APT: 1,240 yd3

Onsite landfill design life would be reduced or require expansion.

Onsite landfill design life would be reduced or require expansion.

Onsite landfill d
would be reduced
expansion.

For tritium recycling upgrade at SRS there would be no change.

For tritium recycling upgrade at SRS there would be no change.

For tritium recyc upgrade at SRS th be no change.

Waste Management-Tri

Other solid nonhazardous waste would be recycled.

Other solid nonhazardous waste would be recycled.

Other solid nonha waste would be re

For tritium recycling upgrade at SRS there would be no change.

For tritium recycling upgrade at SRS there would be no change.

For tritium recyc upgrade at SRS th be no change.

Intersite Transp

Under No Action negligible tritium transport.

Under No Action negligible tritium transport.

Under No Action n tritium transport

Intersite Transport-Collocated

The relative transportation risk of tritium is 29 percent lower than the existing No Action case for all technologies.

The relative transportation risk of tritium is 30 percent lower than the existing No Action case for all technologies.

The relative tran risk of tritium i lower than the ex Action case for a gies.

The potential cancer fatalities per year for transporting tritiated heavy water are 3.57×10^{-5} for the HWR and 6.63×10^{-6} for APT.

The potential cancer fatalities per year for transporting tritiated heavy water are 3.57×10^{-5} for the HWR and 6.63×10^{-6} for APT.

The potential can ties per year for tritiated heavy w 3.57×10^{-5} for the 6.63×10^{-6} for APT

Intersite Transport-Collocated

No intersite transport of low-level waste.

No intersite transport of low-level waste

No intersite tran low-level waste.

-

-

-

Intersite Transport-Tr		
The risk of transporting new tritium is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	The risk of transporting new tritium is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	The risk of trans tritium is about greater than No A to transporting v tritium to SRS.
No intersite transport of LLW.	No intersite transport of LLW.	No intersite tran LLW.

Intersite Transport-Tr		
-	-	-
The potential cancer fatali- ties per year for transporting tritiated heavy water are 1.4x10-5 for the HWR and 6.63x10-6 for APT.	The potential cancer fatali- ties per year for transporting tritiated heavy water are 1.4x10-5 for the HWR and 6.63x10-6 for APT.	The potential can ties per year for tritiated heavy w 1.4x10-5 for the 6.63x10-6 for APT

Table E.S-2.-Summary Comparison of Environmental Impacts of the Commercial Light Wa

Advanced Light Water Reactor porting highly enriched	Complete Construction of a Commercial Reactor	Purchase or Single
Construction		
Construction would result in short- term exceedance of 24-hour PM10 and TSP standards.	Construction related air emissions would increase but would be smaller than ALWR and of shorter	There wou to constr at the pl

for the HWR and MHTGR alternatives from ORR to INEL is 5.1×10^{-4} .	duration. Emissions would be temporary and would not be expected to significantly affect air quality in the project site area.	and target would be constrained to be expected air quality.
Total employment would be 12,600 worker-years over a 6-year period.	Employment would require 3,530 to 5,730 worker-years over 5 years of construction for a 45 percent or 85 percent complete reactor, respectively.	Construct facility years over
Hazardous waste generated from construction activities would be approximately 930 yd ³ .	Hazardous waste generated from construction activities would be substantially less than an ALWR.	The annual hazardous construction target factor would be approximately
Advanced Light Water Reactor	Complete Construction of a Commercial Reactor	Purchase or Single
Operation		
Operation would require approximately 16 billion gallons of water per year. No substantial impacts to surface water are expected.	Operation would require approximately the same amount of water as the ALWR.	Adding the mission to reactor water consumption
Operation would require approximately 830 workers.	Operation would require approximately 830 workers.	Operation 72 additional existing
Approximately 193 dry storage assemblies of spent fuel would be generated and: - 710 yd ³ of LLW - 6 yd ³ of mixed waste.	Approximately 193 dry storage assemblies of spent fuel would be generated and: - 490 yd ³ of LLW - the amount of mixed waste would be similar to the ALWR.	Approximate assemblies generated - 160 yd ³ - no additional generated
Worker exposure for all personnel would be approximately 170 person-rem per year.	Worker exposure for all personnel would be approximately 240 person-rem.	Worker exposure for all personnel
Tritium production would result in the emission of approximately 6,840 curies per year of gaseous tritium and 1,740 curies per year of liquid tritium.	Gaseous and liquid tritium emissions would be similar to ALWR.	Tritium production the emissions year of gaseous 1,460 curies tritium emissions.
Radiological releases associated with production of tritium would result in an annual dose of 90 person-rem to the 50-mile population.	Radioactive releases associated with production of tritium would be similar to the ALWR.	Radioactive with production result in 0.5 person-rem population.
For a high consequence/low probability accident, approximately 1.7 cancer fatalities and a risk of 2.6×10^{-7} cancer fatalities per year could result.	Similar to ALWR.	No substantial consequences expected.





DOE/EIS-0161

Final Programmatic
Environmental Impact Statement
for Tritium Supply and Recycling

Volume I

United States Department of Energy
Office of Reconfiguration

October 1995

Department of Energy
Washington, DC 20585
October 19, 1995

Dear Interested Party:

The Final Programmatic Environmental Impact Statement (PEIS) for Tritium Supply and Recycling has now been completed. Tritium is an essential component of every warhead in the current and projected United States nuclear weapons stockpile. Tritium decays at a rate of 5.5 percent per year and must be replaced periodically as long as the Nation relies on a nuclear deterrent. In accordance with the Atomic Energy Act of 1954, as amended, the Department of Energy is responsible for developing and maintaining the capability to produce nuclear materials such as tritium. Currently, the Department does not have the capability to produce tritium in the required amounts.

The Tritium Supply and Recycling PEIS evaluates the siting, construction, and operation of tritium supply technology alternatives and recycling facilities at each of five candidate sites. The PEIS also evaluates the use of a commercial reactor for producing tritium.

On October 10, 1995, the Department announced its preferred alternative, a dual-track strategy under which the Department would begin work on two promising production options: use of an existing commercial light water reactor and construction of a linear accelerator. The Savannah River Site in South Carolina has been identified as the preferred site for an accelerator, should one be constructed. Details on this preferred alternative can be found in the Executive Summary and in section 3.7 of Volume I of the PEIS. A Record of Decision will follow in late November.

The Department of Energy appreciates your continued participation in this Program.

Sincerely,

Stephen M. Sohinki, Director
Office of Reconfiguration

DOE/EIS-0161
October 1995

Changes to the Draft PEIS that are less than a paragraph, are shown in double under Final PEIS. Larger text changes are shown by sidebar notation.

COVER SHEET

RESPONSIBLE AGENCY: U.S. Department of Energy

COOPERATING AGENCY: U.S. Environmental Protection Agency

TITLE: Final Programmatic Environmental Impact Statement for Tritium Supply and Rec

CONTACT: For additional information on this Statement, write or call:

Stephen M. Sohinki, Director
Office of Reconfiguration
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, DC 20585
Attention: TSR PEIS
Telephone: (202) 586-0838

For general information on the DOE National Environmental Policy Act process, write

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

ABSTRACT: Tritium, a radioactive gas used in all of the Nation's nuclear weapons, is replaced periodically in order for the weapon to operate as designed. Currently, the required amounts of tritium within the Nuclear Weapons Complex.

The PEIS for Tritium Supply and Recycling evaluates the alternatives for the siting tritium supply and recycling facilities at each of five candidate sites: the Idaho Nevada Test Site, the Oak Ridge Reservation, the Pantex Plant, and the Savannah River tritium supply and recycling facilities consist of four different tritium supply technologies: Modular High Temperature Gas-Cooled Reactor, Advanced Light Water Reactor, and Accelerator-Driven Tritium. The PEIS also evaluates the impacts of the DOE purchase of an existing open commercial light water reactor or the DOE purchase of irradiation services contract reactors. Additionally, the PEIS includes an analysis of multipurpose reactors that produce plutonium, and produce electricity.

Evaluation of impacts on land resources, site infrastructure, air quality and acous

soils, biotic resources, cultural and paleontological resources, socioeconomics, and impacts during normal operation and accidents to workers and the public, waste management are included in the assessment.

PUBLIC COMMENTS: In preparing the Final PEIS, DOE considered comments received by mail, hearings, transcribed from messages recorded by telephone, and those transmitted via interactive public hearings were held in April 1995 at the following locations where identified during discussions were summarized by notetakers: Washington, DC; Las Vegas, Tennessee; Pocatello, Idaho; North Augusta, South Carolina; and Amarillo, Texas.

Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

Chemicals and Units of Measure

Metric Conversion Chart

Metric Prefixes

SUMMARY

CHAPTER 1: INTRODUCTION

1.1 The Tritium Supply and Recycling Proposal

1.2 Compliance with the National Environmental Policy Act for Tritium Supply and Recycling

1.3 Time Period Considered in Analysis

1.4 Background

1.4.1 Defense Program Mission

1.4.2 Evolution of the Tritium Supply and Recycling Proposal

1.5 Other National Environmental Policy Act Reviews

1.5.1 Stockpile Stewardship and Management Programmatic Environmental Impact Statement

1.5.2 Waste Management Programmatic Environmental Impact Statement

1.5.3 Long-Term Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement

1.5.4 Site-Wide Environmental Support Statements

1.5.5 Programmatic Spent Nuclear Fuel Management Environmental Impact Statement

1.5.6 Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Reactor Spent Nuclear Fuel

1.6 Program Changes

1.7 Public Participation

1.7.1 The Scoping Process

1.7.2 Public Comment Process on the Draft Programmatic Environmental Impact Statement

1.7.3 Major Comments Received on Draft Programmatic Environmental Impact Statement

1.7.4 Changes from the Draft Programmatic Environmental Impact Statement

1.8 Organization of the Programmatic Environmental Impact Statement

1.9 Preparation of the Programmatic Environmental Impact Statement

CHAPTER 2: PURPOSE OF AND NEED FOR THE DEPARTMENT OF ENERGY'S ACTION

2.1 Purpose of and Need for the Department of Energy's Action

CHAPTER 3: TRITIUM SUPPLY AND RECYCLING ALTERNATIVES

3.1 Development of Tritium Supply and Recycling Alternatives

3.1.1 Planning Assumptions and Basis for Analysis

3.1.2 Environmental Impact Analysis

3.1.3 Alternatives Considered but Eliminated from Detailed Study

3.2 Tritium Supply and Recycling Alternatives

3.2.1 No Action

3.2.2 Tritium Supply and Recycling

3.2.3 Other Missions Beyond Tritium Production

3.3 Candidate Sites

3.3.1 Site Selection

3.3.2 Idaho National Engineering Laboratory

3.3.3 Nevada Test Site

3.3.4 Oak Ridge Reservation

3.3.5 Pantex Plant

3.3.6 Savannah River Site

3.3.7 Commercial Light Water Reactor Site

3.4 Tritium Supply Technologies and Recycling

3.4.1 Background

3.4.1.1 Production of Tritium

- 3.4.1.2 Construction
- 3.4.1.3 Operation
- 3.4.1.4 Cooling Systems
- 3.4.1.5 Decontamination and Decommissioning
- 3.4.2 Tritium Supply Technologies
 - 3.4.2.1 Heavy Water Reactor
 - 3.4.2.2 Modular High Temperature Gas-Cooled Reactor
 - 3.4.2.3 Advanced Light Water Reactor
 - 3.4.2.4 Accelerator Production of Tritium
 - 3.4.2.5 Commercial Light Water Reactor
- 3.4.3 Tritium Recycling and Extraction
 - 3.4.3.1 New Recycling Facility
 - 3.4.3.2 Tritium Recycling Facilities Upgrades at Savannah River Site
 - 3.4.3.3 Extraction and Target Fabrication Facilities for Commercial Light W Reactor
- 3.5 Pollution Prevention and Waste Minimization
- 3.6 Comparison of Tritium Supply and Recycling Alternatives
- 3.7 Agency Preferred Alternative

CHAPTER 4: AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

- 4.1 Environmental Resource Methodologies
 - 4.1.1 Land Resources
 - 4.1.2 Site Infrastructure
 - 4.1.3 Air Quality and Acoustics
 - 4.1.4 Water Resources
 - 4.1.5 Geology and Soils
 - 4.1.6 Biotic Resources
 - 4.1.7 Cultural and Paleontological Resources
 - 4.1.8 Socioeconomics
 - 4.1.9 Radiation and Hazardous Chemical Environment
 - 4.1.10 Waste Management
 - 4.1.11 Intersite Transportation
 - 4.1.12 Cumulative Impacts

- 4.1.13 Environmental Justice
- 4.2 Idaho National Engineering Laboratory
 - 4.2.1 Description of Alternatives
 - 4.2.2 Affected Environment
 - 4.2.2.1 Land Resources
 - 4.2.2.2 Site Infrastructure
 - 4.2.2.3 Air Quality and Acoustics
 - 4.2.2.4 Water Resources
 - 4.2.2.5 Geology and Soils
 - 4.2.2.6 Biotic Resources
 - 4.2.2.7 Cultural and Paleontological Resources
 - 4.2.2.8 Socioeconomics
 - 4.2.2.9 Radiation and Hazardous Chemical Environment
 - 4.2.2.10 Waste Management
 - 4.2.3 Environmental Impacts
 - 4.2.3.1 Land Resources
 - 4.2.3.2 Site Infrastructure
 - 4.2.3.3 Air Quality and Acoustics
 - 4.2.3.4 Water Resources
 - 4.2.3.5 Geology and Soils
 - 4.2.3.6 Biotic Resources
 - 4.2.3.7 Cultural and Paleontological Resources
 - 4.2.3.8 Socioeconomics
 - 4.2.3.9 Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents
 - 4.2.3.10 Waste Management
- 4.3 Nevada Test Site
 - 4.3.1 Description of Alternatives
 - 4.3.2 Affected Environment
 - 4.3.2.1 Land Resources
 - 4.3.2.2 Site Infrastructure
 - 4.3.2.3 Air Quality and Acoustics
 - 4.3.2.4 Water Resources

- 4.3.2.5 Geology and Soils
- 4.3.2.6 Biotic Resources
- 4.3.2.7 Cultural and Paleontological Resources
- 4.3.2.8 Socioeconomics
- 4.3.2.9 Radiation and Hazardous Chemical Environment
- 4.3.2.10 Waste Management
- 4.3.3 Environmental Impacts
 - 4.3.3.1 Land Resources
 - 4.3.3.2 Site Infrastructure
 - 4.3.3.3 Air Quality and Acoustics
 - 4.3.3.4 Water Resources
 - 4.3.3.5 Geology and Soils
 - 4.3.3.6 Biotic Resources
 - 4.3.3.7 Cultural and Paleontological Resources
 - 4.3.3.8 Socioeconomics
 - 4.3.3.9 Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents
 - 4.3.3.10 Waste Management
- 4.4 Oak Ridge Reservation
 - 4.4.1 Description of Alternatives
 - 4.4.2 Affected Environment
 - 4.4.2.1 Land Resources
 - 4.4.2.2 Site Infrastructure
 - 4.4.2.3 Air Quality and Acoustics
 - 4.4.2.4 Water Resources
 - 4.4.2.5 Geology and Soils
 - 4.4.2.6 Biotic Resources
 - 4.4.2.7 Cultural and Paleontological Resources
 - 4.4.2.8 Socioeconomics
 - 4.4.2.9 Radiation and Hazardous Chemical Environment
 - 4.4.2.10 Waste Management
 - 4.4.3 Environmental Impacts

4.4.3.1 Land Resources

4.4.3.2 Site Infrastructure

4.4.3.3 Air Quality and Acoustics

4.4.3.4 Water Resources

4.4.3.5 Geology and Soils

4.4.3.6 Biotic Resources

4.4.3.7 Cultural and Paleontological Resources

4.4.3.8 Socioeconomics

4.4.3.9 Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents

4.4.3.10 Waste Management

4.5 Pantex Plant

4.5.1 Description of Alternatives

4.5.2 Affected Environment

4.5.2.1 Land Resources

4.5.2.2 Site Infrastructure

4.5.2.3 Air Quality and Acoustics

4.5.2.4 Water Resources

4.5.2.5 Geology and Soils

4.5.2.6 Biotic Resources

4.5.2.7 Cultural and Paleontological Resources

4.5.2.8 Socioeconomics

4.5.2.9 Radiation and Hazardous Chemical Environment

4.5.2.10 Waste Management

4.5.3 Environmental Impacts

4.5.3.1 Land Resources

4.5.3.2 Site Infrastructure

4.5.3.3 Air Quality and Acoustics

4.5.3.4 Water Resources

4.5.3.5 Geology and Soils

4.5.3.6 Biotic Resources

4.5.3.7 Cultural and Paleontological Resources

4.5.3.8 Socioeconomics

4.5.3.9 Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents

4.5.3.10 Waste Management

4.6 Savannah River Site

4.6.1 Description of Alternatives

4.6.2 Affected Environment

4.6.2.1 Land Resources

4.6.2.2 Site Infrastructure

4.6.2.3 Air Quality and Acoustics

4.6.2.4 Water Resources

4.6.2.5 Geology and Soils

4.6.2.6 Biotic Resources

4.6.2.7 Cultural and Paleontological Resources

4.6.2.8 Socioeconomics

4.6.2.9 Radiation and Hazardous Chemical Environment

4.6.2.10 Waste Management

4.6.3 Environmental Impacts

4.6.3.1 Land Resources

4.6.3.2 Site Infrastructure

4.6.3.3 Air Quality and Acoustics

4.6.3.4 Water Resources

4.6.3.5 Geology and Soils

4.6.3.6 Biotic Resources

4.6.3.7 Cultural and Paleontological Resources

4.6.3.8 Socioeconomics

4.6.3.9 Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents

4.6.3.10 Waste Management

4.7 Intersite Transport of Tritium Supply and Recycling Materials

4.7.1 Affected Environment

4.7.1.1 Site Transportation Interfaces for Hazardous Materials

4.7.1.2 Packaging

4.7.1.3 Reactor Vessel Transport

- 4.7.2 Environmental Impacts
 - 4.7.2.1 No Action
 - 4.7.2.2 Tritium Supply and Recycling Alternatives
- 4.8 Potential Impacts From Tritium Supply Options
 - 4.8.1 Sale of Steam from Tritium Supply Technologies
 - 4.8.2 Dedicated Power Plant for Accelerator Production of Tritium
 - 4.8.2.1 Coal-Fired Power Plant
 - 4.8.2.2 Natural Gas-Fired Power Plant
 - 4.8.3 Multipurpose Reactor
 - 4.8.3.1 Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility
 - 4.8.3.2 Mixed-Oxide Fueled Advanced Light Water Reactors
 - 4.8.3.3 Plutonium-Oxide Fueled Modular High Temperature Gas-Cooled Reactor
- 4.9 Cumulative Impacts
- 4.10 Commercial Light Water Reactor Alternative and/or Contingency
 - 4.10.1 Commercial Light Water Reactor Plant Description
 - 4.10.1.1 Cooling and Auxiliary Water Systems
 - 4.10.1.2 Radioactive Waste Treatment Systems
 - 4.10.1.3 Nonradioactive Waste Systems
 - 4.10.1.4 Power-Transmission Systems
 - 4.10.2 Commercial Light Water Reactor Plant Environment
 - 4.10.2.1 Land Use
 - 4.10.2.2 Water Use
 - 4.10.2.3 Water Quality
 - 4.10.2.4 Air Quality
 - 4.10.2.5 Aquatic Resources
 - 4.10.2.6 Terrestrial Resources
 - 4.10.2.7 Radiological Impacts
 - 4.10.2.8 Chemical Impacts
 - 4.10.2.9 Socioeconomic Factors
 - 4.10.3 Potential Impacts
 - 4.10.3.1 Completing Construction of a Commercial Reactor
 - 4.10.4 Institutional Issues

4.11 Producing Tritium at an Earlier Date

4.12 Unavoidable Adverse Environmental Impacts

4.13 Relationship Between Local Short-Term Uses of the Environment and the Main Enhancement of Long-Term Productivity

4.14 Irreversible and Irretrievable Commitments of Resources

4.15 Facility Transition

4.16 Environmental Justice in Minority and Low-Income Populations

CHAPTER 5: ENVIRONMENTAL, OCCUPATIONAL SAFETY & HEALTH PERMITS AND COMPLIANCE REQUIREMENTS

5.1 Introduction and Purpose

5.2 Background

5.3 Environmental Statutes, Orders, and Agreements

5.4 Federal and State Environmental Enforcement

5.5 Compliance with Occupational Safety and Health Requirements

CHAPTER 6: REFERENCES

CHAPTER 7: LIST OF PREPARERS

CHAPTER 8: LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THIS STATEMENT were SENT

CHAPTER 9: GLOSSARY

CHAPTER 10: INDEX

List of Figures

Figure S-1 Current and Former Nuclear Weapons Complex Sites.

Figure S-2 Tritium Supply and Recycling Alternatives.

Figure 1.4-1 Current and Former Nuclear Weapons Complex Sites.

Figure 1.4.1-1 Nuclear Weapons Stockpile Memorandum Process.

Figure 1.4.2-1 Evolution of the Reconfiguration Program, 1991-1995.

Figure 1.7.2-1 Public Hearing Locations and Dates, 1995.

Figure 2.1-1 Estimated Tritium Inventory and Reserve Requirements.

Figure 3.2-1 Tritium Supply and Recycling Alternatives.

Figure 3.3.1-1 Site Selection Process.

Figure 3.4.1-1 Tritium Supply and Recycling Complex.

Figure 3.4.2.1-1 Heavy Water Reactor Facility (Typical).

Figure 3.4.2.2-1 Modular High Temperature Gas-Cooled Reactor Facility (Typical).

Figure 3.4.2.3-1 Advanced Light Water Reactor Facility (Typical).

Figure 3.4.2.4-1 Accelerator Production of Tritium Facility Site Layout (Typical).

Figure 3.4.3.1-1 New Tritium Recycling Facility (Typical).

Figure 3.4.3.2-1 Tritium Recycling Facilities Upgrades at Savannah River Site (Gene

Figure 4.2-1 Idaho National Engineering Laboratory, Idaho, and Region.

Figure 4.2.1-1 Primary Facilities and Proposed Tritium Supply Site at Idaho National Engineering Laboratory.

Figure 4.2.2.1-1 Generalized Land Use at Idaho National Engineering Laboratory and

Figure 4.2.2.4-1 Surface Water Features at Idaho National Engineering Laboratory.

Figure 4.2.2.4-2 Generalized Groundwater Flow and Groundwater Contamination in Idaho National Engineering Laboratory Area.

Figure 4.2.2.5-1 Major Fault Systems and Historic Earthquakes in Idaho National Engineering Laboratory Region.

Figure 4.2.2.5-2 Seismic Zone Map of the United States.

Figure 4.2.2.6-1 Distribution of Plant Communities at Idaho National Engineering Laboratory

Figure 4.2.2.8-1 Economy for Idaho National Engineering Laboratory Regional Economic

Figure 4.2.2.8-2 Population and Housing for Idaho National Engineering Laboratory Region of Influence [Page 1 of 2].

Figure 4.2.2.8-2 Population and Housing for Idaho National Engineering Laboratory Region of Influence [Page 2 of 2].

Figure 4.2.2.8-3 1992 Local Government Public Finance for Idaho National Engineering Laboratory Region of Influence.

Figure 4.2.3.8-1 Total Project-Related Employment (Direct and Indirect) and Percent Over No Action from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Regional Economic Area.

Figure 4.2.3.8-2 Unemployment Rate, Per Capita Income, and Percentage Increase from Supply Technologies and Recycling for Idaho National Engineering Laboratory Regional Economic Area.

Figure 4.2.3.8-3 Population and Housing Percentage Increase Over No Action During Project Construction from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence, 2005.

Figure 4.2.3.8-4 Population and Housing Percentage Increase Over No Action at Full Project from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence, 2010.

- Figure 4.2.3.8-5 City and County Total Revenues and Expenditures Percentage Increases No Action During Peak Construction from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence.
- Figure 4.2.3.8-6 County and City Total Revenues and Expenditures Percentage Increases No Action at Full Operation from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence, 2010.
- Figure 4.2.3.8-7 School District Total Revenues and Expenditures Percentage Increases No Action During Peak Construction from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence.
- Figure 4.2.3.8-8 School District Total Revenues and Expenditures Percentage Increases No Action at Full Operation from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence, 2010.
- Figure 4.2.3.9-1 High Consequence Accident-Cancer Fatalities Complementary Cumulative Distribution Functions for Tritium Supply and Recycling Severe Accident for Idaho National Engineering Laboratory.
- Figure 4.3-1 Nevada Test Site, Nevada, and Region.
- Figure 4.3.1-1 Primary Facilities, Proposed Tritium Supply Site, and Testing Areas at Nevada Test Site.
- Figure 4.3.2.1-1 Generalized Land Use at Nevada Test Site and Vicinity.
- Figure 4.3.2.4-1 Groundwater Hydrologic Units at Nevada Test Site and Vicinity.
- Figure 4.3.2.5-1 Major Fault Systems and Historic Earthquakes in Nevada Test Site Region.
- Figure 4.3.2.6-1 Distribution of Plant Communities at Nevada Test Site.
- Figure 4.3.2.6-2 Distribution of Desert Tortoise at Nevada Test Site.
- Figure 4.3.2.8-1 Economy for Nevada Test Site Regional Economic Area.
- Figure 4.3.2.8-2 Population and Housing for Nevada Test Site Region of Influence.
- Figure 4.3.2.8-3 1992 Local Government Public Finance for Nevada Test Site Region of Influence.
- Figure 4.3.3.8-1 Total Project-Related Employment (Direct and Indirect) and Percent Increase over No Action from Tritium Supply Technologies and Recycling for Nevada Test Site Regional Economic Area.
- Figure 4.3.3.8-2 Unemployment Rate, Per Capita Income, and Percentage Increase over No Action from Tritium Supply Technologies and Recycling for Nevada Test Site Regional Economic Area.
- Figure 4.3.3.8-3 Total Population and Housing Percentage Increase over No Action During Peak Construction from Tritium Supply Technologies and Recycling for Nevada Test Site Region of Influence, 2005.
- Figure 4.3.3.8-4 Total Population and Housing Percentage Increase over No Action at Full Operation from Tritium Supply Technologies and Recycling for Nevada Test Site Region of Influence, 2010.
- Figure 4.3.3.8-5 County, City, and School District Total Revenues and Expenditures Percentage Increase over No Action During Peak Construction from Tritium Supply Technologies and Recycling for Nevada Test Site Region of Influence.
- Figure 4.3.3.8-6 County, City, and School District Total Revenues and Expenditures Percentage Increase over No Action at Full Operation from Tritium Supply Technologies and Recycling for Nevada Test Site Region of Influence, 2010.

and Recycling for Nevada Test Site Region of Influence, 2010.

Figure 4.3.3.9-1 High Consequence Accident-Cancer Fatalities Complementary Cumulative Distribution Functions for Tritium Supply and Recycling Severe Accident Nevada Test Site.

Figure 4.4-1 Oak Ridge Reservation, Tennessee, and Region.

Figure 4.4.1-1 Primary Facilities and Proposed Tritium Supply Site at Oak Ridge Reservation

Figure 4.4.2.1-1 Generalized Land Use at Oak Ridge Reservation and Vicinity.

Figure 4.4.2.1-2 Future Land Use at Oak Ridge Reservation, Oak Ridge, Tennessee.

Figure 4.4.2.4-1 Surface Water Features at Oak Ridge Reservation.

Figure 4.4.2.6-1 Distribution of Plant Communities at Oak Ridge Reservation.

Figure 4.4.2.8-1 Economy for Oak Ridge Reservation Regional Economic Area.

Figure 4.4.2.8-2 Population and Housing for Oak Ridge Reservation Region of Influence

Figure 4.4.2.8-3 1992 Local Government Public Finance for Oak Ridge Reservation Region of Influence.

Figure 4.4.3.8-1 Total Project-Related Employment (Direct and Indirect) and Percent Over No Action from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Regional Economic Area.

Figure 4.4.3.8-2 Unemployment Rate, Per Capita Income, and Percentage Increase Over No Action from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Regional Economic Area.

Figure 4.4.3.8-3 Total Population and Housing Percentage Increase Over No Action Due to Construction from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Region of Influence, 2005.

Figure 4.4.3.8-4 Total Population and Housing Percentage Increase Over No Action at Full Operation from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Region of Influence, 2010.

Figure 4.4.3.8-5 County, City, and School District Total Revenues and Expenditures Increase Over No Action During Peak Construction from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Region of Influence

Figure 4.4.3.8-6 County, City, and School District Total Revenues and Expenditures Increase Over No Action at Full Operation from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Region of Influence, 2010.

Figure 4.4.3.9-1 High Consequence Accident-Cancer Fatalities Complementary Cumulative Distribution Functions for Tritium Supply and Recycling Severe Accident Oak Ridge Reservation.

Figure 4.5-1 Pantex Plant, Texas, and Region.

Figure 4.5.1-1 Primary Facilities, Proposed Tritium Supply Sites, and Testing Areas at Pantex Plant.

Figure 4.5.2.1-1 Generalized Land Use at Pantex Plant and Vicinity.

Figure 4.5.2.1-2 Future Land Use at Pantex Plant.

Figure 4.5.2.1-3 Designated Industrial Sites at Pantex Plant.

Figure 4.5.2.4-1 Potentiometric Surface of the Ogallala Aquifer at Pantex Plant.

Figure 4.5.2.8-1 Economy for Pantex Plant Regional Economic Area.

Figure 4.5.2.8-2 Population and Housing for Pantex Plant Region of Influence.

Figure 4.5.2.8-3 1992 Local Government Public Finance for Pantex Plant Region of In

Figure 4.5.3.8-1 Total Project-Related Employment (Direct and Indirect) and Percent Over No Action from Tritium Supply Technologies and Recycling for Plant Regional Economic Area.

Figure 4.5.3.8-2 Unemployment Rate, Per Capita Income, and Percentage Increase Over No Action from Tritium Supply Technologies and Recycling for Pante Regional Economic Area.

Figure 4.5.3.8-3 Total Population and Housing Percentage Increase over No Action Du Construction from Tritium Supply Technologies and Recycling for Pa Region of Influence, 2005.

Figure 4.5.3.8-4 Total Population and Housing Percentage Increase over No Action at Operation from Tritium Supply Technologies and Recycling for Pante Region of Influence, 2010.

Figure 4.5.3.8-5 County and City Total Revenues and Expenditures Percentage Increas No Action During Peak Construction from Tritium Supply Technologe Recycling for Pantex Plant Region of Influence, 2005.

Figure 4.5.3.8-6 County and City Total Revenues and Expenditures Percentage Increas No Action at Full Operation from Tritium Supply Technologies and R Pantex Plant Region of Influence, 2010.

Figure 4.5.3.8-7 School District Total Revenues and Expenditures Percentage Increas No Action During Peak Construction from Tritium Supply Technologe Recycling for Pantex Plant, 2005.

Figure 4.5.3.8-8 School District Total Revenues and Expenditures Percentage Increas No Action at Full Operation from Tritium Supply Technologies and R Pantex Plant, 2010.

Figure 4.5.3.9-1 High Consequence Accident-Cancer Fatalities Complementary Cumulati Distribution Functions for Tritium Supply and Recycling Severe Acc Pantex Plant.

Figure 4.6-1 Savannah River Site, South Carolina, and Region.

Figure 4.6.1-1 Primary Facilities and Proposed Tritium Supply Site at Savannah Rive

Figure 4.6.2.1-1 Generalized Land Use at Savannah River Site and Vicinity.

Figure 4.6.2.4-1 Surface Water Features and Groundwater Contamination Areas at Sava River Site.

Figure 4.6.2.6-1 Distribution of Plant Communities at Savannah River Site.

Figure 4.6.2.8-1 Economy for Savannah River Site Regional Economic Area.

Figure 4.6.2.8-2 Population and Housing for Savannah River Site Region of Influence

Figure 4.6.2.8-3 1992 Local Government Public Finance for Savannah River Site Regio Influence.

Figure 4.6.3.8-1 Total Project-Related Employment (Direct and Indirect) and Percent Over No Action from Tritium Supply Technologies with Recycling Upg

Savannah River Site Regional Economic Area.

- Figure 4.6.3.8-2 Unemployment Rate, Per Capita Income, and Percentage Increase Over No Action from Tritium Supply Technologies and Recycling Upgrade f Savannah River Site Regional Economic Area.
- Figure 4.6.3.8-3 Total Employment, Unemployment Rate, and Per Capita Income for No and Tritium Recycling Phaseout for Savannah River Site Regional Ec Area, 2010.
- Figure 4.6.3.8-4 Total Population and Housing Percentage Increase Over No Action Du Construction from Tritium Supply Technologies and Recycling Upgrad Savannah River Site Region of Influence, 2005.
- Figure 4.6.3.8-5 Total Population and Housing Percentage Increase Over No Action at Operation from Tritium Supply Technologies and Recycling Upgrade f Savannah River Site Region of Influence, 2010.
- Figure 4.6.3.8-6 Total Population and Housing Percentage Decrease Under No Action f Tritium Recycling Phaseout for Savannah River Site Region of Infl u
- Figure 4.6.3.8-7 County and City Total Revenues and Expenditures Percentage Decrease No Action for the Tritium Recycling Phaseout for Savannah River Si of Influence, 2010.
- Figure 4.6.3.8-8 County and City Revenues and Expenditures Percentage Increase Over During Peak Construction from Tritium Supply Technologies and Recy Upgrade for Savannah River Site Region of Influence, 2005.
- Figure 4.6.3.8-9 County and City Revenues and Expenditures Percentage Increase Over at Full Operation from Tritium Supply Technologies and Recycling U Savannah River Site Region of Influence, 2010.
- Figure 4.6.3.8-10 School District Total Revenues and Expenditures Percentage Increa No Action During Peak Construction from Tritium Supply Technologi Recycling Upgrade for Savannah River Site Region of Influence, 20
- Figure 4.6.3.8-11 School District Total Revenues and Expenditures Percentage Increa No Action at Full Operation from Tritium Supply Technologies and Upgrade for Savannah River Site Region of Influence, 2010.
- Figure 4.6.3.8-12 School District Total Revenues and Expenditures Percentage Decrea No Action from the Tritium Recycling Phaseout for Savannah River of Influence, 2010.
- Figure 4.6.3.9-1 High Consequence Accident-Cancer Fatalities Complementary Cumulati Distribution Functions for Tritium Supply and Recycling Severe Acc Savannah River Site.
- Figure 4.8.3.1-1 Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility P
- Figure 4.8.3.1-2 Manufacturing Building Layout Plan.
- Figure 4.10-1 Commercial Nuclear Power Plants Within Eleven Energy-Demand Regions o United States.
- Figure 4.10-2 Commercial Nuclear Power Plants with Design Electrical Rating Greater 1,100 Megawatts Electric Within Eleven Energy-Demand Regions of the U States.
- Figure 4.16-1 Minority Population Distribution for Idaho National Engineering Labor Surrounding Area.
- Figure 4.16-2 Low-Income Distribution by Poverty Status for Idaho National Engineer

Laboratory and Surrounding Area.

Figure 4.16-3 Minority Population Distribution for Nevada Test Site and Surrounding

Figure 4.16-4 Low-Income Distribution by Poverty Status for Nevada Test Site and Su
Area.

Figure 4.16-5 Minority Population Distribution for Oak Ridge Reservation and Surrou
Area.

Figure 4.16-6 Low-Income Distribution by Poverty Status for Oak Ridge Reservation a
Surrounding Area.

Figure 4.16-7 Minority Population Distribution for Pantex Plant and Surrounding Are

Figure 4.16-8 Low-Income Distribution by Poverty Status for Pantex Plant and Surrou
Area.

Figure 4.16-9 Minority Population Distribution for Savannah River Site and Surround

Figure 4.16-10 Low-Income Distribution by Poverty Status for Savannah River Site an
Surrounding Area.

List of Tables

Table 3.3.2-1 Current Missions at Idaho National Engineering Laboratory

Table 3.3.3-1 Current Missions at Nevada Test Site

Table 3.3.4-1 Current Missions at Oak Ridge Reservation

Table 3.3.5-1 Current Missions at Pantex Plant

Table 3.3.6-1 Current Missions at Savannah River Site

Table 3.4.2.1-1 Heavy Water Reactor Construction Requirements

Table 3.4.2.1-2 Heavy Water Reactor Operation Requirements

Table 3.4.2.1-3 Heavy Water Reactor Estimated Spent Nuclear Fuel and Waste Volumes

Table 3.4.2.2-1 Modular High Temperature Gas-Cooled Reactor Construction Requiremen

Table 3.4.2.2-2 Modular High Temperature Gas-Cooled Reactor Operation Requirements

Table 3.4.2.2-3 Modular High Temperature Gas-Cooled Reactor Estimated Spent Nuclear
Waste Volumes

Table 3.4.2.3-1 Advanced Light Water Reactor Construction Requirements

Table 3.4.2.3-2 Advanced Light Water Reactor Operation Requirements

Table 3.4.2.3-3 Advanced Light Water Reactor (Large) Estimated Spent Nuclear Fuel a
Volumes

Table 3.4.2.3-4 Advanced Light Water Reactor (Small) Estimated Spent Nuclear Fuel a
Volumes

Table 3.4.2.4-1 Accelerator Production of Tritium Construction Requirements

Table 3.4.2.4-2	Accelerator Production of Tritium Operation Requirements
Table 3.4.2.4-3	Accelerator Production of Tritium (Full) Estimated Waste Volumes
Table 3.4.2.4-4	Accelerator Production of Tritium (Phased) Estimated Waste Volumes
Table 3.4.2.4-5	Accelerator Production of Tritium Power Plant Construction Requirem
Table 3.4.2.4-6	Accelerator Production of Tritium Power Plant Operation Requirement
Table 3.4.3.1-1	New Tritium Recycling Facility Construction Requirements
Table 3.4.3.1-2	New Tritium Recycling Facility Operation Requirements
Table 3.4.3.1-3	New Tritium Recycling Facility Estimated Waste Volumes
Table 3.4.3.2-1	Upgraded Tritium Recycling Facilities Construction Requirements
Table 3.4.3.2-2	Upgraded Tritium Recycling Facilities Operation Requirements
Table 3.4.3.2-3	Upgraded Tritium Recycling Facilities (Unconsolidated-With Building Waste Volumes
Table 3.4.3.2-4	Upgraded Tritium Recycling Facilities (Consolidated-Without Buildin Waste Volumes
Table 3.4.3.3-1	Extraction Facility for Commercial Light Water Reactor Construction Requirements
Table 3.4.3.3-2	Extraction Facility for Commercial Light Water Reactor Operation Re
Table 3.4.3.3-3	Extraction Facility for Commercial Light Water Reactor Waste Volume
Table 3.4.3.3-4	Target Fabrication Facility for Commercial Light Water Reactor Cons Requirements
Table 3.4.3.3-5	Target Fabrication for Commercial Light Water Reactor Operation Req
Table 3.4.3.3-6	Target Fabrication for Commercial Light Water Reactor Waste Volumes
Table 3.6-1	Summary Comparison of Environmental Impacts of Tritium Supply and Recyc Alternatives
Table 3.6-2	Summary Comparison of Environmental Impacts of the Commercial Light Wat Reactor Alternative
Table 4.2.2.2-1	Baseline Characteristics for Idaho National Engineering Laboratory
Table 4.2.2.2-2	Subregional Power Pool Electrical Summary for Idaho National Engine Laboratory
Table 4.2.2.3-1	Comparison of Baseline Ambient Air Concentrations with Most Stringe Applicable Regulations and Guidelines at Idaho National Engineering 1989-1991
Table 4.2.2.4-1	Summary of Surface Water Quality Monitoring Data for Big Lost River National Engineering Laboratory, 1985
Table 4.2.2.4-2	Groundwater Quality Monitoring Data at Idaho National Engineering L 1990-1991
Table 4.2.2.5-1	The Modified Mercalli Scale of 1931, with Approximate Correlations Scale and Maximum Ground Acceleration

Table 4.2.2.6-1	Federal and State-Listed Threatened, Endangered, and Other Special Species That May Be Found On the Site or In the Vicinity of the Pro Supply Site at Idaho National Engineering Laboratory
Table 4.2.2.9-1	Sources of Radiation Exposure to Individuals in the Vicinity, Unrel National Engineering Laboratory Operations, 1992
Table 4.2.2.9-2	Doses to the General Public from Normal Operations at Idaho Nationa Engineering Laboratory, 1992 (committed effective dose equivalent)
Table 4.2.2.9-3	Doses to the Worker Onsite from Normal Operations at Idaho National Engineering Laboratory, 1992 (committed effective dose equivalent)
Table 4.2.2.10-1	Spent Nuclear Fuel and Waste Management at Idaho National Engineer Laboratory
Table 4.2.3.1-1	Potential Changes to Land Use Resulting from Tritium Supply Technol Recycling at Idaho National Engineering Laboratory
Table 4.2.3.2-1	Modifications to Site Infrastructure for Tritium Supply Technologie at Idaho National Engineering Laboratory
Table 4.2.3.2-2	Impacts on Subregional Electrical Power Pool from Tritium Supply Te and Recycling at Idaho National Engineering Laboratory
Table 4.2.3.3-1	Estimated Cumulative Concentrations of Pollutants Resulting from Tr Technologies and Recycling Including No Action at Idaho National En Laboratory
Table 4.2.3.4-1	Potential Changes to Water Resources Resulting from Tritium Supply and Recycling at Idaho National Engineering Laboratory
Table 4.2.3.6-1	Potential Impacts to Biotic Resources During Construction and Opera from Tritium Supply Technologies and Recycling at Idaho National En Laboratory
Table 4.2.3.9-1	Potential Radiological Impacts to the Public and Workers Resulting Operation of Tritium Supply Technologies and Recycling at Idaho Nat Engineering Laboratory
Table 4.2.3.9-2	Potential Hazardous Chemical Impacts to the Public and Workers Resu Normal Operation at Idaho National Engineering Laboratory
Table 4.2.3.9-3	Tritium Supply Technologies and Recycling High Consequence/Low Prob Radioactive Release Accidents and Consequences at Idaho National En Laboratory
Table 4.2.3.9-4	Tritium Supply Technologies and Recycling Low-to-Moderate Consequen High Probability Radioactive Release Accidents and Consequences at National Engineering Laboratory
Table 4.2.3.10-1	Projected Spent Nuclear Fuel and Waste Management for No Action at National Engineering Laboratory
Table 4.2.3.10-2	Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes fo Supply Technologies and Recycling at Idaho National Engineering La
Table 4.2.3.10-3	Potential Spent Nuclear Fuel and Waste Management Impacts from Tri Supply Technologies and Recycling at Idaho National Engineering La
Table 4.3.2.2-1	Baseline Characteristics for Nevada Test Site
Table 4.3.2.2-2	Subregional Power Pool Electrical Summary for Nevada Test Site

Table 4.3.2.3-1	Comparison of Baseline Ambient Air Concentrations with Most Stringe Applicable Regulations and Guidelines at Nevada Test Site, 1990-199
Table 4.3.2.4-1	Groundwater Quality Monitoring Data at Nevada Test Site, 1991-1992
Table 4.3.2.6-1	Federal and State-Listed Threatened, Endangered, and Other Special Species That May Be Found On the Site or In the Vicinity of the Pro Supply Site at Nevada Test Site
Table 4.3.2.9-1	Sources of Radiation Exposure to Individuals in the Vicinity, Unrel Test Site Operations
Table 4.3.2.9-2	Doses to the General Public from Normal Operation at Nevada Test Si (committed effective dose equivalent)
Table 4.3.2.9-3	Doses to the Worker Onsite from Normal Operation at Nevada Test Sit (committed effective dose equivalent)
Table 4.3.2.10-1	Waste Management at Nevada Test Site
Table 4.3.3.1-1	Potential Changes to Land Use Resulting from Tritium Supply Technol Recycling at Nevada Test Site
Table 4.3.3.2-1	Modifications to Site Infrastructure for Tritium Supply Technologie at Nevada Test Site
Table 4.3.3.2-2	Impacts on Subregional Electrical Power Pool from Tritium Supply Te and Recycling at Nevada Test Site
Table 4.3.3.3-1	Estimated Cumulative Concentrations of Pollutants Resulting from Tr Technologies and Recycling Including No Action at Nevada Test Site
Table 4.3.3.4-1	Potential Changes to Water Resources Resulting from Tritium Supply and Recycling at Nevada Test Site
Table 4.3.3.6-1	Potential Impacts to Biotic Resources Resulting During Construction from Tritium Supply Technologies and Recycling at Nevada Test Site
Table 4.3.3.9-1	Potential Radiological Impacts to the Public and Workers Resulting Operation of Tritium Supply Technologies and Recycling at Nevada Te
Table 4.3.3.9-2	Potential Hazardous Chemical Impacts to the Public and Workers Resu Normal Operation at Nevada Test Site
Table 4.3.3.9-3	Tritium Supply Technologies and Recycling High Consequence/Low Prob Radioactive Release Accidents and Consequences at Nevada Test Site
Table 4.3.3.9-4	Tritium Supply Technologies and Recycling Low-to-Moderate Consequen Probability Radioactive Release Accidents and Consequences at Nevad
Table 4.3.3.10-1	Projected Waste Management Under No Action at Nevada Test Site
Table 4.3.3.10-2	Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes fo Supply Technologies and Recycling at Nevada Test Site
Table 4.3.3.10-3	Potential Spent Nuclear Fuel and Waste Management Impacts from the Supply Technologies and Recycling at Nevada Test Site
Table 4.4.2.2-1	Baseline Characteristics for Oak Ridge Reservation
Table 4.4.2.2-2	Subregional Power Pool Electrical Summary for Oak Ridge Reservation
Table 4.4.2.3-1	Comparison of Baseline Ambient Air Concentrations with Most Stringe Applicable Regulations and Guidelines at Oak Ridge Reservation, 199

Table 4.4.2.4-1	Summary of Clinch River Surface Water Quality Monitoring at Oak Ridge Reservation, 1991
Table 4.4.2.4-2	Groundwater Quality Monitoring Data at Oak Ridge Reservation, 1991
Table 4.4.2.6-1	Federal and State-Listed Threatened, Endangered, and Other Special Species That May Be Found On the Site or In the Vicinity of Proposed Supply Site at Oak Ridge Reservation
Table 4.4.2.9-1	Sources of Radiation Exposure to Individuals in the Vicinity, Unrel Ridge Reservation Operations
Table 4.4.2.9-2	Doses to the General Public from Normal Operation at Oak Ridge Reservation 1992 (committed effective dose equivalent)
Table 4.4.2.9-3	Doses to the Worker Onsite from Normal Operation at Oak Ridge Reservation 1992 (committed effective dose equivalent)
Table 4.4.2.10-1	Spent Nuclear Fuel and Waste Management at Y-12 Plant
Table 4.4.2.10-2	Spent Nuclear Fuel and Waste Management at Oak Ridge National Laboratory
Table 4.4.2.10-3	Waste Management at K-25 Site
Table 4.4.3.1-1	Potential Changes to Land Use Resulting from Tritium Supply Technologies and Recycling at Oak Ridge Reservation
Table 4.4.3.2-1	Modifications to Site Infrastructure for Tritium Supply Technologies at Oak Ridge Reservation
Table 4.4.3.2-2	Impacts on Subregional Electrical Power Pool from Tritium Supply Technologies and Recycling at Oak Ridge Reservation
Table 4.4.3.3-1	Estimated Cumulative Concentrations of Pollutants Resulting from Tritium Supply Technologies and Recycling Including No Action at Oak Ridge Reservation
Table 4.4.3.4-1	Potential Changes to Water Resources Resulting from Tritium Supply Technologies and Recycling at Oak Ridge Reservation
Table 4.4.3.6-1	Potential Impacts to Biotic Resources During Construction and Operation of Tritium Supply Technologies and Recycling at Oak Ridge Reservation
Table 4.4.3.9-1	Potential Radiological Impacts to the Public and Workers Resulting from Operation of Tritium Supply Technologies and Recycling at Oak Ridge Reservation
Table 4.4.3.9-2	Potential Hazardous Chemical Impacts to the Public and Workers Resulting from Normal Operations at Oak Ridge Reservation
Table 4.4.3.9-3	Tritium Supply Technologies and Recycling High Consequence/Low Probability Radioactive Release Accidents and Consequences at Oak Ridge Reservation
Table 4.4.3.9-4	Tritium Supply Technologies and Recycling Low-to-Moderate Consequence Probability Radioactive Release Accidents and Consequences at Oak Ridge Reservation
Table 4.4.3.10-1	Projected Spent Nuclear Fuel and Waste Management for No Action at Oak Ridge Reservation
Table 4.4.3.10-2	Estimated Generated Annual Spent Nuclear Fuel and Waste Volumes from Tritium Supply Technologies and Recycling at Oak Ridge Reservation
Table 4.4.3.10-3	Potential Spent Nuclear Fuel and Waste Management Impacts from Tritium Supply Technologies and Recycling at Oak Ridge Reservation

Table 4.5.2.2-1 Baseline Characteristics for Pantex Plant

Table 4.5.2.2-2 Subregional Power Pool Electrical Summary for Pantex Plant

Table 4.5.2.3-1 Comparison of Baseline Ambient Air Concentrations with Most Stringe Applicable Regulations and Guidelines at Pantex Plant, 1991

Table 4.5.2.4-1 Summary of Surface Water Quality Monitoring Data for Playa 1 at Pan 1991

Table 4.5.2.4-2 Groundwater Quality Monitoring Data for the Ogallala Aquifer Wells Plant, 1990

Table 4.5.2.4-3 Groundwater Quality Monitoring for the Perched Zone Wells at Pantex 1990

Table 4.5.2.6-1 Federal and State-Listed Threatened, Endangered, and Other Special Species That May be Found On the Site or In the Vicinity of Propose Supply Site on Pantex Plant

Table 4.5.2.9-1 Sources of Radiation Exposure to Individuals in the Vicinity, Unrel Plant Operations

Table 4.5.2.9-2 Doses to the General Public from Normal Operation at Pantex Plant, (committed effective dose equivalent)

Table 4.5.2.9-3 Doses to the Worker Onsite from Normal Operation at Pantex Plant, (committed effective dose equivalent)

Table 4.5.2.10-1 Waste Management at Pantex Plant

Table 4.5.3.1-1 Potential Changes to Land Use Resulting from Tritium Supply Technol Recycling at Pantex Plant

Table 4.5.3.2-1 Modifications to Site Infrastructure for Tritium Supply Technologie at Pantex Plant

Table 4.5.3.2-2 Impacts on Subregional Electrical Power Pool from Tritium Supply Te and Recycling at Pantex Plant

Table 4.5.3.3-1 Estimated Cumulative Concentrations of Pollutants Resulting from Tr Technologies and Recycling Including No Action at Pantex Plant

Table 4.5.3.4-1 Potential Changes to Water Resources Resulting from Tritium Supply and Recycling at Pantex Plant

Table 4.5.3.6-1 Potential Impacts to Biotic Resources During Construction and Opera from Tritium Supply Technologies and Recycling at Pantex Plant

Table 4.5.3.9-1 Potential Radiological Impacts to the Public and Workers Resulting Operation of Tritium Supply Technologies and Recycling at Pantex Pl

Table 4.5.3.9-2 Potential Hazardous Chemical Impacts to the Public and Workers Resu Normal Operation at Pantex Plant

Table 4.5.3.9-3 Tritium Supply Technologies and Recycling High Consequence/Low Prob Radioactive Release Accidents and Consequences at Pantex Plant

Table 4.5.3.9-4 Tritium Supply Technologies and Recycling Low to Moderate Consequen Radioactive Release Accidents and Consequences at Pantex Plant

Table 4.5.3.10-1 Projected Waste Management for No Action at Pantex Plant, 1992

Table 4.5.3.10-2	Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes for Supply Technologies and Recycling at Pantex Plant
Table 4.5.3.10-3	Potential Spent Nuclear Fuel and Waste Management Impacts from Tritium Supply Technologies and Recycling at Pantex Plant
Table 4.6.2.2-1	Baseline Characteristics for Savannah River Site
Table 4.6.2.2-2	Subregional Power Pool Electrical Summary for Savannah River Site
Table 4.6.2.3-1	Comparison of Baseline Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines at Savannah River Site, 1985-
Table 4.6.2.4-1	Summary of Surface Water Quality Monitoring Data for the Savannah River Site, 1991
Table 4.6.2.4-2	Groundwater Quality Monitoring Data at Savannah River Site, 1991
Table 4.6.2.6-1	Federal and State-Listed Threatened, Endangered, and Other Special Species That May Be Found On the Site or In the Vicinity of the Proposed Supply Site at Savannah River Site
Table 4.6.2.9-1	Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated Savannah River Site Operations, 1992
Table 4.6.2.9-2	Doses to the General Public from Normal Operations at Savannah River Site, 1992 (committed effective dose equivalent)
Table 4.6.2.9-3	Doses to the Worker Onsite from Normal Operations at Savannah River Site, 1992 (committed effective dose equivalent)
Table 4.6.2.10-1	Spent Nuclear Fuel and Waste Management at Savannah River Site
Table 4.6.3.1-1	Potential Changes to Land Use Resulting from Tritium Supply Technologies and Recycling at Savannah River Site
Table 4.6.3.2-1	Modifications to Site Infrastructure for Tritium Supply Technologies Phaseout at Savannah River Site
Table 4.6.3.2-2	Impacts on the Subregional Electrical Power Pool from Tritium Supply Technologies at Savannah River Site
Table 4.6.3.3-1	Estimated Cumulative Concentrations of Pollutants Resulting from Tritium Supply Technologies and Upgraded Recycling Including No Action at Savannah River Site
Table 4.6.3.4-1	Potential Changes to Water Resources Resulting from Tritium Supply Technologies and Recycling at Savannah River Site
Table 4.6.3.6-1	Potential Impacts to Biotic Resources Resulting from Tritium Supply Technologies and Recycling During Construction and Operation at Savannah River Site
Table 4.6.3.9-1	Potential Radiological Impacts to the Public and Workers Resulting from Operation of Tritium Supply Technologies and Recycling at Savannah River Site
Table 4.6.3.9-2	Potential Hazardous Chemical Impacts to the Public and Workers Resulting from Normal Operation at Savannah River Site
Table 4.6.3.9-3	Radioactive Release Accidents and Consequences for Existing No Action Recycling Operations at Savannah River Site
Table 4.6.3.9-4	Tritium Supply Technologies and Recycling High Consequence/Low Probability Radioactive Release Accidents and Consequences at Savannah River Site

Table 4.6.3.9-5	Tritium Supply Technologies and Recycling Low-to-Moderate Consequen Probability Radioactive Release Accidents and Consequences at Savan Site
Table 4.6.3.10-1	Projected Spent Nuclear Fuel and Waste Management for No Action at River Site
Table 4.6.3.10-2	Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes fo Supply Technologies and Recycling at Savannah River Site
Table 4.6.3.10-3	Potential Spent Nuclear Fuel and Waste Management Impacts from Tri Supply Technologies and Recycling at Savannah River Site
Table 4.7.1.1-1	Transportation Modes and Comparison Ratings for the Candidate Sites
Table 4.7.2.2-1	Comparison of Relative Mileage Risk
Table 4.7.2.2-2	Accident Impacts from Transporting Low-Level Waste from Pantex Plan Nevada Test Site
Table 4.8.3.1-1	Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility Ke Parameters
Table 4.8.3.1-2	Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility Co Requirements
Table 4.8.3.1-3	Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility Op Requirements
Table 4.8.3.1-4	Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility Wa Volumes
Table 4.8.3.1-5	Pit Disassembly/Conversion Facility Key Design Parameters
Table 4.8.3.1-6	Pit Disassembly/Conversion Facility Construction Requirements
Table 4.8.3.1-7	Pit Disassembly/Conversion Facility Operation Requirements
Table 4.8.3.1-8	Pit Disassembly/Conversion Facility Waste Volumes
Table 4.8.3.1-9	Mixed-Oxide Fuel Fabrication Worker and Population Impacts of High Consequence Accidents
Table 4.8.3.1-10	Mixed-Oxide Fuel Fabrication Worker and Population Impacts of Low Consequence/High Probability Accidents
Table 4.8.3.2-1	Increase of Radioactive Materials for the Mixed-Oxide Fueled Light Reactor
Table 4.8.3.3-1	Multipurpose Modular High Temperature Gas-Cooled Reactor Estimated Construction Material/Resource Requirements
Table 4.8.3.3-2	Multipurpose Modular High Temperature Gas-Cooled Reactor Estimated Utility Requirements
Table 4.10.3.1-1	Estimated Total Construction Materials/Resources Consumption to Co Nuclear Power Plant
Table 4.10.3.1-2	Estimated Peak Year Construction Air Emissions From Activities to Nuclear Power Plant
Table 4.10.3.1-3	Estimated Construction Workers Needed by Year to Complete a Nuclea Plant

Table 4.10.3.1-4	Estimated Construction Waste Generated to Complete a Nuclear Power
Table 4.10.3.1-1	Generic Commercial Light Water Reactor Operational Parameters
Table 4.10.3.1-2	Commercial Light Water Reactor Operational Parameter Changes From Production
Table 4.10.3.2-3	Radiological Consequences of Transportation Accidents Shipping Tri Rods
Table 4.16-1	Selected Demographic Characteristics for Idaho National Engineering La Region-of-Influence
Table 4.16-2	Selected Demographic Characteristics for Nevada Test Site Region-of-In
Table 4.16-3	Selected Demographic Characteristics for Oak Ridge Reservation Region-Influence
Table 4.16-4	Selected Demographic Characteristics for Pantex Plant Region-of-Influe
Table 4.16-5	Selected Demographic Characteristics for Savannah River Site Region-of Influence
Table 5.3-1	Federal Environmental Statutes, Regulations, and Orders
Table 5.3-2	Selected Department of Energy Environment, Safety, and Health Orders
Table 5.3-3	Department of Energy Agreements with Federal and State Environmental Regulatory Agencies
Table 5.3-4	State Environmental Statutes, Regulations, and Orders
Table 5.5-1	Estimated Number of Construction Worker Fatalities by Technology

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS Acronyms, Abbreviations, and Conversion Charts

Acronyms and Abbreviations

APT	Accelerator Production of Tritium
ALWR	Advanced Light Water Reactor
AQCR	Air Quality Control Region
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
D&D	decontamination and decommissioning
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DOT	Department of Transportation
DP	DOE Office of the Assistant Secretary for Defense Programs
EA	environmental assessment
EIS	environmental impact statement

EM	DOE Office of the Assistant Secretary for Environmental Management
EPA	Environmental Protection Agency
ES&H	environment, safety and health
HAP	hazardous air pollutants
HE	high explosive(s)
HEPA	high efficiency particulate air
HEU	highly enriched uranium
HI	Hazard Index
HLW	high-level waste
HQ	Hazard Quotient
HWR	Heavy Water Reactor
INEL	Idaho National Engineering Laboratory
IP	implementation plan
Leq	equivalent sound level
LLW	low-level waste
MHTGR	Modular High Temperature Gas-Cooled Reactor
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PEIS	programmatic environmental impact statement
PM10	particulate matter of aerodynamic diameter less than 10 micrometers
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
ROI	region-of-influence
SAR	Safety Analysis Report
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Officer
SRS	Savannah River Site
START	Strategic Arms Reduction Treaty
TOC	total organic compounds
TRU	transuranic
TSCA	Toxic Substances Control Act
TSP	total suspended particulates
TSS	tritium supply site
USFWS	U.S. Fish and wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compounds
VRM	Visual Resource Management
WIPP	Waste Isolation Pilot Plant

Chemicals and Units of Measure

BGY	billion gallons per year
Btu	British thermal units
Ci	curie
CCl4	carbon tetrachloride
CO	carbon monoxide
CFC	chlorofluorocarbons
dB	decibel

dba	decibel A-weighted
DCE	1, 2-dichloroethylene
F	Fahrenheit
ft ²	square feet
ft ³	cubic feet
ft ³ /s	cubic feet per second
g	gram
gal	gallon
GPD	gallons per day
gpm	gallons per minute
GPY	gallons per year
HCFC-22	chlorodifluoromethane
HMX	cyclotetramethylenetetranitramine or 1, 3, 5, 7-tetranitro-1, 3,5, 7-tetr
hr	hour
kg	kilogram
kV	kilovolt
kVA	kilovolt-ampere
kW	kilowatt
kWh	kilowatt hour
lb	pound
lb/hr	pounds per hour
lb/yr	pounds per year
Li	lithium
mCi	millicurie (one-thousandth of a curie)
mCi/ml	millicurie per milliliter
mg	milligram (one-thousandth of a gram)
mg/l	milligram per liter
MGD	million gallons per day
MGY	million gallons per year
mrem	millirem (one-thousandth of a rem)
MVA	megavolt-ampere
MW	megawatt
Mwe	megawatt electric
Mwh	megawatt hour
MWt	megawatt thermal
nCi	nanocurie (one-billionth of a curie)
nCi/g	nanocuries per gram
NO ₂	nitrogen dioxide
NO _x	nitrogen oxides
O ₃	ozone
Pb	lead
PCB	polychlorinated biphenyl
pCi	picocurie (one-trillionth of a curie)
pCi/l	picocuries per liter
PETN	pentaerythritol tetramtrate
ppb	parts per billion
ppm	parts per million
Pu	plutonium
RDX	cyclotrimethylenetrinitrainine
rem	roentgen equivalent man
SO ₂	sulfur dioxide
TATB	triaminotrinitrobenzene
TCA	1,1, 1-trichloroethane
TCE	trichloroethylene
TNT	trinitrotoluene
U	uranium
yd ³	cubic yards
uCi	microcurie (one-millionth of a curie)
uCi/g	microcuries per gram
ug	microgram (one-millionth of a gram)
ug/kg	micrograms per kilogram
ug/l	micrograms per liter
ug/m ³	micrograms per cubic meter
um	micron or micrometer (one-millionth of a meter)

Metric Conversion Chart

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

Metric Prefixes

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



SUMMARY

INTRODUCTION

In January 1991, the Secretary of Energy announced that the Department of Energy (DOE) Office of the Assistant Secretary for Defense Programs (DP) would prepare a programmatic environmental impact statement (PEIS) examining alternatives for the reconfiguration of the Nation's Nuclear Weapons Complex (Complex). The framework for the Reconfiguration Study was described in the January 1991 Nuclear Weapons Complex Reconfiguration Study, a detailed examination of alternatives for the future Complex. Because of the significant changes in the world since January 1991, especially with regard to projected future requirements for the United States nuclear weapons stockpile, the framework described in the Nuclear Weapons Reconfiguration Study does not exist today. Therefore, the DOE has separated the Reconfiguration PEIS into two PEISs: a Tritium Supply and Recycling PEIS; and a Stockpile Stewardship and Management PEIS. The Tritium Supply and Recycling Proposal is analyzed in this PEIS. The Stockpile Stewardship and Management Proposal is currently being analyzed in a separate PEIS being prepared by DP.

Another issue which was once part of reconfiguration was the storage of all weapons fissile materials, primarily highly enriched uranium and plutonium. In early 1994 the Secretary established a Departmentwide program for developing recommendations and for directing implementation of decisions concerning disposition of excess nuclear materials. This program was recognized in the FY 1995. Defense Authorization Bill which directs that an office be established for this purpose.

A determination was made that a PEIS was needed to support the decision making for disposition of surplus weapons-usable fissile materials. Since long-term storage is closely related (connected) to disposition, the long-term storage analysis that had been part of the Reconfiguration PEIS was moved into the program for Long-Term Storage and Disposition of Weapons-Usable Fissile Materials. As a result of this, a third PEIS, Storage and Disposition of Weapons-Usable Fissile Materials PEIS, is being prepared to analyze alternatives for the long-term storage of all weapons-usable fissile materials, primarily highly enriched uranium and plutonium. That PEIS will also address the disposition of plutonium declared surplus to national defense needs by the President. A PEIS for the disposition of surplus highly enriched uranium is also being prepared.

Tritium Supply and Recycling Proposal

The DOE proposes to provide tritium supply and recycling facilities for the Complex. The Complex is a set of interrelated facilities supporting the research, development, design, manufacture, testing, and maintenance of the Nation's nuclear weapons and the subsequent dismantlement of retired weapons. The Complex consisted of 11 sites located in ten states (figure S-1). Hanford and Idaho National Engineering Laboratory (INEL) are currently part of the Complex. Defense missions have been terminated at the Rocky Flats Plant, Plant, and the Pinellas Plant. Tritium supply deals with the production of new tritium either by a reactor or an accelerator by irradiating target materials with neutrons and subsequent extraction of the tritium in pure form for its use in nuclear weapons. Tritium recycling consists of recovering residual tritium from weapons components, purifying, and refilling weapons components with both recovered and new tritium when it becomes available.

Tritium Supply and Recycling Proposal:

Provide the long-term, assured supply of tritium.

Safely and reliably fulfill all future national defense requirements for tritium.

Protect the health of workers, the general public, and the environment.

Figure (Page S-2)

Figure S-1.-Current and Former Nuclear Weapons Complex Sites.

There is now no capability to produce the required amounts of tritium within the Co Tritium, with a half-life of 12.3 years, is necessary for all weapons that remain i stockpile. Thus, tritium must be replaced periodically as long as the Nation relies nuclear deterrent. Current projections require that a new source of tritium be avai by 2009 and new tritium be available for stockpile use by 2011. This Tritium Supply Recycling Programmatic Environmental Impact Statement evaluates the siting, construction, and operation of tritium supply technology alternatives and recycling facilities at each of five candidate sites. The use of an existing commercial light reactor that would be used for irradiation services or purchased and converted for production is also included as an alternative for long-term tritium supply.

Additionally, this Tritium Supply and Recycling PEIS includes an assessment of the environmental impacts associated with using one or more commercial light water reac for tritium production as a contingency in the event of a national emergency. Speci commercial reactors are not identified in this PEIS.

This PEIS also addresses the environmental impacts of an Advanced Light Water React (ALWR) or modular gas-cooled reactor used as a multipurpose reactor. A commercial r could also be used as a multipurpose reactor. Throughout the PEIS, reference to and discussion of impacts for the multipurpose ALWR are also applicable to a multipurpo commercial reactor. A multipurpose ("triple play") reactor is defined as one capabl producing tritium, "burning" plutonium, and generating revenues through the sale of electric power. The multipurpose ALWR would operate essentially the same as a uranium-fueled tritium production ALWR. Therefore, the environmental impacts from operation of a multipurpose ALWR would be expected to be similar to that from the t production ALWR. However, a plutonium Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would be needed to provide the mixed-oxide fuel rods for the A multipurpose reactor, and would be the major contributor to potential environmental impacts greater than that for uranium-fueled tritium production ALWR. For a modular gas-cooled multipurpose reactor, twice as many reactor modules would be needed both meet tritium requirements and to burn plutonium. A plutonium Pit Disassembly/Conver Facility would also be needed. Thus, the potential environmental impacts for a multipurpose gas-cooled reactor are expected to be substantially greater than a uranium-fueled tritium production gas-cooled reactor.

The PEIS evaluates alternative tritium supply technologies against a baseline tritium requirement (i.e., a specific quantity of tritium, the exact amount of which is classified). Understanding the concept of the baseline tritium requirement is cruci understanding the alternatives and the analysis in the PEIS. The baseline tritium requirement is the amount necessary to support the 1994 Nuclear Weapons Stockpile P which is approved by the President as discussed in section 1.1. In this PEIS, the b tritium requirement is approximately 3/8ths the tritium requirement that was analyz the New Production Reactor Draft EIS published in April 1991. This is the tritium requirement "baseline" which the tritium supply technologies must support, and agai which they are assessed.

This baseline tritium requirement is made up of two specific components: (1) a steady-state tritium requirement to make up for tritium lost through natural decay; (2) a surge tritium requirement to replace any tritium which might be used in the e

the Nation ever dipped into, or lost, its tritium reserve. The sizing of the surge capacity is based on the requirement set forth in the Nuclear Weapons Stockpile Plan to reconstitute the entire reserve in a 5-year period. The steady-state component accounts for approximately 50 percent of the baseline tritium requirement, while the surge accounts for the remaining 50 percent. Tritium supply technologies being evaluated must be able to support the steady-state tritium requirement (a specific quantity of tritium every year) and make up for any lost tritium reserves.

Under No Action, DOE would not establish a new tritium supply capability. The current inventory of tritium would decay and DOE would not meet stockpile requirements of the 1954 Atomic Energy Act. This alternative would be contrary to DOE's mission as specified by the Atomic Energy Act of 1954, as amended. Alternatives for new tritium supply and recycling facilities consist of four different tritium supply technologies and five locations as shown in figure S-2.

Figure (Page S-4)

Figure S-2.-Tritium Supply and Recycling Alternatives.

The Tritium Supply and Recycling Proposal will proceed in three phases. The first phase involves preparing information to support programmatic decisions on siting and technology. This includes preparing this PEIS and the associated Record of Decision (ROD). The second phase includes the following programmatic decisions:

Whether to build new tritium supply and new or upgraded tritium recycling facilities

Where to locate new tritium supply and recycling facilities; and

Which technologies to employ for tritium supply.

Time Frame of Proposed Action:

1999 to 2009-Construction.

2010-Initial Operation.

2010 to 2050-Full Operation.

During the second phase, DOE would develop detailed designs and meet project-specific National Environmental Policy Act (NEPA) requirements which would focus on where on particular site the facility would be placed and construction and operation impacts. The third phase would involve constructing, testing, and certifying the selected tritium supply and recycling facilities, leading to full operation. Present plans are to have tritium supply facilities fully operational by the year 2010 with new tritium available for use approximately 1 year later. This PEIS also includes an analysis of providing tritium at an earlier date (approximately 2005) to support a higher stockpile level.

Following publication of the ROD, DOE will develop a schedule as part of the plan to implement the ROD decision. The schedule will be subject to change and include reassessments required by congressional authorizations and appropriations. Because of many uncertainties associated with this proposal, assumptions were made regarding time periods used in the PEIS analyses. For example, the PEIS assumes an environmental baseline period for construction between 1999 and 2009, and an operational period beginning in 2010 and extending for 40 years. Project-level NEPA documents will identify in detail specific construction and operational periods for each project implemented.

AGENCY PREFERRED ALTERNATIVE

The Council on Environmental Quality (CEQ) Regulations require an agency to identify a preferred alternative(s) in the Final Environmental Impact Statement (40 CFR 1502.15). The preferred alternative is the alternative which the agency believes would best fulfill the statutory mission, giving consideration to environmental, economic, technical, and social factors. Consequently, to identify a preferred alternative, the Department has developed information on potential environmental impacts, costs, technical risks, and schedule.

risks for the alternatives under consideration.

This PEIS provides information the environmental impacts. Cost, schedule, and techn analyses have also been prepared, and are summarized in the Tritium Supply and Recy Technical Reference Report which is available in the appropriate DOE Reading Rooms public review.

Based upon the analysis presented in the documents identified above, the Department preferred alternative is a acquisition strategy that assures tritium production for the nuclear weapons stockpile rapidly, cost effectively, and safely. The preferred strategy is to begin work on the two most promising production alternatives: (1) pu an existing commercial light water reactor or irradiation services with an option t purchase the reactor for conversion to a defense facility; (2) design, build, and t critical components of an accelerator system for tritium production. Within a three period, the Department would select one of the alternatives to serve as the primary of tritium. The other alternative, if feasible, would be developed as a back-up tritiumsource.

Savannah River Site has been designated as the preferred site for an accelerator, s one be built. The preferred alternative for tritium recycling and extraction activi to remain at the Savannah River Site with appropriate consolidation and upgrading o current facilities, and construction of a new extraction facility.

PURPOSE OF AND NEED FOR THE DEPARTMENT OF ENERGY'S ACTION

Since nuclear weapons came into existence in 1945, a nuclear deterrent has been a cornerstone of the Nation's defense policy and national security. The President rei this principle in his July 3, 1993, radio address to the Nation. Tritium was used i design process to enhance the yield of nuclear weapons and allows for the productio smaller or more powerful warheads to satisfy the needs of modern delivery systems. result, the United States strategic nuclear systems are based on designs that use t and, consequently, require a reliable tritium supply source. Tritium has a relative short radioactive half-life of 12.3 years. Because of this relatively rapid radioac decay, tritium must be replenished periodically in nuclear weapons to ensure that t will function as designed. Over the past 40 years, DOE has built and operated 14 re to produce nuclear materials for weapons purposes, including tritium. Today, none o reactors are operational, and no tritium has been produced since 1988.

Pursuant to the Atomic Energy Act of 1954, as amended, DOE is responsible for devel and maintaining the capability to produce tritium and other nuclear materials, whic required for the defense of the United States. The primary use of tritium is for maintaining the Nation's stockpile of nuclear weapons as directed by the President Nuclear Weapon Stockpile Plan (section 1.4.1).

The Nuclear Weapons Stockpile Plan is normally forwarded annually from the Secretar the Department of Defense (DOD) and DOE via the National Security Council to the Pr for approval. The Nuclear Weapons Stockpile Plan reflects the size and composition stockpile needed to defend the United States and provides an assessment of the DOE' ability to support the proposed stockpile. Many factors are considered in the devel of the Nuclear Weapons Stockpile Plan, including the status of the currently approv stockpile, arms control negotiations and treaties, Congressional constraints, and t status of the nuclear material production and fabrication facilities. Revisions of Nuclear Weapons Stockpile Plan could be issued when any of the factors indicate the to change requirements established in the annual document. The most current Nuclear Weapons Stockpile Plan, which was approved by President Clinton on March 7, 1994, authorizes weapons production and retirement through fiscal year 1999. The analysis this PEIS is based on the requirements of the 1994 Nuclear Weapons Stockpile Plan w based on START II stockpile levels (approximately 3,500 accountable weapons). The 1 Nuclear Weapons Stockpile Plan represents the latest official guidance for tritium requirements. A Nuclear Weapons Stockpile Plan for 1995 has not yet been issued. Ap CA, which is classified, contains quantitative projections for tritium requirements based on the 1994 Nuclear Weapons Stockpile Plan, and details of the transportation analysis.

Even with a reduced nuclear weapons stockpile and no identified requirements for new nuclear weapons production in the foreseeable future, an assured long-term tritium and recycling capability will be required. Presently, no source of new tritium is available. The effectiveness of the United States nuclear deterrent capability depends on the Nation's current stockpile of nuclear weapons or those it can produce, but on its ability to reliably and safely provide the tritium needed to support these weapons.

Until a new tritium supply source is operational, DOE will continue to support tritium requirements by recycling tritium from weapons retired from the Nation's nuclear weapons stockpile. However, because tritium decays relatively quickly, recycling can only meet tritium demands for a limited time. Current projections, derived from classified projections of future stockpile scenarios, indicate that recycled tritium will adequately support the Nation's nuclear weapons stockpile until approximately 2011. After that, without a new tritium supply source, it would be necessary to utilize the strategic reserve of tritium in order to maintain the readiness of the nuclear weapons stockpile. The strategic reserve of tritium contains a quantity of tritium maintained for emergencies and contingencies. In such a scenario, once the strategic tritium reserve was depleted, the nuclear deterrent capability would degrade because the weapons in the stockpile would not be capable of functioning as designed. Eventually, the nuclear deterrent would be lost. The proposed tritium supply and recycling facilities would provide the capability to produce tritium safely and reliably in order to meet the Nation's defense requirements well into the 21st century while also complying with environment, safety, and health standards.

Tritium, with a 12.3-year half-life, decays at the rate of approximately 5 percent per year and is necessary for all nuclear weapons that remain in the stockpile.

DOE has analyzed the activities that must take place in order to bring a new tritium supply source into operation. The analysis indicates that it could take approximately 10 years to research, develop, design, construct, and test a new tritium supply source before new tritium production can begin. Thus, in order to have reasonable confidence that the Nation will be able to maintain an effective nuclear deterrent, prudent management dictates that DOE proceed with the proposed action now.

Changes from the Draft Programmatic Environmental Impact Statement

The 60-day public comment period for the Draft PEIS began on March 17, 1995, and ended on May 15, 1995. However, comments were accepted as late as June 23, 1995. During the period, public hearings were held in Las Vegas, NV; Washington, DC; Pocatello, ID; Ridge, TN; North Augusta, SC; and Amarillo, TX. Two hearings were held at each location. In addition, the public was encouraged to provide comments via mail, fax, electronic bulletin board (Internet), and telephone (toll-free 800-number).

During public review of the Draft PEIS a majority of the comments regarded concerns about alternatives and/or candidate sites were not given the correct amount of consideration factors including cost and technical feasibility. Although these concerns made up the majority of the comments, many others involved the resources analyzed, NEPA and regulatory issues, and DOE and Federal policies as they related to the PEIS. The major issues identified by commentators included the following:

The electrical requirements of the various alternatives, particularly the APT, and potential for the ALWR and MHTGR to produce electricity;

The impacts of the alternatives on groundwater, including the potential for aquifer depletion and contamination and the consideration of the use of treated wastewater for cooling;

The socioeconomic impacts, both positive and negative, of locating or failing to locate

facility at one of the candidate sites;

The generation, storage, and disposal of radioactive and hazardous wastes (including spent nuclear fuel) and the associated risks;

The impacts of the alternatives on human health (both from radiation and hazardous chemicals) and how these risks were determined and evaluated;

The relationship of this PEIS to other DOE documents and programs, particularly the Management PEIS and the Fissile Materials Disposition Program, and the need to make decisions based on all associated programs and activities concurrently;

The need for decisions to be based on many different factors, including environment cost, and safety concerns;

The failure of DOE to consider a no tritium or zero stockpile alternative, and the negative national and international implications of building a new tritium supply facility; and

The need for DOE to consider a commercial reactor alternative in greater detail.

Additionally, as a result of public comments, DOE published on August 25, 1995 a Notice in the Federal Register (60 FR 44327) to include the purchase of irradiation services for a commercial reactor as a reasonable alternative. The Draft PEIS considered this an unreasonable alternative because of the long-standing policy of the United States that civilian nuclear facilities should not be utilized for military purpose and nonproliferation concerns. Nonetheless, the Draft PEIS included an evaluation of the environmental impacts of irradiation services using an existing commercial reactor to make tritium. Because of public comments on the Notice, public review of the Draft and further consideration of nonproliferation issues, purchase of irradiation services was evaluated in the PEIS as a reasonable alternative. During the extended comment period there were two major issues of concern raised:

License and regulatory implications; and

Non-proliferation concerns.

Revisions in the Final PEIS include additional discussion and analysis in the following areas: severe accidents and design-basis accidents for all tritium supply technologies; site-specific environmental impacts of a dedicated power plant for the Accelerator Production of Tritium (APT); revisions to water resources sections; site-specific analysis of the multipurpose reactor that could produce tritium, burn plutonium as fuel, and produce electricity; and the commercial reactor alternative, specifically the purchase of an existing reactor and the purchase of irradiation services for DOE target rods to produce tritium. Each of these areas will be discussed in more detail below.

Analyses of an ALWR design-basis accident were reevaluated as a result of public comment questioning the apparent severity and frequency of the accident consequences shown in the Draft PEIS. Additional analyses were performed to accurately estimate the impacts of a more reasonable design-basis accident and these results have been included in the PEIS.

The analyses of impacts of severe reactor accidents were also revised. The Draft PEIS presented the impacts of a single severe accident for each of the reactor technologies. Since accident consequences vary greatly depending on the selected accident frequency value, a spectrum of severe accidents with a range of frequencies was used to perform a more representative analysis for each technology. The new analyses reflect the probable effects of a set of accidents for each reactor rather than the single accident scenario.

Public comments also suggested that a disparity existed between the reactor and APT accident analyses, thereby creating a bias in favor of the APT. The Final PEIS now includes an APT severe accident with loss of confinement. The new accident analysis includes a more severe initiating event, a lower frequency, and a higher consequence than the analysis presented in the Draft PEIS.

Additionally, the Final PEIS has been modified to include a qualitative discussion impacts to involved workers (workers assigned to the facility and located in close proximity to the facility as a result of the proposed action) and quantitative impacts to noninvolved workers (workers collocated at the site independent of the proposed action). For involved workers, impacts were addressed qualitatively, explaining the significant risk for exposure and fatality and that mitigative features would be provided in the design and operation to minimize worker impacts from accidents.

For the noninvolved worker, the impacts were represented by the exposure of a hypothetical worker at several prescribed distances from the accident (but within the boundary). These impacts were described in terms of dose (rems), increases in the likelihood of cancer fatalities, and risk of cancer for the maximally exposed noninvolved worker.

Another significant change in the document is a more detailed description of potential impacts of a dedicated power plant for the APT. The section has been revised to include site-specific impacts for the gas-fired power plant.

Based on public comments received at the hearings, two revisions were incorporated into the water resources sections for NTS and Pantex. For NTS, the Final PEIS incorporates more accurate recharge rates and information regarding the potential project use of the aquifer to present a more accurate impact on groundwater resources.

For Pantex, the Final PEIS includes the use of reclaimed sanitary wastewater source from Hollywood Road Wastewater Treatment Plant and the Pantex Plant Wastewater Treatment for tritium supply cooling water.

A more detailed analysis of the multipurpose reactor has been included in the Final PEIS. Since the multipurpose reactor would use plutonium fuel, an analysis of the construction impacts of a Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility to support a multipurpose ALWR has been incorporated in the site-specific analysis for each of the five candidate sites. Impacts of only the Pit Disassembly/Conversion part of the facility are included for the multipurpose MHTGR since this technology already includes a fuel fabrication component. For the operation of a multipurpose reactor, additional impacts regarding the impacts on atmospheric emissions, liquid emissions, water requirements, socioeconomics, human health (for both normal operations and accidents), waste management, and intersite transportation has been included in the site-specific analysis.

Analysis and a discussion of potential impacts have been expanded and included in the Final PEIS on the alternative of DOE purchasing an existing operating commercial reactor to produce an incomplete reactor and converting it to production of tritium for defense purposes. Also included in the Final PEIS is an analysis of the alternative of DOE purchasing irradiation services from one or more commercial light water reactors for the production of tritium using DOE targets.

Alternatives

The alternatives considered for tritium supply and recycling consist of four different supply technologies and five locations (figure S-2). The four technologies to provide new supply of tritium are: Heavy Water Reactor (HWR), Modular High Temperature Gas-Reactor (MHTGR), Advanced Light Water Reactor (ALWR), and Accelerator Production of Tritium (APT). The five candidate sites evaluated for such a facility are INEL, Nevada Test Site (NTS), Oak Ridge Reservation (ORR), Pantex Plant, and Savannah River Site.

No Action

To satisfy NEPA requirements, No Action is presented for comparison with the action alternatives. Under No Action, DOE would not establish a new tritium supply capability; the current inventory of tritium would decay, and DOE would not meet stockpile requirements. The current DOE missions at each candidate site are assumed to continue under No Action.

Tritium Supply and Recycling

The tritium supply technologies and site alternatives are described below. For each alternative except for alternatives at SRS, a new tritium recycling facility could be collocated with the new tritium supply facilities or DOE could use the existing recycling facilities at SRS after upgrade. For the alternatives at SRS, DOE would use existing recycling facilities at SRS that would be upgraded to support the tritium mission.

Technologies

Heavy Water Reactor. The HWR would be a low pressure, low temperature reactor whose purpose would be to produce tritium. The HWR would use heavy water as the reactor coolant and moderator. Because of the low temperature of the exit coolant, a power conversion system designed to produce electrical power as an option would not be feasible. The conceptual design of the HWR complex includes a fuel and target fabrication facility, a tritium target processing facility, an interim spent fuel storage building, a general services building, and a security infrastructure. The HWR complex would cover approximately 260 acres. Construction of the HWR would take somewhat less than 8 years and require approximately 2,320 workers during the peak construction period. Operation of the HWR would require approximately 930 workers.

Modular High Temperature Gas-Cooled Reactor. The MHTGR would be a high temperature, moderate pressure reactor whose primary purpose would be to produce tritium. Three reactors would be required to produce the goal quantities of tritium. The MHTGR would use helium gas as a core coolant and graphite as a moderator. Because of the high temperature of the exit coolant, a power conversion facility designed to produce electricity is an integral part of the design and is included in the analysis. The design of the MHTGR complex, in addition to three reactors, would include a fuel and target fabrication facility, a tritium target processing facility, helium storage buildings, waste treatment facilities, spent fuel storage facility, a general services building, a security infrastructure, and a power conversion facility consisting of three turbine-generators and associated electrical control equipment. The MHTGR complex would cover approximately 360 acres. Construction of the MHTGR would take about 9 years and require approximately 2,210 workers during the peak construction period. Operation of the MHTGR would require approximately 910 workers.

A modular gas-cooled reactor like the MHTGR would also be capable of performing the "triple play" missions of producing tritium, burning plutonium, and generating electricity. To burn plutonium in a gas-cooled reactor, a plutonium Pit Disassembly version Facility would be needed. Additionally, because tritium production decreases significantly in a plutonium-fueled gas-cooled reactor, twice as many reactor modules would be necessary in order to produce the steady-state tritium requirements. This doubling of reactor modules would be the major contributor to potential environmental impacts for this scenario. The PEIS contains an assessment of these potential environmental impacts.

Range of Selected Construction Requirements for Tritium Supply Technologies:

Electrical Energy Demand:

40,000 to 120,000 MWh

Land Use:

173 to 360 acres

Total Number of Construction Workers:

2,200 to 3,500

Water Consumption:

41,700,000 to 200,000,000 gallons
(over a 5 to 9 year period)

Steel Consumption:

45,000 to 68,000 tons

Advanced Light Water Reactor. The ALWR would be a high temperature, high pressure reactor whose primary purpose would be to produce tritium. There are two options for the ALWR technology: a Large ALWR (1,300MWe) and a Small ALWR (600MWe). The large and small include four candidates: a large or small pressurized water reactor or a large or small boiling water reactor. All ALWR options would use light (regular) water as the reactor coolant and moderator. Like the MHTGR, a power conversion facility is an integral part of the design for the ALWR because of the high temperature of the exit coolant. The design of the ALWR complex would include an interim spent fuel storage building, a waste treatment facility, a tritium target processing facility, warehouses, a power conversion facility and security infrastructure. Unlike the other technologies, the ALWR would not have a fuel fabrication facility since fuel rods would be obtained from offsite sources. The ALWR complex would cover approximately 350 acres. Construction of the ALWR would take about 5 years and require approximately 3,500 workers for the Large ALWR and 2,200 workers for the Small ALWR during the peak construction period. Operation of the Large ALWR would require approximately 830 workers and the Small ALWR would require approximately 500 workers.

An ALWR would also be capable of performing the "triple play" missions of producing tritium, burning plutonium, and generating electricity. The multipurpose ALWR would operate essentially the same as a uranium-fueled tritium production ALWR. Therefore environmental impacts from operation of a multipurpose ALWR would be expected to be unchanged from the tritium production ALWR. To burn plutonium in an ALWR, a plutonium Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would be needed to produce the mixed-oxide fuel rods for the ALWR, and would be the major contributor to potential environmental impacts for this scenario. This PEIS contains an assessment of these potential environmental impacts.

Accelerator Production of Tritium. The APT would be a linear accelerator whose purpose would be to produce tritium. The APT accelerates a proton beam in a long tunnel toward two target/blanket assemblies located in separate target stations. There are two target/blanket concepts being considered in the conceptual design of the APT: the spallation-induced lithium conversion target and the helium-3 target. The accelerator, 3,940 feet in length, would be housed in a concrete tunnel buried 40 to 50 feet underground. The APT facility would require a peak electrical load of approximately 355 MWe to produce the 3/8 goal tritium quantity, and 355 MWe to produce the steady-state tritium requirement. The conceptual design of the APT complex would include: a target building that would house the target chambers located in a subterranean structure at the same level as the accelerator; a tritium processing facility to extract tritium from targets; a klystron remanufacturing and maintenance facility; waste treatment building to treat all generated wastes; security infrastructures and various administration, operation, and maintenance facilities. The APT complex would cover approximately 17 acres. Construction of the APT would take about 5 years and require approximately 2,000 workers during the peak construction period. Operation of the APT would require approximately 624 workers. A phased construction approach to the APT is also an option.

Commercial Light Water Reactor. The purchase by DOE of an existing operating or partially completed commercial power reactor is an alternative to meet the stockpile tritium requirement. Production of tritium using irradiation services contracted from commercial power reactor(s) (with the option to purchase the reactor) is also an alternative. Commercial light water reactors use both pressurized water and boiling water technologies. Of the two types, pressurized water reactors are more readily adaptable to the requirements of tritium production by DOE tritium target rod irradiation because they utilize boron poison rods which could be replaced by tritium target rods.

Commercial pressurized water reactors are high-temperature, high-pressure reactors

use ordinary light water as the coolant and moderator and are capable of generating amounts of electricity through a steam turbine generator. The range of electrical production for these plants is approximately 390 million to 6,900 million kWh per year using an assumed annual capacity factor of 62 percent. A typical commercial light water reactor facility includes the reactor building, spent fuel storage facilities, cooling towers, a switchyard for the transmission of generated electricity, maintenance buildings, administrative buildings, and security facilities. Acreage for existing operating commercial light water reactor facilities ranges from a low of 84 to a high of 30,000.

The designs of typical commercial reactors incorporate numerous safety features including a reactor containment building to limit any release of radioactivity; an emergency cooling system for heat removal in the event of a loss of coolant or a loss of pump; an emergency shutdown system with safety rods independent of the reactor control rods; and a backup system to remove heat from the reactor if the primary coolant fails to circulate.

The representative drawing for the ALWR complex (figure ES-7) would be similar to a commercial light water reactor complex except that tritium target fabrication and processing facilities would not be typical facilities. If a partially completed reactor were purchased, these facilities could potentially be constructed along with the final construction of the reactor.

A commercial reactor would also be capable of performing the "triple play" missions: producing tritium, burning plutonium, and generating electricity. The multipurpose commercial reactor would operate essentially the same as a uranium-fueled tritium production ALWR. Therefore, the environmental impacts from operation of a multipurpose commercial reactor would be expected to be unchanged from the tritium production ALWR. To burn plutonium in a commercial reactor, a plutonium Pit Disassembly/Conversion/Mixed Fuel Fabrication Facility would be needed to provide the mixed-oxide fuel rods for the commercial reactor, and would be the major contributor to potential environmental impacts for this scenario. The PEIS contains a generic assessment of these potential environmental impacts.

SITES

Commercial Light Water Reactor. The commercial light water reactor alternative does include a specific site for analysis in the PEIS. Therefore, any one of the existing operating commercial nuclear reactors or partially completed reactors is a potential candidate site for the tritium supply mission. Currently, 109 commercial nuclear power plants are located at 71 sites in 32 of the contiguous states. Of these, 53 sites are located east of the Mississippi River. No commercial nuclear power plants are located in Alaska or Hawaii. Approximately one-half of these 71 sites contain two or three nuclear units per site.

Typically, commercial nuclear power plant sites and the surrounding area are flat-to-rolling countryside in wooded or agricultural areas. More than 50 percent of sites have 50-mile population densities of less than 200 persons per square mile and 80 percent have 50-mile densities of less than 500 persons per square mile.

Site areas range from 84 to 30,000 acres. Twenty-eight site areas range from 500 to 1,000 acres and an additional 12 sites are in the 1,000 to 2,000-acre range. Thus, almost 90 percent of the plant sites encompass 500 to 2,000 acres. The larger land-use areas associated with plant cooling systems that include reservoirs, artificial lakes, and buffer areas.

Idaho National Engineering Laboratory. INEL was established in 1949 and currently occupies approximately 570,000 acres near Idaho Falls, ID. INEL performs research and development activities on reactor performance; conducts materials testing and environmental monitoring activities; performs research and development activities for the processing of waste; conducts breeder reactor research; and is a naval reactor training site. There are currently no defense program missions at INEL.

Nevada Test Site. NTS was established in 1950 and currently occupies approximately

acres located 65 miles northwest of Las Vegas, NV. The site has conducted underground testing of nuclear weapons and evaluations of the effects of nuclear weapons on military communications systems, electronics, satellites, sensors, and other materials. In October 1992, underground nuclear testing was halted, yet the site maintains the capability and infrastructure necessary to resume testing if authorized by the President. There are currently two defense program missions at NTS: maintain underground nuclear testing program capabilities and maintain nuclear emergency search team program capabilities.

Range of Selected Operation Requirements
for Tritium Supply Technologies:

Electrical Energy Demand:

260,000 to 3,740,000MWh per
year

Land Use:

173 to 360 acres

Total Number of Operation

Workers:

500 to 930

Water Consumption:

0.03 to 16 billion gallons per year

Spent Nuclear Fuel Generation:

0 to 80yd³ per year

Oak Ridge Reservation. ORR was established in 1942 as part of the World War II Manhattan Project and is located on approximately 35,000 acres within the city boundaries of Oak Ridge, TN. It includes three major facilities: Oak Ridge National Laboratory; Y-12 (Y-12); and the K-25 Site (the former Oak Ridge Gaseous Diffusion Plant). Y-12 is the primary location of defense program missions. The Y-12 assignment includes the dismantling of nuclear weapons components returned from the Nation's arsenal, maintaining nuclear production capability and stockpile support, storing special nuclear materials, and providing special manufacturing support to DOE programs. In addition to the four defense program missions identified above, ORR also has the mission to fabricate uranium and lithium components and parts for nuclear weapons.

Pantex Plant. Pantex was established in 1951 and currently occupies approximately 1,000 acres near Amarillo, TX. The current defense program missions at Pantex are to assemble and disassemble nuclear weapons; perform weapons repair, modification, and disposal; conduct stockpile evaluation and testing; and provide interim storage for plutonium. Pantex is the only DOE facility that can execute the final assembly of a nuclear weapon for the Department of Defense (DOD) stockpile.

Savannah River Site. SRS was established in 1950 as a nuclear materials production and occupies approximately 198,000 acres south of Aiken, SC. The major nuclear facilities at SRS have included fuel and target fabrication facilities; nuclear material production reactors; chemical separation plants used for recovery of plutonium and uranium isotopes; a uranium fuel processing area; and the Savannah River Technology Center that provides process support. The current defense program mission at SRS is to process tritium and conduct tritium recycling and reservoir filling in support of stockpile requirements. SRS also has the mission to process backlog targets and spent nuclear fuel.

Alternatives Considered But Eliminated From Detailed Study

By law, DOE is required to support the Nuclear Weapons Stockpile Plan. In order to do this, DOE must maintain a nuclear weapons production, maintenance, and surveillance capacity consistent with the President's Stockpile Plan. For the proposed action, the

following alternatives were considered but eliminated from detailed study for the reasons stated below.

Purchase Tritium From Foreign Sources. DOE has considered the purchase of tritium from other sources, including foreign nations. Conceptually, the purchase of tritium from foreign governments could provide a fraction of the tritium requirement. However, there is no national policy against purchase of defense materials from foreign sources. DOE has determined that the uncertainties associated with obtaining tritium from foreign sources render this alternative unreasonable for an assured long-term supply.

Redesign of Weapons to Require Less or No Tritium. The nuclear warheads in the enduring stockpile were designed and built in an era when the tritium supply was assured, when underground nuclear testing was being conducted, and when military needs required that warheads be optimized in terms of weight and volume. Replacing these warheads with ones that would use little or no tritium for the sole reason of reducing overall tritium demand would be infeasible and unreasonable. Without underground nuclear testing to verify their safety and reliability, new warhead designs cannot deviate very far from current designs which require the use of tritium. Even with underground testing to facilitate new designs and a fully operational production complex, it would still take many years to build enough warheads to replace the enduring stockpile. Therefore, replacing the enduring stockpile of warheads with new designs would most likely take longer and could cost more than constructing and operating a new tritium supply facility. Because neither the President nor the Congress has approved that the government embark on a costly and expansive design, testing, and construction program solely to eliminate tritium requirements, weapons redesign to use less or no tritium is not a reasonable short or long-term alternative.

Use of Existing Department of Energy Reactors or Accelerators. DOE (and its predecessor agencies) has designed, constructed, and operated many nuclear reactors over the past years. The majority of these reactors were designed to assist in the development of nuclear research and safety standards development. DOE has also constructed nuclear reactors to produce the materials required to support the production and maintenance of nuclear weapons and has constructed nuclear reactors in support of the Naval Propulsion Program.

Among the first experimental reactors were the water boiler at Los Alamos National Laboratory and CP-3 at Argonne National Laboratory-West, which were completed in 1949. Since then, numerous experimental and research reactors were constructed for a variety of purposes, including material tests, new reactor concepts, and safety experiments. Four DOE research reactors are currently operational: the High Flux Isotope Reactor at the Oak Ridge Reservation (ORR); the High Flux Beam Reactor at Brookhaven National Laboratory; the Experimental Breeder Reactor-II and the Advanced Test Reactor at the Idaho National Engineering Laboratory (INEL). In addition, there are some low power/critical facilities supporting medical research (at Brookhaven) and supporting reactor core configuration research (at Argonne National Laboratory-West and INEL). None of these facilities is large enough to produce the amount of tritium required to support the projected stockpile requirements. All are fully or partially committed to existing programs and were constructed in the early 1960s, rendering their design life reliability unsuitable for the time frame required for a new, assured, long-term tritium supply facility.

Of the existing DOE reactors that are currently not being operated, only one has the potential for producing any significant quantities of tritium: the Fast Flux Test Facility at the Hanford Site. This facility was designed and constructed to perform material research for the national liquid-metal breeder reactor program. This small (440-MW thermal (MWt)) experimental reactor, based on liquid-metal reactor technology, could, after substantial core and cooling system modifications, as well as target technology development, have the potential to supply a significant percentage of the steady state tritium requirement. The Fast Flux Test Facility, however, was designed in the late 1960s and began operation in 1980. The Fast Flux Test Facility is currently defueled. A technical study to extend the life of the Fast Flux Test Facility 10 years past its 20-year lifetime has been completed. While technically possible to extend the lifetime to 2010, the facility would be at the end of even the extended life. Relying on the ability to further modify and operate the Fast Flux Test Facility well into the middle of the 21st century is not a reasonable alternative.

DOE also constructed and operated more than a dozen nuclear reactors for production nuclear materials at SRS and the Hanford Site, starting with the early part of the Manhattan Project during World War II. None of these reactors is currently operating. Of those reactors specifically designed to produce nuclear materials for the nuclear weapons program, the K-Reactor at SRS is the only remaining reactor which could be of returning to operation. It is presently in a "cold stand-by state" and has not been operated since 1988. The reactor was shut down for major environmental, safety, and upgrades, to comply with today's stringent standards. DOE discontinued the K-Reactor Restart Program when the reduced need for tritium to support a smaller stockpile decreased the need for tritium. In this context, reliance upon the ability to upgrade and operate well into the middle of the next century a first generation reactor designed in the 1950s is not a reasonable alternative for new, long-term, assured tritium supply.

DOE has been a world leader in the design and construction of particle accelerators currently operates six national facilities. Of the existing research accelerators, capable of producing significant quantities of tritium. The existing DOE research accelerators are all of the pulsed design and are only capable of producing low power accelerator beams in the 800 kilowatt (kW) range. A production accelerator facility utilizing continuous wave operation, would be required to deliver a high power proton beam of 100 megawatt (MW) for tritium production. None of the existing research accelerators could be reasonably upgraded to meet the long-term, assured tritium requirements.

Alternative Sites. Section 3.3.1 describes the process that was carried out to identify the range of reasonable site alternatives for the tritium supply and recycling facilities that are considered in this PEIS. The process of determining these reasonable tritium supply alternative sites has been evolutionary, starting with the engineering study criteria developed by the New Production Reactor program, then utilizing additional criteria and considerations from the Reconfiguration Program, information related to changing missions at DOE sites, and input from public scoping.

During the preparation of this PEIS, the Department has continued to assess other alternative sites. In fact, once the APT was added as a potential tritium supply technology, an assessment was conducted to determine if the Los Alamos National Laboratory, which operates a linear accelerator and is the home of significant accelerator expertise, would be a reasonable site for a tritium producing accelerator.

The APT conceptual designs for tritium supply have established that evaporative cooling towers would be used to dissipate the heat generated in the tritium target assembly in the accelerator facility. These APT cooling water requirements are significantly greater than the current regulated allotment of water for Los Alamos National Laboratory and increasing the allotment to support the APT water requirement would be impractical, infeasible, and in any event beyond DOE's control.

It may be possible that an APT could use nonevaporative cooling towers which would reduce the water requirements. However, there is sufficient technical uncertainty regarding the feasibility and practicality of using nonevaporative cooling towers for continuous wave APT to render this option unacceptable as a source for the Nation's supply of tritium. The other five sites being analyzed in this PEIS could reasonably support the water requirements of the APT using evaporative cooling towers and, thus, would not incur the technical uncertainty and risk of Los Alamos National Laboratory. Thus, DOE has concluded that Los Alamos National Laboratory is not a reasonable site for an accelerator to produce tritium (LADOE1994a:1).

REDUCED TRITIUM REQUIREMENTS

The need for new tritium supply is based on the 1994 Nuclear Weapons Stockpile Plan which projects a need for new tritium by approximately 2011 based on a START II level stockpile size of approximately 3,500 accountable weapons. A smaller than START II stockpile would extend the need date for new tritium beyond approximately 2011. If the need for tritium were significantly later than 2011, the Department would not have a proposal for a new tritium supply, and would not be preparing a PEIS for Tritium Supply and Recycling.

Environmental impacts

In accordance with CEQ regulations, the environmental consequences discussions provide the analytical detail for comparisons of environmental impacts associated with the various tritium supply technologies and recycling facilities. Discussions are provided for each DOE site and each environmental resource and relevant issues that could be affected.

For comparison purposes, environmental concentrations of emissions and other potential environmental effects are presented with appropriate regulatory standards or guidelines. However, the compliance with regulatory standards is not necessarily an indication of the significance or severity of the environmental impact for NEPA purposes.

The purpose of the analysis of environmental consequences is to identify the potential for environmental impacts. The environmental assessment methods used and the factors considered in assessing environmental impacts are discussed in section 4.1, environmental resource methodologies, and in the appropriate appendices. The potential for impacts to a given resource or relevant issue is described in the introduction to each section within the site discussions (sections 4.2 through 4.10). A brief narrative summary of the impacts by site and resource or relevant issues follows.

For the resource or issue area, the summary presents the range of impacts (high and low) and associated technology collocated with tritium recycling. For a more detailed comparison of impacts for the tritium supply and recycling alternatives, the reader is referred to section 3.6 and appendix I.

Idaho National Engineering Laboratory

Land Resources. Construction and operation of a tritium supply would disturb between 173 acres (APT) and 360 acres (MHTGR). Collocation of tritium recycling would require an additional 202 acres during construction and 196 acres during operation. Siting any tritium supply technologies alone or collocated with recycling at INEL would be consistent with site development plans. No visual impacts are expected.

Site Infrastructure. New site infrastructure (e.g., roads and transmission lines) would be required to support all technologies. The power requirements would exceed the current electrical requirements of 93 MWe by 11 MWe (MHTGR) to 515 MWe (APT).

Air Quality and Acoustics. Construction activities would result in exceedance of 24 PM₁₀ and state TSP standards. Air pollutant concentrations would increase during operation but would be within standards. An increase in onsite noise would result from construction and operation of a tritium supply. Offsite noise impacts would be negligible.

Water Resources. Surface waters would not be affected by construction or operation. Groundwater use would range from 10 MGY (APT) to 35 MGY (Large ALWR) during construction. Operation water requirements would range from 44 MGY (MHTGR) to 1,214 MGY (APT). Total groundwater use for all the reactor technologies except APT would be less than 1 percent of the INEL groundwater allotment. The APT total groundwater use for operation represents approximately 11 percent of the INEL groundwater allotment.

Geology and Soils. Construction and operation would neither affect nor be affected by geological conditions. The soil disturbed area would range from 375 acres (APT) and 562 acres (MHTGR). Soil erosion due to wind and stormwater runoff would be minor.

Biotic Resources. During construction and operation, terrestrial resources would be affected by the disturbance of between 375 acres (APT) and 562 acres (MHTGR) of habitat. Impacts from salt drift are possible with the APT. Wetlands and aquatic resources would not be affected. No Federal-listed, threatened, or endangered species would be affected, but several Federal candidate or state-listed species may be affected.

Cultural and Paleontological Resources. Some NRHP-eligible prehistoric and historic

resources may occur within the disturbed area. Native American resources may be affected by land disturbance and audio or visual intrusions. The HWR and ALWR would not be expected to affect paleontological resources. However, the MHTGR and APT may affect paleontological resources where excavations could extend down to 50 feet or deeper.

Socioeconomics. Employment in the economic study area would increase by 7,200 (MHTGR) to 10,800 persons (either ALWR) during peak construction. Employment during full operation would increase in the economic study area by 4,100 (APT) to 4,900 persons (HWR and ALWR). Unemployment would decrease from 6.4 percent, the projected baseline, to 4.5 percent for all technologies during peak construction and 4.9 (APT) to 4.6 percent (HWR and MHTGR) during full operation. Per capita income would increase by an annual average of approximately 1 percent during peak construction and full operation for every technology except HWR, which would increase by 1 to 2 percent during peak construction and 2 percent during full operation.

Population and housing demand within the region of influence would increase by between 2 (APT) and 9 percent (ALWR) during construction and approximately 2 percent for all technologies during operation.

For every technology except ALWR, total revenues and expenditures for most region-of-influence (ROI) counties, cities, and school districts would increase by an annual average of between 2 and less than 1 percent through 2005 and between 1 and 0 percent through 2010. For either ALWR, total revenues and expenditures within the ROI of influence would increase between 4 and less than 1 percent in the first 3 years of construction and decrease 1 to 2 percent annually through 2020. Total revenues and expenditures for all technologies would increase by annual averages of less than 1 percent through 2020.

Traffic conditions on access roads to INEL are expected to degrade due to increased traffic and congestion, particularly on U.S. Route 20/26, the primary access route.

Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents. The dose to the maximally exposed member of the public from total site operation for 1 year would range from 0.11 (APT with helium-3 target) to 0.36 (ALWR) mrem. The associated risk of fatal cancer from 40 years of operation would range from 2.3×10^{-6} to 7.3×10^{-6} , respectively.

The annual 50-mile population dose from total site operation in 2030 would range from 23 (APT with helium-3 target) to 73 person-rem (Large ALWR) and could result in 0.45 to 1.4 fatal cancers over 40 years of operation.

The average annual dose to a site worker would range from 31 (MHTGR) to 49 mrem (Large ALWR) with the associated risk of fatal cancer from 40 years of operation ranging from 5.0×10^{-4} to 7.9×10^{-4} , respectively. The annual dose to the total site workforce would range from 250 (MHTGR) to 392 person-rem (Large ALWR) and could result in 4 to 6.3 fatal cancers over 40 years of operation. All doses to the public and to site workers are within regulatory limits.

Any exposures to site workers and the public resulting from emissions of hazardous chemicals are expected to be within regulatory limits and have negligible cancer risk.

For low-to-moderate consequence/ high probability accidents, the consequences and risks associated with the APT are negligible. For the technology with the most severe consequences, the HWR, the increased likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 8.1×10^{-6} . Given the accident probability of 1.0×10^{-3} per year, the cancer risk would be 8.1×10^{-9} per year. For the population within 50 miles of the accident (150,000), the associated cancer risk would be 7.4×10^{-4} per year. If this accident occurred, this exposure would result in 0.074 cancer fatalities. The increased likelihood of cancer fatality to a worker located 1,000 m from the release point would be 1.1×10^{-4} . The cancer risk to the worker would be 1.1×10^{-4} per year.

For high consequence/low probability accidents, the consequences to a maximally exposed individual at the site boundary is small for the APT. The technology with the most

severe consequences to the general population is the Small ALWR. For Small ALWR high consequence/low probability accidents, the increased likelihood of cancer fatality maximally exposed individual at the site boundary would be 2.3×10^{-3} with an associated cancer risk of 3.6×10^{-10} per year. For the population residing within 50 miles of the accident (150,000), the associated cancer risk would be 6.4×10^{-7} per year. If this accident occurred, this exposure would result in 4.1 cancer fatalities. The increased likelihood of cancer fatality to a worker located 1,000 meters from the release point would be 0.094. The cancer risk to the worker would be 1.5×10^{-8} per year.

Waste Management. Spent nuclear fuel would be generated by the HWR, MHTGR, and ALWR require a new storage facility. The APT would not generate spent fuel. Liquid LLW would be generated by every technology except APT. Existing treatment facility may be adequate for all technologies except the Large ALWR. Solid LLW would be generated and require 3 (APT and Small ALWR) and 15 acres per year (HWR) of onsite LLW disposal area. The generation of liquid mixed LLW would be negligible for all technologies. Solid mixed LLW would increase by 3 yd³ per year (MHTGR) to 122 yd³ per year (HWR). The HWR increase would require new or expanded treatment and storage facilities.

Hazardous waste generation would increase by approximately 4 yd³ per year (APT) to 1 yd³ per year (MHTGR). The use of existing hazardous waste management facilities is feasible. All technologies would generate liquid sanitary waste and require new treatment facilities. Solid sanitary waste generation would increase by 8,640 yd³ per year (APT) to 15,000 yd³ per year (HWR). Existing landfill design life would be reduced or require expansion. Other solid nonhazardous wastes would be recycled.

Intersite Transport. For all technologies, the relative risk associated with transporting tritium is 29 percent lower than the existing case (No Action) because the distance travelled is shorter. The potential cancer fatalities per year for transporting tritium heavy water is 3.57×10^{-5} (HWR) and 6.63×10^{-6} (APT) for both tritium supply alone and supply with recycling. There is no intersite transport of LLW for any technology. The risk of transporting new tritium for supply alone is about 2 percent greater than No Action (due to transporting new tritium to SRS). The annual risk from transporting highly-enriched uranium fuel feed material (HWR and MHTGR alternatives) from ORR to the site is 5.1×10^{-4} fatalities.

Nevada Test Site

Land Resources. Construction and operation of a tritium supply would disturb between 100 (APT) and 360 acres (MHTGR). Collocation of tritium recycling would require an additional 202 acres during construction and 196 acres during operations. Siting any of the tritium supply technologies alone or collocated with recycling at NTS would be consistent with site development plans. Some visual impacts are expected.

Site Infrastructure. New site infrastructure (e.g., roads and transmission lines) would be required to support all technologies. The power requirements would exceed the current electrical requirement of 28 MWe by 55 MWe (MHTGR) to 559 MWe (APT).

Air Quality and Acoustics. Construction activities would result in exceedance of 24 PM₁₀ and state TSP standards. Air pollutant concentrations would increase during operation but would be within standards. An increase in onsite noise would result from construction and operation of a tritium supply. Offsite noise impacts would be negligible.

Water Resources. Surface waters would not be affected by construction or operation. Groundwater use would range from 10 MGY (APT) to 35 MGY (Large ALWR) during construction. Operation water requirements would range from 44 MGY (MHTGR) to 1,214 MGY (APT). Total site groundwater withdrawals would not exceed the lowest estimated aquifer recharge rate.

Geology and Soils. Construction and operation would neither affect nor be affected by geological conditions. The soil disturbed area would range from 375 (APT) to 562 acres (MHTGR). Soil erosion due to wind and stormwater runoff would be minor.

Biotic Resources. During construction and operation, terrestrial resources would be

affected by the disturbance of between 375 (APT) and 562 acres (MHTGR) of habitat. Impacts from salt drift are possible with the APT. Wetlands and aquatic resources would not be affected. One Federal-listed, threatened species, the desert tortoise, may be affected. Several Federal candidate or state-listed species may also be affected.

Cultural and Paleontological Resources. Some NRHP-eligible prehistoric and historic resources may occur within the disturbed area. Native American resources may be affected by land disturbance and audio or visual intrusions. Paleontological resources may also be affected.

Socioeconomics. Employment in the economic study area would increase by 9,100 (MHTGR) to 13,700 persons (either ALWR) during peak construction. Employment during full operation would increase in the economic study area by 4,600 (APT) to 5,500 persons (HWR and Unemployment would decrease from 5 percent, the projected baseline, to between 3.9 percent during peak construction and to between 4.3 (HWR) and 4.4 percent (APT) during full operation. Per capita income would increase by an annual average of approximately 1 percent during peak construction and full operation for each technology.

Population and housing demand within the ROI would increase by between 1 percent (HWR, MHTGR, and APT) and 2 percent (ALWR) during construction and by less than 1 percent for all technologies during operation.

For each technology, total revenues and expenditures for all regions of influence, counties, cities, and school districts would increase by annual averages of between 4 and less than 1 percent through 2005, between 1 and 2 percent through 2010, and by less than 1 percent annually through 2020.

Traffic conditions on access roads to NTS are expected to degrade due to increased traffic and congestion, particularly on Mercury Highway, the primary access route.

Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents. The annual dose to the maximally exposed member of the public from total site operation for 1 year would range from 0.13 (APT with helium-3 target) to 0.4 (ALWR) mrem. The associated risk of fatal cancer from 40 years of operation would range from 2.6×10^{-6} to 8.0×10^{-6} , respectively.

The annual 50-mile population dose from total site operation in 2030 could range from 0.25 (APT with helium-3 target) to 0.25 (Small ALWR) person-rem and could result in 1.6×10^{-5} to 5.1×10^{-3} fatal cancers over 40 years of operation.

The average annual dose to a site worker would range from 26 (MHTGR) to 140 (Large ALWR) mrem with the associated risk of fatal cancer from 40 years of operation ranging from 4.2×10^{-4} to 2.3×10^{-3} , respectively. The annual dose to the total site workforce would range from 33 (MHTGR) to 180 (Large ALWR) person-rem and could result in 0.53 to 2.0 fatal cancers over 40 years of operation. All doses to the public and to site workers are within regulatory limits.

Any exposures to site workers and the public resulting from emissions of hazardous chemicals are expected to be within regulatory limits and have negligible cancer risk.

For low-to-moderate consequence/high probability accidents associated with operation, the consequences and risks associated with the APT are negligible. For the technology with the most severe consequences, the HWR, the increased likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 4.2×10^{-6} . Given the accident probability of 1.0×10^{-3} per year, the cancer risk would be 4.2×10^{-9} per year. For the population residing within 50 miles of the accident (18,000), the associated cancer risk would be 1.2×10^{-6} per year. If this accident occurred, this exposure would result in 1.2×10^{-3} cancer fatalities. The increased likelihood of cancer fatality to a worker located 1,000 meters from the release point would be 2.8×10^{-5} . The cancer risk to the worker would be 2.8×10^{-8} per year.

For high consequence/low probability accidents associated with operation, the consequences to a maximally exposed individual at the site boundary would be small for the APT. The technology with the most severe consequences to the general population is the Small

For Small ALWR high consequence/low probability accidents, the increased likelihood cancer fatality to a maximally exposed individual at the site boundary would be 6.3 with an associated cancer risk of 9.8×10^{-10} per year. For the population residing within 50 miles of the accident (18,000), the associated cancer risk would be 6.1×10^{-8} per year. If this accident occurred, this exposure would result in 0.39 cancer fatalities. The increased likelihood of cancer fatality to a worker located 1,000 meters from the reactor point would be 0.087. The cancer risk to the worker would be 1.4×10^{-8} per year.

Waste Management. Spent nuclear fuel would be generated by the HWR, MHTGR, and ALWR require a new storage facility. The APT would not generate spent fuel. Liquid LLW would be generated by every technology except APT and would require new or separate treatment facilities. Solid LLW would be generated and require between 2.5 (APT) and Small ALWR 13.5 acres per year (HWR) of onsite LLW disposal area. Liquid mixed LLW would be generated by each technology and would require an organic mixed waste treatment capability. Solid mixed LLW would increase by 3 (MHTGR) to 122 yd³ per year (HWR) and would require an organic mixed waste treatment capability.

Hazardous waste generation would increase by 4 (APT) to 101 yd³ per year (MHTGR). Separate expanded hazardous waste management facilities may be required for all technologies except the APT. All technologies would generate liquid sanitary waste and require new or separate treatment facilities. Solid sanitary waste generation would increase by 8,640 (APT) to 15,000 yd³ per year (HWR). Existing landfill design life would be reduced or require expansion. Other solid nonhazardous wastes would be recycled.

Intersite Transport. For all technologies, the relative risk associated with transporting tritium is 30 percent lower than the existing case (No Action) because the distance travelled is shorter. The potential cancer fatalities per year from transporting tritium heavy water is 3.57×10^{-5} (HWR) and 6.63×10^{-6} (APT). There is no intersite transport for any technology. The risk of transporting new tritium for supply alone is about 10 percent greater than No Action (due to transporting new tritium to SRS). The annual increase from transporting highly-enriched uranium fuel feed material (HWR and MHTGR alternatives) from ORR to NTS is 5.1×10^{-4} fatalities.

Oak Ridge Reservation

Land Resources. Construction and operation of a tritium supply technology would displace between 173 (APT) and 360 acres (MHTGR). Collocation of tritium recycling would require additional 202 acres during construction and 196 acres during operation. Siting any of the tritium supply technologies alone or collocated with recycling at ORR would displace some land designated as National Environmental Research Park. Some visual impacts are expected.

Site Infrastructure. No new site infrastructure (e.g., roads and transmission lines) would be required to support any technologies. The power requirements would be less than current site electrical requirement of 1,411 MWe by 1,252 MWe (MHTGR) to 738 MWe (APT).

Air Quality and Acoustics. Construction would result in exceedance of 24-hour PM₁₀ state TSP standards. Air pollutant concentrations would increase during construction but would be within standards. An increase in onsite noise would result from construction and operation of a tritium supply. Offsite noise impacts would be negligible.

Water Resources. Surface water use would range from 10 (APT) to 35 MGY (Large ALWR) during construction. Operation surface water requirements would range from 1,214 (APT) to 16,014 MGY (Large ALWR). These represent increases of between less than 1 and 2 percent during construction and 66 and 866 percent during operation. Blowdown discharges to surface waters would range from 250 (APT) to 6,202 MGY (Large ALWR). Groundwater would not be affected by construction or operation.

Geology and Soils. Construction and operation would neither affect nor be affected by geological conditions. The soil disturbed area would range from 375 (APT) to 562 acres (MHTGR). Soil erosion due to wind and stormwater runoff would be minor.

Biotic Resources. During construction and operation, terrestrial resources would be

affected by the disturbance of between 375 (APT) and 562 acres (MHTGR) of habitat. Salt from an evaporative cooling system could impact an additional limited acreage for a technologies. Increased stream flow from construction and operational discharges could affect wetland and aquatic plant communities. No Federal-listed, threatened, or endangered species would be affected, but several state-listed species may be affected.

Cultural and Paleontological Resources. Some NRHP-eligible prehistoric and historic resources are expected to occur within the disturbed area. Native American resources may be affected by land disturbance and audio or visual intrusions. Paleontological resources may be affected, but impacts would be negligible.

Socioeconomics. Employment in the economic study area for collocated tritium supply recycling would increase between 8,000 (MHTGR) and 12,000 persons (ALWR) during construction. Employment during operation would increase in the economic study area between 4,300 and 5,200 persons (HWR). Unemployment would decrease from 6.2 percent, the projected baseline, to between 4.8 (ALWR) and 5.2 percent (HWR and MHTGR) during construction and between 5.6 (HWR, MHTGR, and ALWR) and 5.7 percent (APT) during operation. Per capita income would increase by an average of 1 percent for all technologies during construction and operation.

Population and housing demand in the ROI would increase by less than 1 percent during construction and operation for all technologies.

For each technology, total revenues and expenditures for most ROI counties, cities, school districts would increase by annual averages of approximately 1 percent or less through 2010, and by less than 1 percent through 2020.

Traffic conditions on access roads to ORR are expected to degrade due to increased traffic and congestion, particularly on Bear Creek Road, the primary access route.

Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents. The dose to the maximally exposed member of the public from total site operation for 1 year would range from 4.3 (APT with helium-3 target) to 8.8 mrem (Large ALWR) for atmospheric release and would be 14 mrem for liquid release for all technologies. The associated risk of fatal cancer from 40 years of operation would be 8.6×10^{-5} , 1.8×10^{-4} , and 2.7×10^{-4} (for ALWRs), respectively.

The annual 50-mile population dose from total site operation in 2030 would range from 68 (APT with helium-3 target) to 90 person-rem (Large ALWR) and could result in 1.4 to 1.8 fatal cancers over 40 years of operation.

The average annual dose to a site worker would range from 18 (MHTGR) to 26 mrem (Large ALWR) with the associated risk of fatal cancer from 40 years of operation ranging from 2.9×10^{-4} to 4.2×10^{-4} , respectively. The annual dose to the total site workforce would range from 350 (MHTGR) to 490 (Large ALWR) person-rem and could result in 5.6 to 7.2 fatal cancers over 40 years of operation. All doses to the public and to site workers are within regulatory limits.

Any exposures to site workers and the public resulting from emissions of hazardous chemicals are expected to be within regulatory limits and have negligible cancer risk.

For low-to-moderate consequence/high probability accidents associated with operation, the consequences and risks associated with the APT are negligible. For the technology with the most severe consequences, the HWR, increased likelihood of cancer fatality to a maximally exposed individual at the site boundary would be of 6.8×10^{-5} . Given the a probability of 1.0×10^{-3} per year, the cancer risk would be 6.8×10^{-8} per year. For the population residing within 50 miles of the accident (1,062,000), the associated cancer risk would be 7.5×10^{-4} per year. If this accident occurred, this exposure would result in 0.75 cancer fatalities. The increased likelihood of cancer fatality to a worker located 1,000 meters from the release point would be 1.6×10^{-4} . The cancer risk to the worker would be 1.6×10^{-7} per year.

For high consequence/low probability accidents associated with operation, the consequences to a maximally exposed individual at the site boundary would be small.

APT. The technology with the most severe consequences to the general population is Small ALWR. For Small ALWR high consequence/low probability accidents, the increase likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 0.042 with an associated cancer risk of 6.6×10^{-9} per year. For the population residing within 50 miles of the accident (1,062,000), the associated cancer risk would be 5.1×10^{-6} per year. If this accident occurred, this exposure would result in 33 cancer fatalities. The increased likelihood of cancer fatality to a worker located 1,000 m from the release point would be 0.10. The cancer risk to the worker would be 1.6×10^{-6} per year.

Waste Management. Spent nuclear fuel would be generated by the HWR, MHTGR, and ALWR require a new storage facility. The APT would not generate spent fuel. All technologies except the APT would generate liquid LLW and require a new treatment facility. All technologies would generate solid LLW and require between 0.6 (APT) and 3.5 (HWR) a per year of onsite LLW disposal area. The increase in liquid and solid mixed LLW generation would have minimal impact and could be handled with existing/planned facilities.

Hazardous waste generation would increase by 4 yd³ per year (APT) to 101 yd³ per year (MHTGR) and could be handled with existing/planned facilities. Liquid nonhazardous sanitary waste generation would increase from 260 (APT) to 6,310 MGY (Large ALWR) and require additional treatment facilities. Solid nonhazardous sanitary waste generation would increase between 8,640 (APT) and 15,000 yd³ per year (HWR). Existing landfill disposal life would be reduced or require expansion. Other solid nonhazardous wastes would be recycled.

Intersite Transport. For all technologies, the relative risk of transporting tritium is percent lower than the existing case (No Action) because the distance travelled is shorter. The potential cancer fatalities per year from transporting tritiated heavy water are 3.57×10^{-5} (HWR) and 6.63×10^{-6} (APT). There is no intersite transport of LLW for any technology. The risk of transporting new tritium for supply alone is about 2 percent greater than No Action (due to transporting new tritium to SRS).

Pantex

Land Resources. Construction and operation of a tritium supply would disturb between 173 (APT) and 360 acres (MHTGR). Collocation of tritium recycling would require an additional 202 acres during construction and 196 acres during operation. Siting any tritium supply technologies alone or collocated with recycling at Pantex would be consistent with site development plans. No visual impacts are expected.

Site Infrastructure. No roads or railroads would be required to support any technology but all would require new transmission lines. The power requirements would exceed the current site electrical requirement of 13 MWe by 61 MWe (MHTGR) to 565 MWe (APT).

Air Quality and Acoustics. Construction activities would result in exceedance of 24 PM₁₀ standard. Air pollutant concentrations would increase during operation but would be within standards. An increase in onsite noise would result from construction and operation of a tritium supply. Offsite noise impacts would be negligible.

Water Resources. Surface waters and groundwater would not be affected by construction or operation. Reclaimed sanitary wastewater use would range from 10 MGY (APT) to 35 MGY (Large ALWR) during construction. Operation water requirements would range from 43 (APT) to 1,214 MGY (APT).

Geology and Soils. Construction and operation would neither affect nor be affected by geological conditions. The soil disturbed area for collocated tritium supply and recycling would range from 375 (APT) to 562 acres (MHTGR). Soil erosion due to wind and stormwater runoff would be minor.

Biotic Resources. During construction and operation, terrestrial resources would be affected by the disturbance of 375 (APT) to 562 acres (MHTGR) of habitat. Impacts from drift are possible with the APT. Playa wetlands could be degraded by discharges. Aquatic resources would not be affected. One federal-listed species, the bald eagle, could

temporarily affected during construction, and several Federal candidate or state-listed species may also be affected.

Cultural and Paleontological Resources. Some NRHP-eligible prehistoric and historic resources may occur within the disturbed area. Native American resources may be affected by land disturbance and audio or visual intrusions. Paleontological resources may also be affected.

Socioeconomics. Employment in the economic study area would increase by 7,300 (MHTG 10,900 persons (either ALWR) during peak construction. Employment during full operation would increase in the economic study area by 4,400 (APT) to 5,300 persons (HWR and M). Unemployment would decrease from 4.6 percent, the projected baseline, to between 2.5 and 2.8 percent (all technologies) during peak construction and to between 2.5 (HWR and MHTGR) and 2.8 percent (APT) during full operation. Per capita income would increase by no more than 1 percent during peak construction and full operation.

Population and housing demand within the region of influence would increase by between 3 (HWR and MHTGR) and 7 percent (ALWR) during construction and between 1 percent (APT) and 2 (HWR, MHTGR, ALWR) during operation.

Total revenues and expenditures for most region of influence counties, cities, and districts would increase by annual averages of 1 percent to 3 percent through 2005 and decrease annually by 1 percent until 2010. Between 2010 and 2020, total revenues and expenditures for all technologies would increase at annual averages of less than 1 percent.

Traffic conditions on access roads to Pantex are expected to degrade due to increased worker traffic and congestion, particularly on Farm-to-Market Road 683, the primary route.

Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents. The annual dose to the maximally exposed member of the public from total site operation with a collocated supply and recycling facility for 1 year would range from 1.4 (APT with helium-3 target) to 4.9 mrem (Large ALWR). The associated risk of fatal cancer from 40 years of operation would range from 2.9×10^{-5} to 9.8×10^{-5} , respectively.

The annual 50-mile population dose from total site operation in 2030 would range from 37 (APT with helium-3 target) to 37 (Large ALWR) person-rem and could result in 0.18 to 0.37 fatal cancers over 40 years of operation.

The average annual dose to a site worker would range from 22 (MHTGR) to 68 (Large ALWR) mrem with the associated risk of fatal cancer from 40 years of operation ranging from 3.5×10^{-4} to 1.1×10^{-3} , respectively. The annual dose to the total site workforce would range from 67 (MHTGR) to 210 (Large ALWR) person-rem and could result in 1.1 to 3.3 fatal cancers over 40 years of operation.

Although the noncancer adverse health effects to the public and onsite workers are within regulatory health limits, No Action cancer risks to the public and the onsite worker emissions of hazardous chemicals exceed the accepted regulatory threshold level of 1.0×10^{-6} annually. Potential mitigation, such as chemical substitution, can minimize health risks.

For low-to-moderate consequence/high probability accidents associated with operation, the consequences and risks associated with the APT are negligible. For the technology with the most severe consequences, the HWR, the increased likelihood of cancer fatality to the maximally exposed individual at the site boundary would be 6.2×10^{-6} . Given the accident probability of 1.0×10^{-3} per year, the cancer risk would be 6.2×10^{-9} per year. For a population residing within 50 miles of the accident (287,000), the associated cancer risk would be 2.6×10^{-5} per year. If this accident occurred, this exposure would result in cancer fatalities. The increased likelihood of cancer fatality to a worker located 100 meters from the release point would be 1.2×10^{-5} . The cancer risk to the worker would be 1.2×10^{-8} per year.

For high consequence/low probability accidents associated with operation, the consequences

to a maximally exposed individual at the site boundary are small for the APT. The technology with the most severe consequences to the general population is the Small For Small ALWR high consequence/low probability accidents, the increased likelihood cancer fatality to a maximally exposed individual at the site boundary would be 0.0 an associated cancer risk of 4.6×10^{-9} per year. For the population residing within miles of the accident (287,000), the associated cancer risk would be 6.7×10^{-7} per y this accident occurred, this exposure would result in 4.3 cancer fatalities. The in likelihood of cancer fatality to a worker located 1,000 meters from the release poi would be 0.070. The cancer risk to the worker would be 1.1×10^{-8} per year.

Waste Management. Spent nuclear fuel would be generated by the HWR, MHTGR, and ALWR would require a new storage facility. The APT would not generate spent fuel. General liquid LLW would increase for all technologies except the APT and require new treatment facilities. Solid LLW generation would increase for all technologies, requiring a new staging facility and between 16 (APT) and 92 (HWR) additional LLW shipments to NTS. to the NTS alternative for the additional LLW disposal area required at NTS. The in generation of liquid mixed LLW could be handled with existing/planned facilities. Solid mixed LLW generation would increase from 3yd³ per year (MHTGR) to 122yd³ per year (The HWR increase would require expansion of existing and planned treatment and storage facilities).

Hazardous waste generation would increase from 4 (APT) to 101yd³ per year (MHTGR). Liquid sanitary waste generation would increase for all technologies and would require new treatment facilities. Solid sanitary waste generation would increase by 8,640 (APT) 15,000yd³ per year (HWR). Existing offsite landfill design life would be reduced or require expansion. Other solid nonhazardous wastes would be recycled.

Intersite Transport. The risk of transporting tritium is zero since there is no intersite transportation with collocating supply and recycling for all technologies at Pantex potential cancer fatalities per year from transporting tritiated heavy water is 3.5 (HWR) and 6.63×10^{-6} (APT). For intersite transportation of LLW, credible accidents associated with locating tritium supply and recycling at Pantex would result in fatal cancers per year from radiological releases varying from 5.2×10^{-9} (APT) to 3.0×10^{-8} (and from 6.9×10^{-5} (APT) to 4.0×10^{-4} fatalities per year (HWR) from non-radiological causes. For intersite transportation of LLW, credible accidents associated with locating tritium supply alone at Pantex would result in fatal cancers per year from radiological releases varying from 3.25×10^{-9} (APT) to 2.8×10^{-8} (HWR) and from 4.30×10^{-5} (APT) to 3.70×10^{-4} (HWR) fatalities per year from non-radiological causes. The risk of transporting of new tritium for supply alone is about 2 percent greater than that for No (due to transporting new tritium to SRS). The annual risk from transporting highly-enriched uranium fuel feed material (HWR and MHTGR alternatives) from ORR to is 5.1×10^{-4} fatalities.

Savannah River Site

Land Resources. Construction and operation of a tritium supply technology with the upgraded recycling facility would disturb between 173 (APT) and 360 acres (MHTGR). The of an evaporative cooling tower would result in visible plumes during certain atmospheric conditions.

Site Infrastructure. New site infrastructure (e.g., roads and transmission lines) would be required to support all technologies. The power requirements would range from exceed the current site electrical requirement 130 MWe by 350 MWe (APT) to current site electrical requirement by being less than the 104 MWe (Large ALWR).

Air Quality and Acoustics. Construction activities would result in exceedance of 24 PM₁₀ standards. Air pollutant concentrations would increase during operation but would be within standards. An increase in onsite noise would result from construction and operation of a tritium supply. Offsite noise impacts would be negligible.

Water Resources. Surface water would not be required for construction. Operation surface water requirements would range from 1,229 (APT) to 15,946MGY (Large ALWR) and represent increases of between 6 and 78 percent during operation, respectively. The generation

sanitary waste would range from 0.3 (APT) to 28 MGY (Large ALWR) during construction 7 (APT) to 90MGY (Large ALWR) during operation, respectively. Blowdown discharges to surface waters would range from 240 (APT) to 6,192MGY (Large ALWR). Groundwater use increase by 33MGY during construction and 90 MGY (Large ALWR) during operation, representing increases of land 3 percent, respectively.

Geology and Soils. Construction and operation would neither affect nor be affected geological conditions. The area of disturbed soil would range from 200 (APT) to 387 acres (MHTGR). Soil erosion due to wind and stormwater runoff would be minor.

Biotic Resources. Terrestrial resources would be affected by the disturbance of bet 173 (APT) and 360 acres (MHTGR) and of habitat. Salt drift from an evaporative cooling system could impact an additional limited acreage for all technologies. Construction operational discharges to an onsite stream could affect wetland and aquatic community. No Federal-listed, threatened, or endangered species would be affected, but several state-listed species may be affected.

Cultural and Paleontological Resources. Three NRHP-eligible historic sites occur within the area that would be disturbed during construction. No historic resources would be affected. Native American resources may be affected by land disturbance and audio or visual intrusions. Paleontological resources may be affected, but impacts would be negligible.

Socioeconomics. Employment in the economic study area would increase between 6,900 (and 10,800 persons (ALWR) during construction. Employment during operation would increase in the economic study area between 1,600 (APT) and 2,400 persons (HWR). Unemployment decrease from 4.8 percent, the projected baseline, to between 3.9 (HWR, ALWR, and APT) 4 percent (MHTGR) during construction and to between 4.5 (HWR) and 4.6 percent (MHTGR, A and APT) during operation. Per capita income would increase by an average of approximately 1 percent for all technologies during construction and operation.

Population and housing demand within the ROI would increase by between less than 1 (HWR, MHTGR, APT) and less than 3 percent (ALWR) during construction and by less than 1 percent for all technologies during operation.

Total revenues and expenditures for most ROI counties, cities, and school districts increase by an annual average of less than 1 percent through 2020 for all technologies except for the ALWR. For the ALWR, revenues and expenditures would increase between less than 1 percent through 2005 and then remain flat until 2010. Between 2010 and 2020, total revenues and expenditures would increase by annual averages of less than 1 percent.

Traffic conditions on access roads to SRS are expected to degrade due to increased traffic and congestion, particularly on South Carolina Route 125, the primary access route.

Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents. Dose to the maximally exposed member of the public from total site operation for 1 year would range from 2.5 (APT with a helium-3 target) to 3.9 mrem (Large ALWR) for atmospheric release. The associated risk of fatal cancer from 40 years of operation would range from 7.8×10^{-5} to 4.9×10^{-5} , respectively. The dose from liquid releases from 1 year would range from 0.077 mrem (MHTGR and APT) to 0.26 mrem (Small ALWR). The associated risk of fatal cancers from 40 years of operation would range from 1.5×10^{-6} to 5.3×10^{-6} , respectively.

The annual 50-mile population dose from total site operation in 2030 would range from 220 (APT with the helium-3 target) to 340 person-rem (Large ALWR) and could result in 6.8 fatal cancers over 40 years of operation, respectively.

The average annual site dose to a site worker would range from 33 (MHTGR) to 42 mrem (ALWR) with the associated risk of fatal cancer from 40 years of operation ranging from 5.3×10^{-4} to 6.7×10^{-4} , respectively. The annual dose to the total site workforce would range from 510 (MHTGR) to 650 person-rem (Large ALWR) and could result in 8.2 to 10 fatal cancers over 40 years of operation, respectively.

Although the noncancer adverse health effects to the public are within regulatory limits, the No Action worker effects from emission of hazardous chemicals exceed the limit. The No Action cancer risks to both the public and onsite workers exceed the generally accepted threshold of regulatory concern of 1×10^{-6} .

For low-to-moderate consequence/high probability accidents associated with operation consequences to a maximally exposed individual at the site boundary would be small for the APT. The technology with the most severe consequences to the general population is the HWR. For HWR low-to-moderate consequence/high probability accidents, the increased likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 2.3×10^{-5} . Given the accident probability of 1.0×10^{-3} per year, the cancer risk would be 2.3×10^{-8} per year. For the population residing within 50 miles of the accident (773,000), the associated cancer risk would be 7.3×10^{-4} per year. If this accident occurred, the exposure would result in 0.73 cancer fatalities. The increased likelihood of cancer fatality to a worker located 1,000 meters from the release point would be 2.9×10^{-4} . The cancer risk to the worker would be 2.9×10^{-7} per year.

For high consequence/low probability accidents associated with operation, the consequences to a maximally exposed individual at the site boundary would be small for the APT. The technology with the most severe consequences to the general population is the Small ALWR. For Small ALWR high consequence/low probability accidents, the increased likelihood of cancer fatality to a maximally exposed individual at the site boundary would be 1.9 with an associated cancer risk of 2.9×10^{-10} per year. For the population residing within 50 miles of the accident (773,000), the associated cancer risk would be 2.3×10^{-6} per year. If this accident occurred, this exposure would result in 14 cancer fatalities. The increased likelihood of cancer fatality to a worker located 1,000 meters from the release point would be 0.067. The cancer risk to the worker would be 1.1×10^{-8} per year.

Waste Management. Spent nuclear fuel would be generated by the HWR, MHTGR, and ALWR and require a new storage facility. The APT would not generate spent fuel. All technologies except the APT would generate liquid LLW and require a new treatment facility. All technologies would generate solid LLW and require between 1 (APT) and 12 acres per year (HWR) of onsite LLW disposal area. No additional liquid mixed LLW would be generated by the tritium supply technologies. The generation of solid mixed LLW would increase by 7,600 yd³ per year (MHTGR) to 120 yd³ per year (HWR). The HWR may require new or expanded treatment and storage facilities.

Hazardous waste generation would increase by 3 (APT) to 100 yd³ per year (MHTGR) and require additional storage facilities except for APT. Liquid nonhazardous sanitary waste would increase by 245 (APT) to 6,290 MGY (Large ALWR) and require additional treatment facilities. Solid nonhazardous sanitary waste generation would increase by 1,240 (APT) to 7,600 yd³ per year (HWR). Existing landfill design life would be reduced or require expansion. Other solid nonhazardous wastes would be recycled.

Intersite Transport. The risk associated with transportation of tritium when collocated supply and recycling is the same as No Action for all supply technologies. There is no intersite transport of LLW for any supply technology. The annual risk from transport of highly-enriched uranium fuel feed material (HWR and MHTGR alternatives) from ORR to the reactor would be 5.1×10^{-4} fatalities.

Multipurpose ("Triple Play") Reactor

The Department's Office of Fissile Materials Disposition is preparing a PEIS addressing the issue of how to dispose of plutonium that is excess to nuclear weapons requirements. Among the alternatives to be analyzed in the Long-Term Storage and Disposition of Weapons-Usable Fissile Materials PEIS is the use of plutonium as a fuel in existing reactors, modified, or new nuclear reactors.

The nuclear reactors evaluated for tritium production in the PEIS for Tritium Supply and Recycling utilize uranium as the fuel source, and the analysis in this PEIS is based on that design. Nonetheless, it is technically feasible to also use plutonium or plutonium-oxide (mixed-oxide) fuel for a tritium production reactor. Congress and commercial entities have expressed interest in developing a multipurpose ("triple play") reactor.

reactor that could produce tritium, "burn" plutonium, and generate revenues through sale of electric power. Only the ALWR and MHTGR would be capable of performing the play missions; the potential environmental impacts from these triple play reactors summarized below.

Advanced Light Water Reactor. If an ALWR were used to burn plutonium, the major contributions to potential environmental impacts would be from a new plutonium Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility. Such a facility could disturb up to 129 acres of land, and require a peak construction force of 550 during peak year of the 6 year construction period.

During operation, this facility would require approximately 10 percent as much water as a large ALWR at a dry site, and would employ as many workers as the ALWR. Radiological exposures to workers during normal operation would be kept as low as reasonably achievable, and would not be expected to exceed 50mrem per worker per year. If all workers were exposed to such a dose, a highly conservative assumption, 0.52 latent cancer fatalities (less than one) would be expected over the 40 year operation life expectancy. The goal for the facility for public radiation exposure would be not to exceed 1 mrem effective dose equivalent per year.

Safety analysis reports have not been prepared for this facility. However, bounding accident scenarios have been identified from safety analysis reports for similar plutonium processing facilities. Criticality accidents, explosions, and fires could occur in such a facility, and release radiation to the environment. The use of plutonium in an ALWR would not significantly affect the consequences of radioactivity releases from severe accidents, though there would be some small changes in the source term release spectrum and frequency.

Using a mixed-oxide fuel in an ALWR would have no major effect on reactor operation; therefore, impacts would not be expected to change significantly from those associated with utilizing a uranium fueled reactor. This is based on a study conducted by the DOE in the Final Generic Environmental Statement on the Use of Recycled Plutonium in Mixed Oxide Fuel in Light Water Reactors.

Modular High Temperature Gas-Cooled Reactor. To burn plutonium in a modular gas-cooled reactor, a plutonium Pit Disassembly/Conversion Facility would also be needed, and environmental impacts from such a facility are expected to be approximately the same as those described for the facility to support a multipurpose ALWR. In a plutonium-fueled gas-cooled reactor, however, tritium production decreases significantly. Thus, twice as many reactor modules would be necessary in order to produce the steady-state tritium requirements. This doubling of reactor modules would be the major contributor to potential environmental impacts for this scenario.

Overall, building twice as many reactor modules could double most environmental impacts. Some construction impacts (land disturbed, construction duration, and peak construction workforce) might be less than double because of economies of scale and shared support infrastructure. Depending upon the particular site, some impacts could be significantly reduced.

During operation of twice as many reactor modules, water requirements could increase 10 percent. Impacts to groundwater would not change significantly from those expected for the three module MHTGR at those sites that would use groundwater resources. The expected workforce increase would approximately double any socioeconomic impacts and radiation doses to workers. Radiation exposure to the public from normal operation might also double. The use of plutonium in a MHTGR would not significantly affect severe accident consequences because fuel failures are not expected in any severe accident. Spent fuel management would also double with the addition of twice as many reactor modules.

Commercial Light Water Reactor

The purchase by DOE of an existing operating or partially completed commercial power reactor is a reasonable alternative being evaluated to meet the stockpile tritium requirement mission. Production of tritium using irradiation services contracted from commercial power reactors is also being evaluated as a reasonable alternative and a potential contingency measure to meet the projected tritium requirements for the

Nation's nuclear weapons stockpile in the event of a national emergency. The reactors employed for domestic electric power generation in the United States are conventional light water reactors, which use ordinary water as moderator and coolant. The potential environmental impacts of the commercial light water reactor alternative are summarized below.

The option to purchase an operating commercial power reactor or finish construction partially complete commercial reactor to support the stockpile tritium requirement have similar impacts. The reactor technologies and characteristics would be the same. However, some additional land use impacts may occur to incorporate security infrastructure and other requirements which would be needed for a DOE-owned and -operated tritium production facility. The potential land use impacts would result from new buffer zone requirements, new fencing, security buildings, and road access restrictions or construction of new roads.

The environmental impacts of completing construction of an unfinished commercial nuclear power plant would be relative to the extent that the potential power plant has been completed by the utility. For construction impact analysis, a range of reactor completion (45 percent to 85 percent) was used. Environmental impacts from the upgrade existing site infrastructure to support renewed construction activities would be minimal. Completing construction of a nuclear reactor would result in impacts resulting from emissions, increased worker numbers, and waste generation and management. Air emissions would be temporary and would not be expected to significantly affect air quality in project area. The increase in construction workers would have potential impact on the local economy and area population, housing, and local services. Because a majority of the nuclear power plant infrastructure and the power plant itself have already been completed using a much larger overall workforce and peak workforce, socioeconomic impacts are expected to be minor.

Construction activities are expected to generate construction debris and other hazardous and nonhazardous wastes. Typical hazardous wastes generated during the completion of construction phase would include paints, solvents, acids, oils, and degreasers. Advancing environmental impacts from management and disposal of these wastes would not be expected.

The commercial reactor alternatives for producing tritium would result in additional environmental impacts from the changes in the reactor operational characteristics due to the introduction of DOE target rods. Impacts would likely result from core changes, personnel requirements, effluents, waste, spent fuel, radiation exposure, and transportation/handling.

Core Changes. Production of tritium in a commercial light water reactor would require physical changes to the reactor core, which could range from replacement of burnable poison elements with DOE target elements to the replacement of fuel rods with DOE target assemblies. Core changes could alter the accident basis and would modify the source term. The estimated additional core tritium content in curies per reactor at the end of the irradiation period would be 3.2×10^7 for a single reactor. Because of the reduced burnup in the reactor core, the total fission products in each fuel rod would decrease.

Personnel Requirements. An estimated 75 additional personnel would be needed for a commercial nuclear power facility. The additional personnel would represent an increase of approximately 9 percent for a single reactor. The number of personnel would be small at each commercial reactor site if multiple reactors were used.

Effluent. Because of the addition of DOE target rods, airborne and water-borne effluents would be expected to change (particularly for tritium). Estimates for expected increase of gaseous tritium effluent range from 5,740 Ci per year for a single reactor to 3,000 Ci per year in the multiple reactor scenario. Estimated increases of liquid tritium effluent range from 1,460 Ci per year for a single reactor to 935 Ci per year per reactor in multiple reactor scenario.

Waste. Additional activities associated with the handling, processing, and shipping of target assemblies would be expected to increase waste generation rates at the commercial reactor site. An estimated 164 yd³ per year of LLW per reactor would be expected. This would be approximately a 50-percent increase for a typical plant. No increase in mixed

waste generation would be anticipated. Depending on the selected site, expansion of existing or construction of new facilities may be required.

Spent Nuclear Fuel. More frequent refueling operations and the segmenting of fuel assemblies could result in an increase in spent nuclear fuel volumes. With the single reactor case, 137 additional spent fuel assemblies (40 yd³, assuming 8 ft³/assembly) be generated each year. This amounts to approximately 58 metric tons of heavy metal. This represents more than a 3-fold increase over the average of 56 assemblies (24 m tons of heavy metal) for a typical pressurized commercial light water reactor. The 12-month refueling cycles with full core discharge would accelerate the consumption of available spent nuclear fuel pool storage and would require earlier use of additional storage alternatives such as dry storage at some commercial reactor sites.

Worker Radiation Exposure. New DOE target assembly process activities and, in some more frequent refueling-type operations would be expected to increase radiation exposure for some categories of workers. Estimates for expected increases of exposure for personnel range from 19 person-rem per reactor for maintenance workers to less than 1 person-rem for supervisory personnel. In the multiple reactor scenario, no additional refueling personnel would be required; therefore, no additional worker exposure would be expected. The increase in person-rem per reactor for all personnel ranges from 24 for maintenance workers to 1 for supervisory personnel.

Radiological Impacts

Normal Operations. The impact from adding tritium targets to a commercial reactor would vary depending on the reactor type, reactor site location, and the number of sites involved in the tritium production mission. The maximum impacts at a given site would occur if all of the tritium were produced at that site. The impacts would lessen at a given site if multiple sites are used.

Considering that the arithmetic mean annual radiation dose to people who lived within a 50-mile radius of a commercial nuclear power plant in 1991 was about 1.2 person-rem and 0.95 person-rem from airborne and liquid releases, respectively) and the median less than 0.2 person-rem (NUREG/CR-2850), impacts of normal operation from tritium production are expected to be less than the NESHAPS 10 mrem limit for atmospheric releases and less than the drinking water limit of 4 mrem. It is estimated that the changes in radioactive releases associated with the production of tritium in a single reactor result in an annual dose increase of 0.51 person-rem to the 50-mile population. This would result in a calculated increase of 0.010 fatal cancer in this population as a result of 40 years of reactor operation. There would be a slightly larger increase in total number of fatal cancers in the several population groups for the multiple reactor scenario compared with the single reactor, but the risk to an individual member of the public would be less because of the larger number of people exposed.

Detailed impact analysis would be performed after the reactor/site combination(s) has been selected. If the results of the impacts analysis indicates exceedances of either NESHAPS and/or drinking water limits, the reactor's radioactive waste management system would be revised to reduce the effluent to acceptable limits.

Transportation/Handling. Assuming that an inventory of 500 target rods would be accumulated for shipment at one time in NRC-approved fuel assembly shipping casks, and one cask per transport truck, approximately 12 shipments per year would occur. The curie content per truck would be approximately 2.7×10^6 . The upper bound radiological consequences of an accident during transportation from a single site to SRS might incur an additional 240 person-rem per year.

Qualitative Comparison

To aid the reader in understanding the differences in environmental impacts among the alternatives (particularly the tritium supply technology alternatives i.e., HWR, MHWR, ALWR, and commercial light water reactor), this section presents a brief, qualitative summary comparison of the alternatives. Chapter 3, tables 3.6-1 and 3.6-2 presents

quantitative comparisons of greater detail.

For some of the resource areas evaluated in the PEIS, the analyses indicate that there are no major differences in the environmental impacts among the tritium supply technology and site alternatives. Resource areas where no major differences exist, or where potential environmental impacts are small, are: land resources, air quality, water resources, geology and soils, biotic resources, and socioeconomic factors. For these resource areas, the general conclusion is particularly true when comparing the operational impacts of tritium supply facilities. For construction, this general conclusion is also particularly true when comparing among the various types of new tritium supply facilities (e.g., MHTGR, ALWR, and APT).

However, when comparing the potential impacts of constructing a new tritium supply facility against the alternative of using an existing commercial reactor (purchase of irradiation services or purchase and conversion of an existing commercial reactor), environmental impacts of the latter are clearly less because the facility already exists, and, thus, there are minimal construction-related environmental impacts. For tritium recycling, this also applies when comparing the existing tritium recycling facilities at SRS against constructing a new tritium recycling facility at another

For other resource areas evaluated in the PEIS, the analyses indicate that there are notable environmental impact differences. Resource areas where notable differences are: site infrastructure (electrical requirements), human health (from radiological impacts due to accidents), and wastes generated. Each of these resource areas are discussed in greater detail below.

Site Infrastructure. Infrastructure and electrical capacity exists at each of the alternative sites to adequately support any of the tritium supply technology alternatives. Nonetheless, because the MHTGR and ALWR technologies could generate electricity while also producing tritium, these technologies could have a positive environmental impact by delaying the need to build some electrical generating facilities in the future. The PEIS acknowledges, and qualitatively discusses, these potential "avoided" environmental impacts. The APT, and to a significantly lesser degree the HWR, would be energy consumers. The PEIS assesses the environmental impacts of providing power to energy consumers. Thus, in terms of environmental impacts, there could be approximately 1,800 MWe of difference (i.e., ALWR generating 1,300 MWe versus an APT consuming 500 MWe) between the tritium supply technologies. For commercial reactors that already exist and produce electrical power, there would be no change to the existing electrical infrastructure.

Human Health. There are differences among the tritium supply technology and site alternatives regarding the potential human health impacts from accidents. The potential consequences are directly related to the amount of radioactivity released and the population density near the facility. For each of the tritium supply technology alternatives, the probability of severe accidents occurring is extremely small, on the order of once every millions of years at most. Based upon the PEIS analyses of the technologies, the ALWR could cause the largest potential impacts to human health from severe accidents, while the MHTGR would have the smallest potential impacts. Because the APT does not utilize fissile materials, and there is no significant decay heat, the virtually no radiological consequences from any APT accidents.

Consequently, the APT would have the smallest potential impacts to human health from accidents. The commercial reactor alternatives do not acquire any substantial risks assuming a tritium-production mission.

Regarding the site alternatives, in the event of an accident at sites with small populations (INEL, NTS, and to a lesser extent Pantex), there would be fewer impacts on human health. Because ORR and SRS have larger populations within 50 miles of the proposed facilities, these two sites have greater potential human health impacts than the other sites. Because there are virtually no radiological consequences from any APT accidents, there are no grounds for discrimination among sites in the case of the APT. It is, in essence, site neutral with respect to potential impacts to human health.

Generated Wastes

Spent Fuel Generation. All of the tritium supply reactor technologies would generate spent fuel. While the MHTGR would generate the greatest volume of spent fuel (because of graphite moderator), the residual heavy metal content of spent fuel from the ALWR would be the greatest. Reactors providing irradiation services would not generate additional spent fuel over and above what they would otherwise generate during their planned lifetime, assuming that multiple reactors are used and the operating scenarios do not change fuel cycles. However, if only a single reactor were used (irradiation service purchased and converted), additional spent fuel would likely be generated because the reactor's refueling cycle would be shortened. The APT is not a reactor and would not generate spent fuel.

Low-Level Waste. None of the alternatives would generate unacceptably large amounts of low-level waste. However, of the alternatives, the HWR would create the most low-level waste in 1 year (almost 5 times as much as any other reactor alternative). The APT would generate the least amount of low-level waste annually. In producing tritium, the commercial reactor alternatives would generate additional low-level waste, but this amount would be less than the new reactor alternatives. With regards to sites, except for all sites have the ability to handle and dispose of low-level nuclear waste at the site. Low-level nuclear waste generated at Pantex would need to be shipped to another site for disposal.





CHAPTER 1: INTRODUCTION

Chapter 1 begins with a description of the Department of Energy's Tritium Supply and Recycling Proposal. This chapter also describes the Department of Energy's compliance with the National Environmental Policy Act for tritium supply and recycling, time periods considered in this analysis, and other Department of Energy National Environmental Policy Act documents that are currently being prepared or are in the planning phase. Chapter 1 includes discussions of the background of the Nuclear Weapons Complex Reconfiguration Program, recent changes affecting the Reconfiguration Program, the specific alternatives analyzed in this document, the public participation process used to obtain public input on the issues addressed in the Draft Programmatic Environmental Impact Statement, and changes made from the Draft Programmatic Environmental Impact Statement. The chapter concludes with the organization of the document.

1.1 The Tritium Supply and Recycling Proposal

The Department of Energy (DOE) proposes to provide tritium supply and recycling facilities for the Nation's Nuclear Weapons Complex (Complex). Tritium, a man-made radioactive isotope of hydrogen, is an essential component of every warhead in the current and projected U.S. nuclear weapons stockpile. These warheads depend on tritium to perform as designed. Tritium decays at 5.5 percent per year and must be replaced periodically as long as the Nation relies on a nuclear deterrent. The Complex does not have the capability to produce the required amounts of tritium. Projections require that new tritium be available by approximately 2011. This Tritium Supply and Recycling Programmatic Environmental Impact Statement (PEIS) evaluates the siting, construction, and operation of tritium supply technology alternatives and recycling facilities at each of five candidate sites: the Idaho National Engineering Laboratory (INEL), Nevada Test Site (NTS), Oak Ridge Reservation (ORR), the Pantex Plant, and the Savannah River Site (SRS). This PEIS assesses the environmental impacts of all reasonable alternatives discussed below, including No Action.

Tritium supply deals with the production of new tritium in either a reactor or an accelerator by irradiating target materials with neutrons and the subsequent extraction of the tritium in pure form for its use in nuclear weapons. Tritium recycling consists of recovering residual tritium from weapons components, purifying it, and refilling weapons components with both recovered and new tritium when it becomes available.

Under No Action, DOE would not establish a new tritium supply capability. The current inventory of tritium would decay and DOE would not meet stockpile requirements of the National Nuclear Security Administration. This would be contrary to DOE's mission as specified by the Atomic Energy Act of 1954, as amended. The current DOE missions assumed to continue under No Action are listed in section 3.3 for each candidate site.

Alternatives for new tritium supply and recycling facilities consist of four different tritium supply technologies and five locations. The four technologies proposed to provide a new supply of tritium are Heavy Water Reactor (HWR), Modular High Temperature Gas-Cooled Reactor (MHTGR), Advanced Light Water Reactor (ALWR), and Accelerator Production of Tritium (APT). Both Large (1,300 MWe) and Small (600 MWe) options for the APT are evaluated as well as a phased approach for the APT. Also included as an alternative is the use of an existing commercial light water reactor that would be used for irradiation services or purchased and converted for tritium production. Additionally, this Tritium Supply and Recycling PEIS includes an assessment of the environmental impacts associated with using one or more commercial light water reactors for tritium production as a contingency in the event of a national emergency. Specific commercial reactors are identified in this PEIS.

This PEIS also addresses the environmental impacts of an ALWR, modular gas-cooled reactor, and a small modular reactor.

or commercial light water reactor used as a multipurpose reactor. A multipurpose ("play") reactor is defined as one capable of producing tritium, "burning" plutonium, generating revenues through the sale of electric power.

1.2 Compliance with the National Environmental Policy Act for Tritium Supply and Re

DOE intends to comply with the National Environmental Policy Act (NEPA) for tritium supply and recycling in two phases. The first phase includes this PEIS and subsequent Record of Decision (ROD). The second phase includes site-specific NEPA documents that would be tiered from this PEIS. Decisions will be based on relevant factors including economic and technical considerations, DOE statutory mission requirements, and environmental impacts. As required by NEPA, this PEIS provides environmental analysis support the ROD. In addition to the analysis in this PEIS, engineering studies will provide cost, schedule, and technical feasibility analyses for consideration in the ROD. These studies are presented in the Technical Reference Report.

The programmatic decisions needed to plan for tritium supply and recycling focus on and technology. Project-level decisions would focus on construction and operation impacts and would be made after subsequent site-specific tiered NEPA reviews are completed.

The ROD may include the following programmatic decisions:

Whether to build new tritium supply and new or upgraded tritium recycling facilities

Where to locate new tritium supply and recycling facilities; and

Which technologies to employ for tritium supply.

The ROD will not include decisions regarding clean-up or waste management at phased facilities; the ultimate disposition of these facilities; or the long-term storage, treatment, and ultimate disposal of some wastes and spent fuel. These activities are covered by separate NEPA documents (section 1.5). However, this PEIS does address the waste management implications of the alternatives considered to the extent needed to support programmatic decisions regarding the sites and technologies analyzed.

The design goals of any new processes and facilities will include achieving, to the greatest extent practicable, pollution prevention and waste minimization. In addition, one of the design goals is to maximize the ease of ultimate decontamination and decommissioning (D&D). The ROD will identify the waste management implications on facility design for each of the alternatives and any future actions (including D&D).

In accordance with the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 CFR 1500-1508), DOE intends to "tier" site-specific environmental analyses in this PEIS for specific project proposals; therefore, subsequent proposed actions for specific facilities and their impacts are not analyzed in this PEIS. The "tiered" analyses and their related decision documents would be completed before project implementation could begin.

1.3 Time Period Considered in Analysis

The Tritium Supply and Recycling Proposal would proceed in three phases. The first involves preparing information to support programmatic decisions on siting and technology. This includes preparing this PEIS and the associated ROD. During the second phase, DOE would develop detailed designs and meet project-specific NEPA requirements to implement the programmatic decisions. The third phase would involve constructing, testing, and certifying the selected tritium supply and recycling facilities, leading to full operation. Present planning requires the tritium facilities to be fully operational by the year 2010 with new tritium available for use approximately 1 year later. The PEIS includes analyses of providing tritium at an earlier date should that become necessary.

Following this PEIS, DOE would develop a schedule for implementing the ROD decision.

schedule would be subject to change and include reassessments required by congressional authorizations and appropriations. Although the individual schedules of any activity projects may overlap, the current uncertainty associated with any given activity or project requires that assumptions be made regarding the time periods used in this PEIS analysis.

Because of the uncertainties associated with the scheduling of the second and third phases, this PEIS assumes an environmental baseline period for construction between 2000 and 2009, and an operational period of 40 years beginning in approximately 2010. Although the design life of the tritium supply and recycling facilities has not yet been determined by engineering studies, the assumption of an operational period of approximately 40 years is consistent with the operating periods used in prior DOE NEPA documents for similar facilities. Project-level tiered NEPA documents would identify in detail the specific construction and operational periods for each project implemented.

1.4 Background

The Complex is a set of interrelated facilities supporting the research, development, design, manufacture, testing, and maintenance of the Nation's nuclear weapons and the subsequent dismantlement of retired weapons. In the past, Complex facilities have processed large numbers of nuclear weapons from new components. However, due to substantial reductions in the requirements for nuclear weapons, the Complex's current focus has shifted to weapon dismantlement, recycling nuclear materials used in building nuclear weapons, storing strategic materials for future use, and conducting surveillance and maintenance activities to ensure the continued reliability and safety of the weapons in the National stockpile. The Complex consisted of 11 sites located in 10 states, as shown in Figure 1.4-1. Hanford and INEL are currently not part of the Complex. Defense missions have been terminated at the Rocky Flats Plant, Mound Plant, and the Pinellas Plant.

1.4.1 Defense Program Mission

As a matter of national policy, Congress declared in the Atomic Energy Act of 1954 that the development, use, and control of atomic energy shall be directed so as to make the maximum contribution to the general welfare, subject at all times to the paramount objective of making the maximum contribution to the common defense and security. In addition, Congress assigned the nuclear weapons manufacturing and stockpile sustainment role to the Atomic Energy Commission. Today that role resides with DOE.

The size of the Nation's nuclear weapons stockpile is determined on a year-to-year basis. The Secretaries of Defense and Energy, in coordination with the Nuclear Weapons Council, jointly sign and submit the Nuclear Weapons Stockpile Memorandum. The Nuclear Weapons Stockpile Memorandum transmits the Nuclear Weapons Stockpile Plan to the President for final approval. The Plan covers an 11-year period, specifies the types and quantities of weapons required, and sets limits on the size and nature of stockpile changes that can be made without additional approval from the President. As such, the Nuclear Weapons Stockpile Plan is the basis for all weapons planning in DOE. The President takes the Nuclear Weapons Stockpile Memorandum under advisement each year and issues a National Security Directive to DOE and the Department of Defense (DOD) approving the Nuclear Weapons Stockpile Plan for implementation. Figure 1.4.1-1 depicts the Nuclear Weapons Stockpile Memorandum process.

1.4.2 Evolution of the Tritium Supply and Recycling Proposal

The Tritium Supply and Recycling Proposal has evolved from the original Reconfiguration Program. The original reconfiguration concept, changes over time, and reasons for the changes are discussed in detail in the revised Implementation Plan (IP) for the Tritium Supply and Recycling PEIS and are outlined briefly below. A detailed discussion of the current tritium supply proposal follows. Figure 1.4.2-1 depicts the evolution of the Reconfiguration Program and the Tritium Supply and Recycling Proposal.

Figure (Page 1-4)

Figure 1.4-1.-Current and Former Nuclear Weapons Complex Sites.

Figure (Page 1-5)

Figure 1.4.1-1.-Nuclear Weapons Stockpile Memorandum Process.

Figure (Page 1-6)

Figure 1.4.2-1.-Evolution of the Reconfiguration Program, 1991-1995.

The Complex is administered by the DOE Office of the Assistant Secretary for Defense Programs (DP) and consists of government-owned, contractor-operated facilities located at 11 sites around the country. Many of the facilities in the Complex were constructed more than four decades ago and will need repairs, upgrades, and/or modifications to meet current environmental, safety, and health (ES&H) requirements. Additionally, many of the facilities were sized to meet stockpile requirements substantially larger and more diverse than current requirements or those expected in the future.

Congress, recognizing that a comprehensive rather than a piecemeal approach was needed to address problems arising from an aging Complex, directed in the National Defense Authorization Act for fiscal years 1988 to 1989 (Public Law 100-180), that a study be conducted and a plan prepared by the President to modernize the Complex. The product of this study, titled the U.S. Department of Energy Nuclear Weapons Complex Modernization Report (December 1988), was submitted to Congress on January 12, 1989. The report called for extensive modernization of facilities over a 15 to 20-year period.

In September 1989, DOE established a Modernization Review Committee to review the assumptions and recommendations contained in the Modernization Report. Chaired by the Under Secretary, the committee was directed to reexamine the modernization issue and to develop a program to address the issues already identified. In January 1991, this committee issued a report summarizing their findings. This study, entitled the Nuclear Weapons Complex Reconfiguration Study (DOE/DP-0083), outlined a proposed future Complex and charted the course necessary to achieve the goal of modernization. It included discussion of potential configurations of the future Complex, transitional activities, activities necessary for compliance with NEPA, and recommendations to improve management of the Complex.

On February 11, 1991, DOE published a Notice of Intent (NOI) in the Federal Register (FR 5590) to prepare a PEIS, pursuant to NEPA, on reconfiguring the Complex. The NOI proposed to analyze the environmental impacts of the alternatives presented in the Nuclear Weapons Complex Reconfiguration Study.

In September 1991, the President made the first of three announcements involving significant reductions in the nuclear weapons stockpile. As a consequence of stockpile reductions, decreased demand for tritium, and an increased supply of recovered tritium from dismantled weapons, the urgency to develop a new tritium supply source was eased. Consequently, on November 1, 1991, DOE announced its decision to incorporate the environmental impact analysis for the DOE New Production Reactor Capacity Proposal into the Reconfiguration PEIS and include the new production reactor siting and technology decisions in the Reconfiguration ROD. This action added the programmatic analysis of tritium supply capacity into the Reconfiguration PEIS. The New Production Reactor Program was evaluating the potential environmental impacts of siting either an HWR, Light Water Reactor, or MHTGR at Hanford, INEL, or SRS. It also considered the No Action alternative of continuing tritium production at the K or L-Reactor at SRS. The New Production Reactor Program, which was subsequently deferred, provided engineering and design information for use in the Reconfiguration PEIS.

In December 1991, the Secretary decided to separate the nonnuclear consolidation from the Reconfiguration PEIS, from the nuclear analysis. The reasons for this included the potential for near-term, significant cost savings and the fact that nonnuclear consolidation decisions would neither affect nor be affected by the Reconfiguration decisions.

On January 27, 1992, DOE provided the public notice of its plans to prepare an environmental assessment (EA) for its proposal to consolidate certain nonnuclear facilities in the Complex (57FR3046). These facilities manufacture nonnuclear parts

required for nuclear weapons and perform regular testing of individual components. Final EA was published on June 31, 1993 and a Finding of No Significant Impact was published in the Federal Register (58 FR 176) on September 14, 1993. Shortly thereafter DOE began implementing the Nonnuclear Manufacturing Consolidation Program. This act terminated the Complex mission at Mound, Pinellas, and Rocky Flats Environmental Technology Site (formerly known as Rocky Flats Plant). Activities previously performed at these facilities will be consolidated primarily at the Kansas City Plant, with the remaining activities being relocated to SRS, Los Alamos National Laboratory, and Sandia National Laboratories, New Mexico.

Further stockpile reductions, including the Strategic Arms Reduction Talks (START) Protocol, resulted in DOE reevaluating the Reconfiguration Program. On July 23, 1993 revised NOI for the Reconfiguration PEIS was published in the Federal Register (58 FR 39528). This NOI described DOE's vision of a much smaller and more highly integrated Complex than originally planned. Additionally, long-term storage options for plutonium and highly enriched uranium were added to this PEIS analysis. In this regard, the alteration of consolidated long-term storage facilities for plutonium and highly enriched uranium was added, since weapons retirements were occurring in larger numbers and at a faster rate than was ever envisioned. In addition, the components were not being recycled into weapons, as they had been in the past. This situation placed increased importance on the stewardship of existing special nuclear materials.

The Hanford Site was dropped and NTS was added as a candidate site for future weapons complex missions. DOE also added alternatives to consider upgrades and/or modifications to existing facilities to meet the reduced workload requirements while still complying with ES&H regulations. Upgrades and/or modifications were considered in addition to new facilities. The new facilities were downsized from previous plans and the option of integrating research, development, and testing activities into the plant designs and the consideration of accelerator technology for the production of tritium were also added.

In September and October 1993, DOE held a series of public scoping meetings following the issuance of the revised NOI. During the public scoping period, many members of the public questioned why DOE was proceeding to analyze new weapons facilities in general, and component fabrication facilities in particular, given the lack of requirements for weapons and an otherwise limited workload. There appeared to be a perception among members of the public that the evaluation of new facilities in the PEIS indicated an intention to construct these facilities in a predetermined time frame. In addition, members of the public commented that DOE should address alternatives for the disposition of plutonium that is in excess of strategic needs, in addition to alternatives for long-term storage.

DOE has concluded that the framework described in the Nuclear Weapons Complex Reconfiguration Study does not exist today. Contributing factors to this conclusion include public comments at the September and October 1993 PEIS scoping meetings; the fact that no new nuclear weapons production is required for the foreseeable future; budget constraints; and DOE's decision to prepare a PEIS on long-term storage and disposition of weapons-usable fissile materials (59 FR 31985). As a result of these changed circumstances, DOE decided to separate the Reconfiguration PEIS into two PEISs: (1) Tritium Supply and Recycling PEIS to address the need for tritium and (2) a Stockpile Stewardship and Management PEIS to address the rest of the Complex (59 FR 54175).

1.5 Other National Environmental Policy Act Reviews

The Tritium Supply and Recycling PEIS has been coordinated with other NEPA document Programmatic NEPA documents currently in progress, recently completed, or in the planning phase are discussed in the following sections.

1.5.1 Stockpile Stewardship and Management Programmatic Environmental Impact Statement

The Stockpile Stewardship and Management PEIS, which is currently being prepared, is analyzing alternatives for the Department to fulfill its responsibilities for ensuring the safety and reliability of the stockpile without underground nuclear testing. The

stewardship includes activities required to maintain a high-level of confidence in safety, reliability, and performance of nuclear weapons in the absence of underground testing and to be prepared to test weapons if directed by the President. Stockpile management activities include maintenance, evaluation, repair, or replacement of weapons in the existing stockpile.

An NOI to prepare the Stockpile Stewardship and Management PEIS was published in the Federal Register (60 FR 31291) on June 14, 1995. Eight public scoping meetings were held around the country during June, July, and August 1995. The results of the scoping process and a discussion of the alternatives to be analyzed will be documented in the IP for the Stockpile Stewardship and Management PEIS expected to be published in October 1995.

1.5.2 Waste Management Programmatic Environmental Impact Statement

The Waste Management PEIS, which is currently being prepared, is analyzing alternatives for managing the safe disposal of radioactive, hazardous, and mixed (i.e. radioactive and hazardous) wastes. When completed, the PEIS will support DOE decisions on the management of processes or facilities for treatment, storage, or disposal of radioactive, hazardous, or mixed wastes. An NOI to prepare the Waste Management PEIS was published in the Federal Register (55 FR 42633) on October 22, 1990. The results of the scoping process, which included public scoping meetings and public workshops on the Draft I and a discussion of alternatives are documented in the Final IP for the Waste Management PEIS (DOE/EIS-0200) published in January 1994. The Draft PEIS was issued in September 1995.

This PEIS addresses management of wastes and the facilities needed to accomplish an interim waste management mission in a manner that is consistent with future Environmental Management Program decisions. Additionally, this PEIS discusses ways to minimize waste generation during operation. The Waste Management PEIS is also addressing longer term management of wastes, including wastes that may be generated from long-term tritium supply and recycling activities. Many technologies required for the ultimate treatment and disposal of DOE wastes must still be developed. This is an even longer effort and will follow decisions based on the Waste Management PEIS. Preparation of PEISs has been closely coordinated to ensure that any cross-cutting issues are fully considered in the decision-making process.

1.5.3 Long-Term Storage and Disposition of Weapons-Usable Fissile Materials Program Environmental Impact Statement

The Long-Term Storage and Disposition of Weapons-Usable Fissile Materials PEIS, which is currently being prepared, is analyzing alternatives for the long-term storage of weapons-usable fissile materials, and the disposition of weapons-usable fissile materials declared surplus to national defense needs by the President. One of the alternatives analyzed would utilize surplus plutonium as a fuel in existing, modified, or new nuclear reactors. The tritium supply technologies analyzed in this PEIS have the potential to utilize surplus plutonium as a fuel. A discussion of disposing of plutonium in a new tritium supply facility is discussed in appendix A.3. An NOI to prepare the Long-Term Storage and Disposition of Weapons-Usable Fissile Materials PEIS was published in the Federal Register (59 FR 31985) on June 21, 1994. The results of the scoping process included the public scoping workshops announced in the Federal Register (59 FR 3643 July 18, 1994, and a discussion of the alternatives to be analyzed were documented in the IP for the Long-Term Storage and Disposition of Weapons-Usable Fissile Materials PEIS (DOE/EIS-0229-IP) published in March 1995.

1.5.4 Site-Wide Environmental Support Statements

Site-Wide Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components. The Department is currently preparing the Site-Wide Environmental Impact Statement (EIS) for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components. An amendment was issued on June 23, 1995, (60 FR 32661) which announced modification in the scoping

this EIS concerning the proposed action and alternatives for some of the Pantex operations. One of the announced modifications was for the alternative addressing the possible relocation of some or all of the Pantex operations to one or more sites.

The Pantex Site-Wide EIS is also analyzing alternatives to the interim storage of plutonium pits from disassembled weapons at Pantex pending decisions on their disposition. The Draft Site-Wide EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components is expected to be completed in December 1995.

Site-Wide Environmental Impact Statement for the Nevada Test Site. The Site-Wide EIS (59FR40897) August 10, 1994, which is expected to be released for public review in November 1995 evaluates resource management alternatives for NTS that would support current and future defense related missions, research and development, waste management, environmental restoration, infrastructure maintenance, and facility upgrades and alternative uses over the next 5 to 10 years. The alternatives include: (1) No Action, continue existing missions and operations at the present level. No Action also includes the potential to resume underground nuclear testing and conducting other nuclear weapons related experiments at the site; (2) Expanded Use, which would maximize the use of the site in support of national programs of both defense and nondefense nature. National Defense activities could include a resumption of underground nuclear testing with the required support activities; conducting other nuclear weapons related experiments; the construction and operation of various types of simulator facilities and other experimental test facilities; tritium production; plutonium storage and disposition; nuclear weapons and disassembly and similar activities that could be best conducted at a remote site; (3) Other alternatives such as variations of the No Action alternative.

1.5.5 Programmatic Spent Nuclear Fuel Management Environmental Impact Statement

In the ROD (60 FR 28680) for the Programmatic Spent Nuclear Fuel Management EIS, DOE decided to regionalize spent nuclear fuel management by fuel type at three sites: Hanford, INEL, and SRS. The regionalization strategy will result in the inventory of spent nuclear fuel (in metric tons of heavy metal) reaching 2,103 at Hanford, 426 at INEL, and 21 at SRS.

1.5.6 Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Spent Nuclear Fuel

DOE is preparing an EIS to evaluate the potential impacts of the adoption and implementation of a policy to accept foreign research reactor spent nuclear fuel that contains uranium enriched in the United States. Under the proposed policy, the United States would accept approximately 24,300 fuel elements of highly enriched uranium or low-enriched uranium from foreign research reactors in approximately 30 nations during a 10 to 15-year period. The implementation of this policy would result in the receipt of spent nuclear fuel at one or more United States marine ports of entry and overland transport to one or more DOE sites.

1.6 Program Changes

A number of significant program changes have occurred since publication of the Nuclear Weapons Complex Reconfiguration Study and the original NOI (56 FR 5590) to prepare the PEIS. These changes include the following:

Long-Term Storage for Special Nuclear Materials. Since the original Reconfiguration Proposal was published, a significant number of weapons have been and will continue to be retired from the Nation's active nuclear weapons stockpile. Previously, the stockpile reductions mandated that relatively few weapons would be retired without replacement. Therefore, when the original NOI and IP were prepared, the long-term storage of the materials was not a contemplated mission requirement since disassembled components would be recycled into new weapons. Presently, DOE does not have a long-term consolidated facility to store either plutonium or highly enriched uranium. Therefore, DOE is preparing the Long-Term Storage and Disposition of Weapons-Usable Fissile Materials PEIS to a

long-term storage of these materials.

Siting Alternatives for Weapons Functions. In the original February 1992 IP for the Reconfiguration PEIS, Hanford, INEL, ORR, Pantex, and SRS were identified as reasonable alternative sites for the proposed reconfigured facilities. However, based upon reevaluation of the original proposal, DOE added NTS to this PEIS as a potential site for the tritium supply and recycling facilities. NTS is a large, remote site that meets minimum qualification criteria (56 FR 5595) against which the other sites were evaluated, and it has a significant existing infrastructure that could accommodate functions. Additionally, Hanford was eliminated as a candidate site for the future Complex because nuclear weapons production functions at that site have been terminated. The site is now dedicated to the DOE Office of the Assistant Secretary for Environmental Management (EM) activities.

Tritium Production. The New Production Reactor EIS was intended to assess Hanford, and SRS as alternative sites for new tritium supply. At the same time the decision was made to eliminate Hanford, NTS was added to the list as a candidate site for a new supply. In addition, given the much smaller capacity needed to satisfy the tritium production requirements than originally contemplated, DOE concluded that ORR and Pantex constitute reasonable candidate sites for tritium supply and recycling facilities. Therefore, ORR and Pantex were added to the list of candidate sites for these facilities in this PEIS.

Weapons Complex Mission Changes. Since the publication of the original NOI, there have been changes within the Complex that have affected the No Action alternative in this PEIS. Some functions that were previously performed at particular sites can no longer be performed in existing facilities at those sites. More specifically, the K-Reactor has been placed in cold standby with no planned provision for restart. This has effectively eliminated DOE's ability to produce tritium to support the projected stockpile requirements. Consequently, at some point the nuclear deterrent capability of the Complex would either be lost or based upon weapons which would be significantly different from those in the current stockpile. This capability would not meet present mission requirements.

1.7 Public Participation

Public participation for the PEIS consisted of two primary activities: the scoping and the public comment process. CEQ regulations (40 CFR 1501.7) require "an early and continuing process for determining the scope of issues to be addressed and for identifying the significant issues related to a Proposed Action." This is usually called the public scoping process. Section 1.7.1 briefly describes the scoping process and major issues identified for analysis in the PEIS.

1.7.1 The Scoping Process

Scoping for the Draft PEIS consisted of both internal DOE scoping and external public scoping. Internal DOE scoping began with expert working groups that produced the U. Department of Energy Nuclear Weapons Modernization Report (December 1988) and the Nuclear Weapons Complex Reconfiguration Study. External scoping began after DOE completed the Nuclear Weapons Complex Reconfiguration Study and published an NOI in the Federal Register (56 FR 5590) on February 11, 1991. The original NOI public scoping phase, which included public meetings at potentially affected sites, ended September 30, 1991. The scoping process and results of the first NOI are discussed in detail in the February 1992 IP (DOE/EIS-0161IP). A revised NOI (58 FR 39528) was published on July 23, 1993, and a final public scoping was conducted through October 29, 1993. A Notice was published in the Federal Register (59 FR 54175) on October 28, 1994, inviting public comment on the proposal to separate the Reconfiguration PEIS into two separate PEISs.

Public scoping meetings for the revised NOI were conducted at 12 locations around the country to allow interested parties to present verbal comments and other information. Comments received through public scoping were organized and reviewed for consideration during the preparation of the revised IP and this PEIS. An extensive summary of all

comments received during the public scoping process, along with the planned scope and content of this PEIS, was published in the revised IP (DOE/EIS-0161IPREV).

1.7.2 Public Comment Process on the Draft Programmatic Environmental Impact Statement

DOE's goal was to conduct the public comment process in a manner that encouraged discussion and mutual understanding of the NEPA process and the alternatives analyzed in the PEIS. After the Draft PEIS was published, a 60-day public comment period was held. Changes to this PEIS that resulted from public comments during this process are described in section 1.7.2.1.

In February 1995, DOE published the Draft Programmatic Environmental Impact Statement for Tritium Supply and Recycling evaluating the siting, construction, and operation of tritium supply technology alternatives and recycling facilities at five candidate sites within the Complex. The 60-day public comment period for the Draft PEIS began on March 1, 1995, and ended on May 15, 1995. However, comments were accepted as late as June 23, 1995.

During the comment period, public hearings were held in Washington, DC; Pocatello, ID; Las Vegas, NV; North Augusta, SC; Oak Ridge, TN; and Amarillo, TX. Two hearings were held at each location. In addition, the public was encouraged to provide comments via mail, electronic bulletin board (Internet), and telephone (toll-free 800 number). Figure 1.7.2-1 shows the dates and locations of the hearings.

Figure (Page 1-12)

Figure 1.7.2-1.-Public Hearing Locations and Dates, 1995.

In response to public comments and feedback critical of DOE's traditional courtroom hearing format, the public hearings held for the Draft PEIS were conducted using an interactive format. The format chosen allowed for a two-way interaction between DOE and the public; increased public awareness and understanding of project-related impacts discussed in the Draft PEIS; and encouraged informed public input and comments on the Draft PEIS. Neutral facilitators were present at the hearings to direct and clarify discussions and comments.

All public hearing comment summaries were combined with comments received by mail, Internet, or telephone during the public comment period. Volume III of this PEIS, the comment response document, describes the public comment process in detail, presents comment summaries and responses, and provides copies of all comments received.

1.7.3 Major Comments Received on Draft Programmatic Environmental Impact Statement

During public review of the Draft PEIS a large number of the comments received reflected concerns that alternatives and/or candidate sites were not given the correct amount of consideration on factors including cost and technical feasibility. Although these concerns made up the majority of the comments, many others involved the resources analyzed, and regulatory issues, and DOE and Federal policies as they related to the PEIS. The issues identified by commentors include the following:

The electrical requirements of the various alternatives, particularly the APT, and the potential for the MHTGR and ALWR to produce electricity;

The impacts of the alternatives on groundwater, including the potential for aquifer depletion and contamination and the consideration of the use of treated wastewater for cooling;

The socioeconomic impacts, both positive and negative, of locating or failing to locate a facility at one of the candidate sites;

The generation, storage, and disposal of radioactive and hazardous wastes (including spent nuclear fuel) and the associated risks;

The impacts of the alternatives on human health (both from radiation and hazardous

chemicals) and how these risks were determined and evaluated;

The relationship of this PEIS to other DOE documents and programs, particularly the Waste Management PEIS and the Fissile Materials Disposition Program, and the need to make decisions based on all associated programs and activities concurrently;

The need for decisions to be based on many different factors, including environmental cost, and safety concerns;

The failure of DOE to consider a no tritium or zero stockpile alternative, and the negative national and international implications of building a new tritium supply facility; and

The need for DOE to consider a commercial reactor alternative in greater detail.

Additionally, as a result of public comments, DOE published on August 25, 1995, a Notice in the Federal Register (60 FR 44327) to reopen the comment period for 21 days in order to solicit comments on the Department's intention to include in the PEIS the purchase of irradiation services from a commercial reactor as a reasonable alternative to producing tritium. During the extended comment period, there were two major issues of concern raised:

License and regulatory implications; and

Non-proliferation concerns.

All of the comments identified above are summarized and responded to in detail in Chapter 3 of volume III. Substantial revisions to the PEIS resulting from public comments are discussed below.

Revisions in the Final PEIS include additional discussion and analysis in the following areas: severe accidents and design-basis accidents for all tritium supply technologies; site-specific environmental impacts of a dedicated power plant for the APT; revisions to water resources sections; site-specific analysis of the multipurpose reactor that could produce tritium, burn plutonium as fuel, and produce electricity; and the commercial reactor alternative, specifically the purchase of an existing reactor and the purchase of irradiation services for DOE target rods to produce tritium. Each of these areas is discussed in more detail in the following section.

1.7.4 Changes from the Draft Programmatic Environmental Impact Statement

As a result of comments received on the Draft PEIS, several changes were incorporated into this PEIS. Revisions to the document include additional discussion and analysis in the following areas: severe accidents and design-basis accidents for all tritium supply technologies; site-specific environmental impacts of a dedicated power plant for the APT; revisions to water resources sections; site-specific analysis of the multipurpose reactor that could produce tritium, burn plutonium as fuel, and produce electricity; purchase of irradiation services from a commercial reactor; and analysis of producing tritium at an earlier date in order to support a larger stockpile size.

Analysis of an ALWR design-basis accident was reevaluated as a result of public comment questioning the apparent severity and frequency of the accident consequences shown in the Draft PEIS. Additional analyses were performed to accurately estimate the impacts of a more reasonable design-basis accident and these results have been included in the PEIS in sections 4.1.3.9, 4.2.3.9, 4.3.3.9, 4.4.3.9, 4.5.3.9, 4.6.3.9, and appendix F.2.2.3.

The analyses of impacts of severe reactor accidents, located in the Final PEIS sections 4.1.3.9, 4.2.3.9, 4.3.3.9, 4.4.3.9, 4.5.3.9, 4.6.3.9, and appendix F.2.1.3 were revised. Since accident consequences vary greatly depending on the selected frequency value, a spectrum of severe accidents with a range of frequencies was used to perform a more representative analysis for each technology. The resulting impacts presented in this section reflect the probable effects of a set of accidents for each reactor rather

the single accident scenario.

Public comments also suggested that a disparity existed between the reactor and APT accident analyses, thereby creating a bias in favor of the APT. A new accident analysis presented in sections 4.1.3.9, 4.2.3.9, 4.3.3.9, 4.4.3.9, 4.5.3.9, 4.6.3.9, and appendix F.2.1.4 for the APT has a more severe initiating event, a lower frequency, and a higher consequence than the analysis presented in the Draft PEIS.

Additionally, PEIS sections 4.1.3.9, 4.2.3.9, 4.3.3.9, 4.4.3.9, 4.5.3.9, 4.6.3.9, and appendix E.2 have been modified to include a qualitative discussion of impacts to workers (workers assigned to the facility and located in close proximity to the facility as a result of the proposed action) and quantitative impacts to noninvolved workers (workers collocated at the site independent of the proposed action).

Another change in the document is a more detailed description in section 4.8.2 of potential impacts of a dedicated power plant for the APT. The section has been modified to indicate that site-specific impacts for the gas-fired power plant have been included at each site in sections 4.2 through 4.6. The discussion of the site-specific cumulative impacts on land use, air quality, water resources, biotics, socioeconomics, human health, and rail transport is presented within sections 4.2 through 4.6.

Based on public comments received at the hearings, two revisions were incorporated into the water resources sections for NTS and Pantex. For NTS, section 4.3.2.4 incorporated accurate recharge rates and information regarding the potential project use of the aquifer to present a more accurate impact on groundwater resources. The new data were utilized to revise section 4.3.3.4 and provide more accurate potential environmental impacts to the NTS aquifer.

For Pantex, section 4.5.2.4 has been modified to include additional information on reclaimed sanitary wastewater sources, the Hollywood Road Wastewater Treatment Plant at the Pantex Plant Wastewater Treatment Plant. Section 4.5.3.4 now includes the projected amount and availability of reclaimed water from each source and the impacts of using reclaimed sanitary wastewater as a source of tritium supply cooling water.

To present a more detailed analysis of the multipurpose reactor option, section 4.8 has been revised. Construction and operation impacts discussed in section 4.8.3.1 have been incorporated as additional discussion in the site-specific sections (sections 4.2 through 4.6) at the end of each affected resource section for a multipurpose ALWR and a MHTGR.

Additionally, as a result of public comments, DOE published on August 25, 1995 a Notice in the Federal Register (60 FR 44327) to include the purchase of irradiation services from a commercial reactor as a reasonable alternative. The Draft PEIS considered this an unreasonable alternative because of the long-standing policy of the United States that civilian nuclear facilities should not be utilized for military purposes and nonproliferation concerns. Nonetheless, the Draft PEIS included an evaluation of the environmental impacts of irradiation services using an existing commercial reactor to make tritium. Because of public comments on the Notice, public review of the Draft and further consideration of nonproliferation issues, purchase of irradiation services is evaluated in the PEIS as a reasonable alternative.

Revisions have also been made in chapter 3.4 and sections 4.10 of this PEIS to provide additional information and analysis on the commercial reactor alternative. Analysis of the alternative of DOE purchasing an existing operating commercial reactor or an incomplete reactor and converting it to production of tritium for defense purposes.

A new section has also been added to the Final PEIS (section 4.11, providing tritium earlier date). The new section evaluates the potential impacts of providing tritium earlier date to support a higher stockpile level. The new section was added because the START II Treaty has not been ratified.

1.8 Organization of the Programmatic Environmental Impact Statement

This PEIS is divided into three volumes. Volume I contains the summary and the main and Volume II contains technical appendixes that provide supporting details for the analyses in Volume I along with additional project information. Volume III contains comments received on the Draft PEIS during the public review period and the DOE res A PEIS executive summary which is more detailed than the summary contained in this also available as a separate publication.

Volume I contains the summary and 10 chapters. Chapter 1 provides an introduction t Tritium Supply and Recycling Proposal and the approach to this PEIS. Chapter 2 pres the purpose of and need for the DOE's action. Chapter 3 describes the Tritium Suppl Recycling Proposal and alternatives. Chapter 4 includes discussions of the affected environment and environmental impacts of the alternatives, and chapter 5 contains environmental, occupational safety, and health permits and compliance requirements. remaining chapters contain references; a list of preparers; a list of agencies, organizations, and persons to whom copies of this PEIS were sent; a glossary; and a index.

Volume II contains nine appendixes of technical information in support of the environmental analyses presented in Volume I. These appendixes contain information following issues: nuclear facilities; air quality and acoustics; biotic resources; socioeconomics; human health; facility accidents; intersite transportation; environmental management; and summary comparison of environmental consequences of t tritium supply and recycling alternatives.

Volume III (Comment Response Document) contains a description of the public hearing process; how the comment response document is organized and instructions for its us brief summary of changes to the Draft PEIS; and all comments received and DOErespon

1.9 Preparation of the Programmatic Environmental Impact Statement

This PEIS has been prepared in accordance with Section 102(2)(c) of NEPA as amended U.S.C. 4321 et seq.), and implemented by regulations promulgated by the CEQ (40 CFR 1500-1508) and as provided in the DOE NEPA regulations (10 CFR 1021). The organizat this document (as described in section 1.8) is consistent with CEQ regulations (40 1502.10).





CHAPTER 2: PURPOSE OF AND NEED FOR THE DEPARTMENT OF ENERGY'S ACTION

Chapter 2 discusses the Department of Energy's purpose and need to provide a tritium supply and recycling capability.

2.1 Purpose of and Need for the Department of Energy's Action

Since nuclear weapons came into existence in 1945, a nuclear deterrent has been a cornerstone of the Nation's defense policy and national security. The President reinforced this principle in his July 3, 1993, radio address to the Nation. Tritium was used in the design process to enhance the yield of nuclear weapons and allows for the production of smaller or more powerful warheads to satisfy the needs of modern delivery systems. As a result, the United States strategic nuclear systems are based on designs that use tritium. Thus, the Nation requires a reliable supply source of tritium to maintain the nuclear weapon stockpile. Tritium has a relatively short radioactive half-life of 12.3 years. Because of this relatively rapid radioactive decay, tritium must be replenished periodically in nuclear weapons to ensure that they will function as designed. Over the past 40 years, the Department of Energy (DOE) has built and operated 14 reactors to produce nuclear materials, including tritium. Today, none of these reactors is operational, and no tritium has been produced since 1988.

Pursuant to the Atomic Energy Act of 1954, DOE is responsible for developing and maintaining the capability to produce nuclear materials such as tritium, that are required for the defense of the United States. The primary use of tritium is for maintaining the Nation's stockpile of nuclear weapons as directed by the President's Nuclear Weapons Stockpile Plan (section 1.4.1).

The Nuclear Weapons Stockpile Plan is normally forwarded annually from the Secretary of the Department of Defense and DOE via the National Security Council to the President for approval. The Nuclear Weapons Stockpile Plan reflects the size and composition of the stockpile needed to defend the United States. The Nuclear Weapons Stockpile Plan provides an assessment of DOE's ability to support the proposed stockpile. Many factors are considered in the development of the Nuclear Weapons Stockpile Plan, including the size of the currently approved stockpile, arms control negotiations and treaties, Congressional constraints, and the status of the nuclear material production and fabrication facilities. Revisions of the Nuclear Weapons Stockpile Plan could be issued when the factors indicate the need to change requirements established in the annual document. The most current Nuclear Weapons Stockpile Plan, which was approved by President Clinton on March 7, 1994, authorizes weapons production and retirement through fiscal year 2000. The analysis in this Programmatic Environmental Impact Statement (PEIS) is based on requirements of the 1994 Nuclear Weapons Stockpile Plan, which is based on START II stockpile levels (approximately 3,500 accountable weapons). The 1994 Nuclear Weapons Stockpile Plan represents the latest official guidance for tritium requirements. A new Nuclear Weapons Stockpile Plan for 1995 has not yet been issued. Appendix CA, which is classified, contains quantitative projections for tritium requirements based on the 1994 Nuclear Weapons Stockpile Plan and details of a transportation analysis conducted by the National Security Council of shipping routes involved in nuclear weapons production.

Even with a reduced nuclear weapons stockpile and no identified requirements for new nuclear weapons production in the foreseeable future, an assured long-term tritium supply and recycling capability will be required to maintain the weapons determined to be required for national defense under the prevailing Nuclear Weapons Stockpile Plan. Presently, no source of new tritium is available. The effectiveness of the United States' nuclear deterrent capability depends not only on the Nation's current stockpile of nuclear weapons or those it can produce, but also on its ability to reliably and safely provide the tritium needed to support these weapons.

Until a new tritium supply source is operational, DOE will continue to support tritium requirements by recycling tritium from weapons retired from the Nation's nuclear weapons stockpile (section 3.4.1). However, because tritium decays relatively quickly, recycling can only meet the tritium demands for a limited time. Current projections, derived from classified projections of future stockpile scenarios, indicate that recycled tritium will adequately support the Nation's nuclear weapons stockpile until approximately (figure 2.1-1). After that time, without a new tritium supply source, it would be necessary to use the strategic reserve of tritium to maintain the readiness of the weapons stockpile. The strategic reserve of tritium contains a quantity of tritium maintained for emergencies and contingencies. In such a scenario, once the strategic tritium reserve is depleted, the nuclear deterrent capability would degrade because all of the weapons in the stockpile would be capable of functioning as designed. Eventually, the nuclear deterrent would be lost. The proposed tritium supply and recycling facilities would provide the capability to produce tritium safely and reliably to meet the Nation's defense requirements well into the 21st century while also complying with environment, safety, and health (ES&H) standards.

Figure (Page 2-2)

Figure 2.1-1.-Estimated Tritium Inventory and Reserve Requirements.

DOE has analyzed the activities that must take place to bring a new tritium supply into operation. The analysis indicates that it could take approximately 15 years to research, develop, design, construct, and test a new tritium supply source before nuclear tritium production can begin. Thus, to have reasonable confidence that the Nation will be able to maintain an effective nuclear deterrent, prudent management dictates that DOE proceed with the proposed action now. In addition, DOE was required to meet a statutory deadline of March 1, 1995, to issue a PEIS addressing tritium supply alternatives (Public Law 103-160, section 3145). That deadline was met by the issuance of the Draft Programmatic Environmental Impact Statement for Tritium Supply and Recycling in February 1995. Following public hearings, comments received have been considered in preparing the Final PEIS, which will be submitted to Congress to close out DOE's obligation with respect to the intent of Public Law 103-160, section 3145.

