DOE/EIS-0161-Vol.1

Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling

Volume I

United States Department of Energy
Office of Reconfiguration

October 1995

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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

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Changes to the Draft PEIS that are less than a paragraph, are shown in double underline in this 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 Recycling (DOE/EIS-0161).

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ABSTRACT: Tritium, a radioactive gas used in all of the Nation's nuclear weapons, has a short half-life and must be replaced periodically in order for the weapon to operate as designed. Currently, there is no capability to produce the required amounts of tritium within the Nuclear Weapons Complex.

The PEIS for Tritium Supply and Recycling evaluates the alternatives for the siting, construction, and operation of tritium supply and recycling facilities at each of five candidate sites: the Idaho National Engineering Laboratory, the Nevada Test Site, the Oak Ridge Reservation, the Pantex Plant, and the Savannah River Site. Alternatives for new tritium supply and recycling facilities consist of four different tritium supply technologies: Heavy Water Reactor, Modular High Temperature Gas-Cooled Reactor, Advanced Light Water Reactor, and Accelerator Production of Tritium. The PEIS also evaluates the impacts of the DOE purchase of an existing operating or partially completed commercial light water reactor or the DOE purchase of irradiation services contracted from commercial power reactors. Additionally, the PEIS includes an analysis of multipurpose reactors that would produce tritium, dispose of plutonium, and produce electricity.

Evaluation of impacts on land resources, site infrastructure, air quality and acoustics, water resources, geology and soils, biotic resources, cultural and paleontological resources, socioeconomics, radiological and hazardous chemical impacts during normal operation and accidents to workers and the public, waste management, and intersite transport are included in the assessment.

PUBLIC COMMENTS: In preparing the Final PEIS, DOE considered comments received by mail, fax, handed in at hearings, transcribed from messages recorded by telephone, and those transmitted via Internet. In addition, interactive public hearings were held in April 1995 at the following locations where comments and concerns identified during discussions were summarized by notetakers: Washington, DC; Las Vegas, Nevada; Oak Ridge, Tennessee; Pocatello, Idaho; North Augusta, South Carolina; and Amarillo, Texas.

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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
L_{eq}	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
PM_{10}	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
$CC1_4$	carbon tetrachloride
CO	carbon monoxide
CFC	chlorofluorocarbons
dB	decibel
dBA	decibel A-weighted
DCE	1, 2-dichlororethylene
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-tetrazocine
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	pentaerythritoltetranitrate
ppb	parts per billion
ppm	parts per million
Pu	plutonium
RDX	cyclotrimethylenetrinitramine
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
µCi	microcurie (one-millionth of a curie)
µCi/g	microcuries per gram
µg	microgram (one-millionth of a gram)
µg/kg	micrograms per kilogram
µg/l	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
µm	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	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
sq. inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

Metric Prefixes

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

SUMMARY

Summary

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 PEIS 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 Department 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-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 excess nuclear materials. This program was recognized in the FY 1995. Defense Authorization Bill 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 so 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, *The 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. An EIS 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 not part of the Complex. Defense missions have been terminated at the Rocky Flats Plant, Mound Plant, and the Pinellas Plant. 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.

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.**

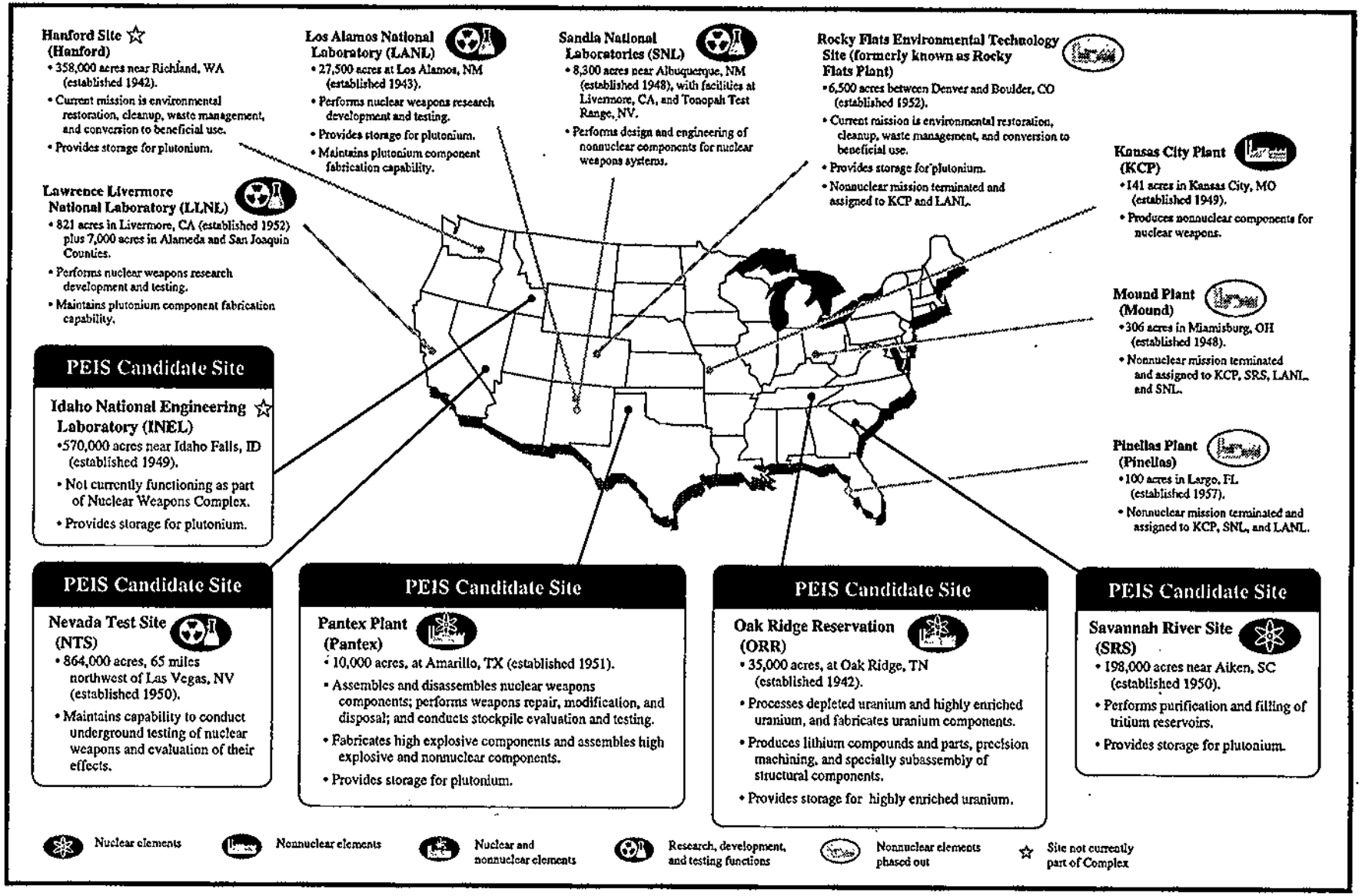


FIGURE S–1.—*Current and Former Nuclear Weapons Complex Sites.*

There is now no capability to produce the required amounts of tritium within the Complex. Tritium, with a half-life of 12.3 years, is necessary for all weapons that remain in the stockpile. Thus, tritium must be replaced periodically as long as the Nation relies on a nuclear deterrent. Current projections require that a new source of tritium be available by 2009 and new tritium be available for stockpile use by 2011. This *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 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.

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 not identified in this PEIS.

This PEIS also addresses the environmental impacts of an Advanced Light Water Reactor (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, reference to and discussion of impacts for the 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 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 tritium 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 ALWR 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 to meet tritium requirements and to burn plutonium. A plutonium Pit Disassembly/Conversion 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 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 approved by the President as discussed in section 1.1. In this PEIS, the baseline tritium requirement is approximately 3/8ths the tritium requirement that was analyzed in the New Production Reactor Draft EIS published in April 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; and (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.

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 tritium. 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.

The Tritium Supply and Recycling Proposal will proceed in three phases. The first phase involves

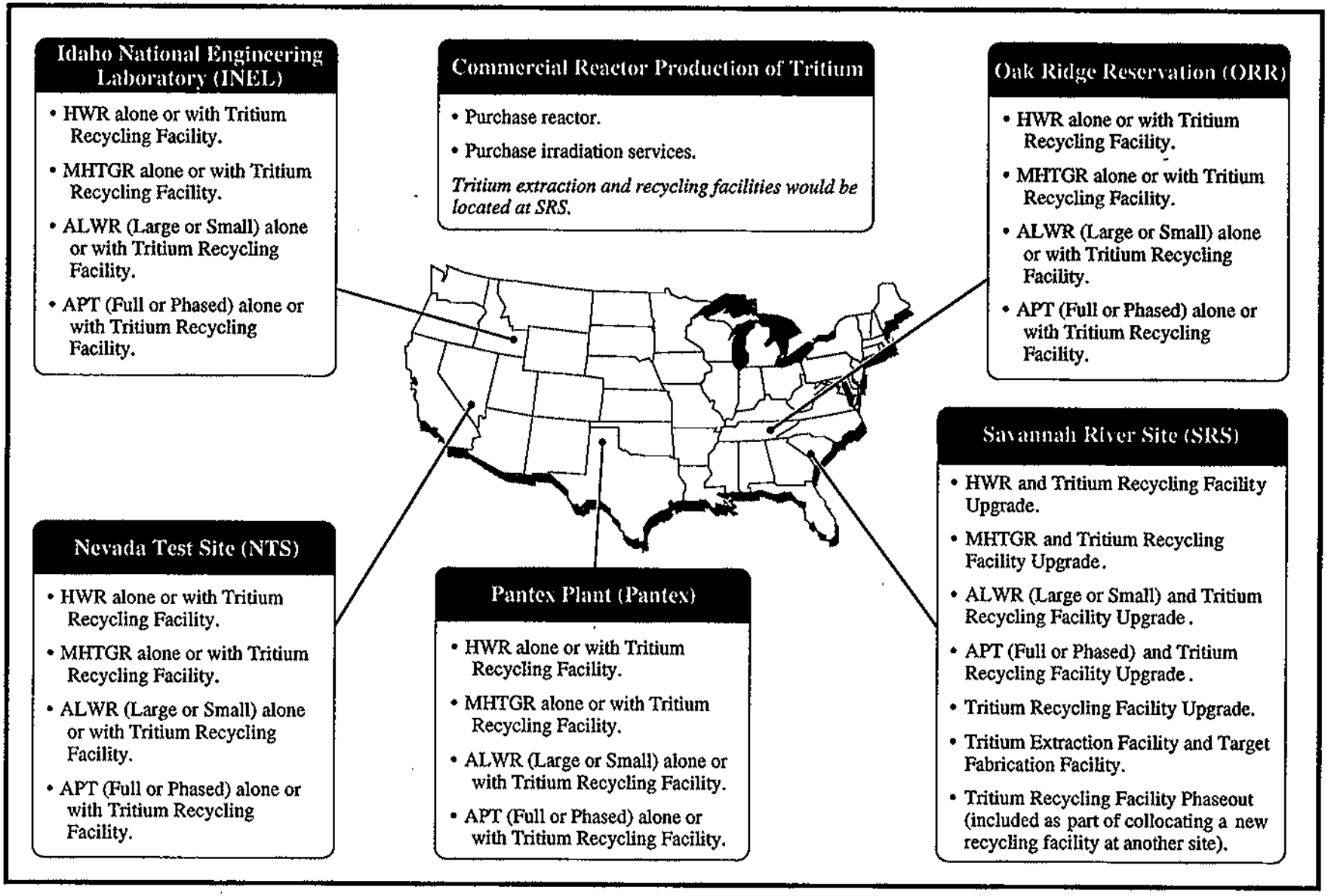


FIGURE S–2.—*Tritium Supply and Recycling Alternatives.*

preparing information to support programmatic decisions on siting and technology. This includes preparing this PEIS and the associated Record of Decision (ROD). 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.

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 a 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 the 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 the many uncertainties associated with this proposal, assumptions were made regarding the 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 the specific construction and operational periods for each project implemented.

AGENCY PERFERRED ALTERNATIVE

The Council on Environmental Quality (CEQ) Regulations require an agency to identify its preferred alternative(s) in the Final Environmental Impact Statement (40 CFR 1502.14(e)). The preferred alternative is the alternative which the agency believes would fulfill its statutory mission, giving consideration to environmental, economic, technical, and other 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 technical analyses have also been prepared, and are summarized in the Tritium Supply and Recycling Technical Reference Report which is available in the appropriate DOE Reading Rooms for public review.

Based upon the analysis presented in the documents identified above, the Department's 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 activities 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 reiterated 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 and, consequently, require 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 14 reactors to produce nuclear materials for weapons purposes, including tritium. Today, none of these 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 developing and maintaining the capability to produce tritium and other nuclear materials, which 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 in the Nuclear Weapon Stockpile Plan (section 1.4.1).

The *Nuclear Weapons Stockpile Plan* is normally forwarded annually from the Secretaries of the Department of Defense (DOD) 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 and provides an assessment of the 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 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 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. A *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 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 supply and recycling capability will be required. 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. 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 2011. 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 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 21stcentury while also complying with environment, safety, and health (ES&H) 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 15 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 comment period, public hearings were held in Las Vegas, NV; Washington, DC; Pocatello, ID; Oak 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 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 DOE 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 the 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 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 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 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 PEIS, and further consideration of nonproliferation issues, purchase of irradiation services is 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 was 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 from a more reasonable design-basis accident and these results have been included in the Final PEIS.

The analyses of impacts of severe reactor accidents was 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 has 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 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 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 in 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 NTS aquifer to present a more accurate impact on groundwater resources.

For Pantex, the Final PEIS includes the use of reclaimed sanitary wastewater sources, the Hollywood Road Wastewater Treatment Plant and the Pantex Plant Wastewater Treatment Plant 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 detail 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 this PEIS on the alternative of DOE purchasing an existing operating commercial reactor or 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 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). 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 (SRS).

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 either 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 utilize 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 sole 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 350 MWt 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 MGTGR 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 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 ALWR technology: a Large ALWR (1,300 MWe) and a Small ALWR (600 MWe). The large and small options 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 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. 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, the 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 Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would be needed to provide the mixed-oxide fuel rods for the ALWR, and would be the major contributor to potential environmental impacts for this

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

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 one of 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 550 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 the targets; a klystron remanufacturing and maintenance facility; waste treatment buildings to treat all generated wastes; security infrastructures and various administration, operation, and maintenance facilities. The APT complex would cover approximately 173 acres. Construction of the APT would take about 5 years and require approximately 2,760 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 burnable 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 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 core cooling system for heat removal in the event of a loss of coolant or a 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.

A commercial reactor would also be capable of performing the "triple play" missions of 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-Oxide 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 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 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 the sites have 50-mile population densities of less than 200 persons per square mile and over 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 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. 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 864,000 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 3,740,000 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 yd^3 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 Plant (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 10,000 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 site 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, while 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 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 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 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-West, 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. Only four DOE research reactors are currently operational: the High Flux Isotope Reactor at Oak Ridge Reservation (ORR); the High Flux Beam Reactor at Brookhaven National Laboratory; and 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 at 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 materials 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 10 years past its design 20-year lifetime has been completed. While technically possible to extend the lifetime, in 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 operational. 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 capable 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 health 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 delayed 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 1940s 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, none is 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 studies and 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 assemblies and 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 infeasible, and in any event beyond DOE's control.

It may be possible that an APT could use nonevaporative cooling towers which would greatly reduce the water requirements. However, there is sufficient technical uncertainty regarding the feasibility and practicality of using nonevaporative cooling towers for a continuous wave APT to render this option unacceptable as a source for the Nation's only 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 (LA DOE 1994a: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 size would extend the need date for new tritium beyond approximately 2011. If the need for new 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 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 appendixes. 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 summary 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 of the 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 site 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-hour PM_{10} 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 (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 (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 MHTGR). 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 region 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 worker 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 1.5 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 residing within 50 miles of the accident (150,000), the associated cancer risk would be 7.4×10^{-5} 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 meters from the release point would be 1.1×10^{-4}. The cancer risk to the worker would be 1.1×10^{-7} 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 to a 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, and 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 between 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 yd^3 per year (MHTGR) to 122 yd^3 per year (HWR). The HWR increase may require new or expanded treatment and storage facilities.

Hazardous waste generation would increase by approximately 4 yd^3 per year (APT) to 101 yd^3 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 yd^3 per year (APT) to 15,000 yd^3 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 tritiated 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 INEL is 5.1×10^{-4} fatalities.

Nevada Test Site

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 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 site 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-hour PM_{10} 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 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 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 MHTGR). Unemployment would decrease from 5 percent, the projected baseline, to between 3.9 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 region 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 worker traffic and congestion, particularly on Mercury Highway, 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 0.13 (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 0.08 (APT with helium-3 target) to 0.25 (Small ALWR) person-rem and could result in 1.6×10^{-3} 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 2.8 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 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 6.3×10^{-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 release 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, and 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) and 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 yd^3 per year (HWR) and would require an organic mixed waste treatment capability.

Hazardous waste generation would increase by 4 (APT) to 101 yd^3 per year (MHTGR). Separate or 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 yd^3 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 tritiated heavy water is 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). The annual risk 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 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 of the tritium supply technologies alone or collocated with recycling at ORR would disturb 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 the 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 PM_{10} 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 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 drift from an evaporative cooling system could impact an additional limited acreage for all 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 and 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 (APT) 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 to 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, and 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 worker 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 risks of fatal cancer from 40 years of operation would be 8.6×10^{-5}, 1.8×10^{-4}, and 2.7×10^{-4} (2.8×10^{-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 7.9 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 accident 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 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 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 meters from the release point would be 0.10. The cancer risk to the worker would be 1.6×10^{-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 0.6 (APT) and 3.5 (HWR) acres 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 yd^3 per year (APT) to 101 yd^3 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 yd^3 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 of transporting tritium is 13 percent lower than the existing case (No Action) because the distance travelled is shorter. The potential cancer fatalities per year from transporting triated heavy water is 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 of the 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 technologies, 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-hour PM_{10} 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 (MHTGR) 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 salt 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 be 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 (MHTGR) to 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 MHTGR). Unemployment would decrease from 4.6 percent, the projected baseline, to between 2.2 (for 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 school districts would increase by annual averages of 1 percent to 3 percent through 2005 then 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 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 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 9.2 (APT with helium-3 target) to 37 (Large ALWR) person-rem and could result in 0.18 to 0.73 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 from emissions of hazardous chemicals exceed the accepted regulatory threshold level of 1.0×10^{-6} annually. Potential mitigation, such as chemical substitution, can minimize these 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 a maximally exposed individual at the site boundary would be 6.2×10^{-6}. Given the

accident probability of $1.0x10^{-3}$ per year, the cancer risk would be $6.2x10^{-9}$ per year. For the population residing within 50 miles of the accident (287,000), the associated cancer risk would be $2.6x10^{-5}$ per year. If this accident occurred, this exposure would result in 0.026 cancer fatalities. The increased likelihood of cancer fatality to a worker located 1,000 meters from the release point would be $1.2x10^{-3}$. The cancer risk to the worker would be $1.2x10^{-8}$ 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 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 0.029 with an associated cancer risk of $4.6x10^{-9}$ per year. For the population residing within 50 miles of the accident (287,000), the associated cancer risk would be $6.7x10^{-7}$ per year. If this accident occurred, this exposure would result in 4.3 cancer fatalities. The increased likelihood of cancer fatality to a worker located 1,000 meters from the release point would be 0.070. The cancer risk to the worker would be $1.1x10^{-8}$ per year.

Waste Management. Spent nuclear fuel would be generated by the HWR, MHTGR, and ALWR, and would require a new storage facility. The APT would not generate spent fuel. Generation of 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. Refer to the NTS alternative for the additional LLW disposal area required at NTS. The increased generation of liquid mixed LLW could be handled with existing/planned facilities. Solid mixed LLW generation would increase from 3 yd^3 per year (MHTGR) to 122 yd^3 per year (HWR). The HWR increase would require expansion of existing and planned treatment and storage facilities.

Hazardous waste generation would increase from 4 (APT) to 101 yd^3 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) to 15,000 yd^3 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. The potential cancer fatalities per year from transporting tritiated heavy water is $3.57x10^{-5}$ (HWR) and $6.63x10^{-6}$ (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 $5.2x10^{-9}$ (APT) to $3.0x10^{-8}$ (HWR) and from $6.9x10^{-5}$ (APT) to $4.0x10^{-4}$ fatalities per year (HWR) from non-radiological causes. For intersite transportation of LLW, credible accidents associated with locating a tritium supply alone at Pantex would result in fatal cancers per year from radiological releases varying from $3.25x10^{-9}$ (APT) to $2.8x10^{-8}$ (HWR) and from $4.30x10^{-5}$ (APT) to $3.70x10^{-4}$ (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 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 Pantex is $5.1x10^{-4}$ 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 use 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 exceeding 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-hour PM_{10} stan-

dards. 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 15,946 MGY (Large ALWR) and represent increases of between 6 and 78 percent during operation, respectively. The generation of sanitary waste would range from 0.3 (APT) to 28 MGY (Large ALWR) during construction and 7 (APT) to 90 MGY (Large ALWR) during operation, respectively. Blowdown discharges to surface waters would range from 240 (APT) to 6,192 MGY (Large ALWR). Groundwater use would increase by 33 MGY during construction and 90 MGY (Large ALWR) during operation, representing increases of 1 and 3 percent, respectively.

Geology and Soils. Construction and operation would neither affect nor be affected by 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 between 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 and operational discharges to an onsite stream could affect wetland and aquatic communities. 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 (MHTGR) 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 would decrease from 4.8 percent, the projected baseline, to between 3.9 (HWR, ALWR, and APT) and 4 percent (MHTGR) during construction and to between 4.5 (HWR) and 4.6 percent (MHTGR, ALWR, 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 percent (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 would 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 4 and less than 1 percent through and 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 worker traffic and congestion, particularly on South Carolina Route 125, 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 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 4.4 to 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 (Large 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 health limits, the No Action worker effects from emission of hazardous chemicals exceed this 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, 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 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, this 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 1.9×10^{-3} 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 from the tritium supply technologies. The generation of solid mixed LLW would increase by 1 yd^3 per year (MHTGR) to 120 yd^3 per year (HWR). The HWR may require new or expanded treatment and storage facilities.

Hazardous waste generation would increase by 3 (APT) to 100 yd^3 per year (MHTGR) and would 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 yd^3 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 collocating 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 transporting highly-enriched uranium fuel feed material (HWR and MHTGR alternatives) from ORR to SRS is 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, 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-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 the sale of electric power. Only the ALWR and MHTGR would be capable of performing the triple play missions; the potential environmental impacts from these triple play reactors are 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 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 650 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 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 plants. 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 operations, and 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 NRC, 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 the 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 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 by 80 percent. Impacts to groundwater would not change significantly from those expected with 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 as 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 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 minor. Completing construction of a nuclear reactor would result in impacts resulting 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 the construction phase would include paints, solvents, acids, oils, and degreasers. Adverse 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 burn up 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 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 effluent 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 3,680 Ci per year in the multiple reactor scenario. Estimated increases of liquid tritium effluent ranges 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 DOE target assemblies would be expected to increase waste generation rates at the commercial reactor site. An estimated 164 yd^3 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 yd^3, assuming 8 ft^3/assembly) would 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 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 refueling 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 (0.25 and 0.95 person-rem from airborne and liquid releases, respectively) and the median was 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 would 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 the result of 40 years of reactor operation. There would be a slightly larger increase in the 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) have 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 PEIS alternatives (particularly the tritium supply technology alternatives i.e., HWR, MHTGR, 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 socioeconomics. For these resource areas, this general conclusion is particularly true when comparing the operational impacts of the 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., HWR, 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), the 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 site.

For other resource areas evaluated in the PEIS, the analyses indicate that there are notable environmental impact differences. Resource areas where notable differences exist 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 facility 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 the 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 reactor 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 smallest potential impacts to human health from accidents. The commercial reactor alternatives do not acquire any substantial risks by 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 to 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 the 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 or 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 Pantex, 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

Chapter 1

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 the key 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 tritium. 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 ALWR 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 not identified in this PEIS.

This PEIS also addresses the environmental impacts of an ALWR, modular gas-cooled reactor or commercial light water reactor used as a multipurpose 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.

1.2 Compliance with the *National Environmental Policy Act* for Tritium Supply and Recycling

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 analyses to 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 siting 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 cleanup or waste management at phased-out 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 being 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 from this PEIS for specific project proposals; therefore, subsequent proposed actions regarding 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 phase 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 also 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. The schedule

would be subject to change and include reassessments required by congressional authorizations and appropriations. Although the individual schedules of any activities or 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 1999 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 new 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 produced 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 Nation's 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 these 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.

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 environment, safety, and health (ES&H)

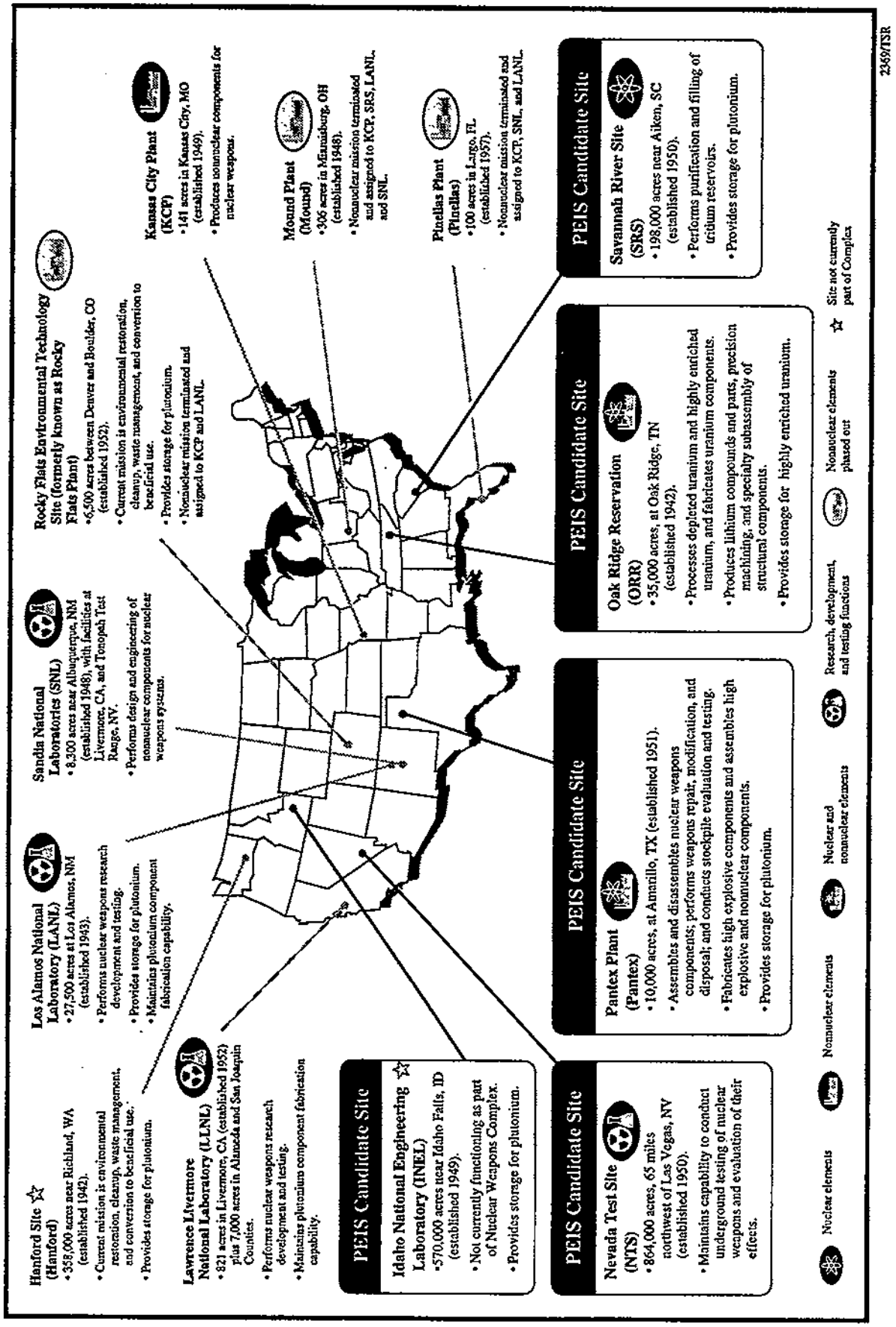


FIGURE 1.4-1.—*Current and Former Nuclear Weapons Complex Sites.*

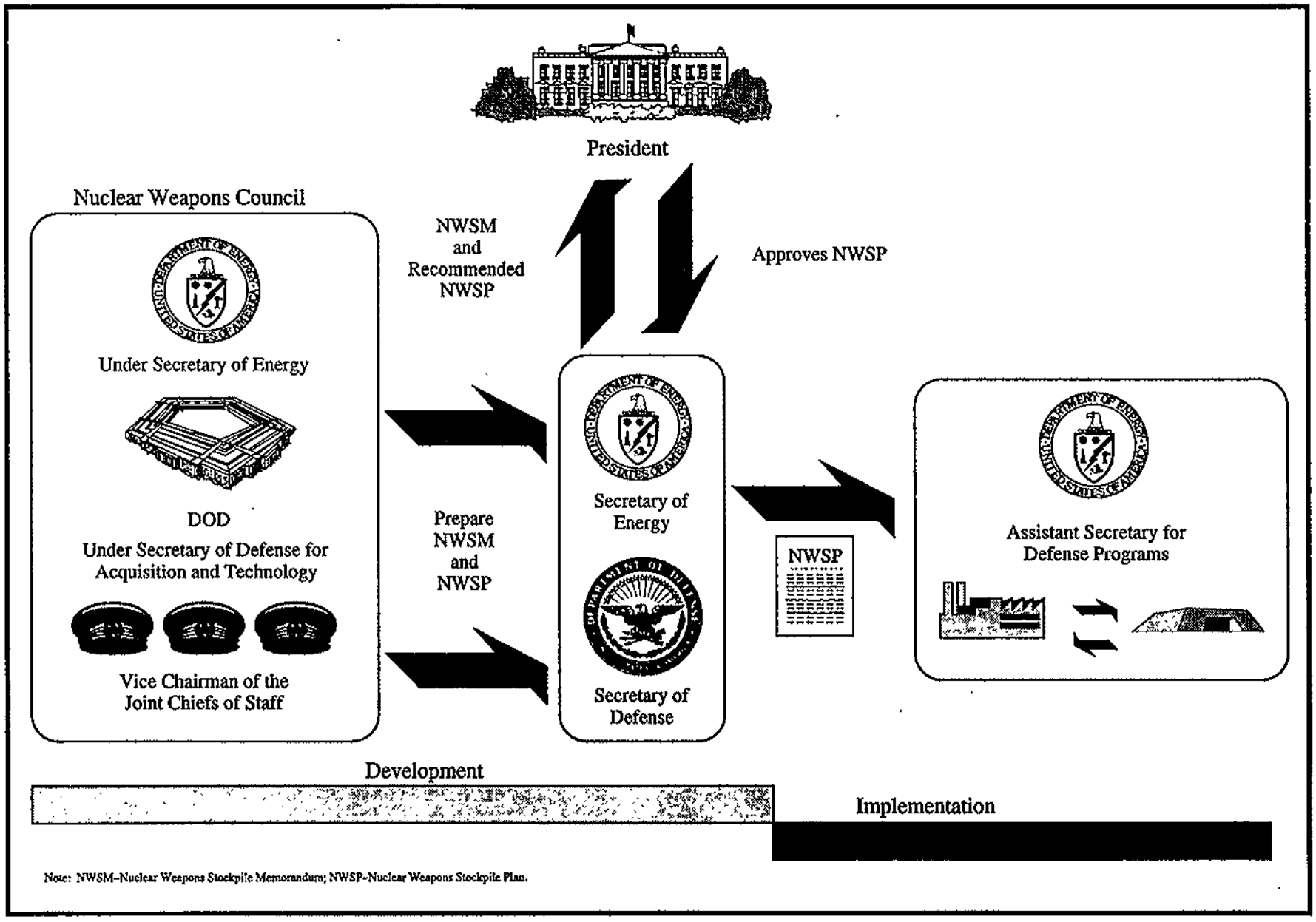


FIGURE 1.4.1–1.—*Nuclear Weapons Stockpile Plan Process.*

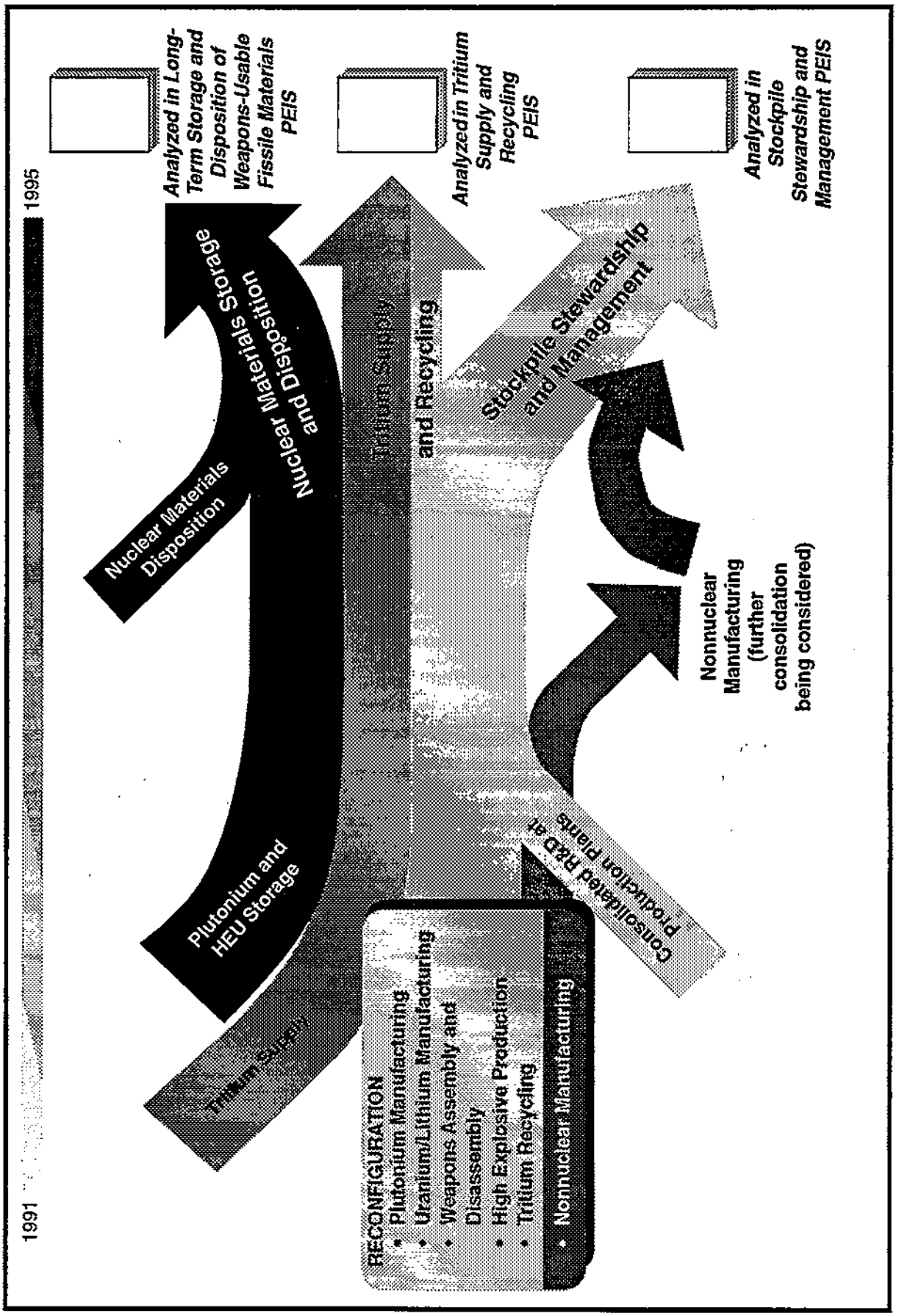


FIGURE 1.4.2-1.—*Evolution of the Reconfiguration Program, 1991–1995.*

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 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 a 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* (56 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 analysis, originally part of 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 (57 FR 3046). These facilities manufacture nonnuclear parts required for nuclear weapons and perform regular testing of individual components. The 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 action has 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) II Protocol, resulted in DOE reevaluating the Reconfiguration Program. On July 23, 1993, a 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 alternative 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 new 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 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 new component fabrication facilities in particular, given the lack of requirements for new weapons and an otherwise limited workload. There appeared to be a perception among many 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, many members of the public commented that DOE should address alternatives for the disposition of plutonium that is excess to 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) the 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 documents. 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. Stockpile stewardship includes activities required to maintain a high-level of confidence in the 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 IP, 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 term effort and will follow decisions based on the Waste Management PEIS. Preparation of the 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 Programmatic 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 being 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, which included the public scoping workshops announced in the *Federal Register* (59 FR 36430) on 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 amended NOI was issued on June 23, 1995, (60 FR 32661) which announced modification in the scope of 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 for NTS (59 FR 40897) 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 main-

tenance, 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 NTS 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 storage and disassembly and similar activities that could be best conducted at a remote site; and (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 213 at SRS.

1.5.6 Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor 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 this 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 these 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 address 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 the minimum qualification criteria (56 FR 5595) against which the other sites were evaluated, and it has a significant existing infrastructure that could accommodate these 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, INEL, 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 tritium 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 at SRS 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 Nation 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 process and the public comment process. CEQ regulations (40 CFR 1501.7) require "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a Proposed Action." 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.S. 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 additional 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. All 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 17, 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, fax, electronic bulletin board (Internet), and telephone (toll-free 800

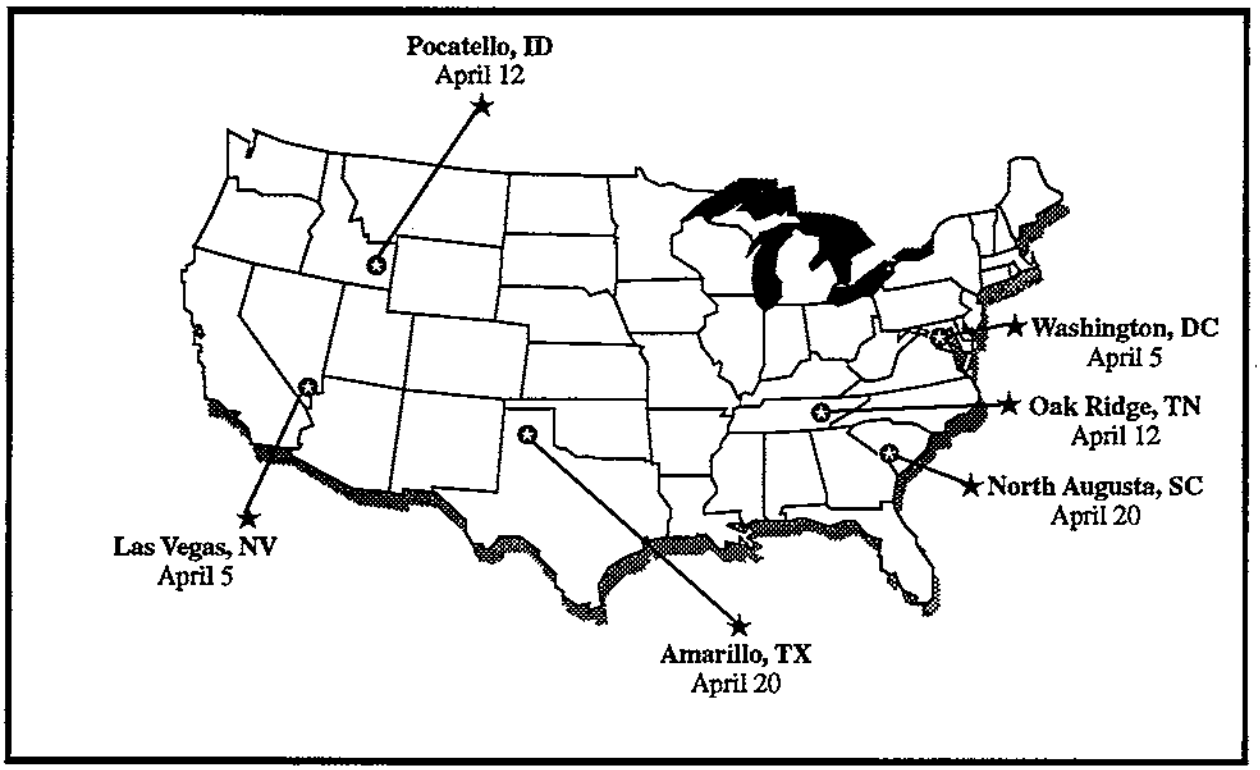


FIGURE 1.7.2–1.—*Public Hearing Locations and Dates, 1995.*

number). Figure 1.7.2–1 shows the dates and locations of the hearings.

In response to public comments and feedback critical of DOE's traditional courtroom-style hearing format, the public hearings held for the Draft PEIS were conducted using a new interactive format. The format chosen allowed for a two-way interaction between DOE and the public; increased public awareness and understanding on project-related impacts discussed in the Draft PEIS; and encouraged informed public input and comments on the document. 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, fax, 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 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 DOE and Federal policies as they related to the PEIS. The major 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 produce 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 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 from a more reasonable design-basis accident and these results have been included in the Final 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 was 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 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. 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 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).

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 for 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 in the water resources sections for NTS and Pantex. For NTS, section 4.3.2.4 incorporated more accurate recharge rates and information regarding the potential project use of the NTS 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 and 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 4.8.3 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 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 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 PEIS, 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 and a discussion of potential impacts has been expanded and included in this PEIS on 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 at an earlier date). The new section evaluates the potential impacts of providing tritium at an earlier date to support a higher stockpile level. The new section was added because a 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 text and Volume II contains technical appendixes that provide supporting details for the analyses in Volume I along with additional project information. Volume III contains the comments received on the Draft PEIS during the public review period and the DOE responses. A PEIS executive summary which is more detailed than the summary contained in this PEIS is also available as a separate publication.

Volume I contains the summary and 10 chapters. Chapter 1 provides an introduction to the Tritium Supply and Recycling Proposal and the approach to this PEIS. Chapter 2 presents the purpose of and need for the DOE's action. Chapter 3 describes the Tritium Supply and 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. The 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 an index.

Volume II contains nine appendixes of technical information in support of the environmental analyses presented in Volume I. These appendixes contain information on the 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 the 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 use; a brief summary of changes to the Draft PEIS; and all comments received and DOE responses.

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 (42 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 organization of this document (as described in section 1.8) is consistent with CEQ regulations (40 CFR 1502.10).

CHAPTER 2

Chapter 2

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 reiterated 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 in the *Nuclear Weapons Stockpile Plan* (section 1.4.1).

The *Nuclear Weapons Stockpile Plan* is normally forwarded annually from the Secretaries 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 status 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 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 Programmatic Environmental Impact Statement (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. A *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 needed 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 2011 (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 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 is depleted, the nuclear deterrent capability would degrade because not 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.

DOE has analyzed the activities that must take place to bring a new tritium supply source 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

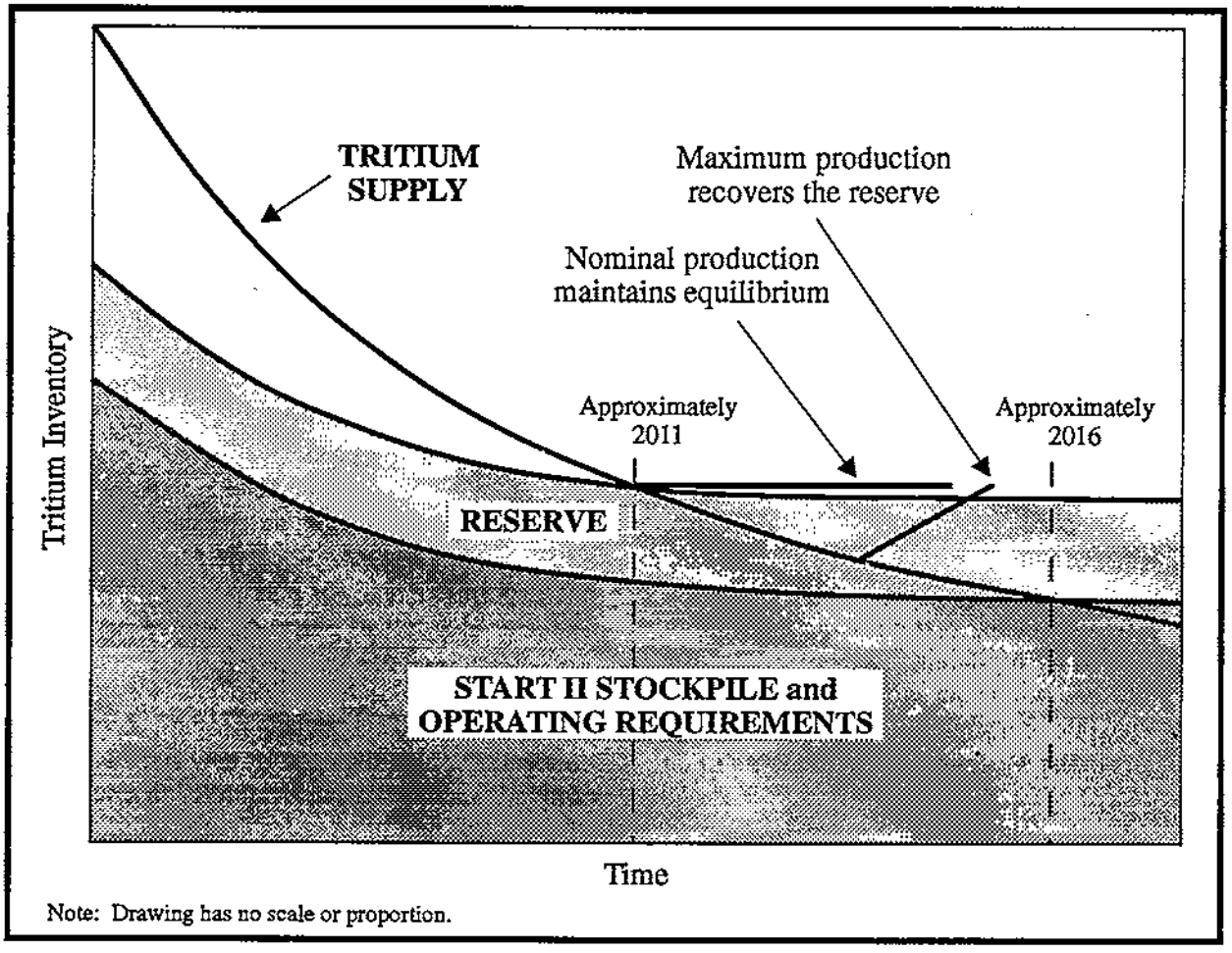


FIGURE 2.1–1.—*Estimated Tritium Inventory and Reserve Requirements.*

new 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 this 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.

CHAPTER 3

Chapter 3

CHAPTER 3: TRITIUM SUPPLY AND RECYCLING ALTERNATIVES

Chapter 3 provides a detailed description of the tritium supply and recycling alternatives for meeting the Nation's nuclear weapons stockpile tritium supply requirements. This chapter begins with a summary of the development of the alternatives, followed by a description of these alternatives, and concludes with a summary comparison of the environmental impacts of the tritium supply and recycling alternatives.

3.1 Development of Tritium Supply and Recycling Alternatives

Tritium is used in nuclear weapons to enhance their performance and to enable the design and production of smaller and more powerful weapons. Since the United States based its design of nuclear weapons on the use of tritium, an assured supply of this isotope is necessary to ensure that the Nation's nuclear weapons stockpile is properly manufactured and maintained. Tritium has a relatively short radioactive half-life of 12.3 years, decaying at the rate of 5.5 percent per year. Because of this radioactive decay, it must be replenished periodically in nuclear weapons so their effectiveness is preserved. Currently, the Nuclear Weapons Complex (Complex) does not have the capability to produce the required amounts of tritium; the last tritium was produced in 1988. Without new production, the Nation's supply of tritium will decrease, through radioactive decay, to the point where the effectiveness of the nuclear weapons stockpile and a cornerstone of our Nation's defense policy, nuclear deterrence, would be lost.

This *Tritium Supply and Recycling Programmatic Environmental Impact Statement* (PEIS) evaluates the potential direct, indirect, and cumulative environmental impacts associated with alternatives for the siting, construction, and operation of tritium supply and recycling facilities at each of five candidate sites. Also analyzed is the purchase by the Department of Energy (DOE) of an existing operating or partially completed commercial light water reactor and its conversion to tritium production for defense purposes. Production of tritium using irradiation services contracted from commercial power reactors is also analyzed as a reasonable alternative and as a potential contingency measure to meet the projected tritium requirements for the Nation's nuclear weapons stockpile in the event of a national emergency. This PEIS assesses the environmental impacts of a range of reasonable alternatives, including No Action, in sufficient detail to allow for meaningful consideration of their comparative merits.

This 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 this PEIS. The baseline tritium requirement is the amount necessary to support the *Nuclear Weapons Stockpile Plan*, which is approved by the President as discussed in section 1.1. In this PEIS, the baseline tritium requirement is approximately 3/8ths of the tritium requirement that was analyzed in the *New Production Reactor Draft Environmental Impact Statement (EIS)* published in April 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; and (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.

Depending on the specific tritium supply technology, there may be two different ways to meet these requirements: (1) construct a tritium supply facility large enough to satisfy the entire baseline tritium requirement, operate that facility at a reduced level to meet the steady-state requirement, and increase the operating tempo up to baseline level if necessary; or (2) if sufficient flexibility exists, construct and operate a tritium supply facility that would satisfy the steady-state tritium requirement (approximately 50 percent of the baseline tritium requirement), and be capable of adding capacity (adding modifications to the steady-state sized facility) in a timely enough fashion to meet the surge tritium requirements.

This PEIS assesses alternatives for both cases. Tritium supply technologies representative of the first case are the Heavy Water Reactor (HWR), the Modular High Temperature Gas-Cooled Reactor (MHTGR), and the Advanced Light Water Reactor (ALWR) (Large and Small). Because the addition of capability for these reactors is not possible or would take more than 5 years, they must be constructed to meet the entire baseline tritium requirement. The only new tritium supply technology representative of the second case is the Accelerator Production of Tritium (APT). The APT has the flexibility to be initially constructed to meet the steady-state tritium requirement and enhanced as necessary to meet the baseline tritium requirement. Additionally, the commercial light water reactor alternative has the flexibility to meet changing tritium requirements by purchasing additional reactors, or irradiation services, as needed.

3.1.1 Planning Assumptions and Basis for Analysis

A number of planning assumptions and considerations form the basis of the analyses and impact assessments presented in this PEIS. These considerations and assumptions follow:

- The purpose of the Department's action is to produce the tritium needed to maintain the Nation's nuclear weapons stockpile.
- Best available design information is utilized to represent tritium supply technologies and recycling facilities being considered for construction at candidate sites. These facilities are briefly described in section 3.4 and are described in greater detail in appendix A. Design maturity of the tritium facilities varies greatly. For example, designs for some of the tritium supply technologies are more mature than others (e.g., HWR technology, a past effort from the New Production Reactor Program, is more mature than that of the APT). However, due to large reductions in estimated future requirements for tritium (resulting in a new requirement equal to approximately 40 percent of the baseline estimate represented in *Environmental and other Evaluations of Alternatives for Siting, Constructing, and Operating New Production Reactor Capacity* (DOE/NP-0014)), even those designs have been downsized to meet reduced requirements. The technical feasibility of each of these alternate technologies is presented in the *Tritium Supply and Recycling Plants Technical Reference Report.* Construction and operational resource requirements are representative numbers only and may change slightly as more data become available.
- Sizing of the tritium supply technologies and recycling facilities is based upon the periodic requirement to replace tritium inventories lost to radioactive decay. Stockpile sizing projections have been developed jointly by the Department of Defense (DOD) and DOE. This process, which culminates in a Presidential directive, is described in section 1.1. These projections and related analyses take into account initiatives and agreements that have substantially reduced the required number of nuclear weapons. New facilities will be designed with the capacity to support tritium requirements for the projected stockpile and to make up the loss of tritium reserves within a 5-year period. An APT, with a reduced capacity,

could initially be built to maintain tritium supply at a level which would support the projected stockpile, but which would have the capability, if necessary, to be modified to meet surge production requirements to reconstitute the tritium reserve. The steady-state component of this option accounts for approximately 50 percent of the total tritium requirement, while the surge accounts for the remaining 50 percent.

- Under the No Action alternative, neither new tritium supply and recycling facilities nor modification/upgrading of the existing recycling facilities at the Savannah River Site (SRS) would be done. This alternative represents a reference condition for each site against which the tritium supply technologies and recycling facilities can be compared. Under No Action, future stockpile tritium requirements would be supported as long as possible by recycling tritium from retired weapons. Eventually, tritium requirements could not be met.

- This PEIS does not attempt to identify specific locations on each site for any of the proposed tritium facilities; however, reference locations used to evaluate the potential environmental impacts of the tritium supply technologies and recycling facilities have been selected at each candidate site. These locations were designated by the individual sites and are consistent with their internal site development plans. These reference locations are designated as the tritium supply site (TSS) and would not interfere with Superfund sites. In general, undeveloped areas are used so that any potential environmental impacts would be greater than those projected for a developed location. These reference locations are defined for each site in sections 4.2 through 4.6. The characterization of the affected environment addresses the entire candidate site and the affected region surrounding each site. The region varies by resource, but generally extends to a 50-mile radius from the center of each site.

- The best available data were used to represent existing conditions at candidate sites in the Draft PEIS. In some cases, information that is several years old represented the best available data regarding design or upper-bound operating conditions of facilities that are now functioning at reduced capacities due to lower workload. Since annual environmental reports take up to a year and sometimes longer to be approved and published, the latest publicly available environmental monitoring and annual report data were used for the Draft PEIS. All candidate sites reviewed and updated, as appropriate, the affected environment sections to accurately describe the site and its environment. In preparing the Final PEIS, any updated information relating to the sites' affected environment was reviewed and appropriate changes were made if new information could potentially change results of the impact analyses.

- Both construction and operation impacts are considered for all resources at all sites. Construction impacts are generally short-term, while operation impacts are expected to be long-term. The period of construction for each alternative varies; however, for analytical purposes of the baseline case (START II), full operations are assumed to begin during the year 2010 and continue until the middle of the 21st century. The Phased APT for reduced tritium requirements would enable operations to begin during the year 2008 or earlier. For purposes of analysis, the representative years have been selected to portray key phases of the project and are as follows: 2005—representative year for peak construction activities, and 2010, 2030, and 2050—representative years for the beginning, middle, and end of the operations phase, respectively. An analysis of changes in impacts in the event tritium is needed

before 2011 is included in section 4.11. Changes to the assumptions in performing this analysis are discussed in that section.

- Generated waste will be managed in accordance with applicable Federal, state, and local laws, regulations, and requirements, as well as DOE's internal waste management requirements, including DOE's pollution prevention and waste minimization policy. A separate PEIS being prepared by the DOE Office of the Assistant Secretary for Environmental Management (EM) will address waste management options for all DOE-generated wastes. The *Environmental Management Programmatic Environmental Impact Statement* (DOE/EIS-0200) will address the treatment, storage, and disposal of radioactive, hazardous, and mixed wastes to include treatment technology application or development. Accordingly, an important consideration in planning for the tritium facilities would be to ensure that wastes can be safely packaged, stored, and transported in compliance with applicable regulatory requirements until viable treatment and disposal options are available.

- Baseline process technologies have been selected for tritium supply technologies and recycling facilities and are integral to the preconceptual designs. The design goals of all new facilities include consideration of waste minimization and pollution prevention to minimize facility and equipment contamination thereby making the future decontamination and decommissioning (D&D) of these facilities as simple and inexpensive as feasible. The relative comparison of D&D activities and potential impacts between tritium supply technologies is presented in section 4.14. These impacts would be the subject of future tiered *National Environmental Policy Act* (NEPA) reviews when those facilities are proposed for retirement.

- The impacts associated with the storage of spent nuclear fuel generated from a new tritium supply facility are analyzed in this PEIS. Impacts presented are based on the management of this spent nuclear fuel at the generation site, either in pools or dry storage bins as appropriate for the type of fuel. Although the recently issued ROD (60 FR 28680) for the *Programmatic Spent Nuclear Fuel Management EIS* outlines a Department-wide approach to the temporary storage of existing spent nuclear fuel at INEL and SRS, this analysis assumes that any spent nuclear fuel generated from a tritium supply facility would be stored on-site to preclude additional transportation to the ultimate disposition site for spent nuclear fuel. Eventually, the spent nuclear fuel would be packaged and transported to a site for ultimate disposition, such as a suitable repository. DOE presently is evaluating the Yucca Mountain Site in Nevada as a repository site, but no acceptance criteria have been established to date. Thus, this PEIS does not assess any long-term impacts associated with ultimate disposition of spent nuclear fuel in a repository because at the present time such impacts are too speculative.

- Low-level waste (LLW) will be disposed of onsite unless specifically prohibited or restricted. Mixed LLW would be stored in *Resource Conservation and Recovery Act* (RCRA)-permitted facilities until treatment to Land Disposal Restriction requirements is available. Sanitary (e.g., sewage and industrial) wastewater would be treated onsite. Hazardous waste generated at the tritium supply and recycling facilities would be accumulated, packaged, shipped offsite to a commercial RCRA facility, and in some instances stored in accordance with all applicable regulatory requirements.

- This PEIS broadly analyzes the environmental impacts associated with construction and operation of electrical distribution capacity for those reactors

(MHTGR and ALWR) capable of generating electricity. Although the sale of steam for power or the generation of electricity is possible, the conditions of such a sale are highly uncertain. For a general discussion of such impacts, see section 4.8.1. Appropriate NEPA reviews would be conducted in connection with any future proposals for such sale.

- For electricity needs, particularly those of the APT, this PEIS assesses the availability of power from the regional power pools that service the various sites. Any additional capacity that would be required is identified. While electricity needs are foreseeable, the specific manner in which that need would be provided is uncertain, particularly with regard to the type of electrical facility, and its location within a regional power pool. It is likely that the electrical requirement would be met by facilities well away from the site itself, or as an option a dedicated power plant (for the APT) could potentially be constructed at a site. Thus, this PEIS assesses the impacts on the regional power pools of providing the required electricity for each tritium supply technology at each site. The site-specific impacts of a conceptual dedicated gas-fired power plant to support the APT is presented in sections 4.2 through 4.6. A generic discussion of the environmental effects to site infrastructure, air quality, water resources, biotic resources, socioeconomics, and waste management of supplying the APT with power from the regional power pool from a power plant is provided in section 4.8.2.

- Fuel for the ALWR technologies would be available for purchase from commercial sources. Enriched uranium to fabricate fuel for the HWR and MHTGR technologies would be available from existing sources. Facilities to fabricate fuel using this uranium are included as part of the design for these alternatives. The PEIS includes an analysis of transportation health risks of HEU to the potential tritium supply candidate sites.

- With the exception of the commercial irradiation services alternative, this PEIS presupposes that the United States Government would design, construct, and operate a new tritium supply facility at any of the five candidate sites. It is conceivable that private sources could design, construct, and operate a tritium supply facility at any of the same five sites and lease irradiation services to the government. In this case the environmental impacts would be the same as the corresponding alternatives evaluated in the PEIS.

- For alternatives involving the commercial light water reactor, the PEIS assesses the environmental impact of the changes resulting from the insertion of tritium production target rods into the reactor. These environmental impact changes would be above and additional to the normal environmental impacts of the ongoing operation of these reactors. Those ongoing environmental impacts are addressed in existing reactor specific environmental documents prepared by the NRC.

- The general impacts of a multipurpose MHTGR and ALWR and associated plutonium fuel processing and fabrication are described in section 4.8.3 of this PEIS. While that section describes a new ALWR operating in a multipurpose mode, that discussion is also applicable to the commercial reactor alternative. A commercial reactor could be used to make tritium, produce electricity, and burn plutonium as fuel. The environmental impacts associated with performing those missions would be similar to those described for the multipurpose ALWR. Throughout the document, references to and discussion of impacts for the multipurpose ALWR can be applied to a multipurpose commercial reactor alternative. The site-specific impacts of the multipurpose reactor and support facilities are described for each of the five candidate sites in sections 4.2 through 4.6 for land

use, geology and soils, water and biotic resources, socioeconomics, human health, and waste management.

3.1.2 Environmental Impact Analysis

This PEIS evaluates the direct, indirect, and cumulative impacts associated with the tritium supply and recycling alternatives. For the reactors, this includes construction impacts of a full-sized facility, and operational impacts associated with producing the baseline tritium requirement (which is the greatest amount of tritium, and thus, the greatest operating tempo that might be required in any given year). This PEIS acknowledges that the reactors would likely produce less than the baseline tritium requirement (i.e., in most years, it would only be necessary to produce 50 percent of the baseline tritium requirement in order to support the steady-state tritium requirement). This PEIS also provides a discussion of differences, if any, in environmental impacts between the conservative baseline tritium requirement operating tempo and the steady-state tritium requirement operating tempo. However, since it is reasonably foreseeable that the reactors would be required to operate to support the baseline tritium requirement, this is the case that will be analyzed in the greatest detail. This case thus bounds the potential impacts associated with producing the steady-state tritium requirement.

For the APT, which has the flexibility to be initially constructed to meet the steady-state tritium requirement and enhanced as necessary to meet the baseline tritium requirement, this PEIS assesses the construction impacts of a full-sized baseline facility because it is highly uncertain when additional capacity might be required. Thus, in order to bound the potential construction impacts, this PEIS assumes that all construction is performed during the same construction period even though it is likely the construction would be phased in. Operationally, using the same logic as that of the reactors, the impacts associated with producing the baseline tritium requirement are presented. The APT would likely be operated at less than the baseline tritium requirement (i.e., again, in most years, it would only be necessary to operate the facilities at 50 percent of the baseline tritium requirement in order to support the steady-state tritium requirement). This PEIS also provides a discussion of differences in environmental impacts between the conservative baseline tritium requirement operating tempo and the steady-state tritium requirement operating tempo.

3.1.3 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 *Nuclear Weapons Stockpile Plan*. For the proposed action, the following alternatives were considered but eliminated from detailed study for the reasons stated:

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 fulfill the tritium requirement. However, while 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 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 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 proposed 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-West, 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. Only four DOE research reactors are currently operational: The High Flux Isotope Reactor at Oak Ridge Reservation (ORR); the High Flux Beam Reactor at Brookhaven National Laboratory; and the Experimental Breeder Reactor-II and the Advanced Test Reactor at 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 at INEL). None of these facilities are 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 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 for producing any significant quantities of tritium: the Fast Flux Test Facility at the Hanford Site (Hanford). This facility was designed and constructed to perform materials 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 10 years past its design 20-year lifetime has been completed. While technically possible to extend the lifetime, in the year 2010 the facility would be at the end of even the extended life. Relying on the ability to modify and operate 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 Hanford, starting with the early part of the Manhattan Project during World War II. None of these reactors is currently operational. 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 capable 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 health 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 delayed 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 1940s 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, none is 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 studies and 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 assemblies and in the accelerator facility. These APT cooling water requirements are significantly greater than the current regulated allotment of water for Los Alamos National Laboratory. Increasing the allotment to support the APT water requirement would be impractical and infeasible, and in any event beyond DOE's control.

It may be possible that an APT could use nonevaporative cooling towers, which would greatly reduce the water requirements. However, there is sufficient technical uncertainty regarding the feasibility and practicality of using nonevaporative cooling towers for a continuous wave APT to render this option unacceptable as a source for the Nation's only 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 (LA DOE 1994a:1).

REDUCED TRITIUM REQUIREMENTS

As discussed in chapter 2, 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 size would extend the need date for new tritium beyond approximately 2011. If the need date for new 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.

3.2 Tritium Supply and Recycling Alternatives

This PEIS evaluates the environmental impacts associated with alternatives for only one functional area of the nuclear element of the Complex: tritium supply and recycling. The nonnuclear element of the Complex has already been evaluated in the *Nonnuclear Consolidation Environmental Assessment (EA) Nuclear Weapons Complex Reconfiguration Program* (DOE/EA-0792). The specific alternatives evaluated in this Tritium Supply and Recycling PEIS are presented in figure 3.2–1 and explained in section 3.2.2. The remaining elements of the Complex, other than tritium supply and recycling, will be covered in the new Stockpile Stewardship and Management PEIS described in section 1.5.1.

3.2.1 No Action

To satisfy the requirements of the *National Environmental Protection Act* of 1969 (NEPA), 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 of tritium. This would be contrary to DOE's mission as specified by the *Atomic Energy Act* of 1954, as amended. Sites would continue waste management programs to meet the legal requirements and commitments in formal agreements and would proceed with cleanup activities. Production facilities and support roles at specific sites, however, would be downsized or eliminated in accordance with the reduced workload projected for the year 2010 and beyond. The current

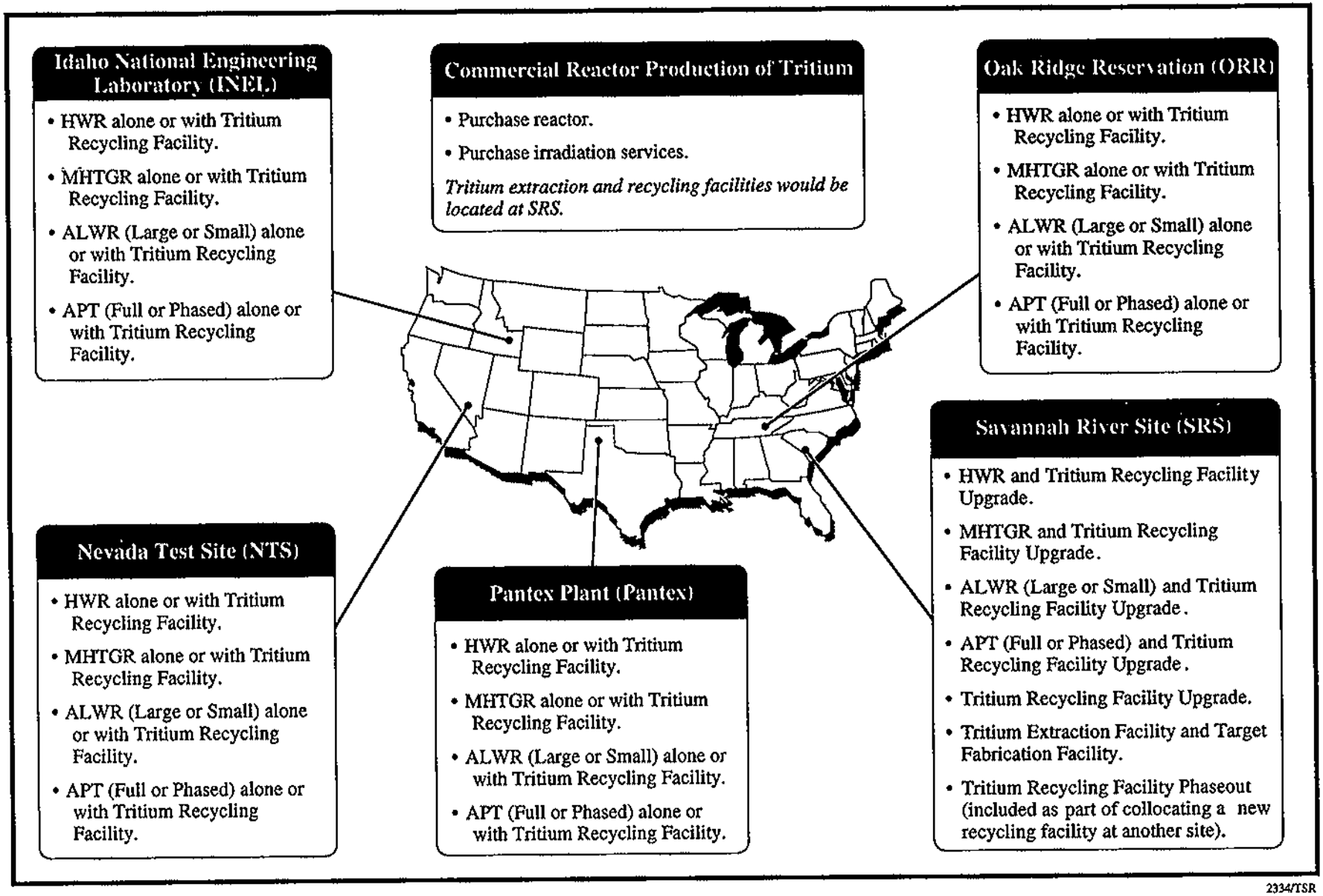


FIGURE 3.2–1.—*Tritium Supply and Recycling Alternatives.*

DOE missions assumed to continue under No Action are listed in section 3.3 for each candidate site.

3.2.2 Tritium Supply and Recycling

The four technologies considered as a new supply of tritium include: HWR, MHTGR, ALWR, and APT. Both Large (1,300 MWe) and Small (600 MWe) options for the ALWR and a phased option for the APT are evaluated. This PEIS includes an analysis of the MHTGR and ALWR technologies for tritium production together with plutonium disposition and steam/electricity production. Also included is the use of commercial light water reactors to irradiate tritium target rods. Descriptions of these technologies and their options are provided in section 3.4. The five candidate sites evaluated for such a facility are INEL, the Nevada Test Site (NTS), ORR, the Pantex Plant, and SRS. Descriptions of specific sites are given in section 3.3.

This PEIS provides environmental analyses to support a decision to select both the tritium supply technology and the location of the tritium supply and recycling facilities. If the tritium supply facility is located at any site other than SRS, the tritium recycling function could be provided either by collocating a new tritium recycling facility at that site or by the upgraded tritium recycling facilities at SRS. If the new tritium supply facility is located at SRS, it would utilize upgraded recycling facilities at SRS. As shown in figure 3.2–1, the following alternatives for tritium supply and recycling are analyzed.

- HWR and New Recycling Facility—Collocation of an HWR for tritium supply and a new tritium recycling facility at either INEL, NTS, ORR, or Pantex. Tritium recycling facilities at SRS would be phased out if any of these alternatives were chosen.

- HWR and Recycling Facilities Upgrade—Location of an HWR for tritium supply at any of the five candidate sites. The Replacement Tritium Facility and other support facilities at SRS would be upgraded for tritium recycling.

- MHTGR and New Recycling Facility—Collocation of an MHTGR for tritium supply and a new tritium recycling facility at either INEL, NTS, ORR, or Pantex. Tritium recycling facilities at SRS would be phased out if any of these alternatives are chosen.

- MHTGR and Recycling Facilities Upgrade—Location of an MHTGR for tritium supply at any of the five candidate sites. The Replacement Tritium Facility and other support facilities at SRS would be upgraded for tritium recycling.

- ALWR and New Recycling Facility—Collocation of an ALWR for tritium supply and new tritium recycling facilities at either INEL, NTS, ORR, or Pantex. Both large and small reactor options are evaluated at each site. Tritium recycling facilities at SRS would be phased out if any of these alternatives are chosen.

- ALWR and Recycling Facilities Upgrade—Location of an ALWR for tritium supply at any of the five candidate sites. Both large and small reactor options are evaluated at each site. The Replacement Tritium Facility and other support facilities at SRS would be upgraded for tritium recycling.

- APT and New Recycling Facility—Collocation of an APT for tritium supply and a new tritium recycling facility at either INEL, NTS, ORR, or Pantex. The Phased APT option, described in section 3.4.2.4 and appendix section A.2.1.4, is evaluated for less than baseline operations. Tritium recycling facilities at SRS would be phased out if any of these alternatives are chosen.

- APT and Recycling Facilities Upgrade—Location of an APT for tritium supply at any of the five candidate sites. The Phased APT option is evaluated for less than baseline operations. The Replacement Tritium Facility and other support facilities at SRS would be upgraded for tritium recycling.

- Commercial Light Water Reactor—Purchase of an existing operating or partially completed commercial light water reactor by DOE and conversion to tritium production for defense purposes or purchase of irradiation services contracted from commercial power reactors. The Replacement Tritium Facility and other support facilities at SRS would be upgraded for tritium recycling. In addition, facilities for tritium extraction and fabrication of tritium targets would be constructed.

3.2.3 Other Missions Beyond Tritium Production

Tritium production is the only mission addressed in this PEIS, although it is possible that some of the tritium supply technology alternatives would be capable of performing missions other than tritium production. Two such examples are plutonium disposition and steam/electricity production.

As discussed in section 1.5.3, alternatives for plutonium disposition are being assessed in the *Long-Term Storage and Disposition of Weapons-Usable Fissile Materials PEIS*. Nonetheless, this PEIS includes an analysis of the option of utilizing the MHTGR and ALWR technologies for tritium production together with plutonium disposition and steam/electricity production.

3.3 CANDIDATE SITES

Five locations (INEL, NTS, ORR, Pantex, and SRS) are being considered as candidate sites for the tritium supply and recycling facilities. All of these sites, with the exception of INEL, are currently performing defense program activities.

For the commercial light water reactor alternatives, no specific site has been identified. Therefore, any one of the existing operating commercial 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, 57 sites are located east of the Mississippi River. Approximately one-half of these 71 sites contain two or three nuclear units per site.

3.3.1 Site Selection

As shown in figure 3.3.1–1, in mid-1988, at the onset of the New Production Reactor Program, 13 DOE-owned sites were considered as potential locations for deployment of a new production reactor. All sites were evaluated against basic screening criteria and only three, Hanford, INEL and SRS, satisfied the criteria. These three sites were further evaluated by a DOE Site Evaluation Panel against more stringent criteria and were found to be suitable for a new production reactor. A detailed discussion of this selection process is described in the *Implementation Plan for the New Production Reactor Capacity Environmental Impact Statement* (DOE/NP-0003).

Concurrent with the publication in the *Federal Register* (56 FR 5590) on February 11, 1991, of the Notice of Intent (NOI) to prepare a PEIS for Reconfiguration of the Nuclear Weapons Complex, a Notice of Availability of an Invitation for Site Proposals for the Nuclear Weapons Complex Reconfiguration Site was also published (56 FR 5595). The invitation solicited proposals for consideration of non-DOE sites and listed five DOE sites which met the initial screening criteria. No additional locations were identified as a result of this invitation.Subsequent evaluation by the Site Evaluation Panel of the DOE sites found them to be fully qualified. These five initial sites were Hanford, INEL, ORR, Pantex, and SRS.

On November 1, 1991, the then Secretary of Energy announced his decision to incorporate the New Production Reactor environmental analysis into the Reconfiguration PEIS. On November 29, 1991, DOE published a Notice of Opportunity for public comment on this issue (56 FR 60985). The New Production Reactor Program had been evaluating the siting of either a HWR, Light Water Reactor, or MHTGR technology at either Hanford, INEL, or SRS to provide new tritium supply capability for the Complex. In light of the reduced requirements resulting from the President's initiative to downsize the nuclear weapons stockpile, the tritium production requirement was reduced. This reduction permitted the addition to the Reconfiguration PEIS of the option of producing tritium using a linear accelerator and of downsizing the three reactor technologies to the new goal quantities. The two reconfiguration sites, ORR and Pantex, previously rejected as candidate sites for

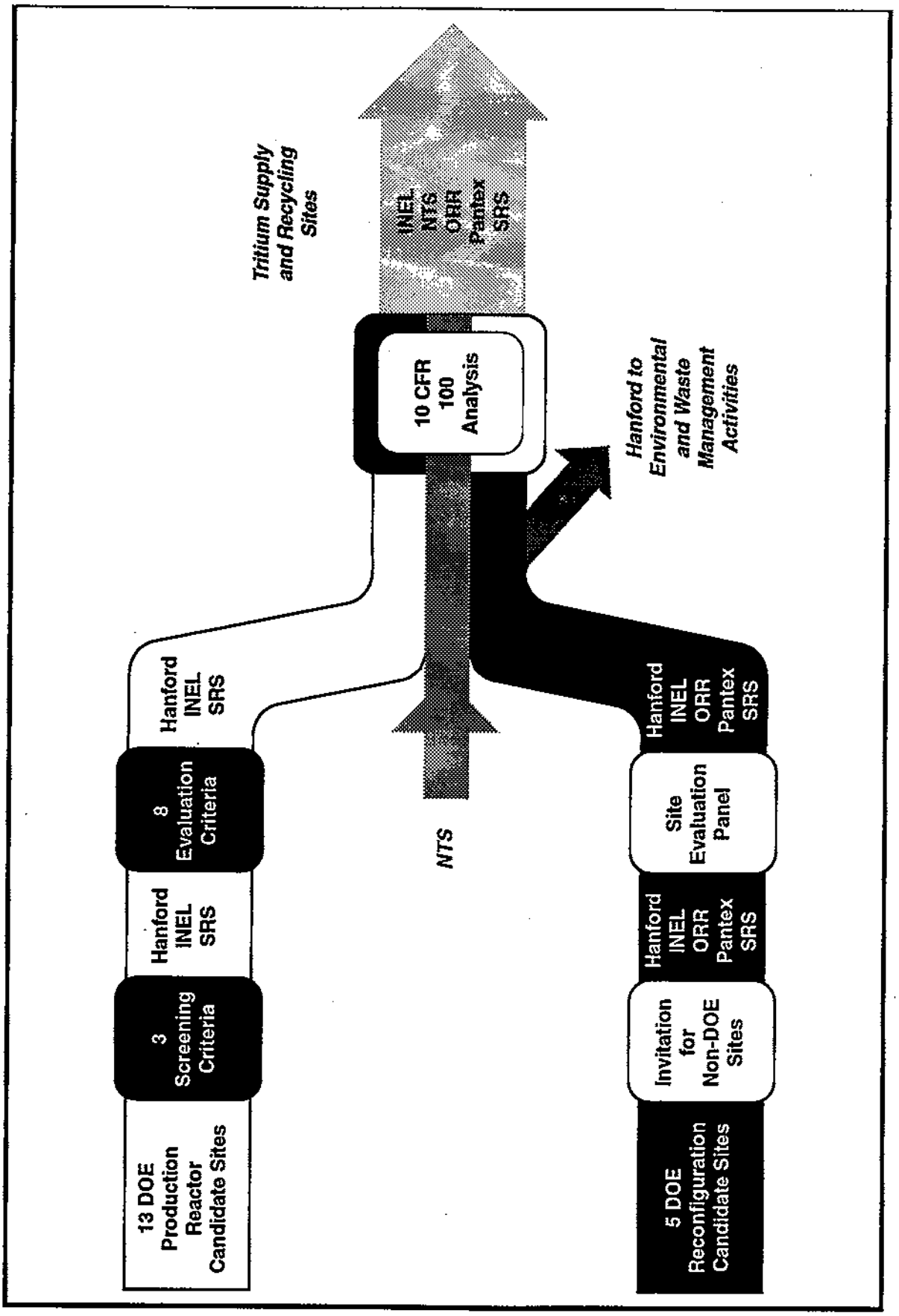


FIGURE 3.3.1-1.—*Site Selection Process.*

a New Production Reactor, were then evaluated using 10 CFR 100 reactor siting criteria and found to be acceptable for the downsized reactors.

A Revised NOI to prepare a PEIS was published in the *Federal Register* (58 FR 39528) on July 23, 1993. In this notice, DOE eliminated Hanford from further consideration as a candidate site because all nuclear weapons production functions at that location had been terminated and it was dedicated to environmental and waste management activities. NTS was evaluated using the siting criteria described above and was determined to be a reasonable site alternative for new tritium supply and recycling facilities. The resulting five sites, INEL, NTS, ORR, Pantex, and SRS, are described in the following sections.

3.3.2 Idaho National Engineering Laboratory

INEL, located on approximately 570,000 acres near Idaho Falls, ID, was established in 1949 to build, test, and operate various types of nuclear facilities. This site is one of DOE's principal centers for conducting nuclear energy research and providing support to the U.S. Navy nuclear fleet. It has the world's largest and most varied collection of reactors, including research, testing, power, and ship propulsion reactors. There have been 52 research and test reactors at INEL that have been used over the years 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 its nuclear reactor research, other INEL facilities are operated to support reactor operations. These facilities include high-level waste (HLW) and LLW processing and storage sites; hot cells; analytical laboratories; machine shops; laundry; railroad; and administrative facilities. Other activities include management of one of DOE's largest storage sites for the LLW and transuranic (TRU) waste generated by defense program activities. Until 1992, spent reactor fuels were reprocessed at the Idaho Chemical Processing Plant to recover enriched uranium and other isotopes. Due to a DOE decision to terminate spent fuel reprocessing, the Idaho Chemical Processing Plant was transferred to the EM Program for disposition. There are currently no defense program activities at INEL.

DOE activities at INEL have been divided among nine distinct and geographically separate functional mission areas as listed in table 3.3.2–1. The current functions can be further grouped into the following two major categories, environmental management activities and other DOE activities.

Environmental Management Activities. Environmental management performs research and development activities for waste processing at the Power Burst Facility and provides waste management expertise to the Radioactive Waste Management Complex. The Power Burst Facility supports facilities for research and development for waste reduction programs and the Boron Neutron Capture Therapy Program. Waste management efforts at INEL are directed toward safe and environmentally sound treatment, storage, and disposal of radioactive, hazardous, and sanitary waste generated from facility operations. Details of environmental management activities are discussed in section 4.2.2.10 and appendix H.

A reactor used for thermal fuels behavior studies is now in a standby mode. Major waste management facilities include the waste engineering development facility, the waste experimental reduction facility, and the mixed waste storage facility.

Other Department of Energy Activities. The following six additional DOE activities are located at INEL:

- The Test Area North complex is the northernmost facility within INEL and consists of several experimental reactors and support facilities conducting research and development activities on reactor performance. These include the technical support facility, the containment test facility, the water reactor research test facility, and the inertial engine test facility. The inertial engine test facility has been abandoned, and no future programs are planned. The remaining facilities support ongoing programs that are expected to continue for the foreseeable future.

- Materials testing and environmental monitoring activities are conducted in the Auxiliary Reactor Area. The facilities in this area are scheduled for D&D.

TABLE 3.3.2–1.—*Current Missions at Idaho National Engineering Laboratory*

Mission	Description	Sponsor
Idaho Chemical Processing Plant	Transferred to management of EM.	Assistant Secretary for Environmental Management
Radioactive Waste Management Complex	Provide waste management functions for present and future site and department needs.	Assistant Secretary for Environmental Management
Power Burst Area	Perform waste processing, technology research, and development. Provide interim storage for hazardous wastes.	Assistant Secretary for Environmental Management
Test Area North	Perform research on reactor safety operations and conduct a specific manufacturing capability project.	Office of Nuclear Energy
Auxiliary Reactor Area	Perform materials testing and environmental monitoring.	Office of Nuclear Energy
Argonne National Laboratory-West	Perform breeder reactor irradiation tests.	Office of Nuclear Energy
Test Reactor Area	Perform irradiation service, develop nuclear instruments, conduct safety programs, and perform geological research. Develop methods to meet radioactive release limits.	Office of Nuclear Energy; Office of Naval Reactors
Naval Reactors Facility	Standby facility for conducting ship propulsion reactor research and training.	Office of Naval Reactors
Central Facilities Area	Provide centralized support services for the site.	Idaho Operations Office

- Argonne National Laboratory-West supports breeder reactor development and the Waste Isolation Pilot Plant (WIPP) test program, as well as stores plutonium for the DOE Office of Nuclear Energy.

- The Test Reactor Area supports the Advanced Test Reactor. This reactor is used for irradiation testing of reactor fuels and material properties; instrumentation for naval reactors; and production of radioisotopes in support of nuclear medicine, industrial applications, research, and product sterilization. Wastes from this facility are handled by the Radioactive Waste Management Complex.

- The Naval Reactors Facility is operated for DOE and the U.S. Navy by Westinghouse Electric Corporation under jurisdiction of DOE's Pittsburgh Naval Reactors Office. Included at this facility are the submarine prototypes and the expended core facility. Activities include the testing of advanced design equipment and new systems for current naval nuclear power propulsion plants and obtaining data for future design. Additionally, the facilities are used to provide a comprehensive nuclear plant operational training program for naval personnel. DOD plans to shut down older prototype reactors, leaving operational only the most modern prototype reactors and Expended Core Facility.

- The mission of the Central Facilities Area is to provide effective, site-wide support services including transportation, shop services, health services, radiation monitoring, and administrative offices.

Non-Department of Energy Activities. Non-DOE activities at INEL include research being conducted by the National Oceanic and Atmospheric Administration, the U.S. Geological Survey (USGS), and various institutions of higher learning. These activities support the designation of INEL as a National Environmental Research Park.

Environmental Regulatory Setting. The Department is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at INEL. The Department is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed upon milestones. A brief description of the environmental regulatory setting at INEL follows. More detail is available in appendix section A.1.1.

The State of Idaho has regulatory authority for air, water, solid waste, mixed waste, and hazardous waste management. DOE and the State of Idaho have developed the Environmental Oversight and Monitoring Agreement to assure the citizens of Idaho that their health and safety and the environment are being protected. DOE is required to comply with all applicable environmental laws and regulations and provide technical and financial support for state activities to assess such compliance at INEL.

The INEL air emissions inventory, completed in March 1991, catalogs and characterizes all vents, stacks, and potential sources of air pollutants at INEL. The air toxic compounds inventory for radioactive and other hazardous air pollutants is being compiled, and when added to the air emissions inventory, will serve as the basis for the operating permits required under Title V of the 1990 *Clean Air Act* (CAA).

All nine public water systems within INEL boundaries are currently in compliance with primary drinking water standards. Annual averages for all onsite and offsite drinking water samples were below EPA's maximum contaminant level for community drinking water systems. INEL holds two National Pollutant Discharge Elimination System (NPDES) permit requests for discharges of noncontact cooling water and for discharges of wastewater to the Big Lost River from the Idaho Chemical Processing Plant.

EPA placed INEL on the National Priorities List (NPL) on December 21, 1989. As a result, DOE entered into a Federal Facility Agreement and Consent Order on December 9, 1991, with EPA and the State of Idaho to coordinate cleanup activities under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) and RCRA. The agreement is implemented by an action plan which outlines the remedial action process which will encompass all investigations of hazardous substances and cleanup activities at INEL.

On October 7, 1992, DOE signed another Consent Order with the State of Idaho to resolve the Hazardous Waste Notice of Violation issued by the State after a September 1990 inspection for 23 alleged hazardous waste violations. This Consent Order provides the schedule for corrective actions which, when completed, will resolve this Notice of Violation.

DOE has proposed to enter into a compliance agreement with the State of Idaho concerning the storage, treatment, and continued generation of land disposal restricted waste that would form the basis for the INEL site-specific mixed waste treatment plan required by the *Federal Facility Compliance Act* of 1992. The proposed agreement would address INEL compliance with the Land Disposal Restrictions of the Hazardous and Solid Waste Amendments of 1984, allowing INEL to continue to operate and to generate, treat, and store mixed wastes.

INEL is not in full compliance at present with the *Toxic Substances Control Act* (TSCA) due to the storage of radioactive polychlorinated biphenyl (PCB)-contaminated equipment and materials. DOE is negotiating a compliance agreement with the State of Idaho for the continued storage of radioactive PCB-contaminated wastes until a method for their treatment or disposal can be developed.

DOE, the U.S. Navy, and the State of Idaho concurred on the Idaho Agreement on August 9, 1993. The Idaho Agreement encompasses the transportation, receipt, processing, and storage of spent nuclear fuel at INEL. This Agreement is a negotiated settlement among the parties to satisfy a June 28, 1993, order by the U.S. District Court for the District of Idaho granting a motion for summary judgment, injunction, and administratively terminating action. The effect of this motion is to limit receipt of spent nuclear fuel pending completion of an EIS analyzing DOE's spent nuclear fuel activities and certain proposed INEL activities.

3.3.3 Nevada Test Site

NTS occupies approximately 864,000 acres in the southeastern part of Nye County in southern Nevada. Located about 65 miles northwest of Las Vegas, NTS is operated by several management and operating contractors under the direction of the Nevada Operations Office. It is a remote, secure facility that maintains the capability for conducting underground testing of nuclear weapons and evaluating the effects of nuclear weapons on military communications systems, electronics, satellites, sensors, and other materials. The first nuclear test at NTS was conducted in January 1951. Since the signing of the Threshold Test Ban Treaty in 1974, it has been the only U.S. site used for nuclear weapons testing. Approximately one-third of the land (located in the eastern and northwestern portions of the site) has been for nuclear weapons testing, one-third (located in the western portion of the site) has been reserved for future missions, and one-third is used for research and development and other facility requirements. Facilities include nuclear device assembly, diagnostic canister assembly, hazardous liquid spill, and the Radioactive Waste Management Site. In addition, Yucca Mountain, an area on the southwestern boundary of the site, is being evaluated by DOE for siting of a spent nuclear fuel and high-level radioactive waste repository. While the primary purpose of Yucca Mountain is for commercial HLW, it is also slated to receive some military HLW.

Activities at NTS are concentrated in several general areas. Most of the onsite work is related to defense program activities, although there are environmental management, other DOE, and non-DOE activities as well. NTS is a unique facility because it is a large open area into which access is tightly controlled, it has a substantial infrastructure, and it has the capability to handle and run tests with hazardous or radioactive materials. Because of this, activities other than nuclear testing, such as mobile missile transporter tests and nuclear rocket tests, have been carried out for other Federal departments and agencies. The current missions and functions of NTS are shown in table 3.3.3–1.

Defense Program Activities. The defense program efforts and the Defense Nuclear Agency (non-DOE activity) activities are closely related, with both contributing to national security. Prior to the moratorium described below, nuclear testing was limited to those tests that supported the safety and reliability of the Nation's nuclear stockpile. The moratorium significantly restricted DOE experiments and virtually eliminated DOE support of Defense Nuclear Agency nuclear tests. In July 1993, the President extended the moratorium on nuclear tests indefinitely (both

TABLE 3.3.3–1.—*Current Missions at Nevada Test Site*

Mission	Description	Sponsor
Maintain Underground Nuclear Testing Program Capabilities	Underground nuclear testing has been suspended; however, the capability to resume testing will be maintained.	Assistant Secretary for Defense Programs
Maintain Nuclear Emergency Search Team Program Capabilities	Tests and exercises are carried out to verify procedures and equipment of the Nuclear Emergency Search Team.	Assistant Secretary for Defense Programs
Radioactive Waste Management	Manage radioactive and mixed waste facilities.	Assistant Secretary for Environmental Management
Support the Yucca Mountain Waste Storage Program	Characterize environment of Yucca Mountain and surrounding area, especially geology, with respect to possible storage of high-level radioactive waste.	Office of Civilian Radioactive Waste Management
Support Arms Control and Treaty Verification Activities	Fulfill U.S. international obligations concerning verification of underground nuclear tests.	Office of Nonproliferation and National Security
Other DOE and non-DOE Missions	Various, as described in text.	Various

DOE and DOD). The moratorium started in October 1992, in accordance with the Hatfield Amendment. However, the President also required that NTS retain the capability to resume testing if authorized. The Nevada Operations Office, with DP oversight, has the lead Federal role in maintaining the capability to respond to certain kinds of national emergencies or situations. The Nuclear Emergency Search Team, a team of highly trained DOE and contractor radiological specialists, can be mobilized in case of accidents involving radioactive materials or a terrorist threat involving nuclear weapons.

The only major new facility for defense program activities is the 100,000 square feet (ft^2) Device Assembly Facility. It is located in Area 6, just south of the control point. Because of its multiple processing areas which include assembly cells, assembly bays, high bays, radiographic facilities, special nuclear materials laboratories, high explosive storage, special nuclear material storage, shipping and receiving areas, and associated administrative and support areas, all aspects of the operations will be handled in this one facility. In addition, the facility provides for increased overall security and permits easier entrance and exit accessibility for the workers during hazardous operations. There will be no manufacturing of special nuclear material at this facility.

Environmental Management Activities. There are active radioactive and mixed waste disposal areas onsite in Areas 3 and 5. The only major environmental management facility anticipated for the NTS is a waste management facility to handle TRU wastes. A major program to characterize the groundwater at NTS is in progress to determine regional flow paths and rates, and to detect any migration of contamination from past nuclear testing.

Other Department of Energy Activities. Although the principal activity at NTS has been the underground testing of nuclear devices, DOE is also involved in a number of other activities. These include the Yucca Mountain waste storage program, liquified gaseous fuel spill tests, and explosive pulsed power experiments.

A high-level radioactive waste facility at nearby Yucca Mountain is under study. The Yucca Mountain high-level radioactive waste facility is handled by the Yucca Mountain Site Characterization Office, which reports directly to the Office of Civilian Radioactive Waste Management. However, because it is based at NTS, the Nevada Operations Office provides some administrative support services to the project.

The Liquified Gaseous Fuel Test Facility in Area 5 was completed in 1986. It is operated on a fee basis for commercial users as a basic research tool for studying the dynamics of accidental releases of hazardous materials and to evaluate the effectiveness of various foams and fire retardants in accidents involving chemicals and hazardous materials.

The manifestation of several other programs remain onsite. In Area 25 the Rover Program (nuclear rocket) facilities cover a large area. Area 26 held the Pluto Program (nuclear ram-jet) and three buildings remain there.

NTS is the demonstration site for the development of a Solar Enterprise Zone in Nevada. A 100 MW solar facility is currently planned at the site, with potential for expansion to 500 MW in the future.

Non-Department of Energy Activities. The main non-DOE activity at NTS was the Defense Nuclear Agency's use of the site as a nuclear weapons effects testing facility. Weapons effects tests were conducted to study a number of nuclear effects including x-rays, gamma rays, neutrons, electromagnetic pulse, air blast, ground and water shock, propagation, and temperature. These tests assessed military systems in a nuclear environment. Various other military exercises and training activities are also carried out at NTS.

Environmental Regulatory Setting. The Department is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at NTS. The Department is engaged in several activities to bring its operations into full regulatory compliance. Negotiated agreements will include financial penalties for nonachievement of agreed upon milestones. A brief description of the environmental regulatory setting at NTS follows. This is described in more detail in appendix section A.1.2.

The State of Nevada has regulatory authority for air, water, solid waste, and hazardous waste. A Memorandum of Understanding between DOE and

the State of Nevada covers radiological releases on NTS and required notifications. Releases to the NTS environment may originate from tunnels, underground test event sites, and facilities where materials are used, processed, stored, or discharged. DOE and the State of Nevada signed an Agreement in Principle in October 1990 to provide DOE funding to Nevada for oversight of environment, safety, and health (ES&H) activities, including environmental restoration activities at NTS. The Agreement in Principle provides the understanding between and commitment of the parties regarding DOE's provision to the State for technical and financial support in return for environmental oversight and monitoring.

Liquid discharges at NTS are primarily the result of equipment cleaning and sanitary wastes. Discharges also result from groundwater seeping into the tunnels in Rainier Mesa, which have now been sealed. Periodic large discharges to lined sumps occur during characterization well drilling, development, and testing. These discharges are done in accordance with a draft fluid management plan being developed in consultation with the State of Nevada. Surface water monitoring at NTS is limited to sampling wastewater flowing into lagoons and ponds under a series of permits issued by the State of Nevada.

In 1987, a DOE Headquarters task force determined that underground nuclear device testing areas are subject to the provisions of CERCLA. Under CERCLA, all releases of hazardous or extremely hazardous substances that exceed reportable quantities must be reported to the National Response Center. Soils contaminated by plutonium and other radioactive contaminants are the major concern for NTS. Preliminary Assessment/Site Investigation reports required by CERCLA were prepared for NTS and provided to EPA in 1988. In 1992, a revised Hazard Ranking System package was provided to EPA. EPA will consider the results derived from the revised Hazard Ranking System to determine if any NTS sites are to be included on the NPL. The State of Nevada and DOE are in the process of negotiating a two-party agreement for environmental restoration pursuant to the State's corrective actions regulations.

The Hazardous Waste Accumulation site on NTS is used to collect hazardous wastes prior to shipping offsite to a RCRA-permitted commercial hazardous waste disposal facility. In May 1990, mixed waste disposal operations were discontinued in compliance with the Land Disposal Restrictions of the Hazardous and Solid Waste Amendment of 1984. Mixed waste disposal operations of offsite generated waste at NTS will not resume until issuance of a State of Nevada RCRA Part B permit.

3.3.4 Oak Ridge Reservation

ORR covers approximately 35,000 acres. It includes the following three major facilities: Oak Ridge National Laboratory; Y-12 Plant, ORR (Y-12); and Oak Ridge K-25 Site (K-25). 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. K-25, formerly known as the Oak Ridge Gaseous Diffusion Plant, now serves as an operations center for environmental restoration and waste management programs.

Y-12 was constructed as part of the World War II Manhattan Project. The first site mission was the separation of U-235 from natural uranium by electromagnetic separation. The magnetic separators were taken out of commission at the end of 1946, when gaseous diffusion became the accepted process for enriching uranium. Missions have evolved and changed with the easing of international tensions and resulting conclusion of Y-12's weapon component production mission.

In the near-term, the operational space at Y-12 will be downsized in response to reduced workloads. Y-12 is designated as the single interim DOE repository for both unirradiated enriched uranium not required for program use and unirradiated depleted uranium. Present interim storage capability will be enhanced to accommodate additional enriched uranium returned from stockpiled weapons and other DOE sites. The current missions and functions are described in table 3.3.4–1.

Defense Program Activities. The five Y-12 defense program assignments include maintaining the capability to fabricate components (primarily uranium and lithium) for nuclear weapons, storing uranium and lithium materials and parts, dismantling nuclear weapon components returned from the national stockpile, processing special nuclear materials,, and

TABLE 3.3.4–1.—*Current Missions at Oak Ridge Reservation*

Mission	Description	Sponsor
Weapons Components	Maintain capability to fabricate uranium and lithium components and parts for nuclear weapons.	Assistant Secretary for Defense Programs
Uranium and Lithium Storage	Store enriched uranium, depleted uranium, and lithium materials and parts.	Assistant Secretary for Defense Programs
Dismantlement Activities	Dismantle nuclear weapon components returned from the stockpile.	Assistant Secretary for Defense Programs
Special Nuclear Material	Process uranium.	Assistant Secretary for Defense Programs
Support Services	Provide support to design agencies as requested.	Assistant Secretary for Defense Programs
Environmental Restoration and Waste Management	Waste Management and D&D activities at Oak Ridge National Laboratory, Y-12, and K-25.	Assistant Secretary for Environmental Management
Research and Development	Oak Ridge National Laboratory basic research and development in energy, health, and environment.	Office of Energy Research; Assistant Secretary for Environment, Safety and Health; Office of Nuclear Energy
Isotope Production	Oak Ridge National Laboratory produces radioactive and stable isotopes not available elsewhere.	Office of Nuclear Energy
Educational and Research Programs	Oak Ridge Institute for Science and Education programs in the areas of health, environment, and energy.	Office of Energy Research; Assistant Secretary for Environment, Safety and Health; Office of Nuclear Energy
Work for other Federal Agencies	Projects to support other Federal programs.	Department of Energy
Technology Transfer	Programs to transfer unique technologies developed at ORR to private industry.	Department of Energy
Meteorological Research	Meteorological and atmospheric diffusion research.	National Oceanic and Atmospheric Administration

providing special production support to the DOE design agencies and other DOE programs.

Historically, Y-12's primary mission has been to fabricate and assemble uranium (enriched and depleted) and lithium components and other specialty compounds in support of the nuclear weapons stockpile. While unprecedented changes in the world are resulting in nuclear disarmament and reduced nuclear weapons stockpiles, Y-12 continues to maintain the capability to fabricate nuclear weapon components as a major mission. Maintaining production capability involves the ability to fabricate materials into components, inspect and certify the components, and produce subassemblies from components.

As nuclear weapons are removed from the stockpile, these returned weapons must be dismantled, and materials and parts appropriately dispositioned. These returned materials and components, as well as those currently located at Y-12, must be safely and securely placed in short-term or long-term storage. Prior to storage, some processing of special nuclear materials must be performed to recover materials from the returned weapons.

Y-12 also provides fabrication support to DOE's weapon design laboratories at Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and Sandia National Laboratories, New Mexico. Y-12 produces components for design evaluation for these customers. In addition, Y-12 performs some

stockpile surveillance activities to ensure reliability of the nuclear stockpile.

Environmental Management Activities. Environmental management activities are currently planned or in progress at each major functional area on ORR. These activities are summarized below.

K-25. The site D&D program will continue to perform Phase I activities including the removal of hazardous materials, utilities, ventilation, lubrication, and cooling systems from the buildings until 1998. In addition, uranium deposits will be removed from process equipment; buildings will be characterized for radiological contamination; and pilot-scale projects will be implemented to test and evaluate technologies before full-scale decontamination, dismantlement, and demolition of the buildings take place. DOE's only TSCA mixed waste incinerator is located at K-25.

Within the environmental restoration program, site assessments will continue to be the focus through 1998. Investigations will proceed according to priorities based on risks to human health and the environment. In addition, ongoing remediation work will continue and interim corrective actions will be initiated as needed.

Oak Ridge National Laboratory. The primary outlook for waste management activities at Oak Ridge National Laboratory is to provide waste treatment, storage, and disposal support to DOE's research and development programs. Among areas of emphasis will be increased attention to waste reduction activities, full implementation of waste certification and characterization programs for all waste types, and continued improvement of facility operations through routine maintenance, operator training, and facility upgrades and involvement of private industry capabilities.

Remedial action is proceeding in 12 of 20 regions known as waste area groupings. These 12 waste area groupings contain about 222 sites of contamination. Current activity is focused upon actions which address conditions with potential for affecting human health and the environment.

Y-12. Waste management activities at Y-12 continue to treat, store, and dispose of waste generated by defense program activities and other resident programs. The decreasing amount of waste generated by defense production at Y-12 is expected to be offset by waste from weapon dismantlement activities, while the volume of waste from environmental restoration and D&D activities will significantly increase. Environmental management activities are discussed in detail in section 4.4.2.10 and in appendix H.

Other Department of Energy Activities. Other DOE activities conducted at ORR include missions and programs of K-25, Oak Ridge National Laboratory, Y-12, nondefense program missions, and the Oak Ridge Institute for Science and Education.

K-25 serves as the operations center for the management and operations contractor's programs. K-25 also houses DOE's Center for Environmental Technology and Center for Waste Management. Missions include activities in technology development; technology transfer; engineering technology; uranium enrichment support; and engineering, computing, and telecommunications.

Oak Ridge National Laboratory supports DOE activities in energy production and conservation technologies, physical and life sciences, scientific and technological user facilities, environmental protection and waste management, science and technology transfer, and education. Oak Ridge National Laboratory also supplies radioactive and stable isotopes that are not available from the private sector.

In addition to the defense program activities described previously, Y-12 provides support to Oak Ridge National Laboratory and other government agencies for processing source materials. The Oak Ridge Institute for Science and Education's primary missions are to provide educational and research programs in the areas of health, environment, and energy for DOE, other Federal agencies, and private industry.

Non-Department of Energy Activities. At present, the only non-DOE activity at ORR is the ongoing meteorological and atmospheric diffusion research work at the National Oceanic and Atmospheric Administration Atmospheric Turbulence and Diffusion Laboratory. This facility also provides services to DOE contractors and operates the

Weather Instrument Telemonitoring Monitoring System for DOE. The site also provides support for Department of Defense programs as needed.

Environmental Regulatory Setting. The Department is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at ORR. The Department is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed upon milestones. A brief description of the environmental regulatory setting at ORR follows. More detail is available in appendix section A.1.3.

The State of Tennessee has regulatory authority for air, water, solid waste, hazardous waste, and mixed waste (hazardous component only). DOE and the State of Tennessee have signed a Monitoring and Oversight Agreement intended to assure Tennessee citizens that their health, safety, and environment are being protected during ORR facility operations. Under this agreement, DOE will provide financial support to allow the State of Tennessee to carry out its commitment under the Monitoring and Oversight Agreement and the Federal Facility Agreement regarding cleanup activities.

EPA placed ORR on the NPL on December 21, 1989. To satisfy the requirement for an interagency agreement, DOE, EPA Region IV, and the State of Tennessee completed a Federal Facility Agreement effective January 1, 1992.

On March 26, 1993, EPA Region IV certified that DOE had completed all of the actions required by the ORR Radionuclide National Emissions Standards for Hazardous Air Pollutants (NESHAP) Federal Facility Compliance Agreement that they entered into on October 31, 1991. ORR is now considered to be in compliance with the *National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities* (40 CFR 61, Subpart H).

Activities are underway to reduce discharges of priority pollutants, high temperature water, and toxic agents such as chlorine to the East Fork Poplar Creek. NPDES permits are required for each ORR facility. A renewed NPDES permit was issued to K-25 on October 1, 1992. The ORNL is operating under the provisions of its expired permit while the State of Tennessee acts on the remaining NPDES permit renewal. ORNL submitted a request for modification of its NPDES permit based on evidence that past exceedances of permit limits for total suspended solids, oil, and grease have not impacted watershed water quality. Y-12's NPDES permit was approved on July 1, 1995.

ORR facilities are being operated with a combination of RCRA Part B permits and interim status regulations. The RCRA Part B permit applications have been submitted for all of the active storage and treatment units listed on the Part A permit. The Federal Facility Compliance Agreement signed by EPA and DOE on June 12, 1992, addresses ORR compliance with the Land Disposal Restrictions of the Hazardous and Solid Waste Amendments of 1984, allowing ORR to continue to operate, and to generate and store mixed wastes. This agreement and subsequent plans would form the basis for the ORR site-specific treatment plan required by the *Federal Facility Compliance Act* of 1992.

TSCA requires that PCB wastes be disposed of within 1 year of initial storage. However, some PCB wastes are not acceptable to the TSCA incinerator at K-25 and therefore have been stored in excess of 1 year. On June 11, 1992, DOE formally requested negotiation of a Federal Facility Compliance Agreement with EPA to allow development of a treatment and disposal schedule for ORR's radioactive PCB-contaminated waste and storage or disposal per the Agreement.

3.3.5 Pantex Plant

Pantex is located about 17 miles northeast of Amarillo, TX, on approximately 10,000 acres. Pantex was originally constructed by the U.S. Army as a conventional bomb plant early during World War II and was deactivated and vacated after the war. In 1949, Texas Technological College (Texas Tech) purchased the entire site for a token fee of $1 for use in experimental agriculture. However, in 1951, the Atomic Energy Commission asked the Army to "recapture" the main plant and 10,000 surrounding

acres for use as a nuclear weapons production facility, at which time the plant was refurbished and expanded. Pantex absorbed the weapons modification functions of the Clarksville, TN, and Medina, TX, plants in 1965 and 1966, respectively. In 1975, Pantex absorbed the functions of the decommissioned Burlington Plant in Iowa. In 1984, an additional 5,800 acres of the original site were leased back from Texas Tech to serve as a security buffer zone between the main plant area and U.S. Highway 60.

Pantex functions include the fabrication of chemical explosives; nuclear weapons assembly, disassembly, testing, quality assurance, repair, and nonnuclear component disposal; and development work in support of the design laboratories. Pantex is the only DOE facility that can execute the final assembly of a nuclear weapon for the DOD stockpile, including the joining of plutonium pits to the chemical explosive main charges to form primary assemblies. In the near term, weapons disassembly and component storage activities will dominate activities at Pantex. Facilities at Pantex will not be downsized or consolidated to a significant degree. Due to ongoing activities to reduce the weapons stockpile, Pantex has developed a capability for sealed pit storage. The present storage capacity is 20,000 units although DOE has agreed to store no more than 12,000 units at Pantex until it completes a site-wide EIS. The current missions and functions are listed in table 3.3.5–1.

Defense Program Activities. Almost all activities at Pantex are related to the defense program. Brief descriptions for operations falling under plant missions and functions are provided in the following paragraphs.

High explosive(s) (HE) components production includes: manufacturing main charge subassemblies and mock components for use in weapon test assemblies; manufacturing small HE components; producing a variety of explosive materials from chemical reactants and commercially produced explosives; and evaluating explosive materials and components through a variety of analytical, mechanical, and explosive tests. New production in the context of the Pantex mission is defined as the final assembly of a new nuclear weapon. Pantex receives weapons components and other materials from throughout the DOE Complex and from the U.S.

TABLE 3.3.5–1.—*Current Missions at Pantex Plant*

Mission	Description	Sponsor
Plutonium Storage	Provide required plant facility.	Assistant Secretary for Defense Programs
High Explosive(s) Components	Manufacture for use in nuclear weapons.	Assistant Secretary for Defense Programs
Weapon Assembly	Assemble nuclear weapons for the stockpile.	Assistant Secretary for Defense Programs
Weapon Maintenance	Retrofit, maintain, and repair stockpile weapons.	Assistant Secretary for Defense Programs
Quality Assurance	Stockpile quality assurance testing and evaluation.	Assistant Secretary for Defense Programs
Weapon Disassembly	Disassemble stockpile weapons as required.	Assistant Secretary for Defense Programs
Test/Training Programs	Assemble nuclear weapon-like devices for training.	Assistant Secretary for Defense Programs
Weapons Dismantlement	Dismantle nuclear weapons no longer required.	Assistant Secretary for Defense Programs
Development Support	Provide support to design agencies as requested.	Assistant Secretary for Defense Programs
Support Services	Provide required plant support services.	Assistant Secretary for Defense Programs
Waste Management	Provide waste management and D&D activities.	Assistant Secretary for Environmental Management

military. Historically, the DOE facilities at SRS, Y-12, the Rocky Flats Environmental Technology Site (formerly known as the Rocky Flats Plant), and the Kansas City Plant, located in Kansas City, MO, have contributed components and subassemblies for use in the final assembly of nuclear weapons. After final assembly, the items produced at Pantex are shipped either to other facilities within the DOE Complex or to military facilities by safe secure trailers.

Modification, maintenance, and repair involves the disassembly of a stockpiled nuclear weapon so that one or more of the components can be repaired, replaced, or modified. After replacing the components, the weapon is reassembled and returned to the stockpile. Pantex also performs many quality assurance evaluation activities on both new and stockpiled nuclear weapons. These tests involve the disassembly of a weapon, the laboratory testing of various components, and the rebuilding of the weapon for shipment back to the stockpile. The plant also disassembles nuclear weapons no longer needed in the stockpile.

In addition to the primary efforts associated with weapons assembly and disassembly, Pantex provides development support and services to the nuclear weapon design agencies and to other government entities as requested. Pantex contains a number of facilities that stage weapon components destined either for the assembly cells or for shipment back to other DOE facilities. Staging procedures may involve the leak testing of staging containers, inventory procedures to verify the number and contents of containers, and unpacking and repacking to physically verify and test contents.

Environmental Management Activities. Waste management operations at Pantex in the near term (1996 to 1997) would add facilities to enhance capabilities to adequately handle existing waste streams. New facilities for HE incineration and hazardous waste staging, treatment, and storage would be coupled with increased use of commercial offsite facilities to treat mixed waste streams. The long-range outlook (5 to 30 years) indicates increased waste generation as a result of accelerated retirement of the weapons inventory. New waste-handling capacities may be required to meet this need, such as new recycling markets. However, upon completion of the current backlog of dismantlements due to the recent stockpile reductions, this waste generation will decrease. Environmental management activities are discussed in detail in section 4.5.2.10 and in appendix H.

Environmental Regulatory Setting. The Department is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at Pantex. The Department is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed upon milestones. A brief description of the environmental regulatory setting at Pantex follows. More detail is available in appendix section A.1.4.

DOE entered into an Agreement in Principle, effective July 31, 1990, with the State of Texas to independently determine and verify any plant operational impacts to the environment. Pursuant to the terms of this agreement, DOE agrees to provide technical and financial support to the state agencies responsible for waste management, environmental monitoring, and emergency response planning at Pantex. DOE will provide the State with a chemical and radiological contaminant inventory and assessment of the plant. The Texas Natural Resources Conservation Commission implemented an environmental monitoring program at Pantex and is providing an independent evaluation of environmental monitoring data. EPA placed Pantex on the NPL on May 31, 1994.

The city of Amarillo operates a major water supply well field immediately north and down gradient of Pantex. Pantex receives its drinking water via five groundwater wells located on the northeast corner of the plant. The water is treated onsite and tested in accordance with requirements for public drinking water systems. The domestic water supply at Pantex meets all of the national primary and secondary drinking water standards for noncommunity, nontransient public water supply systems. The system is being operated and maintained in compliance with the State of Texas statutes and regulations.

On April 25, 1991, the EPA and the Texas Natural Resources Conservation Commission issued a hazardous waste permit to Pantex to manage hazardous and industrial solid wastes and operate a hazardous waste treatment, storage, and disposal facility. Pantex thermally treats explosive waste and explosive-contaminated waste at the Burning Ground. The hazardous waste permit specifically excluded the 17 RCRA units at the Burning Ground, but continued the interim status of the units which can operate under their "Written Grant of Authority" from the Texas Natural Resources Conservation Commission. In November 1991, DOE formally submitted to the State of Texas a request for a modification to add the units at the Burning Ground to its hazardous waste permit. The State of Texas, DOE, and parties to the hearing process are continuing discussions on terms of the proposed permit modification.

3.3.6 Savannah River Site

SRS, located on approximately 198,000 acres near Aiken, SC, became operational in 1953. 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.

Tritium recycling facilities empty tritium from expired reservoirs, purify it to eliminate the helium decay product, and fill replacement reservoirs with specification tritium for nuclear stockpile weapons. Filled reservoirs are delivered to Pantex for weapons assembly and directly to DOD as replacements for expired reservoirs. Historically, DOE has produced tritium at SRS. However, DOE has not produced new tritium since 1988. Until a new supply facility is online, DOE will not have an assured long-term tritium production capability.

Plutonium and spent nuclear fuel processing at SRS have been terminated. DOE is currently preparing a separate EIS to explore the use of these facilities to stabilize existing quantities of plutonium residues. Tritium recycling operations will continue with the Replacement Tritium Facility conducting the majority of these operations. As part of the nonnuclear consolidation, SRS is also in the process of receiving some of the tritium processing functions performed at the Mound Plant in Miamisburg, OH.

The current missions at SRS are shown in table 3.3.6–1. These activities can be categorized as defense program, environmental management, nuclear energy, and other activities.

Defense Program Activities. In the past, the SRS complex for the production of nuclear materials consisted of five reactors (the C-, K-, L-, P-, and R-Reactors) in addition to a fuel and target fabrication plant, two target and spent nuclear fuel chemical separation plants, a tritium-target processing facility, a heavy water rework facility, and waste management facilities. Recently, the K-Reactor, the last operational reactor, was put into cold standby status with no planned provision for restart, thus ending all tritium and special isotope production capability. SRS is conducting tritium-recycling operations in support of stockpile requirements using retired weapons as the tritium supply source.

Environmental Activities. Environmental management is pursuing a 30-year plan to achieve full compliance with all applicable laws, regulations, and agreements; treat, store, and dispose of existing waste; reduce generation of new wastes; clean up inactive waste sites; remediate contaminated groundwater; and dispose of surplus facilities. Environmental management activities are discussed in detail in section 4.6.2.10 and appendix H.

Other Department of Energy Activities. The Savannah River Technology Center provides technical support to all DOE operations at SRS. In this role, it provides process engineering development to reduce costs, waste generation, and radiation exposure. SRS continues to provide Pu-238 required to support space programs and has an expanding mission to transfer unique technologies developed at the site to industry. SRS is also an active participant in the Strategic Environmental Research and Development Program formulated to develop technologies to mitigate environmental hazards at DOD and DOE sites.

Non-Department of Energy Activities. There are several facilities and operations at SRS such as the Savannah River Forest Station, the Savannah River Ecology Laboratory, and the Institute of Archaeology

TABLE 3.3.6–1.—*Current Missions at Savannah River Site*

Mission	Description	Sponsor
Tritium Recycling	Operate H-Area tritium facilities.	Assistant Secretary for Defense Programs
Space Program Support	Provide Pu-238 for space program missions.	Office of Nuclear Energy
Interim Plutonium Storage	Operate Plutonium Storage Facility Vault.	Assistant Secretary for Defense Programs
Waste Management	Operate waste processing facilities.	Assistant Secretary for Environmental Management
Environmental Monitoring and Restoration	Operate remediation facilities.	Assistant Secretary for Environmental Management
Process Backlog Targets and Spent Nuclear Fuel	Operate F- and H-Canyons.	Assistant Secretary for Defense Programs
Research and Development	Savannah River Technology Center Technical support of DP, EM, and Nuclear Energy programs.	Assistant Secretary for Defense Programs; Assistant Secretary for Environmental Management; Office of Nuclear Energy
Other DOE and non-DOE Missions	Various, as described in text.	Various

and Anthropology. The Savannah River Forest Station is an administrative unit of the U.S. Forest Service that provides timber management, research support, soil and water protection, wildlife management, secondary roads management, and fire management to DOE. The Savannah River Forest Station manages 154,000 acres (approximately 80 percent of the site area). It has been responsible for reforestation and manages an active timber business. The Savannah River Forest Station assists with the development and updating of site-wide land use and provides continual support with site layout and vegetative management. It also assists in long-term wildlife management and soil rehabilitation projects.

The Savannah River Ecology Laboratory is operated for DOE by the Institute of Ecology of the University of Georgia. It has established a center of ecological field research where faculty, staff, and students perform interdisciplinary field research and provide an understanding of the impact of energy technologies on the ecosystems of the southeastern United States. This information is communicated to the scientific community, government agencies, and the general public. In addition to Savannah River Ecology Laboratory studies, the Institute of Archaeology and Anthropology is operated by the University of South Carolina to survey the archaeological resources of SRS. This survey is used by DOE when planning new facility additions or modifications, and is referred to in the operations management of the site.

Environmental Regulatory Setting. The Department is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at SRS. The Department is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed upon milestones. A brief description of the environmental regulatory setting at SRS follows. More detail is available in appendix section A.1.5.

The State of South Carolina has regulatory authority for air, water, solid waste, hazardous waste, and mixed waste. DOE and the State of South Carolina have signed a Memorandum of Agreement whereby SRS agrees to abide by South Carolina environmental laws as any other industry in the state, and will also implement an environmental management plan and report regularly on the progress of that plan.

EPA placed SRS on the NPL effective December 21, 1989. DOE entered into a Federal Facility Agreement effective August 16, 1993, with the EPA and the State of South Carolina to coordinate CERCLA and RCRA cleanups under one comprehensive strategy, that expands the ongoing RCRA Facility Investigation Program. This strategy governs the corrective/remedial action process from site investigation through site

remediation, including schedules for producing work plans and facilitating public involvement in decision-making processes.

DOE and EPA entered into the Federal Facility Compliance Agreement for NESHAP on October 31, 1991, allowing SRS to continue operations while installing and certifying additional monitoring and sampling equipment. DOE issued a Letter of Commitment on October 21, 1991, agreeing to redress drinking water system deficiencies. In addition, DOE entered into a Settlement Agreement on February 27, 1990, to satisfy violations of discharging wastewater without a permit.

The Federal Facility Compliance Agreement signed by EPA and DOE on March 13, 1991, addresses SRS compliance with the Land Disposal Restrictions of the Hazardous and Solid Waste Amendments of 1984, allowing SRS to continue to operate, generate, and store mixed wastes. This agreement was amended on April 24, 1992, to include mixed wastes whose treatment standards are outlined in the Land Disposal Restrictions Third Thirds Rule (40 CFR 268.35) and an alternative treatment strategy for M-Area waste. This amended agreement would form the basis for the SRS mixed waste site-specific treatment plan required by the *Federal Facility Compliance Act* of 1992.

TSCA requires PCB wastes to be disposed of within one year of its initial storage. SRS is currently storing radioactive PCB-contaminated equipment and materials past the allowable storage cutoff date. Due to the radioactive nature of these wastes, treatment capability for these wastes is not currently available. DOE is developing this treatment capability and working with South Carolina to approve a treatability study to remove the PCB contamination and return the radioactive materials to SRS as LLW.

3.3.7 Commercial Light Water Reactor Site

The commercial light water reactor alternative does not include a specific site for analysis in the PEIS. 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 the sites have 50-mile population densities of less than 200 persons per square mile and over 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 500 to 1,000 acres and an additional 12 sites are in the 1,000 to 2,000 acre range. Thus, almost 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.

3.4 Tritium Supply Technologies and Recycling

Four new tritium supply technologies are being considered in this PEIS: HWR, MHTGR, ALWR, and APT. Each of these would be either collocated with a new tritium recycling facility or use upgraded recycling facilities at SRS. The PEIS also considers purchase of a commercial reactor and conversion to defense purposes or use of a commercial reactor for irradiation services. These commercial reactor alternatives would use upgraded recycling facilities and new extraction and target fabrication facilities at SRS. These tritium supply technologies and recycling facilities and their construction, operation, and waste generation data are discussed in the following sections.

3.4.1 Background

Tritium, primarily a man-made radioactive isotope of hydrogen, is an essential component of all United States nuclear weapons. Tritium is needed by warheads to ensure that they perform as designed. Because of its radioactive decay, the tritium in the warheads must be periodically replenished. Because it is so rare in nature, all tritium used for weapons and other applications is man-made. However, no new tritium has been produced in the United States since 1988, when all of the tritium-producing reactors at SRS were shut down. Had the Cold War continued, the nuclear weapons stockpile would have quickly run out of tritium if no new tritium were produced. However, because of agreements between the United States and Russia, many nuclear weapons are being removed from the stockpile for dismantlement. This has reduced overall demand for tritium and made more tritium available to support the remaining stockpile. Eventually, however, even this tritium will decay to the point that there will not be enough to meet all nuclear weapons stockpile requirements. A new facility for producing new tritium will be needed early in the next century. The overall tritium supply and recycling complex is depicted in figure 3.4.1–1.

3.4.1.1 *Production of Tritium*

The production of tritium occurs when target materials containing lithium-6 or the gas helium-3 are exposed to neutrons. The subsequent absorption of neutrons by the target atoms causes the target atom to become highly unstable, breaking apart almost instantaneously, leaving tritium as one of the decay products. After neutron bombardment, the target material is removed and the tritium extracted. In the case of the three nuclear reactor technologies analyzed in this PEIS (HWR, MHTGR, and ALWR), neutrons are produced by fission of uranium which has been enriched with U-235. In the case of the proton accelerator, neutrons are produced by the impact of high energy protons in a heavy metal target, such as lead or tungsten. Such a process is called nuclear spallation.

3.4.1.2 *Construction*

Construction of each tritium supply technology would involve heavy construction equipment, such as bulldozers, dump trucks, cranes, concrete trucks, and paving equipment. Construction time would vary from 5 to 9 years, depending upon the tritium supply technology. Heavy duty construction activity would fluctuate during the course of construction. At various times there would be increases in the number of workers, vehicular traffic, and noise.

Construction activity for each of the tritium supply technologies would require a certain amount of onsite clearing and excavation activity for the laying of foundations, the laying of utility cables for electrical systems, and the installation of underground water and sewage systems. Substantial below ground construction would be required for the MHTGR reactor modules and the APT accelerator tunnel.

A construction laydown area would be required for each technology for the purpose of storing raw materials, building supplies, and construction equipment. The size of each laydown area would vary (173 acres to 360 acres), depending on the tritium supply technology, and generally would not exceed the eventual operation area.

3.4.1.3 *Operation*

Although not all of the four technologies use the same methods to produce tritium, they all share common operations facilities. In addition to security, general services, and administrative activities, each technology would require an extraction facility to separate the newly produced tritium from target rods or blankets, a waste treatment facility to process

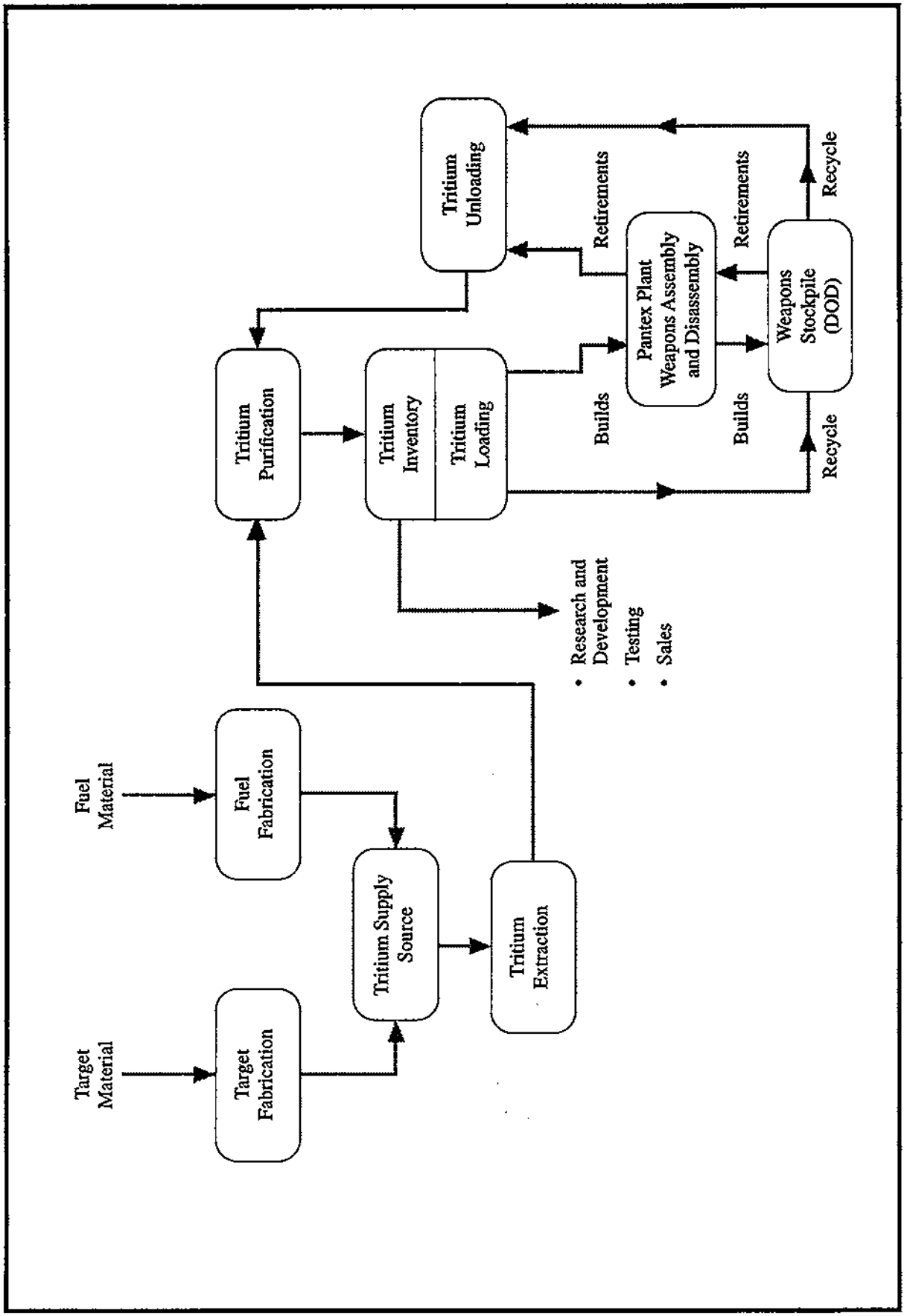


FIGURE 3.4.1–1.—*Tritium Supply and Recycling Complex.*

generated waste and a spent nuclear fuel storage area to store used fuel assemblies. A spent fuel storage facility would not be required for the APT because fuel rods are not used in this technology. Additionally, all of the tritium technologies would require a cooling system, an adequate source of water, and in some cases, a cooling basin.

Each of the reactor technologies would require a periodic changing of the fuel and target rods. Target rods or assemblies would be placed in cooling pools for a short period of time to allow decay of short-lived activation products prior to tritium extraction. The targets would then be sent to the tritium extraction facility where the tritium would be extracted from the irradiated target rods or blankets, purified, and sent to the recycling facility where it would be used to fill tritium reservoirs for weapons. The accelerator would require removal or replacement of the target material depending on the target system chosen. The recycling facility would also take reservoirs returned from the stockpile, empty them, and purify the tritium for reuse in new reservoirs.

Operation for all technologies would require routine maintenance activities such as preventative maintenance and equipment repair, which are found in any industrial activity. Each of the technologies would generate LLW such as glove box tools, protective clothing, and high efficiency particulate air (HEPA) filters; mixed LLW such as rags contaminated with solvents and oils; hazardous wastes, including cleaning solvents and vacuum pump oils; and normal nonhazardous wastes such as sewage and trash. Additionally, the reactor technologies would generate spent nuclear fuel.

3.4.1.4 *Cooling Systems*

Because of the heat generated by nuclear reactors and accelerators, an extensive cooling system would be required to keep them within specified temperature ranges. The heat dissipation system would be dependent on site characteristics. Both wet and dry cooling systems would use water as the heat exchange medium. Wet or dry cooling systems can be used for the reactor technologies considered in this PEIS. As previously described in section 3.1, dry cooling is not presently a feasible option for the APT technology and wet cooling would be used for it even at dry sites.

In a wet or once-through cooling system, water is drawn continuously at a high rate from an adjacent body of water and circulated through a condenser. This condensor transfers waste heat from the reactor or accelerator to the cooling water, and discharges it back into the body of water. Hence, plants with once-through cooling systems are located only near major rivers, large lakes, or an ocean, where the water supply is adequate. Wet systems would typically use natural draft cooling towers (figure 3.4.2.3–1) and the evaporation process to carry off heat.

Dry systems would typically use water in closed non-evaporative mechanical draft cooling towers (figure 3.4.2.1–1) to carry off heat to the atmosphere by conduction through radiator like vanes with fans to move air over the vanes. There would be some water loss through evaporation in a dry system, but significantly less than with a wet tower. Dry cooling towers would be used for the reactors at all dry sites (e.g., sites with limited or no surface water). In this PEIS the dry sites are considered to be INEL, NTS and Pantex.

Depending on the type of cooling system selected and various other factors such as the climatic conditions at the site, these cooling towers could range from 7 stories for mechanical draft dry cooling towers to 20 to 50 stories for natural draft wet cooling towers. Typically, each unit is made of concrete and circular in shape. Natural draft wet cooling towers must be very tall structures in order to produce sufficient draft to work properly. As a result, natural draft wet cooling towers are more expensive to build than mechanical draft dry cooling towers; however their operating costs are significantly less and the units are much quieter in operation. Mechanical draft dry cooling towers usually consist of a number of individual units. As previously stated, they are less expensive to build than natural towers but more costly to operate. This is reflected in higher utility costs, especially for electricity.

3.4.1.5 *Decontamination and Decommissioning*

D&D activities would be carried out at the end of the facility's life to permit the facility to be removed safely from service and to enable the property to be used for other purposes. The scope of work required for D&D activities can range from performing a simple radiological survey to completely dismantling and removing a radioactively-contaminated facility.

Although D&D activities do not begin until the end of a facility's life, planning for D&D begins in the design phase. All proposed tritium supply technologies and recycling facilities would be designed to minimize facility equipment contamination and thereby make future D&D of such facilities as simple and inexpensive as feasible, and to minimize the impacts of future D&D, as required by DOE Orders 5820.2A, *Radioactive Waste Management* and 6430.1A, *General Design Criteria*. Further discussion of future D&D requirements is presented in section 4.14. Examples of design features that may be incorporated into tritium supply and recycling facilities to facilitate future D&D are:

- Modular, separable confinements for radioactive and other hazardous materials that preclude contamination of fixed portions of the structure.
- Localized liquid transfer systems that avoid long runs of buried contaminated piping, including special provisions that ensure the integrity of joints in buried pipelines.
- Exhaust filtration components of the ventilation systems at or near individual enclosures to minimize long runs of internally contaminated ductwork.
- Equipment, including effluent decontamination equipment, that precludes the accumulation of radioactive or other hazardous materials in relatively inaccessible areas, including curves and turns in piping and ductwork.
- Easily decontaminated materials that reduce the amount of radioactive and other hazardous materials requiring disposal.
- Designs that ease cutup, dismantlement, removal, and packaging of contaminated equipment from the facility.
- Modular radiation shielding in lieu of or in addition to monolithic shielding walls.
- Lifting lugs on large tanks and equipment.
- Fully drainable piping systems that carry contaminated or potentially contaminated liquids.

3.4.2 Tritium Supply Technologies

Of the tritium supply technologies considered by DOE for the production of tritium in this PEIS, only the HWR has tritium production operating experience. The light water reactor (upon which the ALWR and commercial reactor alternative are based) and gas reactor technologies have been used in electrical power production but lack tritium production experience and development of tritium target 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 tritium targets.

Since the MHTGR, ALWR, and the commercial reactor were developed originally to produce electricity and as such have steam turbines as an integral part of their designs, this PEIS evaluates the 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 tiered NEPA documents if either of these technologies were chosen and DOE developed a proposal to sell steam or generate electricity. The general impacts of the transmission lines necessary to carry this generated electricity are discussed in section 4.8.1. In addition, the general impacts of constructing and operating a power plant (either coal or natural gas burning) to provide the required power for the APT are also presented in section 4.8.2. As both the MHTGR and the ALWR technologies could also be used for the ultimate disposition of plutonium by burning mixed-oxide fuel, the general impacts of operating these two technologies with mixed-oxide fuel is presented in section 4.8.3. The site-specific impacts of a gas-fired power plant and a multipurpose reactor are described for affected resources in sections 4.2 through 4.6.

3.4.2.1 *Heavy Water Reactor*

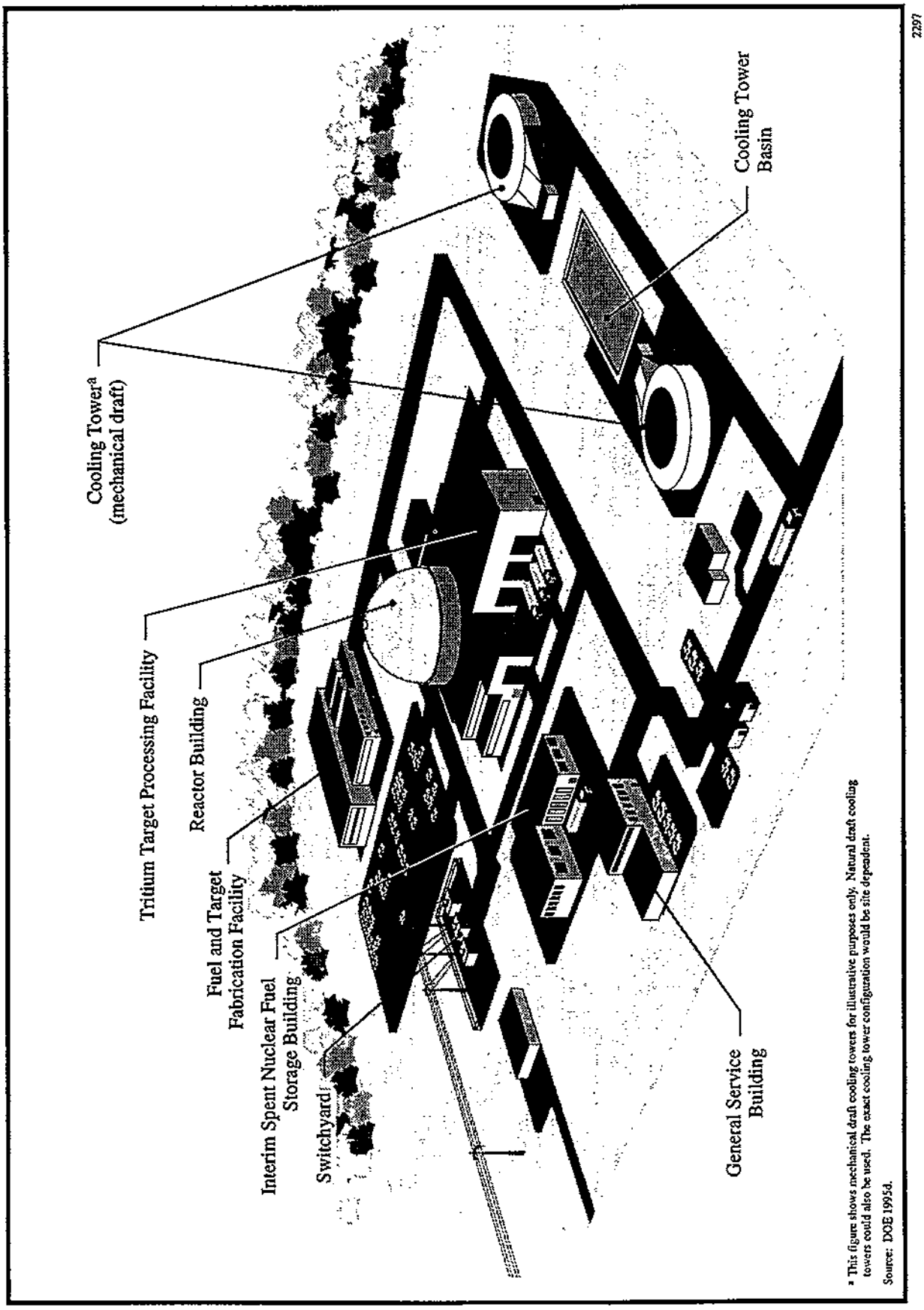
The HWR would be a low pressure, low temperature reactor whose sole purpose would be to produce tritium. A detailed description of the HWR technology and its operation is provided in appendix A. The HWR would use heavy water as the reactor coolant and moderator. Because of the low temperature of the 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 would be surrounded entirely 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 would vary in height, depending on the type of cooling towers utilized. The cooling tower basin, which serves as a holding pond for the cooling towers, would cover approximately 2 acres. In this PEIS dry sites (INEL, NTS, and Pantex) would use mechanical draft dry cooling towers while wet sites (ORR and SRS) would use natural draft wet cooling towers.

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 interim spent fuel storage building to store used target and fuel rods; a general services building for administrative purposes; and security infrastructure to control access to the complex. Figure 3.4.2.1–1 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 radioactivity, an emergency core cooling system to makeup coolant for heat removal in the event of a loss of coolant or a loss of pumping; an emergency shutdown system with safety 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. The construction area would be approximately 260 acres. Once constructed, approximately 1 to 2 years would be needed for systems checkout of the reactor prior to actual tritium production. Construction and operation requirements for the HWR are given in tables 3.4.2.1–1 and 3.4.2.1–2. Estimated waste generation data for the HWR facility are given in table 3.4.2.1–3.



[a] This figure shows mechanical draft cooling towers for illustrative purposes only. Natural draft cooling towers could also be used. The exact cooling tower configuration would be site dependent.

Source: DOE 1995d.

FIGURE 3.4.2.1–1.—*Heavy Water Reactor Facility (Typical).*

TABLE 3.4.2.1–1.—*Heavy Water Reactor Construction Requirements*

Requirement	Consumption
Material/Resources	
Electrical energy (MWh)	87,000
Concrete (yd^3)	220,000
Steel (tons)	45,000
Gasoline, diesel fuel, and lube oil (gal)	2,400,000
Water (gal)	170,000,000
Land disturbance (acres)	260
Employment	
Total employment (worker years)	9,760
Peak employment (workers)	2,320
Construction period (years)	8

Source: DOE 1995d.

TABLE 3.4.2.1–2.—*Heavy Water Reactor Operation Requirements*

Requirement	Consumption
Electrical Energy (MWh/yr)	
Wet site	370,000
Dry site	540,000
Electrical Load (MWe)	
Wet site	51
Dry site	69
Fuel	
Gas (ft^3/yr)	240,000,000
Liquid (GPY)	82,000
Water (MGY)	
Wet site	5,900
Dry site	48
Plant Footprint	
Plant (acres)	260
Employment	
Total workers	930
Badged workers	230

Source: DOE 1995d.

TABLE 3.4.2.1–3.—*Heavy Water Reactor Estimated Spent Nuclear Fuel and Waste Volumes*

Category	Annual Average Volume Generated From Construction (yd^3)	Annual Volume Generated From Operations (yd^3)	Annual Volume Effluent From Operations (yd^3)
Spent Nuclear Fuel	None	7[a]	7[a]
Low-Level			
Liquid	None	10,400[b] (2,100,000 gal)	None
Solid	None	5,200	1,870[c]
Mixed Low-Level			
Liquid	None	None	None
Solid	None	120	120
Hazardous			
Liquid	Included in solid	Included in solid	Included in solid
Solid	20	40	40
Nonhazardous (Sanitary)			
Liquid	79,220 (16,000,000 gal)	238,000[d] (48,000,000 gal)	238,000[d] (48,000,000 gal)
Solid	7,800	7,600	2,530[e]
Nonhazardous (Other)			
Liquid	2,570[f] (520,000 gal)	Included in sanitary	Included in sanitary
Solid	Included in sanitary	6,500[g]	None

[a] Residual heavy metal content in spent nuclear fuel is 660 lb (0.3 metric tons).

[b] Liquid LLW is treated with the remaining LLW sludge being solidified.

[c] Assumes a 100:1 wastewater/sludge ratio in the treatment of liquid LLW, followed by 2:1 increase in volume from solidification of sludge. Assumes compaction factor of 3:1 for compactible solids.

[d] At a dry site, nonevaporative cooling yields no cooling tower blowdown. At a wet site, the liquid effluent is 11,600,000 yd^3 (2,350,000,000 gal).

[e] Assumes overall compaction factor of 3:1.

[f] Does not include groundwater dewatering, if required.

[g] Recyclable wastes.

Source: DOE 1995d.

3.4.2.2 *Modular High Temperature Gas-Cooled Reactor*

The MHTGR would be a high temperature, moderate pressure reactor whose primary purpose would be to produce tritium. A detailed description of the MHTGR technology and its operation is provided in appendix A. 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 will be included in this analysis. In addition to 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 would be surrounded entirely by a security fence. The MHTGR would consist of three 350 MWt reactor vessels housed in adjacent, below-grade, 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, reflectors, 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 three 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 Pantex) would use mechanical draft dry cooling towers and wet sites (ORR and SRS) would use natural draft wet cooling towers.

The design of the MHTGR complex would include a fuel and target fabrication facility, a tritium target processing building, 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. Figure 3.4.2.2–1 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 safety 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 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; a 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. The construction area would be approximately 360 acres. One to two years would be needed after construction for system check-out of the reactor prior to actual tritium production. Construction and operation requirements for the MHTGR are given in tables 3.4.2.2–1 and 3.4.2.2–2. Estimated waste generation data for the MHTGR complex are given in table 3.4.2.2–3

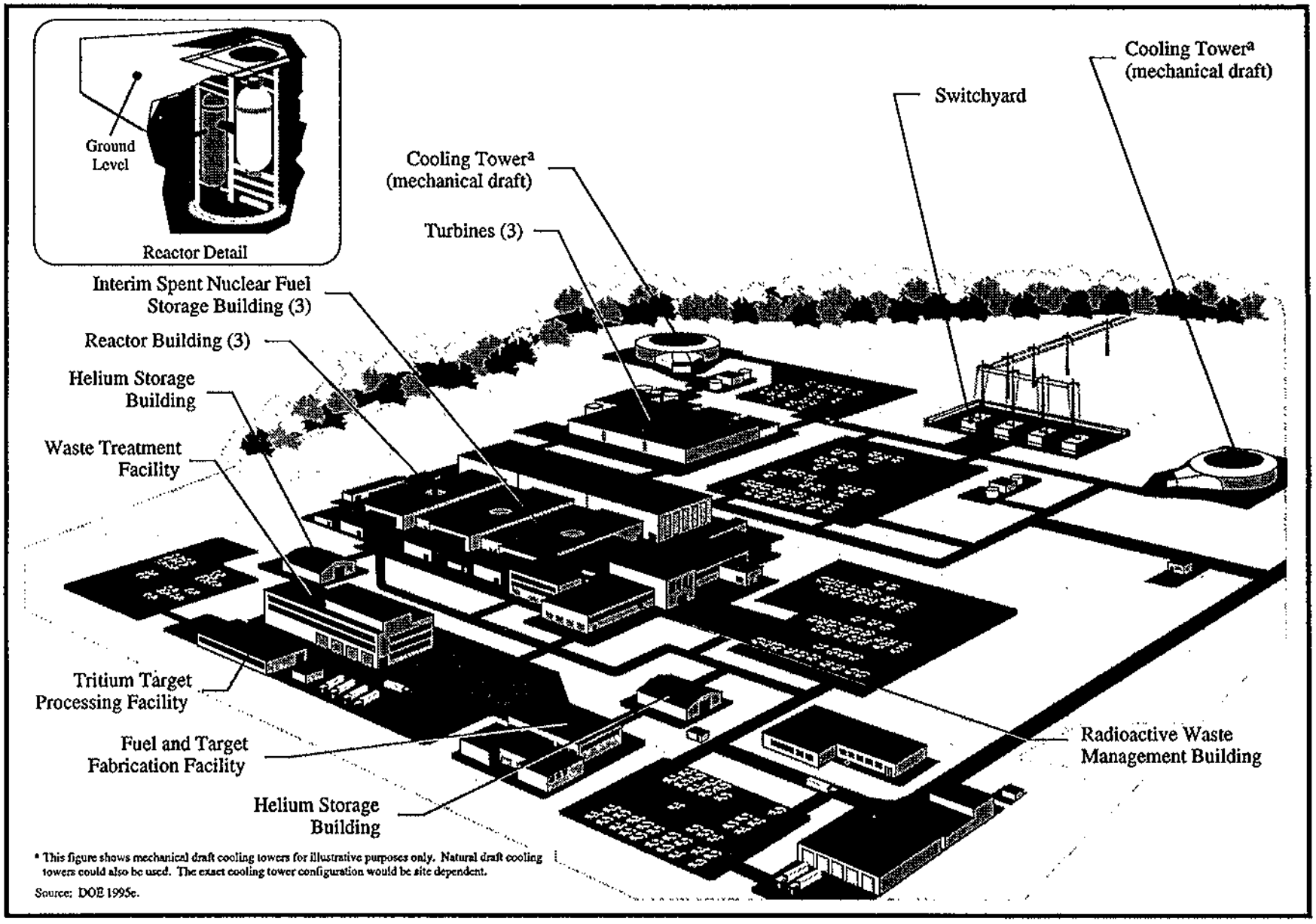


FIGURE 3.4.2.2–1.—*Modular High Temperature Gas-Cooled Reactor Facility (Typical).*

TABLE 3.4.2.2–1.—*Modular High Temperature Gas-Cooled Reactor Construction Requirements*

Requirement	Consumption
Material/Resources	
Electrical energy (MWh)	73,000
Concrete (yd^3)	220,000
Steel (tons)	60,000
Gasoline, diesel fuel, and lube oil (gal)	3,200,000
Water (gal)	160,000,000
Land Disturbance (acres)	360
Employment	
Total employment (worker years)	8,810
Peak employment (workers)	2,210
Construction period (years)	9

Source: DOE 1995e.

TABLE 3.4.2.2–2.—*Modular High Temperature Gas-Cooled Reactor Operation Requirements*

Requirement	Consumption
Electrical Energy (MWh/yr)	
Wet site	260,000
Dry site	360,000
Electrical Load (MWe)	
Wet site	36
Dry site	46
Fuel	
Gas (ft^3/yr)	6,000,000
Liquid (GPY)	81,000
Water (MGY)	
Wet site	4,000
Dry site	30
Plant Footprint	
Plant (acres)	360
Employment	
Total workers	910
Badged workers	180

Source: DOE 1995e.

TABLE 3.4.2.2–3.—*Modular High Temperature Gas-Cooled Reactor Estimated Spent Nuclear Fuel and Waste Volumes*

Category	Annual Average Volume Generated From Construction (yd^3)	Annual Volume Generated From Operations (yd^3)	Annual Volume Effluent From Operations (yd^3)
Spent Nuclear Fuel	None	80[a]	80[a]
Low-Level			
Liquid	None	2,600[b] (525,000 gal)	None
Solid	None	1,300	468[c]
Mixed Low-Level			
Liquid	None	None	None
Solid	None	<1	<1
Hazardous			
Liquid	Included in solid	Included in solid	Included in solid
Solid	20	100	100
Nonhazardous (Sanitary)			
Liquid	64,400 (13,000,000 gal)	149,000[d] (30,000,000 gal)	149,000[d] (30,000,000 gal)
Solid	7,100	7,400	2,470[e]
Nonhazardous (Other)			
Liquid	3,020[f] (610,000 gal)	Included in sanitary	Included in sanitary
Solid	Included in sanitary	6,400[g]	None

[a] Residual heavy metal content in spent nuclear fuel is 530 lb (0.24 metric tons).

[b] Liquid LLW is treated with the remaining LLW sludge being solidified.

[c] Assumes a 100:1 wastewater/sludge ratio in the treatment of liquid LLW, followed by 2:1 increase in volume from solidification of sludge. Assumes compaction factor of 3:1 for compactible solids.

[d] At a dry site nonevaporative cooling yields no cooling tower blowdown. At a wet site the liquid effluent is 8,070,000 yd^3 (1,630,000,000 gal).

[e] Assumes overall compaction factor of 3:1.

[f] Does not include groundwater dewatering, if required.

[g] Recyclable wastes.

Source: DOE 1995e.

3.4.2.3 *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 proposed ALWR technology: a Large ALWR (1,300 MWe) and a Small ALWR (600 MWe). The large and small options would be chosen from the following four candidates: a large or small pressurized water reactor or a large or small boiling water reactor. A detailed description of the ALWR technology options and their operations is provided in appendix A. All ALWR options would use light (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 will be included in this 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 would cover approximately 350 acres and the whole complex 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 in 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 each of 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, warehouses, 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 3.4.2.3–1 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 support areas are descriptive only and can change significantly as design progresses.

The tritium target processing facility would consist of the following two attached structures: a processing building and a support building. The process building would include the tritium extraction processes, laboratory, and other activities associated with handling tritium. The support building contains offices, maintenance areas, and nonradioactive ventilation systems. The type of cooling tower used depends upon where the ALWR is located. In this PEIS dry sites (INEL, NTS and Pantex) would use mechanical draft dry cooling towers and wet sites (ORR and SRS) would use natural draft wet cooling towers.

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 makeup 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. The construction area would be approximately 350 acres. Once constructed, 1 to 2 years would be needed to check out the reactor prior to actual tritium production. Construction and operation requirements for the Large and Small ALWR are given in tables 3.4.2.3–1 and 3.4.2.3–2. Estimated waste generation data for the Large and Small ALWR facility are given in tables 3.4.2.3–3 and 3.4.2.3–4.

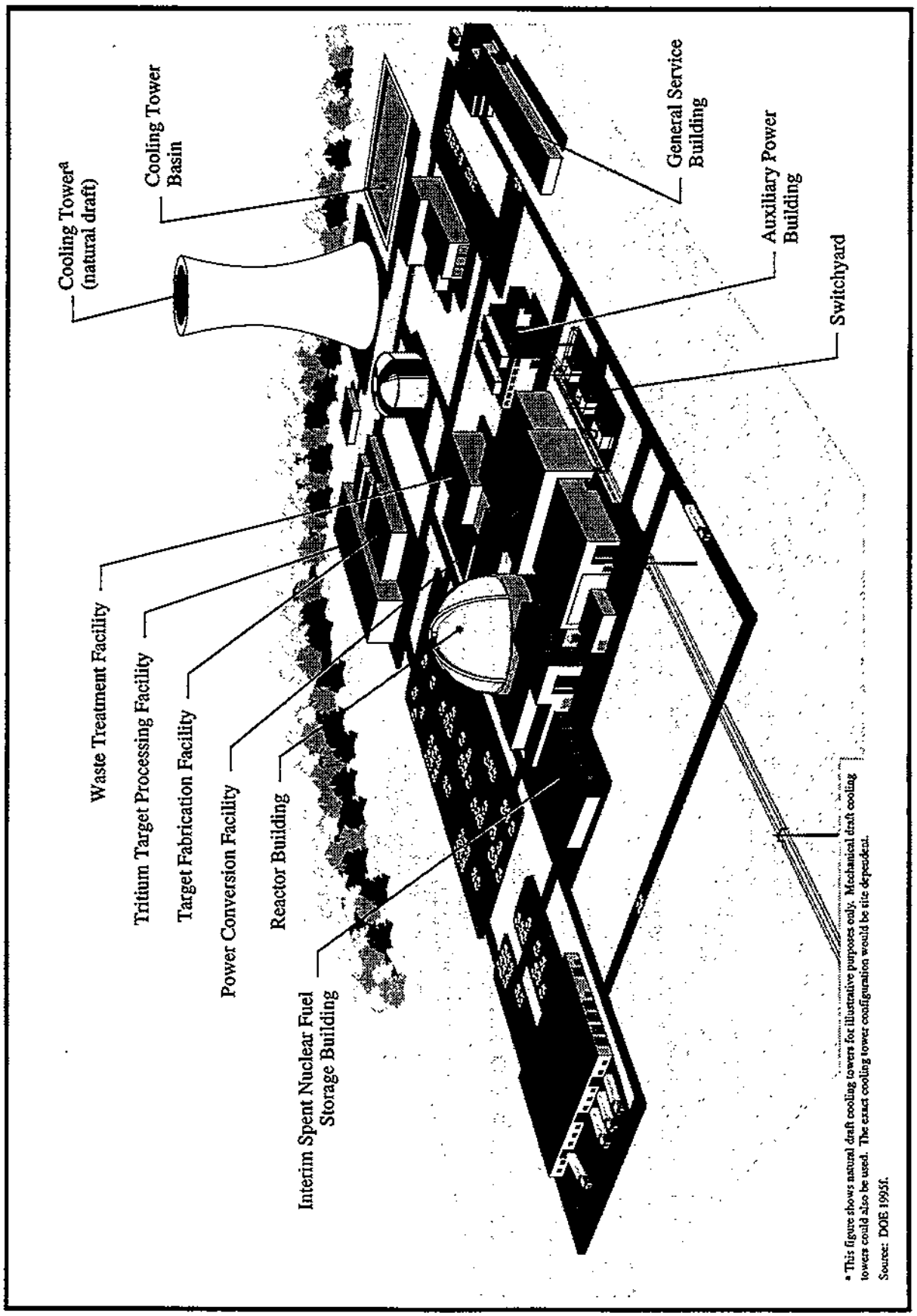


FIGURE 3.4.2.3-1.—*Advanced Light Water Reactor Facility (Typical).*

TABLE 3.4.2.3–1.—*Advanced Light Water Reactor Construction Requirements*

Requirement	Consumption	
	Large ALWR	Small ALWR
Material/Resources		
Electrical energy (MWh)	120,000	120,000
Concrete (yd^3)	380,000	200,000
Steel (tons)	68,000	50,000
Fuel, liquid (gal)	1,500,000	1,500,000
Water (gal)	200,000,000	120,000,000
Land disturbance (acres)	350	350
Employment		
Total employment (worker years)	12,600	7,100
Peak employment (workers)	3,500	2,200
Construction period (years)	6	6

Source: DOE 1995f.

TABLE 3.4.2.3–2.—*Advanced Light Water Reactor Operation Requirements*

Requirement	Consumption	
	Large ALWR	Small ALWR
Electrical Energy (MWh/yr)		
Wet Site	700,000	380,000
Dry Site	1,100,000	580,000
Electrical Load (MWe)		
Wet Site	96	52
Dry Site	140	75
Fuel		
Gas (ft^3/yr)	0	0
Liquid (GPY)	200,000	110,000
Water (MGY)		
Wet site	16,000	7,200
Dry site	90	50
Plant Footprint		
Plant (acres)	350	350
Employment		
Total workers	830	500
Badged workers	210	125

Source: DOE 1995f.

TABLE 3.4.2.3–3.—*Advanced Light Water Reactor (Large) Estimated Spent Nuclear Fuel and Waste Volumes*

Category	Annual Average Volume Generated From Construction (yd^3)	Annual Volume Generated From Operations (yd^3)	Annual Volume Effluent From Operations (yd^3)
Spent Nuclear Fuel	None	55[a]	55[a]
Low-Level			
Liquid	None	24,800[b] (5,000,000 gal)	None
Solid	None	710	567[c]
Mixed Low-Level			
Liquid	None	None	None
Solid	None	6	6
Hazardous			
Liquid	Included in solid	Included in solid	Included in solid
Solid	930	35	35
Nonhazardous (Sanitary)			
Liquid	134,000 (27,000,000 gal)	446,000[d] (90,000,000 gal)	446,000[d] (90,000,000 gal)
Solid	15,000	6,900	2,300[e]
Nonhazardous (Other)			
Liquid	2,480[f] (500,000 gal)	Included in sanitary	Included in sanitary
Solid	Included in sanitary	5,800[g]	None

[a] Residual heavy metal content in spent nuclear fuel is 230,000 lb (105 metric tons).

[b] Liquid LLW is treated with the remaining LLW sludge being solidified.

[c] Assumes a 100:1 wastewater/sludge ratio in the treatment of liquid LLW, followed by 2:1 increase in volume from solidification of sludge. Assumes compaction factor of 3:1 for compactible solids.

[d] At a dry site nonevaporative cooling yields no cooling tower blowdown. At a wet site the liquid effluent is 31,100,000 yd^3 (6,290,000,000 gal).

[e] Assumes overall compaction factor of 3:1.

[f] Does not include groundwater dewatering, if required.

[g] Recyclable wastes.

Source: DOE 1995f.

TABLE 3.4.2.3–4.—*Advanced Light Water Reactor (Small) Estimated Spent Nuclear Fuel and Waste Volumes*

Category	Annual Average Volume Generated From Construction (yd^3)	Annual Volume Generated From Operations (yd^3)	Annual Volume Effluent From Operations (yd^3)
Spent Nuclear Fuel	None	36[a]	36[a]
Low-Level			
Liquid	None	3,910[b] (790,000 gal)	None
Solid	None	660	272[c]
Mixed Low-Level			
Liquid	None	None	None
Solid	None	6	6
Hazardous			
Liquid	Included in solid	Included in solid	Included in solid
Solid	850	35	35
Nonhazardous (Sanitary)			
Liquid	74,300 (15,000,000 gal)	248,000[d] (50,000,000 gal)	248,000[d] (50,000,000 gal)
Solid	10,000	4,200	1,400[e]
Nonhazardous (Other)			
Liquid	2,480[f] (500,000 gal)	Included in sanitary	Included in sanitary
Solid	Included in sanitary	3,500[g]	None

[a] Residual heavy metal content in spent nuclear fuel is 150,000 lb (68 metric tons).

[b] Liquid LLW is treated with the remaining LLW sludge being solidified.

[c] Assumes a 100:1 wastewater/sludge ratio in the treatment of liquid LLW, followed by 2:1 increase in volume from solidification of sludge. Assumes compaction factor of 3:1 for compactible solids.

[d] At a dry site nonevaporative cooling yields no cooling tower blowdown. At a wet site the liquid effluent is 14,100,000 yd^3 (2,850,000,000 gal).

[e] Assumes overall compaction factor of 3:1.

[f] Does not include groundwater dewatering, if required.

[g] Recyclable wastes.

Source: DOE 1995f.

3.4.2.4 *Accelerator Production of Tritium*

The APT would be a linear accelerator whose primary purpose would be to produce tritium. A detailed description of the APT technology and its operation is provided in appendix A. The APT accelerates a proton beam in a long tunnel to one of two target/blanket assemblies located in separate target stations. There are two target/blanket concepts being considered in the conceptual design of the Full APT: the helium-3 target and the spallation-induced lithium conversion target. The helium-3 target is the primary target in the Phased APT option.

The APT complex would cover approximately 173 acres and would be surrounded by a security fence. The accelerator, 3,940 feet in length, would be housed in a concrete tunnel buried 40 to 50 feet underground for radiation shielding. The design of the APT radio frequency power system and its distribution network is similar to that of existing accelerators for which there are decades of operational experience. The existing accelerators have been shown to pose no appreciable health threat to workers and the public. In addition, there is no appreciable danger of interference with communications or the many signal sensitive electronic systems (LANL 1994a:1). 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. Additionally, there would be two cooling towers for the target/blanket beam stop, located next to the target building. The cooling towers and the substations would be approximately one to two stories in height.

The preconceptual design of the APT complex includes: a target building that would house 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 processing 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 3.4.2.4–1 shows a representative drawing of a APT complex. The number and arrangement of buildings and support areas are illustrative only and can change significantly once 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 power 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 a 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 to check out the accelerator prior to actual tritium production.

If desired, a phased construction of the APT could also occur. Under this scenario, initial construction of the APT would complete the majority of the civil engineering and would result in a facility that could produce the steady-state requirement (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. This expansion would consist of the addition of another injector leg, a funnel to combine its proton beam with the other, and additional radio frequency power sources to accelerate it. All tables display requirements for both a full production APT and a phased approach to the construction of an APT. Construction and operation requirements for the APT are given in tables 3.4.2.4–1 and 3.4.2.4–2. Estimated waste generation data for the APT complex are given in tables 3.4.2.4–4 and 3.4.2.4–4. An option to collocate a dedicated natural gas-fueled power plant with the APT at each site is also considered. Estimated construction and operation requirements for this power plant are given in tables 3.4.2.4–5 and 3.4.2.4–6.

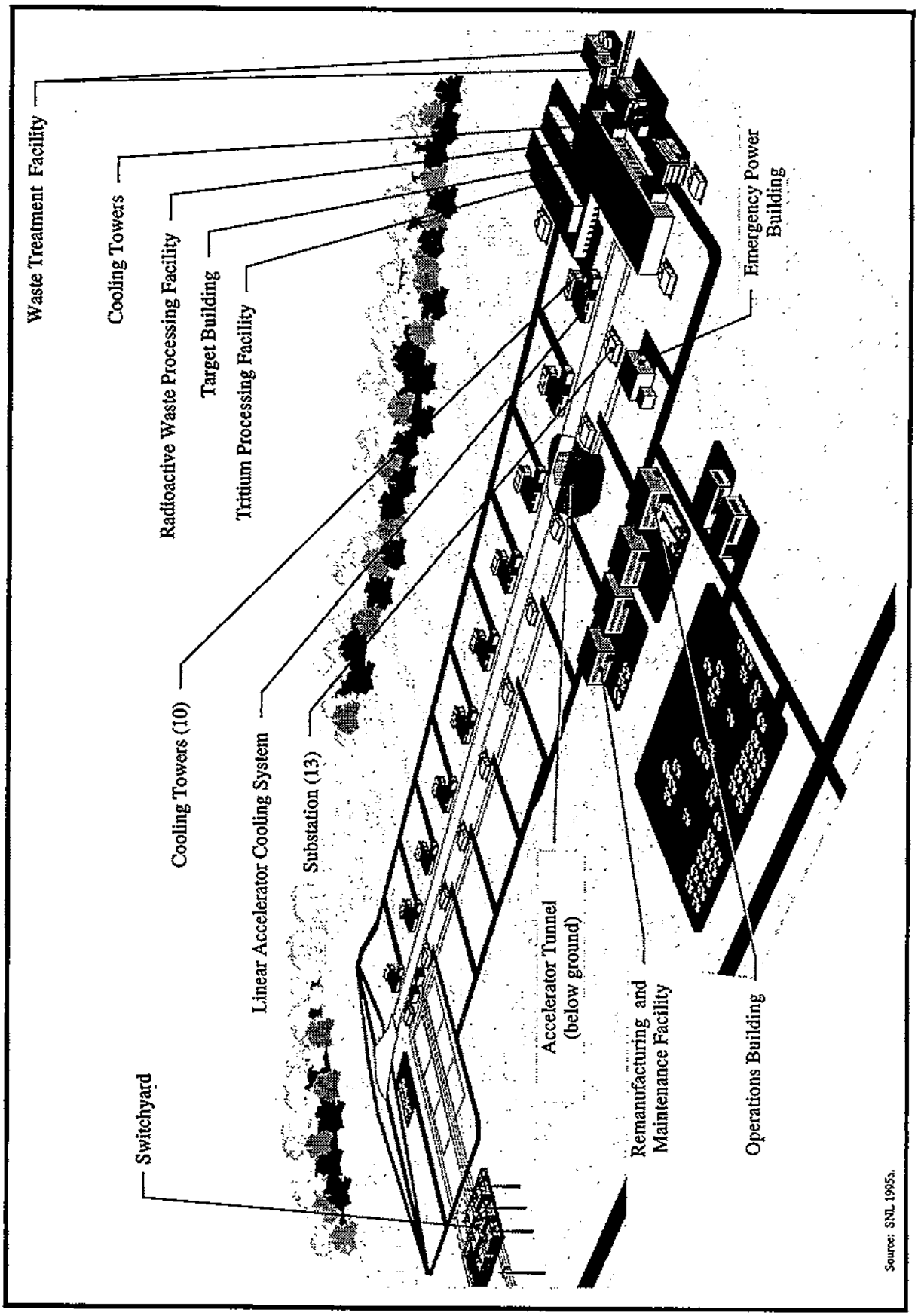


FIGURE 3.4.2.4-1.—*Accelerator Production of Tritium Facility Site Layout (Typical).*

TABLE 3.4.2.4–1.—*Accelerator Production of Tritium Construction Requirements*

Requirement	Consumption	
	Full APT	Phased APT
Material/Resources		
Electrical energy (MWh)	40,000	40,000
Concrete (yd^3)	275,000	275,000
Steel (tons)	61,495	55,820
Gasoline, diesel fuel, and lube oil (gal)	2,110,000	2,110,000
Water (gal)	41,700,000	41,700,000
Land Disturbance (acres)	173	173
Employment		
Total employment (worker years)	6,380	6,380
Peak employment (workers)	2,760	2,760
Construction period (years)	5	5

Source: SNL 1995a.

TABLE 3.4.2.4–2.—*Accelerator Production of Tritium Operation Requirements*

Requirement	Consumption (Wet and Dry Sites)	
	Full APT	Phased APT
Electrical Energy (MWh/yr)	3,740,000	2,400,000
Electrical Load (MWe)	550	355
Fuel		
Gas (ft^3/yr)	0	0
Liquid (GPY)	13,200	13,200
Water (MGY)	1,200	770
Plant Footprint		
Plant (acres)	173	173
Employment		
Total workers	624	624
Badged workers	258	258

Source: SNL 1995a.

TABLE 3.4.2.4–3.—*Accelerator Production of Tritium (Full) Estimated Waste Volumes*

Category	Annual Average Volume Generated From Construction (yd^3)	Annual Volume Generated From Operations (yd^3)	Annual Volume Effluent From Operation (yd^3)[a]
Low-Level			
Liquid	None	None	None
Solid	None	544	221[b]
Mixed Low-Level			
Liquid	None	None	None
Solid	None	6.8	3.9
Hazardous			
Liquid	Included in solid	None	0.003 (0.6 gal)
Solid	13	2.5	2.5
Nonhazardous (Sanitary)			
Liquid	1,570[c] (317,000 gal)	1,210,000[d] (245,000,000 gal)	<1,000[d] <200,000 gal)
Solid	5,500	1,240	413[e]
Nonhazardous (Other)			
Liquid	Included in sanitary		Included in sanitary
Solid	Included in sanitary		None

[a] The Full APT waste volumes are based on the spallation-induced lithium conversion target. The helium-3 target waste volumes are approximately the same with the exception of solid LLW which is 57 yd^3.

[b] Assumes compaction factor of 3:1 for personnel protection equipment compactible solids and 2:1 for metallics.

[c] Does not include ground dewatering, if required.

[d] At a dry site, the treated effluent from cooling tower blowdown and the sanitary wastewater treatment plant are recycled for reuse as cooling water makeup and other services after treatment. At a wet site the effluent is 1,210,000 yd^3 (245,000,000 gal).

[e] Assumes overall compaction factor of 3:1.

Source: SNL 1995a.

TABLE 3.4.2.4–4.—*Accelerator Production of Tritium (Phased) Estimated Waste Volumes*

Category	Annual Average Volume Generated From Construction (yd^3)	Annual Volume Generated From Operations (yd^3)	Annual Volume Effluent From Operation[a] (yd^3)
Low-Level			
Liquid	None	None	None
Solid	None	68	54
Mixed Low-Level			
Liquid	None	None	None
Solid	None	3	2.5
Hazardous			
Liquid	Included in solid	None	0.003 (0.6 gal)
Solid	13	1.2	1.2
Nonhazardous (Sanitary)			
Liquid	1,570[b] (317,000 gal)	789,000[c] (159,000,000 gal)	<1,000[c] (<200,000 gal)
Solid	5,500	1,240	413[d]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	None	None

[a] Waste volumes based on helium-3 target.
[b] Does not include ground dewatering, if required.
[c] At a dry site the treated effluent from blowdown and sanitary wastewater treatment are recycled for reuse as cooling water makeup and other services after treatment. At a wet site the effluent is 789,000 yd^3 (159,000,000 gal).
[d] Assumes compaction factor of 3:1 for personnel protection equipment compactible solids and 2:1 for metallics.
Source: SNL 1995a.

TABLE 3.4.2.4–5.—*Accelerator Production of Tritium Power Plant Construction Requirements*

Requirement	Consumption
Land Disturbance (acres)	25
Employment	
Total employment (worker years)	300
Peak employment (workers)	225
Construction period (years)	2

Source: Derived from text.

TABLE 3.4.2.4–6.—*Accelerator Production of Tritium Power Plant Operation Requirements*

Requirement	Consumption (Wet and Dry Sites)
Electrical Energy Produced (MWh/yr)	3,740,000
Electrical Load (MWe)	550
Fuel	
Gas (million ft^3/yr)	54,200
Liquid (GPY)	0
Water (MGY)	80
Plant Footprint	
Plant (acres)	25
Employment	
Total workers	75

Source: Derived from text.

3.4.2.5 *Commercial Light Water Reactor*

The commercial light water reactor alternative involves either: 1) the purchase by DOE of an existing operating or partially completed commercial power reactor and the conversion of the facility to tritium production for defense purposes; or 2) the purchase of irradiation services from an operating commercial power plant to produce tritium using DOE supplied tritium target rods. Irradiation services could also be used as a contingency measure to meet the projected tritium requirements for the Nation's nuclear weapons stockpile in the event of a national emergency.

Of the two types of commercial light water reactors, pressurized water reactors are more readily adaptable than boiling water reactors to the production of tritium because they use burnable poison rods which could be replaced by tritium targets; therefore, only pressurized water reactors are considered for the commercial reactor alternative in this PEIS. 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 electricity 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 light water reactor facility includes the reactor building, 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 acres to a high of 30,000 acres.

The designs of typical commercial reactors incorporated numerous safety features to include: a reactor containment building to limit any release of radioactivity; an emergency core cooling system for heat removal in the even of a loss of coolant or a loss of pumping; an emergency shutdown system with safety 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.

Commercial reactor sites would have to obtain new fuel assemblies with the DOE target rods included from an offsite source. Additionally, irradiated target rods would have to be shipped offsite to the SRS tritium extraction and recycling facilities.

The commercial reactor production of tritium alternative includes building new tritium extraction facilities at SRS and upgrading the existing tritium recycling facilities there. Tritium target fabrication could be obtained through commercial vendors or as an option a new facility could be constructed at SRS with the tritium extraction and upgraded recycling facility. All commercial light water reactors have existing NEPA and licensing documents prepared by the NRC to support construction and operation of these facilities.

3.4.3 Tritium Recycling and Extraction

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 the 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 DOD and other activities, or as virgin tritium from the extraction facility that is associated with 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 piece parts necessary for final assembly. The reservoirs would then be placed in storage until they are 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, and 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. The commercial light water reactor alternative would use the existing facilities at SRS. At SRS, an upgrade of the existing recycling facilities would be implemented rather than construction of a new facility. In the case of commercial light water reactor alternative, an extraction facility and possibly a target fabrication facility, would be constructed in addition to the upgrade of the recycling facilities at SRS. Discussed below are the options for new or upgraded recycling facilities and a new extraction and target fabrication facility to support the commercial light water reactor alternative.

3.4.3.1 *New Recycling Facility*

If the tritium supply and recycling facilities are located at any site other than SRS, a new recycling facility would have to be constructed (figure 3.4.2.1–1). 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 they occur. The second building, the auxiliary building, would house non-tritium and extremely small amounts of working tritium. These buildings would be located within a 196-acre plant area. Construction, operation, and waste generation data for the new tritium recycling facility are presented in tables 3.4.3.1–1, 3.4.3.1–2, and 3.4.3.1–3, respectively.

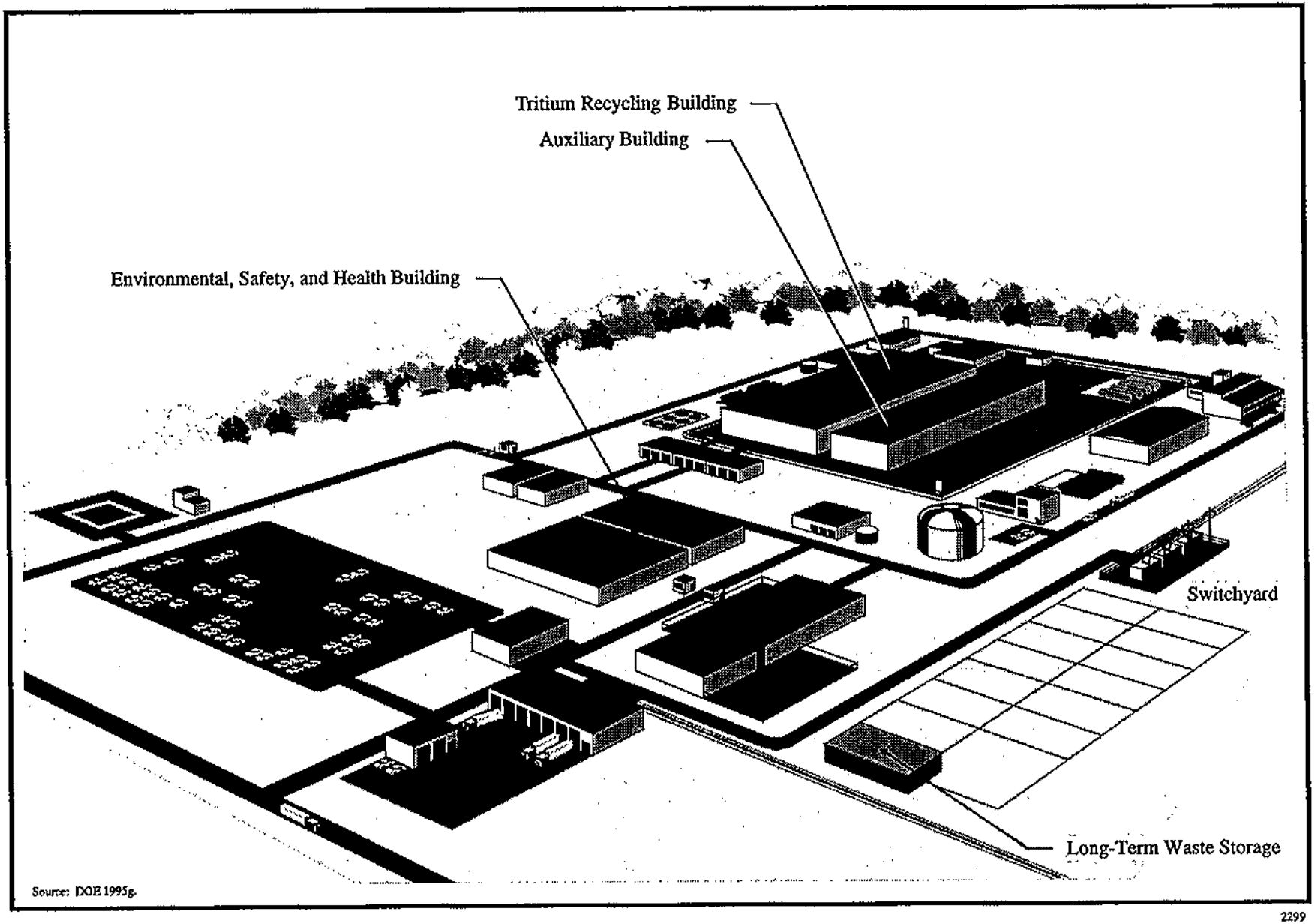


FIGURE 3.4.3.1–1.—*New Tritium Recycling Facility (Typical).*

TABLE 3.4.3.1–1.—*New Tritium Recycling Facility Construction Requirements*

Requirement	Consumption
Material/Resources	
Electrical energy (MWh)	10,000
Concrete (yd^3)	32,000
Steel (tons)	5,600
Gasoline, diesel fuel, and lube oil (gal)	260,000
Water (gal)	6,100,000
Land Disturbance (acres)	202
Employment	
Total employment (worker years)	992
Peak employment (workers)	335
Construction Period (years)	4

Source: DOE 1995g.

TABLE 3.4.3.1–2.—*New Tritium Recycling Facility Operation Requirements*

Requirement	Consumption
Electrical Energy (MWh/yr)	88,000
Electrical Load (MWe)	16
Fuel	
Gas (ft^3/yr)	7,000,000
Liquid (GPY)	50,000
Water (MGY)	
Wet site	37
Dry site	14
Plant Footprint	
Plant (acres)	196
Employment	
Total workers	910
Badged workers	400

Source: DOE 1995g.

TABLE 3.4.3.1–3.—*New Tritium Recycling Facility Estimated Waste Volumes*

Category	Annual Average Volume Generated From Construction (yd^3)	Annual Volume Generated From Operations (yd^3)	Annual Volume Effluent From Operations (yd^3)
Low-Level			
Liquid	None	None	None
Solid	None	350	117 [a]
Mixed Low-Level			
Liquid	None	0.03 (6 gal)	0.03 (6 gal)
Solid	None	2	2
Hazardous			
Liquid	Included in solid	None	None
Solid	0.5	1	1
Nonhazardous (Sanitary)			
Liquid	4,460[b] (900,000 gal)	70,800[c] (14,300,000 gal)	None[e]
Solid	163[d]	7,400	2,470[e]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	None
Solid	Included in sanitary	6,400[f]	None

[a] Assumes overall compaction factor of 3:1.
[b] Does not include groundwater dewatering, if required.
[c] At a dry site, the treated effluent from blowdown plus sanitary, utility, and process wastewater treatment are recycled for reuse as cooling water makeup and other services after treatment. At the wet site, the effluent is 119,000 yd^3/yr (24,000,000 gal/yr).
[d] Includes 20 tons of steel construction waste material which would be recycled as scrap metal.
[e] Assumes overall compaction factor of 3:1.
[f] Recyclable wastes.
Source: DOE 1995g.

3.4.3.2 *Tritium Recycling Facilities Upgrades 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 closed and no consolidation of tritium handling activities. Buildings 232-H, 232-1H, 234-H, 238-H, and 249-H (figure 3.4.3.2–1), would be upgraded to meet DOE Order 5480.28, *Natural Phenomenon Hazards Mitigation*. These upgrades would involve the additions of 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 234-H would require upgrades to its reservoir storage encased safes which are used to protect filled reservoirs during high winds and earthquakes. No upgrade modifications would be required for buildings 233-H (Replacement Tritium Facility), 235-H, 236-H, and 720-H (SNL 1995a).

As a potential mitigation, 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 made 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. Construction and operation requirements for the recycling facilities upgrade at SRS are presented in tables 3.4.3.2–1 and 3.4.2.4–6. The estimated waste generation data is shown in tables 3.4.3.2–3 and 3.4.3.2–4.

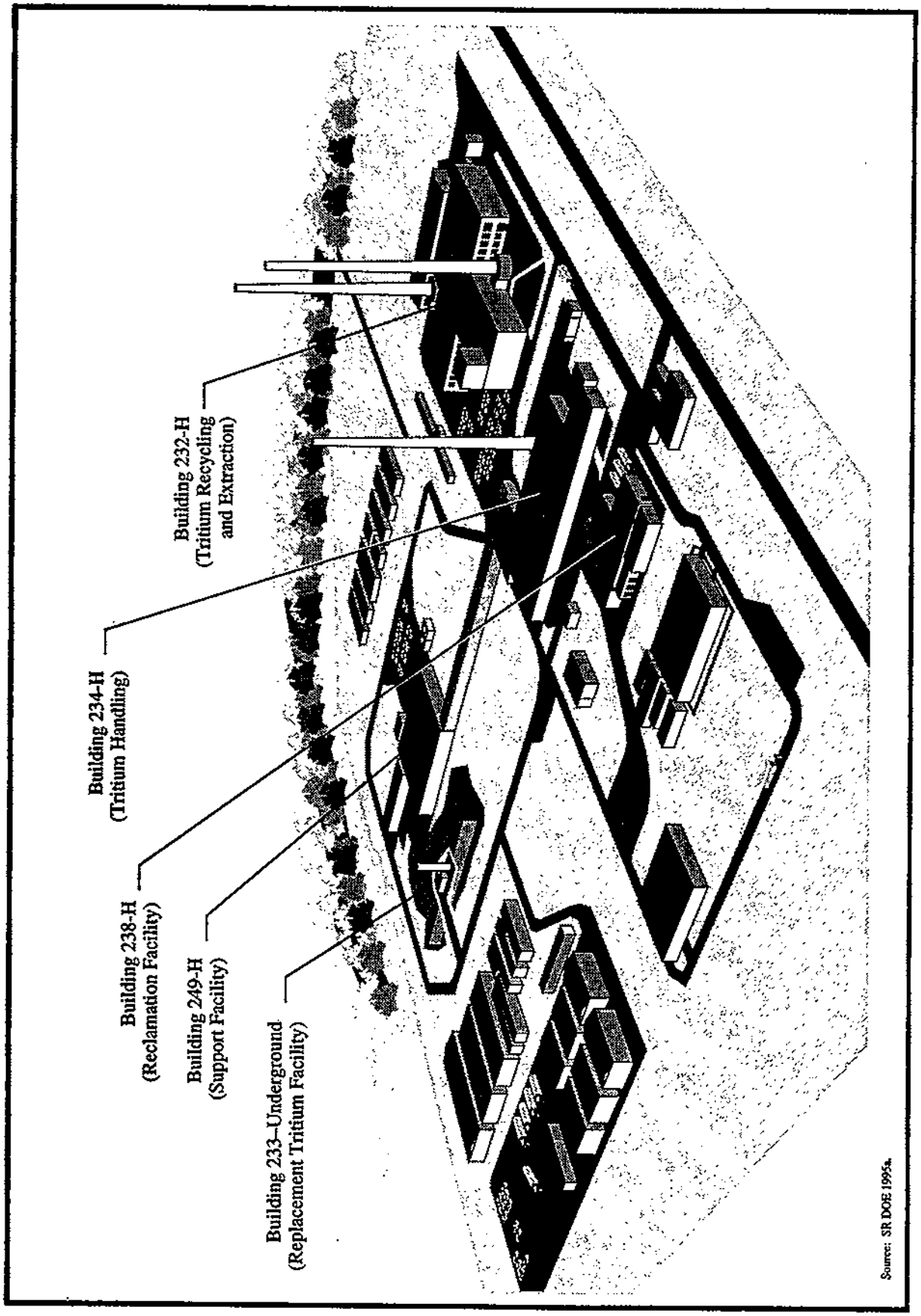


FIGURE 3.4.3.2–1.—*Tritium Recycling Facilities Upgrades at Savannah River Site (Generalized).*

TABLE 3.4.3.2–1.—*Upgraded Tritium Recycling Facilities Construction Requirements*

Requirement	Consumption	
	Unconsolidated with Building 232-H	Consolidated without Building 232-H
Material/Resources		
Electrical energy (MWh)	2,000	2,000
Concrete (yd^3)	1,900	2,100
Steel (tons)	210	240
Gasoline, diesel fuel, and lube oil (gal)	16,000	17,000
Water (gal)	130,000	140,000
Land Disturbance (acres)	NA	NA
Employment		
Total employment (worker years)	62	91
Peak employment (workers)	26	36
Construction period (years)	3	3

Source: SR DOE 1995a.

TABLE 3.4.3.2–2.—*Upgraded Tritium Recycling Facilities Operation Requirements*

Requirement	Consumption	
	Unconsolidated with Building 232-H[a]	Consolidated without Building 232-H
Electrical Energy (MWh/yr)	24,000	24,000
Electrical Load (MWe)	3	3
Coal (tons)	5,200	5,200
Fuel, Liquid (GPY)	60,000	56,000
Water (MGY)	51	51
Employment		
Total workers	970	910
Badged workers	400	400

[a] These figures are included in No Action and represent phase out data.

Source: SR DOE 1995a.

TABLE 3.4.3.2–3.—*Upgraded Tritium Recycling Facilities (Unconsolidated–With Building 232-H) Waste Volumes*

Category	Annual Average Volume Generated From Construction (yd^3)	Annual Volume Generated From Operations (yd^3)	Annual Volume Effluent During Operation (yd^3)
Low-Level			
Liquid	None	None	None
Solid	None	350	117[a]
Mixed Low-Level			
Liquid	None	0.03 (6 gal)	0.03 (6 gal)
Solid	None	2	2
Hazardous			
Liquid	Included in solid	None	None
Solid	<0.3	1	1
Nonhazardous (Sanitary)			
Liquid	149[b] (30,000 gal)	158,000 (32,000,000 gal)	158,000 (32,000,000 gal)
Solid	14[c]	7,800	2,600[d]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	6,800[e]	None

[a] Assumes overall compaction factor of 3:1.

[b] Does not include groundwater dewatering, if required.

[c] Includes 1 ton of steel construction waste material which would be recycled as scrap metal.

[d] Assumes overall compaction factor of 3:1.

[e] Recyclable wastes.

Source: SR DOE 1995a.

TABLE 3.4.3.2–4.—*Upgraded Tritium Recycling Facilities (Consolidated–Without Building 232-H) Waste Volumes*

Category	Annual Average Volume Generated During Construction (yd^3)	Annual Volume Generated From Operations (yd^3)	Annual Volume Effluent During Operation (yd^3)
Low-Level			
Liquid	None	None	None
Solid	None	350	117[a]
Mixed Low-Level			
Liquid	None	0.03 (6 gal)	0.03 (6 gal)
Solid	None	2	2
Hazardous			
Liquid	Included in solid	None	None
Solid	<0.3	1	1
Nonhazardous (Sanitary)			
Liquid	182[b] (36,l)	153,000 (31,000,000 gal)	153,000 (31,000,000 gal)
Solid	15[c]	7,4000	2,470[d]
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	6,400[e]	None

[a] Assumes overall compaction factor of 3:1.
[b] Does not include groundwater dewatering, if required.
[c] Includes 1.3 tons of steel construction waste material which would be recycled as scrap metal.
[d] Assumes overall compaction factor of 3:1.
[e] Recyclable wastes.
Source: SR DOE 1995a.

3.4.3.3 *Extraction and Target Fabrication Facilities for Commercial Light Water Reactor*

The commercial light water reactor alternative does not include a collocated tritium extraction facility at the reactor site. Therefore irradiated DOE target roads would be sent offsite to an extraction facility which would be collocated with the upgraded tritium recycling facility at SRS. Construction, operation, and waste generation data for the commercial light water reactor extraction facility are presented in tables 3.4.3.3–1, 3.4.3.3–2, and 3.4.3.3–3, respectively. Target rods not procured commercially would be manufactured at a new facility at SRS collocated with target extraction and upgraded recycling facilities. Construction, operation, and waste generation data for the target fabrication facility are presented in table 3.4.3.3–4, 3.4.3.3–5, and 3.4.3.3–6, respectively.

TABLE 3.4.3.3–1.—*Extraction Facility for Commercial Light Water Reactor Construction Requirements*

Requirement	Consumption
Material/Resources	
Electrical energy (MWh)	1,000
Concrete (yd^3)	7,800
Steel (tons)	940
Gasoline, diesel fuel, and lube oil (gal)	84,000
Water (gal)	1,000,000
Land Disturbance (acres)	19
Employment	
Total employment (worker years)	326
Peak employment (workers)	144
Construction Period (years)	3

Source: DOE 1995x.

TABLE 3.4.3.3–2.—*Extraction Facility for Commercial Light Water Reactor Operation Requirements*

Requirement	Consumption
Utility	
Electrical energy (MWh)	4,500
Electrical load (MWe)	1.6
Fuel	
Gas (ft^3/yr)	16,000,000
Liquid (GPY)	17,000
Water (MGY)	
Wet site	4,800,000
Plant Footprint	
Plant (acres)	15
Employment	
Total workers	170
Badged workers	70

Source: DOE 1995x.

TABLE 3.4.3.3–3.—*Extraction Facility for Commercial Light Water Reactor Waste Volumes*

Category	Annual Average Volume Generated From Construction (yd^3)	Annual Volume Generated From Operations (yd^3)	Annual Volume Effluent From Operation (yd^3)
Low-Level			
Liquid	None	None	None
Solid	None	460	92
Mixed Low-Level			
Liquid	None	0.015 (3 gal)	0.015 (3 gal)
Solid	None	3	3
Hazardous			
Liquid	Included in solid	Included in solid	Included in solid
Solid	<1	1	1
Nonhazardous (Sanitary)			
Liquid	1,290[a] (260,000 gal)	16,870 (3,400,000 gal)	16,830 (3,400,000 gal)
Solid	54[b]	1,300	325
Nonhazardous (Other)			
Liquid	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	None	None

[a] Does not include groundwater dewatering, if required.
[b] Includes 4.7 tons of steel construction waste material which will be recycled as scrap metal.
Source: DOE 1995x.

TABLE 3.4.3.3–4.—*Target Fabrication Facility for Commercial Light Water Reactor Construction Requirements*

Requirement	Consumption
Material/Resources	
Electrical energy (MWh)	2,100
Concrete (yd^3)	5,300
Steel (tons)	1,900
Gasoline, diesel fuel, and lube oil (gal)	70,000
Water (gal)	4,000,000
Land Disturbance (acres)	11
Employment	
Total employment (worker years)	390
Peak employment (workers)	240
Construction Period (years)	3

Source: DOE 1995z.

TABLE 3.4.3.3–5.—*Target Fabrication for Commercial Light Water Reactor Operation Requirements*

Requirement	Consumption
Electrical energy (MWh/yr)	1,900
Electrical load (MWe)	0.4
Fuel	
Gas (ft^3/yr)	0
Liquid (GPY)	1,500
Water (MGY)	3.3
Plant Footprint	
Plant (acres)	11
Employment	
Total workers	60

Source: DOE 1995z.

TABLE 3.4.3.3–6.—*Target Fabrication for Commercial Light Water Reactor Waste Volumes*

Category	Annual Average Volume Generated From Construction (yd^3)	Annual Volume Generated From Operations (yd^3)	Annual Volume Effluent From Operation (yd^3)
Hazardous			
Liquid	5 (1,000 gal)	Included in solid	Included in solid
Solid	None	3	3
Nonhazardous (Sanitary)			
Liquid	2,376 (480,000 gal)	16,340 (3,300,000 gal)	16,340 (3,300,000 gal)
Solid	5,900	400	400
Nonhazardous (Other)			
Liquid	2,178[a] (440,000 gal)	None	None
Solid	Included in sanitary	None	None

[a] Does not include groundwater dewaterting, if required.
Source: DOE 1995z.

3.5 POLLUTION PREVENTION AND WASTE MINIMIZATION

The *Pollution Prevention Act* of 1990 established a national policy that whenever feasible, pollution should be prevented or reduced at the source. Under the Act, pollution that cannot be prevented should be recycled in an environmentally safe manner. Disposal or other releases into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner. Executive Order 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements* dated August 3, 1993, and DOE Order 5400.1 *General Environmental Protection Program* implement the provisions of the *Pollution Prevention Act* of 1990. Pollution prevention is designed to keep pollutants from being released into the environment. Preventive measures could include source reduction, recycling, treatment, and disposal. The emphasis is on source reduction and recycling to prevent the creation of wastes, i.e., waste minimization. Source reduction and waste minimization techniques include good operating practices, technology modifications, input material changes, and product changes. Use and reuse plus reclamation are onsite and offsite recycling techniques. Tritium supply and recycling facility designs would consider and incorporate waste minimization and pollution prevention to the maximum extent practicable. Segregation of activities that generate radioactive and hazardous wastes would be employed, where possible, to avoid the generation of mixed wastes. Where applicable, treatment to separate radioactive and nonradioactive components would be performed to reduce the volume of mixed wastes and provide for cost-effective disposal or recycle. To facilitate waste minimization, where possible, nonhazardous materials would be substituted for those materials that contribute to the generation of hazardous or mixed waste. Production processes would be configured with minimization of waste production given high priority. Material from the waste streams would be treated to facilitate disposal as nonhazardous wastes, where possible. Some designs produce waste quantities or waste forms that could undergo additional reductions by utilizing emerging technologies. Pollution prevention and waste minimization would be major factors in determining the final design of any facility constructed as part of the Complex. Pollution prevention and waste minimization will be analyzed as part of the site-specific analyses and tiered NEPA documents following the decision on tritium supply and recycling facilities.

3.6 Comparison of Tritium Supply and Recycling Alternatives

A comparison of the environmental impacts of the tritium supply and recycling alternatives is summarized in tables 3.6–1 and 3.6–2. The tables compare the impacts to environmental resources associated with tritium supply technologies and recycling at each of the five candidate sites and the commercial light water reactor. In addition, impacts associated with No Action are included for a baseline comparison.

The table 3.6–1 format presents the impacts of each alternative by resource or issue. Impacts associated with collocation of a tritium supply and recycling alternatives are evaluated for every site except SRS. At SRS, impacts are evaluated for a tritium supply with upgraded recycling. In addition, impacts associated with tritium supply alone alternatives are evaluated for all the candidate sites except SRS. A supply alone alternative does not exist for SRS because of existing recycling facilities. The tritium upgrade at SRS is part of the supply alone alternatives at the other four candidate sites (INEL, NTS, ORR, 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. Table 3.6–2 presents the construction and operation impacts of key issues for the commercial reactor alternative.

Under No Action (2010), DOE would not establish a new tritium supply capability, the current inventory of tritium would decay and DOE would not meet stockpile requirements of tritium. Sites would continue waste management programs to meet the legal requirements and commitments in formal agreements and would proceed with cleanup activities. Production facilities and support roles at specific sites, however, would be downsized or eliminated in accordance with the reduced workload projected for the year 2010 and beyond. The current DOE missions assumed to continue under No Action are listed in section 3.3 for each candidate site.

To aid the reader in understanding the differences in environmental impacts among the PEIS alternatives (particularly the tritium supply technology alternatives i.e., HWR, MHTGR, ALWR, and commercial light water reactor), this section presents a brief, qualitative summary comparison of the alternatives. Tables 3.6–1 and 3.6–2 present a quantitative comparison 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 socioeconomics. For these resource areas, this general conclusion is particularly true when comparing the operational impacts of the 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., HWR, 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), the environmental impacts of the latter are clearly fewer 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 site.

For other resource areas evaluated in this PEIS, the analyses indicate that there are notable environmental impact differences. Resource areas where notable differences exist 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 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 facility in the

future. This PEIS acknowledges, and qualitatively discusses, these potential "avoided" environmental impacts. The APT, and to a significantly lesser degree the HWR, would be energy consumers. This PEIS assesses the environmental impacts of providing power to the 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, the ALWR could cause the largest potential impacts to human health from severe accidents, while the MHTGR would have the smallest potential impacts of the reactor technologies. 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 smallest potential impacts to human health from accidents. The commercial reactor alternatives do not acquire any substantial risks by 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 to 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 the 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 or 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 LLW. However, of the alternatives, the HWR would create the most LLW in a year (almost 5 times as much as any other reactor alternative). The APT would generate the least amount of LLW annually. In producing tritium, the commercial reactor alternatives would generate additional LLW, but this amount would be less than the new reactor alternatives. With regard to sites, except for Pantex, all sites have the ability to handle and dispose of low level nuclear waste at the site. Low-level nuclear wastes generated at Pantex would need to be shipped to another site for disposal.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 1 of 50]

INEL	NTS	ORR	PANTEX	SRS
Land Resources—No Action				
• 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.	• 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 Supply and Recycling				
• Construction and operation of a tritium supply would disturb between 173 and 360 acres. The disturbance for each technology would be: HWR: 260 acres MHGTR: 360 acres ALWR: 350 acres APT: 173 acres	• Construction and operation of a tritium supply would disturb between 173 and 360 acres. The disturbance for each technology would be: HWR: 260 acres MHGTR: 360 acres ALWR: 350 acres APT: 173 acres	• Construction and operation of a tritium supply would disturb between 173 and 360 acres. The disturbance for each technology would be: HWR: 260 acres MHGTR: 360 acres ALWR: 350 acres APT: 173 acres	• Construction and operation of a tritium supply would disturb between 173 and 360 acres. The disturbance for each technology would be: HWR: 260 acres MHGTR: 360 acres ALWR: 350 acres APT: 173 acres	• Construction and operation of a tritium supply and upgraded recycling would disturb between 173 and 360 acres. The disturbance for each technology would be: HWR: 260 acres MHGTR: 360 acres ALWR: 350 acres APT: 173 acres
• Collocation of tritium recycling would require an additional 202 acres during construction and 196 acres during operation for all technologies.	• Collocation of tritium recycling would require an additional 202 acres during construction and 196 acres during operation for all technologies.	• Collocation of tritium recycling would require an additional 202 acres during construction and 196 acres during operation for all technologies.	• Collocation of tritium recycling would require an additional 202 acres during construction and 196 acres during operation for all technologies.	• No additional land needed for upgraded recycling facilities.
• The existing VRM classification of Class 4 visual landscape characteristics would remain unchanged.	• The existing VRM classification of the proposed site would change from Class 2 to Class 5. Depending on the final siting, the facilities may be visible from a portion of the Desert National Wildlife Range.	• The existing VRM classification of Class 4 visual landscape characteristics would change to Class 5, and the use of an evaporative cooling system would result in visible plumes during certain atmospheric conditions.	• The existing VRM classification of Class 4 visual landscape characteristics would remain unchanged.	• The existing VRM classification of Class 4 visual landscape characteristics would change to Class 5, and the use of a wet cooling system would result in visible plumes during certain atmospheric conditions.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 2 of 50]

INEL	NTS	ORR	PANTEX	SRS
Site Infrastructure—No Action				
• 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 reduce by 11,641,800 MWh per year.	• Under No Action the peak electrical load requirement would reduce by 1 MWe. Annual energy consumption would reduce by 7,000 MWh per year.	• Under No Action the peak electrical load requirement would reduce by 214 MWe. Annual energy consumption would reduce by 878,000 MWh per year.
Site Infrastructure—Collocated Tritium Supply and Recycling				
• Collocated tritium supply and recycling would increase the current site electrical requirement by 11 to 515 MWe. The increase for each technology would be:	• Collocated tritium supply and recycling would increase the current site electrical requirement by 55 to 559 MWe. The increase for each technology would be:	• Collocated tritium supply and recycling would require less than the current site electrical requirement by 738 to 1,252 MWe. The reduction for each technology would be:	• Collocated tritium supply and recycling would increase the current site electrical requirement by 61 to 565 MWe. The increase in additional current capacity for each technology would be:	• Tritium supply and upgraded recycling would range from less than the current site electrical requirement by 163 MWe to an increase in the current capacity by 336 MWe. The change in current capacity for each technology would be:
HWR: 34 MHGTR: 11 Large ALWR: 105 Small ALWR: 40 Full APT: 515 Phased APT: 320	HWR: 78 MHGTR: 55 Large ALWR: 149 Small ALWR: 84 Full APT: 559 Phased APT: 364	HWR: 1,237 (less) MHGTR: 1,252 (less) Large ALWR: 1,192 (less) Small ALWR: 1,236 (less) Full APT: 738 (less) Phased APT: 933 (less)	HWR: 84 MWe MHGTR: 61 MWe Large ALWR: 155 MWe Small ALWR: 90 MWe Full APT: 565 MWe Phased APT: 370 MWe	HWR: 163 MWe (less) MHTGR: 178 MWe (less) Large ALWR: 118 MWe (less) Small ALWR: 162 MWe (less) Full APT: 336 MWe (increase) Phased APT: 141 MWe (increase)
• The percent of the power pool capacity margin ranges from 0.45 to 4.15 HWR: 0.62 MHTGR: 0.45 Large ALWR: 1.14 Small ALWR: 0.67 Full APT: 4.15 Phased APT: 2.72	• The percent of the power pool capacity margin ranges from 0.53 to 4.79. HWR: 0.72 MHTGR: 0.53 Large ALWR: 1.32 Small ALWR: 0.77 Full APT: 4.79 Phased APT: 3.14	• The percent of the power pool capacity margin ranges from 1.14 to 12.44. HWR: 1.47 MHTGR: 1.14 Large ALWR: 2.46 Small ALWR: 1.50 Full APT: 12.44 Phased APT: 8.15	• The percent of the power pool capacity margin ranges from 1.53 to 13.93. HWR: 2.09 MHTGR: 1.53 Large ALWR: 3.84 Small ALWR: 2.24 Full APT: 13.93 Phased APT: 9.13	• The percent of the power pool capacity margin ranges from 0.35 to 5.27. HWR: 0.49 MHTGR: 0.35 Large ALWR: 0.92 Small ALWR: 0.50 Full APT: 5.27 Phased APT: 3.40

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 3 of 50]

INEL	NTS	ORR	PANTEX	SRS
Site Infrastructure—Tritium Supply Alone				
• The tritium supply alone would reduce the peak load requirement above by 16 MWe for all technologies.	• The tritium supply alone would reduce the peak load requirement above by 16 MWe for all technologies.	• The tritium supply alone would reduce the peak load requirement above by 16 MWe for all technologies.	• The tritium supply alone would reduce the peak load requirement above by 16 MWe for all technologies.	• No tritium supply alone.
Air Quality and Acoustics—No Action				
• Under No Action no change from existing conditions.	• Under No Action no change from existing conditions.	• Under No Action no change from existing conditions.	• Under No Action no change from existing conditions.	• Under No Action no change from existing conditions.
Air Quality and Acoustics—Collocated Tritium Supply and Recycling				
• Construction of collocated tritium supply and recycling facilities would result in exceedance of 24-hour PM_{10} and TSP standards. Air pollutant concentration would increase during operation but would be within standards. Noise levels would increase during construction and operation.	• Construction of collocated tritium supply and recycling facilities would result in exceedance of 24-hour PM_{10} standards. Air pollutant concentration would increase during operation but would be within standards. Noise levels would increase during construction and operation.	• Construction of collocated tritium supply and recycling facilities would result in exceedance of 24-hour PM_{10} and TSP standards. Air pollutant concentration would increase during operation but would be within standards. Noise levels would increase during construction and operation.	• Construction of collocated tritium supply and recycling facilities would result in exceedance of 24-hour PM_{10} standard. Air pollutant concentration would increase during operation but would be within standards. Noise levels would increase during construction and operation.	• Construction of collocated tritium supply and upgraded recycling facilities would result in exceedance of 24-hour PM_{10} standards. Air pollutant concentration would increase during operation but would be within standards. Noise levels would increase during construction and operation.
Air Quality and Acoustics—Tritium Supply Alone				
• Construction and operation air and noise emissions for the tritium supply alone would be slightly less than those expected above.	• Construction and operation air and noise emissions for the tritium supply alone would be slightly less than those expected above.	• Construction and operation air and noise emissions for the tritium supply alone would be slightly less than those expected above.	• Construction and operation air and noise emissions for the tritium supply alone would be slightly less than those expected above.	• No tritium supply alone.
Water Resources—No Action				
• Under No Action there would be no impacts to water resources.	• Under No Action there would be no impacts to water resources.	• Under No Action there would be no impacts to water resources.	• Under No Action there would be no impacts to water resources.	• Under No Action there would be no impacts to water resources.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 4 of 50]

INEL	NTS	ORR	PANTEX	SRS
Water Resources—Collocated Tritium Supply and Recycling				
• Surface water would not be used during construction.	• Surface water would not be used during construction.	• Surface water use for collocated supply and recycling facilities would range from 10 to 35 MGY during construction. The surface water use and corresponding percentage increase by technology would be: HWR: 23 (1 percent) MHTGR: 19 (1 percent) Large ALWR: 35 (2 percent) Small ALWR: 22 (1 percent) APT: 10 (<1 percent)	• Surface water would not be used during construction.	• Surface water would not be used during construction.
• Groundwater use would range from 10 to 35 MGY during construction. The groundwater use by technology would be: HWR: 23 MHTGR: 19 Large ALWR: 35 Small ALWR: 22 APT : 10	• Groundwater use would range from 10 to 35 MGY during construction. The groundwater use by technology would be: HWR: 23 MHTGR: 19 Large ALWR: 35 Small ALWR: 22 APT: 10	• Groundwater would not be used during construction or operation of any collocated tritium supply and recycling.	• Groundwater would not be used during construction. Reclaimed wastewater use would range from 10 to 35 MGY during construction. The reclaimed wastewater use by technology would be: HWR: 23 MHTGR: 19 Large ALWR: 35 Small ALWR: 22 APT : 10	• Groundwater use would range from 8 to 33 MGY during construction. The groundwater use by technology would be: HWR: 21 MHTGR: 18 Large ALWR: 33 Small ALWR: 20 APT: 8
• The total percent of groundwater use increase during construction by technology would be: HWR: 1 MHTGR: 1 Large ALWR: 2 Small ALWR: 1 Full APT: <1 Phased APT: <1	• The total percent of groundwater use increase during construction by technology would be: HWR: 3 MHTGR: 3 Large ALWR: 5 Small ALWR: 3 Full APT: 1 Phased APT: 1	• No groundwater use.	• The total percent of reclaimed wastewater use increase during construction by technology would be: HWR: <1 MHTGR: <1 Large ALWR: <1 Small ALWR: <1 Full APT: <1 Phased APT: <1	• The total percent of groundwater use increase during construction by technology would be: HWR: <1 MHTGR: <1 Large ALWR: 1 Small ALWR: <1 Full APT: <1 Phased APT: <1

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 5 of 50]

INEL	NTS	ORR	PANTEX	SRS
Water Resources—Collocated Tritium Supply and Recycling				
• No construction will take place in 100- or 500-year floodplains.	• No construction will take place in areas designated as 100-year floodplains, however a 500-year flood plain assessment would be required.	• No construction will take place in areas designated as 100-year floodplains, however a 500-year flood plain assessment would be required.	• No construction will take place in areas designated as 100-year floodplains, however a 500-year flood plain assessment would be required.	• No construction will take place in areas designated as 100-year floodplains, however a 500-year flood plain assessment would be required.
• Stormwater runoff would have negligible impacts on surface water during construction and operation.	• Stormwater runoff would have negligible impacts on surface water during construction and operation.	• Stormwater runoff would have negligible impacts on surface water during construction and operation.	• Stormwater runoff would have negligible impacts on surface water during construction and operation.	• Stormwater runoff would have negligible impacts on surface water during construction and operation.
• Surface water would not be used during operation.	• Surface water would not be used during operation.	• Operation surface water requirements would range from 784 to 16,014 MGY. The surface water use and corresponding percentage increase by technology would be: HWR: 5,914 (320 percent) 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)	• Surface water would not be used during operation.	• Operation surface water requirements would range from 799 to 15,546 MGY. The surface water use and corresponding percentage increase by technology would be: HWR: 5,888 (30 percent) MHTGR: 4,006 (20 percent) Large ALWR: 15,546 (78 percent) Small ALWR: 7,186 (36 percent) Full APT: 1,229 (6 percent) Phased APT: 799 (4 percent)

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 6 of 50]

INEL	NTS	ORR	PANTEX	SRS
Water Resources—Collocated Tritium Supply and Recycling				
• No blowdown discharges to surface water.	• No blowdown discharges to surface water.	• Blowdown discharges to surface waters would range from 168 to 6,192 MGY. Blowdown discharges to surface waters by technology would be: HWR: 2,314 MHTGR: 1,618 Large ALWR: 6,202 Small ALWR: 2,818 Full APT: 250 Phased APT: 178	• No blowdown discharges to surface water.	• Blowdown discharges to surface waters would range from 159 to 6,200 MGY. Blowdown discharges to surface waters by technology would be: HWR: 2,304 MHTGR: 1,608 Large ALWR: 6,192 Small ALWR: 2,808 Full APT: 240 Phased APT: 158
• Groundwater requirements for operation would range from 44 to 1,214 MGY. The groundwater use by technology would be: HWR: 62 MHTGR: 44 Large ALWR: 104 Small ALWR: 64 Full APT: 1,214 Phased APT: 784	• Groundwater requirements for operation would range from 44 to 1,214 MGY. The groundwater use by technology would be: HWR: 62 MHTGR: 44 Large ALWR: 104 Small ALWR: 64 Full APT: 1,214 Phased APT: 784	• Groundwater would not be used for operation.	• Groundwater would not be used for operation. Reclaimed wastewater requirements for operation would range from 44 to 1,214 MGY. The groundwater use by technology would be: HWR: 62 MHTGR: 44 Large ALWR: 104 Small ALWR: 64 Full APT: 1,214 Phased APT: 784	• Groundwater requirements for operation would range from 22 to 105 MGY. The groundwater use by technology would be: HWR: 63 MHTGR: 45 Large ALWR: 105 Small ALWR: 65 Full APT: 22 Phased APT: 22

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 7 of 50]

INEL	NTS	ORR	PANTEX	SRS
Water Resources—Collocated Tritium Supply and Recycling				
• The total percent increase in groundwater use during operation by technology would be: HWR: 3 MHTGR: 2 Large ALWR: 5 Small ALWR: 3 Full APT: 61 Phased APT: 39 Total increase in groundwater use for all the technologies except APT would be approximately less than 1 percent of the INEL groundwater allotment; the APT groundwater use represents an increase of approximately 11 percent of the INEL groundwater allotment.	• The total percent increase in groundwater use during operation by technology would be: HWR: 9 MHTGR: 7 Large ALWR: 16 Small ALWR: 10 Full APT: 181 Phased APT: 117 Groundwater withdrawals during operation would not exceed the lowest estimated aquifer recharge rate for all technologies.	• No groundwater use.	• The total percent of available reclaimed wastewater use during operation by technology would be: HWR: 1 MHTGR: 1 Large ALWR: 2 Small ALWR: 2 Full APT: 28 Phased APT: 18	• The total percent of groundwater use during operation by technology would be: HWR: 2 MHTGR: 1 Large ALWR: 3 Small ALWR: 2 Full APT: <1 Phased APT: <1
Water Resources—Tritium Supply Alone				
• The groundwater requirement for the tritium supply alone would be 1.5 MGY less than for collocation during construction and 14 MGY less than for collocation during operation for all technologies. No surface water would be used.	• The groundwater requirement for the tritium supply alone would be 1.5 MGY less than for collocation during construction and 14 MGY less than for collocation during operation for all technologies. No surface water would be used.	• No groundwater would be used. Total surface water requirement for the tritium supply alone would be 1.5 MGY less than for collation during construction and 37 MGY less than for collocation during operation for all technologies.	• The available reclaimed wastewater requirement for the tritium supply alone would be 1.5 MGY less than for collocation during construction and 14 MGY less than for collocation during operation for all technologies. No surface water or groundwater would be used.	• No tritium supply alone.
Geology and Soils—No Action				
• Under No Action there would be no impacts to geology or soils.	• Under No Action there would be no impacts to geology or soils.	• Under No Action there would be no impacts to geology or soils.	• Under No Action there would be no impacts to geology or soils.	• Under No Action there would be no impacts to geology or soils.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 8 of 50]

INEL	NTS	ORR	PANTEX	SRS
Geology and Soils—Collocated Tritium Supply and Recycling				
• Construction and operation for collocated supply and recycling or the tritium supply alone would neither affect nor be affected by geological conditions.	• Construction and operation for collocated supply and recycling or the tritium supply alone would neither affect nor be affected by geological conditions.	• Construction and operation for collocated supply and recycling or the tritium supply alone would neither affect nor be affected by geological conditions.	• Construction and operation for collocated supply and recycling or the tritium supply alone would neither affect nor be affected by geological conditions.	• Construction and operation of tritium supply with upgraded recycling would neither affect nor be affected by geological conditions.
• The soil disturbed area for collocated supply and recycling would range from 375 to 562 acres. The acres disturbed by each technology would be: HWR: 462 MHTGR: 562 ALWR: 552 APT: 375	• The soil disturbed area for collocated supply and recycling would range from 375 to 562 acres. The acres disturbed by each technology would be: HWR: 462 MHTGR: 562 ALWR: 552 APT: 375	• The soil disturbed area for collocated supply and recycling would range from 375 to 562 acres. The acres disturbed by each technology would be: HWR: 462 MHTGR: 562 ALWR: 552 APT: 375	• The soil disturbed area for collocated supply and recycling would range from 375 to 562 acres. The acres disturbed by each technology would be: HWR: 462 MHTGR: 562 ALWR: 552 APT: 375	• The soil disturbed area for tritium supply with upgraded recycling would range from 173 to 360 acres. The acres disturbed by each technology would be: HWR: 260 MHTGR: 360 ALWR: 350 APT: 173
Geology and Soils—Tritium Supply Alone				
• The disturbed area for the tritium supply alone would be 202 acres less.	• The disturbed area for the tritium supply alone would be 202 acres less.	• The disturbed area for the tritium supply alone would be 202 acres less.	• The disturbed area for the tritium supply alone would be 202 acres less.	• No tritium supply alone.
• Soil erosion due to wind and stormwater runoff would be minor.	• Soil erosion due to wind and stormwater runoff would be minor.	• Soil erosion due to wind and stormwater runoff would be minor.	• Soil erosion due to wind and stormwater runoff would be minor.	• Soil erosion due to wind and stormwater runoff would be minor.
Biotic Resources—No Action				
• 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 there would be no impacts to biotic resources.	• Under No Action there would be no impacts to biotic resources.	• Under No Action there would be no impacts to biotic resources.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 9 of 50]

INEL	NTS	ORR	PANTEX	SRS
Biotic Resources—Collocated Tritium Supply and Recycling				
• Construction and operation of a collocated tritium supply and recycling or supply alone would affect terrestrial resources. The impact would vary by the acreage disturbed during construction for each technology (see geology and soils for acreage).	• Construction and operation of a collocated tritium supply and recycling or supply alone would affect terrestrial resources. The impact would vary by the acreage disturbed during construction for each technology (see geology and soils for acreage).	• Construction and operation of a collocated tritium supply and recycling, or supply alone would affect terrestrial resources. The impact would vary by the acreage disturbed during construction for each technology (see geology and soils for acreage).	• Construction and operation of a collocated tritium supply and recycling, or supply alone would affect terrestrial resources. The impact would vary by the acreage disturbed during construction for each technology (see geology and soils for acreage).	• Construction and operation of a tritium supply with upgraded recycling, would affect terrestrial resources. The impact would vary by the acreage disturbed during construction for each technology (see geology and soils for acreage).
• Impacts from cooling system salt drift are possible with APT.	• Impacts from cooling system salt drift are possible with APT.	• Salt drift from wet cooling towers would likely impact less than 13 acres during operation for all technologies.	• Impacts from cooling system salt drift are possible with APT.	• Salt drift from wet cooling towers would likely impact less than 13 acres during operation for all technologies.
• Wetlands and aquatic resources would not be affected.	• Wetlands and aquatic resources would not be affected.	• Without appropriate mitigation measures, increased stream flow from operational discharges could affect wetland and aquatic plant communities.	• Without appropriate mitigation measures, playa wetlands could be degraded by discharges, aquatic resources would not be affected.	• Without appropriate mitigation measures, construction and operational discharges to an onsite stream could affect wetland and aquatic 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.	• One Federal-listed threatened species, the bald eagle, and six Federal candidate or state-listed species may be affected by construction activities.	• 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.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 10 of 50]

INEL	NTS	ORR	PANTEX	SRS
Biotic Resources—Collocated Tritium Supply and Recycling				
• The ferruginous hawk would 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 well. Neither species should be adversely affected due to the large extent of nearby suitable habitat.	• Four state-listed raptors would lose potential nesting and foraging habitat equal to the amount of disturbed land for each technology, however this type of habitat is abundant in the area. The Tennessee dace and hellbender, both state-listed, could be affected by construction.	• The black tern, white-faced ibis, ferruginous hawk, loggerhead shrike, and bald eagle could lose foraging and/or nesting habitat equal to the amount of land disturbed for each technology during construction. The swift fox would lose potential foraging and denning habitat. The Texas horned lizard could be impacted during land clearing activities.	• The potentially affected species include the awned meadow-beauty, green-fringed orchid, Florida false loosestrife, beak-rush, star-nosed mole and the eastern tiger salamander would lose foraging habitat equal to the disturbed land during construction for each technology.
Cultural and Paleontological Resources—No Action				
• Under No Action there would be no impact to cultural and paleontological resources.	• Under No Action there would be no impact to cultural and paleontological resources.	• Under No Action there would be no impact to cultural and paleontological resources.	• Under No Action there would be no impact to cultural and paleontological resources.	• Under No Action there would be no impact to cultural and paleontological resources.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 11 of 50]

INEL	NTS	ORR	PANTEX	SRS
Cultural and Paleontological Resources—Collocated Tritium Supply and Recycling				
• Some NRHP-eligible prehistoric and historic resources may occur within the tritium supply site.	• Some NRHP-eligible prehistoric and historic resources may occur within the tritium supply site.	• Some NRHP-eligible prehistoric and historic resources may occur within the tritium supply site.	• Some NRHP-eligible prehistoric and historic resources may occur within the tritium supply site.	• Three NRHP-eligible historic sites occur within the area proposed for construction and operation of a tritium supply. No prehistoric resources would be affected.
• Native American resources may be affected by land disturbance and audio or visual intrusions.	• Native American resources may be affected by land disturbance and audio or visual intrusions.	• Native American resources may be affected by land disturbance and audio or visual intrusions.	• Native American resources may be affected by land disturbance and audio or visual intrusions.	• Native American resources may be affected by land disturbance and audio or visual intrusions.
• Paleontological resources may be affected when excavation exceeds 50 feet.	• Paleontological resources may be affected.	• Paleontological resources may be affected.	• Paleontological resources may be affected.	• Paleontological resources may be affected.
Cultural and Paleontological Resources—Tritium Supply Alone				
• Impacts to cultural and paleontological resources from tritium supply alone would be less.	• Impacts to cultural and paleontological resources from tritium supply alone would be less.	• Impacts to cultural and paleontological resources from tritium supply alone would be less.	• Impacts to cultural and paleontological resources from tritium supply alone would be less.	• No tritium supply alone.
Socioeconomics—No Action				
• 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 ORR employment decreased by 300 persons between 1990 and 1994 to 15,000 persons, and will remain at this level through 2020.	• Under No Action Pantex employment increased by 1,000 persons between 1990 and 1994 to 3,400 persons. It will decrease to 1,790 in 2010 and is expected to remain at this level through 2020.	• Under No Action SRS employment decreased by 2,000 persons between 1990 and 1994 to 20,300 persons. It will decrease to 16,900 by 2010 and is expected to remain at this level through 2020.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 12 of 50]

INEL	NTS	ORR	PANTEX	SRS
		Socioeconomics—No Action		
• Under No Action employment in the 63 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.	• Under No Action employment in the regional economic area is expected to grow 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 between 2001 and 2020.
• Under No Action unemployment is expected to be at 6.4 percent between 2001 and 2020. Per capita income is expected to increase from $17,800 to $20,900.	• Under No Action unemployment is expected to be at 5 percent between 2001 and 2020. Per capita income is expected to increase from $23,600 to $25,100.	• Under No Action unemployment is expected to be at 6.2 percent between 2001 and 2020. Per capita income is expected to increase from $17,900 to $20,700.	• Under No Action unemployment is expected to be at 4.6 percent between 2001 and 2020. Per capita income is expected to increase from $22,300 to $25,700.	• Under No Action unemployment is expected to be at 4.8 percent between 2001 and 2020. Per capita income is expected to increase from $18,300 to $21,000.
• Under No Action population and housing annual average increase is expected to be less than 1 percent through 2010.	• Under No Action population and housing annual average increase is expected to be 1 percent through 2020.	• Under No Action population and housing annual average increase is expected to be 1 percent through the year 2009 and less than 1 percent between 2010 and 2020.	• Under No Action population and housing annual average increase is expected to be less than 1 percent through 2020.	• Under No Action population and housing annual average increase is expected to be less than 1 percent through 2010.
• 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.	• Population is expected to reach 561,000 in 2010 and 586,000 in 2020.	• Population is expected to reach 205,100 in 2010 and 209,000 in 2020.	• Population is expected to reach 454,900 in 2010 and 473,000 in 2020.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 13 of 50]

INEL	NTS	ORR	PANTEX	SRS
		Socioeconomics—No Action		
• Under No Action total revenue and expenditures for the ROI counties, cities and school districts is expected to increase by an annual average of less than 1 percent from 2001 to 2020.	• Under No Action total revenue and expenditures for the ROI counties, cities and school districts is expected to increase by an annual average of less than 1 percent to 3 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.	• Under No Action total revenue and expenditures for the ROI counties, cities and school districts is expected to increase by an annual average of approximately 1 percent or less through 2020.	• Under No Action total revenue and expenditures for the ROI counties, cities and school districts is expected to increase by an annual average of less than 1 percent through 2020.	• Under No Action total revenue and expenditures for the ROI counties, cities and school districts is expected to increase by an annual average of less than 1 percent through 2020.
		Socioeconomics—Collocated Tritium Supply and Recycling		
• Employment in the regional economic area would increase by 7,200 to 10,800 persons during peak construction when collocating tritium supply and recycling. The increase by technology would be: HWR: 7,500 MHTGR: 7,200 ALWR: 10,800 APT: 8,750	• Employment in the regional economic area would increase by between 9,100 to 13,700 persons during peak construction when collocating tritium supply and recycling. The increase by technology would be: HWR: 9,500 MHTGR: 9,100 ALWR: 13,700 APT: 11,100	• Employment in the regional economic area would increase by 8,000 to 12,000 persons during peak construction when collocating tritium supply and recycling. The increase by technology would be: HWR: 8,300 MHTGR: 8,000 ALWR: 12,000 APT: 9,700	• Employment in the regional economic area would increase by 7,300 to 10,900 persons during peak construction when collocating tritium supply and recycling. The increase by technology would be: HWR: 7,600 MHTGR: 7,300 ALWR: 10,900 APT: 8,800	• Employment in the regional economic area would increase by 6,900 to 10,800 persons during peak construction of tritium supply and upgraded recycling. The increase by technology would be: HWR: 7,200 MHTGR: 6,900 ALWR: 10,800 APT: 8,500

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 14 of 50]

INEL	NTS	ORR	PANTEX	SRS
Socioeconomics—Collocated Tritium Supply and Recycling				
• Unemployment in the regional economic area would decrease from 6.4 percent (the projected baseline) to 4.5 percent for all technologies during peak construction.	• Unemployment in the regional economic area would decrease from 5 percent (the projected baseline) to 3.9 percent for all technologies during peak construction.	• Unemployment in the regional economic area would decrease from 6.2 percent (the projected baseline) to 5.2 percent to 4.8 percent during peak construction. The estimated unemployment by technology would be: HWR: 5.2 percent MHTGR: 5.2 percent ALWR: 4.8 percent APT: 5 percent	• Unemployment in the regional economic area would decrease from 4.6 percent (the projected baseline) to 2.2 percent during peak construction. The estimated unemployment by technology would be: HWR: 2.2 percent MHTGR: 2.2 percent ALWR: 2.2 percent APT: 2.2 percent	• Unemployment in the regional economic area would decrease from 4.8 percent (the projected baseline) to 4 to 3.9 percent during peak construction. The estimated unemployment by technology would be: HWR: 3.9 percent MHTGR: 4 percent ALWR: 3.9 percent APT: 3.9 percent
• Population and housing demand within the ROI would increase by 5 to 9 percent during construction of a collocated tritium supply and recycling facility. The increase by technology would be: HWR: 5 percent MHTGR: 5 percent ALWR: 9 percent APT: 6.5 percent	• Population and housing demand within the ROI would not increase by more than 2 percent over No Action during construction for all technologies during the first 3 years. HWR and MHTGR would have a continued annual demand of less than 2 percent. ALWR and would have an annual demand growth of 1 percent until peak operation.	• Population and housing demand within the ROI would not increase by more than 1 percent during construction for all technologies.	• Population and housing demand within the ROI would increase by 3 to 7 percent during construction of a collocated tritium supply and recycling facility. The increase by technology would be: HWR: 3 percent MHTGR: 3 percent ALWR: 7 percent APT: 5 percent	• Population and housing demand within the ROI would increase by 1 to 3 percent during construction of a tritium supply and upgraded recycling facility. The increase by technology would be: HWR: 1 percent MHTGR: 1 percent ALWR: 3 percent APT: 1 percent

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 15 of 50]

INEL	NTS	ORR	PANTEX	SRS
Socioeconomics—Collocated Tritium Supply and Recycling				
• Employment in the regional economic area would increase by 4,100 to 4,900 persons during full operation. The increase by technology would be: HWR: 4,900 MHTGR: 4,900 ALWR: 4,700 APT: 4,100	• Employment in the regional economic area would increase by 4,600 to 5,500 persons during full operation. The increase by technology would be: HWR: 5,500 MHTGR: 5,500 ALWR: 5,200 APT: 4,600	• Employment in the regional economic area would increase by 4,300 to 5,200 persons during full operation. The increase by technology would be: HWR: 5,200 MHTGR: 5,100 ALWR: 4,900 APT: 4,300	• Employment in the regional economic area would increase by 4,400 to 5,300 persons during full operation. The increase by technology would be: HWR: 5,300 MHTGR: 5,300 ALWR: 5,000 APT: 4,400	• Employment in the regional economic area would increase by 1,600 to 2,400 persons during full operation. The increase by technology would be: HWR: 2,400 MHTGR: 2,300 ALWR: 2,100 APT: 1,600
• Unemployment in the regional economic area would decrease from 6.4 percent (the projected baseline) to 4.9 to 4.6 percent during full operation. The estimated unemployment by technology would be: HWR: 4.6 percent MHTGR: 4.6 percent ALWR: 4.7 percent APT: 4.9 percent	• Unemployment in the regional economic area would decrease from 5 percent (the projected baseline) to 4.4 to 4.3 percent during full operation. The estimated unemployment by technology would be: HWR: 4.3 percent MHTGR: 4.3 percent ALWR: 4.4 percent APT: 4.4 percent	• Unemployment in the regional economic area would decrease from 6.2 percent (the projected baseline) to 5.7 to 5.6 percent during full operation. The estimated unemployment by technology would be: HWR: 5.6 percent MHTGR: 5.6 percent ALWR: 5.6 percent APT: 5.7 percent	• Unemployment in the regional economic area would decrease from 4.6 percent (the projected baseline) to 2.8 to 2.5 percent during full operation. The estimated unemployment by technology would be: HWR: 2.5 percent MHTGR: 2.5 percent ALWR: 2.7 percent APT: 2.8 percent	• Unemployment in the regional economic area would decrease from 4.8 percent (the projected baseline) to 4.6 to 4.5 percent during full operation. The estimated unemployment by technology would be: HWR: 4.5 percent MHTGR: 4.6 percent ALWR: 4.6 percent APT: 4.6 percent
• Population and housing demand within the ROI would increase by 2 percent for all technologies during operation.	• Population and housing demand within the ROI would increase by no more than 1 percent for all technologies during operation.	• Population and housing demand within the ROI would not increase by more than 1 percent for all technologies during operation.	• Population and housing demand within the ROI would not increase by more than 2 percent for all technologies, except APT where it would not increase by more than 1 percent, during operation.	• Population and housing demand within the ROI would not increase by more than 1 percent for all technologies during operation.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 16 of 50]

INEL	NTS	ORR	PANTEX	SRS
Socioeconomics—Collocated Tritium Supply and Recycling				
• Per capita income in the regional economic area would increase by an annual average of approximately 1 to 2 percent during peak construction and 1 percent during full operation.	• Per capita income in the regional economic area would increase by an annual average of approximately 1 percent during peak construction and full operation for all technologies.	• Per capita income in the regional economic area would increase by an annual average of 1 percent during peak construction and full operation for all technologies.	• Per capita income in the regional economic area would increase by an annual average of no more than 1 percent during peak construction and full operation for all technologies.	• Per capita income in the regional economic area would increase by an annual average of approximately 1 percent during peak construction and full operation for all technologies.
• With a collocated tritium supply and recycling facility total revenues and expenditures for most ROI counties, cities, and school districts would increase by an annual average between 2 and less than 1 percent through the year 2005 and between 1 and 0 percent through the year 2010 for all technologies except ALWR. For the ALWR, total revenue and expenditure within the ROI would increase between 4 percent and less than 1 percent in the first 3 years of construction and decrease 1 to 2 percent annually through the year 2010.	• With a collocated tritium supply and recycling facility total revenues and expenditures for most ROI counties, cities, and school districts would increase by an annual average between 1 and 4 percent for all technologies in the first 3 years of construction. After the peak construction year, there would be increases of 1 to 2 percent annually until 2010. Total revenue and expenditure annual average increases of less than 1 percent to 2 percent between 2001 and 2005 would be expected for the MHTGR and APT. Annual average increases of less than 1 to 4 percent between 2001 and 2005 would be expected for the ALWR.	• With a collocated tritium supply and recycling facility total revenues and expenditures for most ROI counties, cities, and school districts would increase by an annual average of approximately 1 percent or less through 2010. Between 2010 and 2020 total revenue and expenditures are both expected to increase by an annual average of less than 1 percent for all technologies.	• With a collocated tritium supply and recycling facility total revenues and expenditures for most ROI counties, cities, and school districts would increase by an annual average of 1 to 3 percent through the year 2005 then decrease annually by 1 percent until the year 2010. For all technologies total revenues and expenditures are expected to increase at an annual average of less than 1 percent between 2010 and 2020.	• With a tritium supply and upgraded recycling facility total revenues and expenditures for most ROI counties, cities, and school districts would increase by an annual average of less than 1 percent through the year 2020 for all technologies except ALWR. For the ALWR, total revenue and expenditure within the ROI would increase between 4 percent and less than 1 percent in the first 3 years of construction and remain flat until 2010. Between 2010 and 2020, total revenue and expenditures would increase by an annual average of less than 1 percent.

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INEL	NTS	ORR	PANTEX	SRS
Socioeconomics—Collocated Tritium Supply and Recycling				
Total revenues and expenditures for all technologies would increase by annual averages of less than 1 percent through the year 2020.	Revenue and expenditure annual average would increase 1 percent through the year 2020 for all technologies.			
• Traffic conditions would worsen slightly due to increased traffic and congestion on site access roads, particularly on U.S. Route 20/26, the primary access route.	• Traffic conditions would worsen slightly due to increased traffic and congestion on site access roads, particularly on Mercury Highway, the primary access route.	• Traffic conditions would worsen slightly due to increased traffic and congestion on site access roads, particularly on Bear Creek Road, the primary access route.	• Traffic conditions would worsen slightly on site access roads due to increased traffic and congestion, particularly on Farm-to-Market Road 683, the primary access route.	• Traffic conditions would worsen slightly due to increased traffic and congestion on site access roads, particularly on State Route 125, the primary access route.
Socioeconomics—Tritium Supply Alone				
• The effects on employment and income for the tritium supply alone would be slightly less than the effects of collocation with recycling for all technologies.	• The effects on employment and income for the tritium supply alone would be slightly less than the effects of collocation with recycling for all technologies.	• The effects on employment and income for the tritium supply alone would be slightly less than the effects of collocation with recycling for all technologies.	• The effects on employment and income over for the tritium supply alone would be slightly less than the effects of collocation with recycling for all technologies.	• No tritium supply alone.
• Population and housing demands in the ROI during construction of the tritium supply alone would not increase by more than 1 to 8 percent over No Action. The increase by technology would be: HWR: 4 percent MHTGR: 4 percent ALWR: 8 percent APT: 5.5 percent	• Population and housing demands in the ROI during construction of the tritium supply alone would not increase by more than 2 percent over No Action for all technologies.	• Population and housing demands in the ROI during construction of the tritium supply alone would not increase by more than 1 percent over No Action for all technologies.	• Population and housing demands in the ROI during construction of the tritium supply alone would not increase by more than 1 to 6 percent over No Action. The increase by technology would be: HWR: 2 percent MHTGR: 2 percent ALWR: 6 percent APT: 4 percent	• No tritium supply alone.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 18 of 50]

INEL	NTS	ORR	PANTEX	SRS
Socioeconomics—Tritium Supply Alone				
• Population and housing demands in the ROI during operation of the tritium supply alone would not increase by more than 1 percent over No Action for all technologies.	• Population and housing demands in the ROI during operation of the tritium supply alone would not increase by more than 1 percent over No Action for all technologies.	• Population and housing demands in the ROI during operation of the tritium supply alone would not increase by more than 1 percent over No Action for all technologies.	• Population and housing demands in the ROI during operation of the tritium supply alone would not increase by more than 1 percent over No Action for all technologies.	• No tritium supply alone.
• Revenues and expenditures with the tritium supply alone would increase for all ROI county, city and school districts, but these increases would be less than collocating with recycling for all technologies.	• Revenues and expenditures with the tritium supply alone would increase for all ROI county, city and school districts, but these increases would be less than collocating with recycling for all technologies.	• Revenues and expenditures with the tritium supply alone would increase for all ROI county, city and school districts, but these increases would be less than collocating with recycling for all technologies.	• Revenues and expenditures with the tritium supply alone would increase for all ROI county, city and school districts, but these increases would be less than collocating with recycling for all technologies.	
• The effects on site access routes for the tritium supply alone would be slightly less than collocation with recycling for all technologies.	• The effects on site access routes for the tritium supply alone would be slightly less than collocation with recycling for all technologies.	• The effects on site access routes for the tritium supply alone would be slightly less than collocation with recycling for all technologies.	• The effects on site access routes for the tritium supply alone would be slightly less than collocation with recycling for all technologies.	
Radiological and Hazardous Chemical Impacts During Normal Operation—No Action				
• Under No Action for emissions of radiation the dose to the maximally exposed member of the public from 1 year of operation is 6.0×10^{-3} mrem. The risk of fatal cancer to the maximally exposed members of the public from 40 years of operation is 1.2×10^{-7}.	• Under No Action for emissions of radiation the dose to the maximally exposed member of the public from 1 year of operation is 0.04 mrem. The risk of fatal cancer to the maximally exposed members of the public from 40 years of operation is 8.1×10^{-7}.	• Under No Action for emissions of radiation the dose to the maximally exposed member of the public from 1 year of operation is 3.9 mrem from atmospheric release and 14 mrem from liquid release. The risk of fatal cancer to the maximally exposed members of the public from 40 years of operation is 7.8×10^{-5} and 2.7×10^{-4}, respectively.	• Under No Action for emissions of radiation the dose to the maximally exposed member of the public from 1 year of operation is 1.3×10^{-3} mrem. The risk of fatal cancer to the maximally exposed members of the public from 40 years of operation is 2.6×10^{-8}.	• Under No Action for emissions of radiation the dose to the maximally exposed member of the public from 1 year of operation is 2.8 mrem from atmospheric release and 0.077 from liquid release. The risk of fatal cancer to the maximally exposed members of the public from 40 years of operation is 5.6×10^{-5} and 1.5×10^{-6}, respectively.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 19 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological and Hazardous Chemical Impacts During Normal Operation—No Action				
• 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 57 person-rem from total site operations in 2030 would result in 1.1 fatal cancer over 40 years of operation.	• The population dose of 5.7×10^{-4} person-rem from total site operations in 2030 would result in 1.1×10^{-5} fatal cancer over 40 years of operation.	• The population dose of 250 person-rem from total site operations in 2030 would result in 4.9 fatal cancers 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.	• Under No Action the average annual dose to a site worker is 15 mrem with a risk of fatal cancer of 2.4×10^{-4} from 40 years of operation. The annual dose of 37 person-rem to total site workforce would result in 0.59 fatal cancers over 40 years of operation.	• Under No Action the average annual dose to a site worker is 32 mrem with a risk of fatal cancer of 5.2×10^{-4} from 40 years of operation. The annual dose of 480 person-rem to total site workforce would result in 7.7 fatal cancers over 40 years of operation.
• Under No Action for emission of hazardous chemicals the chemical 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. The site worker HI is 0.26 with no cancer risk.	• Under No Action for emission of hazardous chemicals the chemical HI is 3.7×10^{-3} with a cancer risk of 1.8×10^{-9} to the maximally exposed member of the public. The site worker HI is 0.26 with a cancer risk of 7.7×10^{-7}.	• Under No Action for emission of hazardous chemicals the chemical HI is 0.70 with a cancer risk of 3.3×10^{-5} to the maximally exposed member of the public. The site worker HI is 1.8 and the cancer risk is 5.9×10^{-3}. The HI value for the public is within regulatory limits, however, the worker HI exceeds OSHA's action level of 1.0. The cancer risk to both the public and site worker exceed the typical threshold of regulatory concern of 1.0×10^{-6}.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 20 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological and Hazardous Chemical Impacts During Normal Operation—Collocated Tritium Supply and Recycling				
• The dose to the maximally exposed member of the public from total site operations with a collocated tritium supply and recycling facility for 1 year would range from 0.11 to 0.36 mrem from atmospheric releases. The associated risk of fatal cancer from 40 years of operation would range from 2.3×10^{-6} to 7.3×10^{-6}. The annual dose and associated (risk of fatal cancer from 40 years of operation) by technology would be: HWR: 0.29 mrem (5.9×10^{-6}) MHTGR: 0.19 mrem (3.8×10^{-6}) Large and Small ALWR: 0.36 mrem (7.3×10^{-6}) APT (He-3): 0.11 mrem (2.3×10^{-6}) APT (SILC): 0.16 mrem (3.3×10^{-6})	• The dose to the maximally exposed member of the public from total site operations with a collocated tritium supply and recycling facility for 1 year would range from 0.13 to 0.40 mrem from atmospheric releases. The associated risk of fatal cancer from 40 years of operation would range from 2.6×10^{-6} to 8.0×10^{-6}. The annual dose and associated (risk of fatal cancer from 40 years of operation) by technology would be: HWR: 0.31 mrem (6.2×10^{-6}) MHTGR: 0.21 mrem (4.1×10^{-6}) Large and Small ALWR: 0.40 mrem (8.0×10^{-6}) APT (He-3): 0.13 mrem (2.6×10^{-6}) APT (SILC): 0.18 mrem (3.6×10^{-6})	• The dose to the maximally exposed member of the public from total site operations with a collocated tritium supply and recycling facility for 1 year would range from 4.3 to 8.8 mrem from atmospheric release. The associated risk of fatal cancer from 40 years of operation would range from 8.6×10^{-5} to 1.8×10^{-4}. The annual dose and associated (risk of fatal cancer from 40 years of operation) by technology would be: HWR: 7.1 mrem (1.4×10^{-4}) MHTGR: 5.7 mrem (1.1×10^{-4}) Large ALWR: 8.8 mrem (1.8×10^{-4}) Small ALWR: 7.6 mrem (1.5×10^{-4}) APT (He-3): 4.3 mrem (8.6×10^{-5}) APT (SILC): 5.0 mrem (1.0×10^{-4})	• The dose to the maximally exposed member of the public from total site operations with a collocated tritium supply and recycling facility for 1 year would range from 1.4 to 4.9 mrem from atmospheric releases. The associated risk of fatal cancer from 40 years of operation would range from 2.9×10^{-5} to 9.8×10^{-5}. The annual dose and associated (risk of fatal cancer from 40 years of operation) by technology would be: HWR: 3.8 mrem (7.6×10^{-5}) MHTGR: 2.4 mrem (4.8×10^{-5}) Large ALWR: 4.9 mrem (9.8×10^{-5}) Small ALWR: 4.8 mrem (9.6×10^{-5}) APT (He-3): 1.4 mrem (2.9×10^{-5}) APT (SILC): 2.1 mrem (4.2×10^{-5})	• The dose to the maximally exposed member of the public from total site operations with a collocated tritium supply and upgraded recycling facility for 1 year would range from 2.5 to 3.9 mrem from atmospheric release. The associated risk of fatal cancer from 40 years of operation would range from 4.9×10^{-5} to 7.8×10^{-5}. The annual dose and associated (risk of fatal cancer from 40 years of operation) by technology would be: HWR: 3.4 mrem (6.9×10^{-5}) MHTGR: 3.0 mrem (5.9×10^{-5}) Large ALWR: 3.9 mrem (7.8×10^{-5}) Small ALWR: 3.6 mrem (7.1×10^{-5}) APT (He-3): 2.5 mrem (4.9×10^{-5}) APT (SILC): 2.8 mrem (5.6×10^{-5})

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 21 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological and Hazardous Chemical Impacts During Normal Operation—Collocated Tritium Supply and Recycling				
• No liquid releases.	• No liquid releases.	• The dose to the maximally exposed member of the public from total site operation with a collocated tritium supply and recycling facility for 1 year would be 14 mrem from liquid release, the associated risk of fatal cancer from 40 years of operation would be 2.7×10^{-4} for all technologies, except for the ALWRs (2.8×10^{-4}).	• No liquid releases.	• The dose to the maximally exposed member of the public from total site operation with a tritium supply and upgraded recycling facility for 1 year would range from 0.077 to 0.26 mrem from liquid release, the associated risk of fatal cancer from 40 years of operation would range from 1.5×10^{-6} to 5.3×10^{-6}. The annual dose and associated (risk of fatal cancer from 40 years of operation) by technology would be: HWR: 0.16 mrem (3.3×10^{-6}) MHTGR: 0.077 mrem (1.5×10^{-6}) Large ALWR: 0.16 mrem (3.3×10^{-6}) Small ALWR: 0.26 mrem (5.3×10^{-6}) APT (for either target system): 0.077 mrem (1.5×10^{-6})

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INEL	NTS	ORR	PANTEX	SRS
Radiological and Hazardous Chemical Impacts During Normal Operation—Collocated Tritium Supply and Recycling				
• The 50-mile population annual dose from total site operations in 2030 would range from 23 to 73 person-rem and could result in 0.45 to 1.5 fatal cancers from 40 years of operation. The annual dose and (fatal cancers from 40 years of operation) by technology would be: HWR: 53 person-rem (1.1) MHTGR: 37 person-rem (0.73) Large ALWR: 73 person-rem (1.5) Small ALWR: 71 person-rem (1.4) APT (He-3): 23 person-rem (0.45) APT (SILC): 32 person-rem (0.64)	• The 50-mile population annual dose from total site operations in 2030 would range from 0.08 to 0.25 person-rem and could result in 1.6×10^{-3} to 5.1×10^{-3} fatal cancers from 40 years of operation. The annual dose and (fatal cancers from 40 years of operation) by technology would be: HWR: 0.20 person-rem (4.0×10^{-3}) MHTGR: 0.13 person-rem (2.6×10^{-3}) Large ALWR: 0.24 person-rem (4.9×10^{-3}) Small ALWR: 0.25 person-rem (5.1×10^{-3}) APT (He-3): 0.08 person-rem (1.6×10^{-3}) APT (SILC): 0.11 person-rem (2.3×10^{-3})	• The 50-mile population annual dose from total site operations in 2030 would range from 68 to 90 person-rem and could result in 1.4 to 1.8 fatal cancers from 40 years of operation. The annual dose and (fatal cancers from 40 years of operation) by technology would be: HWR: 82 person-rem (1.6) MHTGR: 76 person-rem (1.5) Large ALWR: 90 person-rem (1.8) Small ALWR: 87 person-rem (1.7) APT (He-3): 68 person-rem (1.4) APT (SILC): 73 person-rem (1.5)	• The 50-mile population annual dose from total site operations in 2030 would range from 9.2 to 37 person-rem and could result in 0.18 to 0.73 fatal cancer from 40 years of operation. The annual dose and (fatal cancer from 40 years of operation) by technology would be: HWR: 28 person-rem (0.55) MHTGR: 16 person-rem (0.31) Large ALWR: 37 person-rem (0.73) Small ALWR: 35 person-rem (0.69) APT (He-3): 9.2 person-rem (0.18) APT (SILC): 14 person-rem (0.27)	• The 50-mile population annual dose from total site operations in 2030 would range from 220 to 340 person-rem and could result in 4.4 to 6.8 fatal cancers from 40 years of operation. The annual dose and (fatal cancers from 40 years of operation) by technology would be: HWR: 300 person-rem (6.1) MHTGR: 260 person-rem (5.2) Large ALWR: 340 person-rem (6.8) Small ALWR: 310 person-rem (6.2) APT (He-3): 220 person-rem (4.4) APT (SILC): 250 person-rem (4.9)

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 23 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological and Hazardous Chemical Impacts During Normal Operation—Collocated Tritium Supply and Recycling				
• The average annual dose to a site worker that is associated with total site operations would range from 31 to 49 mrem with a resulting risk of fatal cancer from 40 years of operation ranging from $5.0x10^{-4}$ to $7.9x10^{-4}$. The dose and (fatal cancer risk) that are associated with total site operations, including the following technology, would be: HWR: 33 mrem ($5.2x10^{-4}$) MHTGR: 31 mrem ($5.0x10^{-4}$) Large ALWR: 49 mrem ($7.9x10^{-4}$) Small ALWR: 41 mrem ($6.6x10^{-4}$) APT (for either target system): 33 mrem ($5.2x10^{-4}$)	• The average annual dose to a site worker that is associated with total site operations would range from 26 to 140 mrem with a resulting risk of fatal cancer from 40 years of operation ranging from $4.2x10^{-4}$ to $2.3x10^{-3}$. The dose and (fatal cancer risk) that are associated with total site operations, including the following technology, would be: HWR: 34 mrem ($5.4x10^{-4}$) MHTGR: 26 mrem ($4.2x10^{-4}$) Large ALWR: 140 mrem ($2.3x10^{-3}$) Small ALWR: 92 mrem ($1.5x10^{-3}$) APT (He-3): 34 mrem ($5.5x10^{-4}$) APT (SILC): 36 mrem ($5.7x10^{-4}$)	• The average annual dose to a site worker that is associated with total site operations would range from 18 to 26 mrem with a resulting risk of fatal cancer from 40 years of operation ranging from $2.9x10^{-4}$ to $4.2x10^{-4}$. The dose and (fatal cancer risk) that are associated with total site operations, including the following technology, would be: HWR: 19 mrem ($3.0x10^{-4}$) MHTGR: 18 mrem ($2.9x10^{-4}$) Large ALWR: 26 mrem ($4.2x10^{-4}$) Small ALWR: 22 mrem ($3.6x10^{-4}$) APT (He-3): 18 mrem ($3.0x10^{-4}$) APT (SILC): 19 mrem ($3.0x10^{-4}$)	• The average annual dose to a site worker that is associated with total site operations would range from 22 to 68 mrem with a resulting risk of fatal cancer from 40 years of operation ranging from $3.5x10^{-4}$ to $1.1x10^{-3}$. The dose and (fatal cancer risk) that are associated with total site operations, including the following technology would be: HWR: 25 mrem ($4.0x10^{-4}$) MHTGR: 22 mrem ($3.5x10^{-4}$) Large ALWR: 68 mrem ($1.1x10^{-3}$) Small ALWR: 46 mrem ($7.4x10^{-4}$) APT (He-3): 25 mrem ($3.9x10^{-4}$) APT (SILC): 25 mrem ($4.0x10^{-4}$)	• The average annual dose to a site worker that is associated with total site operations would range from 33 to 42 mrem with a resulting risk of fatal cancer from 40 years of operation ranging from $5.3x10^{-4}$ to $6.7x10^{-4}$. The dose and (fatal cancer risk) that are associated with total site operations, including the following technology would be: HWR: 34 mrem ($5.4x10^{-4}$) MHTGR: 33 mrem ($5.3x10^{-4}$) Large ALWR: 42 mrem ($6.7x10^{-4}$) Small ALWR: 38 mrem ($6.1x10^{-4}$) APT (for either target system): 33 mrem ($5.3x10^{-4}$)

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 24 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological and Hazardous Chemical Impacts During Normal Operation—Collocated Tritium Supply and Recycling				
• The annual dose to the total site workforce would range from 250 to 392 person-rem and could result in 4 to 6.3 fatal cancers from 40 years of operation. The annual dose and (fatal cancers from 40 years of operations) by technology would be: HWR: 261 person-rem (4.2) MHTGR: 250 person-rem (4.0) Large ALWR: 392 person-rem (6.3) Small ALWR: 322 person-rem (5.2) APT (He-3): 260 person-rem (4.2) APT (SILC): 262 person-rem (4.2)	• The annual dose to the total site workforce would range from 33 to 180 person-rem and could result in 0.53 to 2.8 fatal cancers from 40 years of operation. The annual dose and (fatal cancers from 40 years of operations) by technology would be: HWR: 44 person-rem (0.70) MHTGR: 33 person-rem (0.53) Large ALWR: 180 person-rem (2.8) Small ALWR: 100 person-rem (1.7) APT (He-3): 43 person-rem (0.69) APT (SILC): 45 person-rem (0.72)	• The annual dose to the total site workforce would range from 350 to 490 person-rem and could result in 5.6 to 7.9 fatal cancers from 40 years of operation. The annual dose and (fatal cancers from 40 years of operations) by technology would be: HWR: 360 person-rem (5.8) MHTGR: 350 person-rem (5.6) Large ALWR: 490 person-rem (7.9) Small ALWR: 420 person-rem (6.7) APT (He-3): 360 person-rem (5.8) APT (SILC): 362 person-rem (5.8)	• The annual dose to the total site workforce would range from 67 to 210 person-rem and could result in 1.1 to 3.3 fatal cancers from 40 years of operation. The annual dose and (fatal cancers from 40 years of operations) by technology would be: HWR: 78 person-rem (1.2) MHTGR: 67 person-rem (1.1) Large ALWR: 210 person-rem (3.3) Small ALWR: 140 person-rem (2.2) APT (He-3): 77 person-rem (1.2) APT (SILC): 79 person-rem (1.3)	• The annual dose to the total site workforce would range from 510 to 650 person-rem and could result in 8.2 to 10 fatal cancers from 40 years of operation. The annual dose and (fatal cancers from 40 years of operations) by technology would be: HWR: 520 person-rem (8.3) MHTGR: 510 person-rem (8.2) Large ALWR: 650 person-rem (10) Small ALWR: 580 person-rem (9.3) APT (He-3): 520 person-rem (8.3) APT (SILC): 522 person-rem (8.4)
• All doses to the public and site workers are within regulatory limits.	• All doses to the public and site workers are within regulatory limits.	• All doses to the public and site workers are within regulatory limits.	• All doses to the public and site workers are within regulatory limits.	• All doses to the public and site workers are within regulatory limits.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 25 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological and Hazardous Chemical Impacts During Normal Operation—Collocated Tritium Supply and Recycling				
• For chemicals the HI ranges from $1.8x10^{-4}$ to $6.3x10^{-4}$ with no cancer risk to the maximally exposed member of the public. The site worker HI ranges from 0.021 to 0.13 with no cancer risk. All values are within regulatory limits. The HIs by technology would be:	• For chemicals the HI ranges from $1.8x10^{-7}$ to $7.7x10^{-5}$ with no cancer risk to the maximally exposed member of the public. The site worker HI ranges from $3.4x10^{-5}$ to 0.038 with no cancer risk. All values are within regulatory limits. The HIs by technology would be:	• For chemicals the HI ranges from 0.36 to 0.38 with no cancer risk to the maximally exposed member of the public. The site worker HI ranges from 0.35 to 0.26 with no cancer risk. All values are within regulatory limits. The HIs by technology would be:	• For chemicals the HI ranges from $3.7x10^{-3}$ to $7.5x10^{-3}$ with a cancer risk of $1.8x10^{-9}$ to the maximally exposed member of the public. The site worker HI is 0.26 with a cancer risk of $7.7x10^{-7}$. All HI values are within regulatory limits. The HIs by technology would be:	• For chemicals the HI is 0.7 with a cancer risk of $3.3x10^{-5}$ to the maximally exposed member of the public for all technologies. The site worker HI ranges from 1.8 to 1.9 with a cancer risk of $6.0x10^{-3}$ for all technologies . The HI value for the public is within regulatory limits, however the HI value to the worker exceeds the action level of 1.0 based on OSHA's exposure limits. Cancer risks to the public and site workers both exceed the typical threshold of regulatory concern of $1.0x10^{-6}$.
Public HWR: $2.1x10^{-4}$ MHTGR: $1.8x10^{-4}$ Large and Small ALWR: $6.3x10^{-4}$ APT (for either target system): $1.8x10^{-4}$	**Public** HWR: $6.3x10^{-6}$ MHTGR: $2.2x10^{-7}$ Large and Small ALWR: $7.7x10^{-5}$ APT (for either target system): $1.8x10^{-7}$	**Public** HWR: 0.36 MHTGR: 0.36 Large and Small ALWR: 0.38 APT (for either target system): 0.36	**Public** HWR: $4.1x10^{-3}$ MHTGR: $3.7x10^{-3}$ Large and Small ALWR: $7.5x10^{-3}$ APT (for either target system): $3.8x10^{-3}$	**Public** HWR: 0.7 MHTGR: 0.7 Large and Small ALWR: 0.71 APT (for either target system): 0.7
Worker HWR: 0.031 MHTGR: 0.021 Large and Small ALWR: 0.13 APT (for either target system): 0.021	**Worker** HWR: $3.2x10^{-3}$ MHTGR: $3.4x10^{-5}$ Large and Small ALWR: 0.038 APT (for either target system): $3.4x10^{-5}$	**Worker** HWR: 0.27 MHTGR: 0.32 Large and Small ALWR: 0.35 APT (for either target system): 0.26	**Worker** HWR: 0.26 MHTGR: 0.26 Large and Small ALWR: 0.26 APT (for either target system): 0.26	**Worker** HWR: 1.8 MHTGR: 1.8 Large and Small ALWR: 1.8 APT (for either target system): 1.8

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 26 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological and Hazardous Chemical Impacts During Normal Operation—Tritium Supply Alone				
• The annual dose to the maximally exposed member of the public from total site operations would range from 0.0048 to 0.25 mrem. The associated risk of fatal cancer from 40 years of operation would range from $1.0x10^{-7}$ to $5.1x10^{-6}$. The dose and associated (risk of fatal cancer) by technology would be: HWR: 0.18 mrem ($3.7x10^{-6}$) MHTGR: 0.08 mrem ($1.6x10^{-6}$) Large and Small ALWR: 0.25 mrem ($5.1x10^{-6}$) APT (He-3): 0.0048 mrem ($1.0x10^{-7}$) APT (SILC): 0.05 mrem ($1.1x10^{-6}$)	• The annual dose to the maximally exposed member of the public from total site operations would range from 0.01 to 0.28 mrem. The associated risk of fatal cancer from 40 years of operation would range from $2.0x10^{-7}$ to $5.6x10^{-6}$. The dose and associated (risk of fatal cancer) by technology would be: HWR: 0.19 mrem ($3.8x10^{-6}$) MHTGR: 0.09 mrem ($1.7x10^{-6}$) Large and Small ALWR: 0.28 mrem ($5.6x10^{-6}$) APT (He-3): 0.01 mrem ($2.0x10^{-7}$) APT (SILC): 0.06 mrem ($1.2x10^{-6}$)	• The annual dose to the maximally exposed member of the public from total site operations would range from 1.5 to 6 mrem from atmospheric release. The associated risk of fatal cancer from 40 years of operation would range from $3.0x10^{-5}$ to $1.2x10^{-4}$. The dose and associated (risk of fatal cancer) by technology would be: HWR: 4.3 mrem ($8.4x10^{-5}$) MHTGR: 2.9 mrem ($5.4x10^{-5}$) Large ALWR: 6 mrem ($1.2x10^{-4}$) Small ALWR: 4.8 mrem ($9.4x10^{-5}$) APT (He-3): 1.5 mrem ($3.0x10^{-5}$) APT (SILC): 2.2 mrem ($4.4x10^{-5}$)	• The annual dose to the maximally exposed member of the public from total site operations would range from 0.048 to 3.5 mrem. The associated risk of fatal cancer from 40 years of operation would range from $1.0x10^{-6}$ to $7.0x10^{-5}$. The dose and associated (risk of fatal cancer) by technology would be: HWR: 2.4 mrem ($4.8x10^{-5}$) MHTGR: 1.0 mrem ($2.0x10^{-5}$) Large ALWR: 3.5 mrem ($7.0x10^{-5}$) Small ALWR: 3.4 mrem ($6.8x10^{-5}$) APT (He-3): 0.048 mrem ($1.0x10^{-6}$) APT (SILC): 0.7 mrem ($1.4x10^{-5}$)	• No tritium supply alone.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 27 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological and Hazardous Chemical Impacts During Normal Operation—Tritium Supply Alone				
• No liquid release.	• No liquid release.	• The dose to a maximally exposed member of the public from operation for 1 year would be 14 mrem from liquid release for each technology, and the associated risk of fatal cancer from 40 years of operation would be 2.8×10^{-4} for all technologies.	• No liquid release.	• No tritium supply alone.
• The 50-mile population dose from total site operations in 2030 would range from 1.0 to 51 person-rem and could result in 0.01 to 1.1 fatal cancers over 40 years of operation. The dose and (fatal cancers) by technology would be:	• The 50-mile population dose from total site operations in 2030 would range from 0.01 to 0.18 person-rem and could result in 2.0×10^{-4} to 3.7×10^{-3} fatal cancers over 40 years of operation. The dose and (fatal cancers) by technology would be:	• The 50-mile population dose from total site operations in 2030 would range from 57 to 79 person-rem and could result in 1.2 to 1.6 fatal cancers over 40 years of operation. The dose and (fatal cancers) by technology would be:	• The 50-mile population dose from total site operations in 2030 would range from 0.2 to 28 person-rem and could result in 3.9×10^{-3} to 0.55 fatal cancers over 40 years of operation. The dose and (fatal cancers) by technology would be:	• No tritium supply alone.
HWR: 31 person-rem (0.66) MHTGR: 15 person-rem (0.29) Large ALWR: 51 person-rem (1.1) Small ALWR: 49 person-rem (0.96) APT (He-3): 1.0 person-rem (0.01) APT (SILC): 10 person-rem (0.2)	HWR: 0.13 person-rem (2.6×10^{-3}) MHTGR: 0.06 person-rem (1.2×10^{-3}) Large ALWR: 0.17 person-rem (3.5×10^{-3}) Small ALWR: 0.18 person-rem (3.7×10^{-3}) APT (He-3): 0.01 person-rem (2.0×10^{-4}) APT (SILC): 0.04 person-rem (9.0×10^{-4})	HWR: 71 person-rem (1.4) MHTGR: 65 person-rem (1.3) Large ALWR: 79 person-rem (1.6) Small ALWR: 76 person-rem (1.5) APT (He-3): 57 person-rem (1.2) APT (SILC): 62 person-rem (1.3)	HWR: 19 person-rem (0.37) MHTGR: 7 person-rem (0.13) Large ALWR: 28 person-rem (0.55) Small ALWR: 26 person-rem (0.51) APT (He-3): 0.2 person-rem (3.9×10^{-3}) APT (SILC): 5 person-rem (0.09)	

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 28 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological and Hazardous Chemical Impacts During Normal Operation—Tritium Supply Alone				
• The average annual dose to a site worker that is associated with total site operations would range from 33 to 52 mrem with a resulting risk of fatal cancer from 40 years of operation ranging from $5.3x10^{-4}$ to $8.3x10^{-4}$. The dose and (fatal cancer risk) that are associated with total site operations, including the following technology, would be: HWR: 34 mrem ($5.4x10^{-4}$) MHTGR: 33 mrem ($5.3x10^{-4}$) Large ALWR: 52 mrem ($8.3x10^{-4}$) Small ALWR: 43 mrem ($6.9x10^{-4}$) APT (He-3): 34 mrem ($5.4x10^{-4}$) APT (SILC): 34 mrem ($5.5x10^{-4}$)	• The average annual dose to a site worker that is associated with total site operations would range from 37 to 220 mrem with a resulting risk of fatal cancer from 40 years of operation ranging from $6.0x10^{-4}$ to $3.5x10^{-3}$. The dose and (fatal cancer risk) that are associated with total site operations, including the following technology, would be: HWR: 47 mrem ($7.5x10^{-4}$) MHTGR: 37 mrem ($6.0x10^{-4}$) Large ALWR: 220 mrem ($3.5x10^{-3}$) Small ALWR: 130 mrem ($2.2x10^{-3}$) APT (He-3): 48 mrem ($7.7x10^{-4}$) APT (SILC): 51 mrem ($8.2x10^{-4}$)	• The average annual dose to a site worker that is associated with total site operations would range from 19 to 26 mrem with a resulting risk of fatal cancer from 40 years of operation ranging from $3.0x10^{-4}$ to $4.3x10^{-4}$. The dose and (fatal cancer risk) that are associated with total site operations, including the following technology, would be: HWR: 19 mrem ($3.0x10^{-4}$) MHTGR: 19 mrem ($3.0x10^{-4}$) Large ALWR: 26 mrem ($4.3x10^{-4}$) Small ALWR: 23 mrem ($3.7x10^{-4}$) APT (for either target system): 19 mrem ($3.0x10^{-4}$)	• The average annual dose to a site worker that is associated with total site operations would range from 24 to 78 mrem with a resulting risk of fatal cancer from 40 years of operation ranging from $2.9x10^{-4}$ to $1.3x10^{-3}$. The dose and (fatal cancer risk) that are associated with total site operations, including the following technology, would be: HWR: 28 mrem ($4.5x10^{-4}$) MHTGR: 24 mrem ($3.9x10^{-4}$) Large ALWR: 78 mrem ($1.3x10^{-3}$) Small ALWR: 53 mrem ($8.6x10^{-4}$) APT (He-3): 28 mrem ($4.4x10^{-4}$) APT (SILC): 29 mrem ($4.6x10^{-4}$)	• No tritium supply alone.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 29 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological and Hazardous Chemical Impacts During Normal Operation—Tritium Supply Alone				
• The annual dose to the total site workforce would range from 250 to 390 person-rem and could result in 4 to 6.3 fatal cancers over 40 years of operation. The dose and (fatal cancers) by each technology would be: HWR: 260 person-rem (4.2) MHTGR: 250 person-rem (4.0) Large ALWR: 390 person-rem (6.3) Small ALWR: 320 person-rem (5.2) APT (He-3): 258 person-rem (4.1) APT (SILC): 261 person-rem (4.2)	• The annual dose to the total site workforce would range from 42 to 180 person-rem and could result in 0.67 to 2.8 fatal cancers over 40 years of operation. The dose and (fatal cancers) by each technology would be: HWR: 42 person-rem (0.67) MHTGR: 31 person-rem (0.50) Large ALWR: 180 person-rem (2.8) Small ALWR: 98 person-rem (1.7) APT (He-3): 41 person-rem (0.66) APT (SILC): 44 person-rem (0.70)	• The annual dose to the total site workforce would range from 350 to 490 person-rem and could result in 5.6 to 7.9 fatal cancers over 40 years of operation. The dose and (fatal cancers) by each technology would be: HWR: 360 person-rem (5.8) MHTGR: 350 person-rem (5.6) Large ALWR: 490 person-rem (7.9) Small ALWR: 420 person-rem (6.7) APT (for either target system): 360 person-rem (5.8)	• The annual dose to the total site workforce would range from 65 to 210 person-rem and could result in 1.1 to 3.3 fatal cancers over 40 years of operation. The dose and (fatal cancers) by each technology would be: HWR: 76 person-rem (1.2) MHTGR: 65 person-rem (1.1) Large ALWR: 210 person-rem (3.3) Small ALWR: 140 person-rem (2.2) APT (He-3): 75 person-rem (1.2) APT (SILC): 78 person-rem (1.2)	• No tritium supply alone.
• All radiological doses to the public and site workers are within regulatory limits.	• All radiological doses to the public and site workers are within regulatory limits.	• All radiological doses to the public and site workers are within regulatory limits.	• All radiological doses to the public and site workers are within regulatory limits.	• No tritium supply alone.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 30 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological and Hazardous Chemical Impacts During Normal Operation—Tritium Supply Alone				
• For collocation relative percent reduction of the HI to the maximally exposed member of the public and the site worker HI with no cancer risk would be reduced by the below listed percentages for each technology (all values are within regulatory limits):	• For collocation relative percent reduction of the HI to the maximally exposed member of the public and the site worker HI with no cancer risk would be reduced by the below listed percentages for each technology (all values are within regulatory limits):	• For collocation relative percent reduction of the HI to the maximally exposed member of the public and the site worker HI with no cancer risk would be reduced by 0.01 percent for all technologies (all values are within regulatory limits):	• For collocation relative percent reduction of the HI to the maximally exposed member of the public and the site worker HI with no change in either of the cancer risk values would be reduced by the below listed percentages for each technology. The HI values are within regulatory health limits, the cancer risks to the public and site worker exceed the typical threshold of regulatory concern of 1.0×10^{-6}:	• No tritium supply alone.
Public HWR: 0.26 MHTGR: 0.3 ALWR: 0.09 APT: 0.3	**Public** HWR: 1.4 MHTGR: 41.4 ALWR: 0.12 APT: 50.6	**Public** HWR: 0.007 MHTGR: 0.007 ALWR: 0.007 APT: 0.007	**Public** HWR: 0.78 MHTGR: 0.86 ALWR: 0.42 APT: 0.84	
Worker HWR: 0.16 MHTGR: 0.23 ALWR: 0.04 APT: 0.23	**Worker** HWR: 0.53 MHTGR: 50 ALWR: 0.04 APT: 50	**Worker** HWR: 0.015 MHTGR: 0.013 ALWR: 0.011 APT: 0.015	**Worker** HWR: 0.006 MHTGR: 0.006 ALWR: 0.006 APT: 0.006	

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 31 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological Impacts from Accidents—Collocated Tritium Supply Technology				
• The estimated increase in likelihood of cancer fatality and the cancer risk to a maximally exposed individual at the site boundary for a low-to-moderate consequence/ high probability accident associated with operation of a collocated tritium supply and recycling facility would be:	• The estimated increase in likelihood of cancer fatality and the cancer risk to a maximally exposed individual at the site boundary for a low-to-moderate consequence/ high probability accident associated with operation of a collocated tritium supply and recycling facility would be:	• The estimated increase in likelihood of cancer fatality and the cancer risk to a maximally exposed individual at the site boundary for a low-to-moderate consequence/ high probability accident associated with operation of a collocated tritium supply and recycling facility would be:	• The estimated increase in likelihood of cancer fatality and the cancer risk to a maximally exposed individual at the site boundary for a low-to-moderate consequence/ high probability accident associated with operation of a collocated tritium supply and recycling facility would be:	• The estimated increase in likelihood of cancer fatality and the cancer risk to a maximally exposed individual at the site boundary for a low-to-moderate consequence/ high probability accident associated with operation of a collocated tritium supply and recycling facility 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 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 Risk (per year)** HWR: 6.8×10^{-8} MHTGR: 1.1×10^{-9} Large ALWR: 4.3×10^{-10} Small ALWR: 5.8×10^{-10} APT: negligible	**Cancer Risk (per year)** HWR: 6.2×10^{-9} MHTGR: 1.0×10^{-10} Large ALWR: 3.9×10^{-11} Small ALWR: 5.2×10^{-11} APT: negligible	**Cancer Risk (per year)** HWR: 2.3×10^{-8} MHTGR: 3.0×10^{-10} Large ALWR: 1.3×10^{-10} Small ALWR: 2.0×10^{-10} APT: negligible
Cancer Fatality HWR: 8.1×10^{-6} MHTGR: 5.1×10^{-9} Large ALWR: 5.0×10^{-6} Small ALWR: 6.8×10^{-6} APT: negligible	**Cancer Fatality** HWR: 4.2×10^{-6} MHTGR: 2.2×10^{-9} Large ALWR: 2.2×10^{-6} Small ALWR: 3.0×10^{-6} APT: negligible	**Cancer Fatality** HWR: 6.8×10^{-5} MHTGR: 4.4×10^{-8} Large ALWR: 4.3×10^{-5} Small ALWR: 5.8×10^{-5} APT: negligible	**Cancer Fatality** HWR: 6.2×10^{-6} MHTGR: 4.0×10^{-9} Large ALWR: 3.9×10^{-6} Small ALWR: 5.2×10^{-6} APT: negligible	**Cancer Fatality** HWR: 2.3×10^{-5} MHTGR: 1.2×10^{-8} Large ALWR: 1.3×10^{-5} Small ALWR: 2.0×10^{-5} APT: negligible

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 32 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological Impacts from Accidents—Tritium Supply Technology				
• The estimated cancer risk (fatalities per year) and, if the accident occured, the total cancer fatalities for the populations residing within 50 miles for a low-to-moderate consequence/ high probability accident of a tritium supply technology would be:	• The estimated cancer risk (fatalities per year) and, if the accident occured, the total cancer fatalities for the populations residing within 50 miles for a low-to-moderate consequence/ high probability accident of a tritium supply technology would be:	• The estimated cancer risk (fatalities per year) and, if the accident occured, the total cancer fatalities for the populations residing within 50 miles for a low-to-moderate consequence/ high probability accident of a tritium supply technology would be:	• The estimated cancer risk (fatalities per year) and, if the accident occured, the total cancer fatalities for the populations residing within 50 miles for a low to moderate consequence/ high probability accident of a tritium supply technology would be:	• The estimated cancer risk (fatalities per year) and, if the accident occured, the total cancer fatalities for the populations residing within 50 miles for a low-to-moderate consequence/ high probability accident of a tritium supply technology would be:
Cancer Risk HWR: 7.4×10^{-5} MHGTR: 5.0×10^{-7} Large ALWR: 3.8×10^{-7} Small ALWR: 6.2×10^{-7} APT: negligible	**Cancer Risk** 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 Risk** HWR: 7.5×10^{-4} MHTGR: 1.1×10^{-5} Large ALWR: 4.6×10^{-6} Small ALWR: 6.4×10^{-6} APT: negligible	**Cancer Risk** HWR: 2.6×10^{-5} MHTGR: 3.0×10^{-7} Large ALWR: 1.5×10^{-7} Small ALWR: 2.1×10^{-7} APT: negligible	**Cancer Risk (per year)** HWR: 7.3×10^{-4} MHTGR: 6.3×10^{-6} Large ALWR: 3.8×10^{-6} Small ALWR: 6.0×10^{-6} APT: negligible
Cancer Fatality HWR: 0.074 MHGTR: 2.0×10^{-5} Large ALWR: 0.038 Small ALWR: 0.062 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	**Cancer Fatality** HWR: 0.75 MHTGR: 4.3×10^{-4} Large ALWR: 0.46 Small ALWR: 0.64 APT: negligible	**Cancer Fatality** HWR: 0.026 MHTGR: 1.2×10^{-5} Large ALWR: 0.015 Small ALWR: 0.021 APT: negligible	**Cancer Fatality** HWR: 0.73 MHTGR: 2.5×10^{-4} Large ALWR: 0.037 Small ALWR: 0.60 APT: negligible

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 33 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological Impacts from Accidents—Tritium Supply Technology				
• The estimated cancer risk to a worker located 1,000 meters from the release and, if the accident occured, the increase in likelihood of cancer fatality for a low-to-moderate consequence/ high probability accident of a tritium supply technology would be:	• The estimated cancer risk to a worker located 1,000 meters from the release and, if the accident occured, the increase in likelihood of cancer fatality for a low-to-moderate consequence/ high probability accident of a tritium supply technology would be:	• The estimated cancer risk to a worker located 1,000 meters from the release and, if the accident occured, the increase in likelihood of cancer fatality for a low-to-moderate consequence/ high probability accident of a tritium supply technology would be:	• The estimated cancer risk to a worker located 1,000 meters from the release and, if the accident occured, the increase in likelihood of cancer fatality for a low-to-moderate consequence/ high probability accident of a tritium supply technology would be:	• The estimated cancer risk to a worker located 1,000 meters from the release and, if the accident occured, the increase in likelihood of cancer fatality 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 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 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 Risk (per year)** HWR: 1.2×10^{-8} MHTGR: 3.8×10^{-10} Large ALWR: 1.2×10^{-10} Small ALWR: 1.6×10^{-10} APT: negligible	**Cancer Risk (per year)** HWR: 2.9×10^{-7} MHTGR: 8.5×10^{-9} Large ALWR: 2.8×10^{-9} Small ALWR: 3.6×10^{-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	**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	**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	**Cancer Fatality** HWR: 1.2×10^{-5} MHTGR: 1.5×10^{-8} Large ALWR: 1.2×10^{-5} Small ALWR: 1.6×10^{-5} APT: negligible	**Cancer Fatality** HWR: 2.9×10^{-4} MHTGR: 3.4×10^{-7} Large ALWR: 2.8×10^{-4} Small ALWR: 3.6×10^{-4} APT: negligible

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 34 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological Impacts from Accidents—Tritium Supply Technology				
• The estimated cancer risk and, if the accident ocurred, the increase in likelihood of cancer fatality to a maximally exposed individual at the site boundary for a high consequence/low probability accident of a tritium supply technology would be:	• The estimated cancer risk and, if the accident ocurred, the increase in likelihood of cancer fatality to a maximally exposed individual at the site boundary for a high consequence/low probability accident of a tritium supply technology would be:	• The estimated cancer risk and, if the accident ocurred, the increase in likelihood of cancer fatality to a maximally exposed individual at the site boundary for a high consequence/low probability accident of a tritium supply technology would be:	• The estimated cancer risk and, if the accident ocurred, the increase in likelihood of cancer fatality to a maximally exposed individual at the site boundary for a high consequence/low probability accident of a tritium supply technology would be:	• The estimated cancer risk and, if the accident ocurred, the increase in likelihood of cancer fatality to a maximally exposed individual at the site boundary for a high consequence/low probability accident 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 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 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^{-14} APT (SILC): 1.6×10^{-12}	**Cancer Risk (per year)** HWR: 9.5×10^{-8} MHTGR: 1.6×10^{-8} Large ALWR: 2.3×10^{-9} Small ALWR: 4.6×10^{-9} APT (He-3): 6.4×10^{-14} APT (SILC): 1.0×10^{-12}	**Cancer Risk (per year)** HWR: 6.0×10^{-9} MHTGR: 1.0×10^{-9} Large ALWR: 2.0×10^{-10} Small ALWR: 2.9×10^{-10} APT (He-3): 4.1×10^{-15} APT (SILC): 7.3×10^{-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}	**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}	**Cancer Fatality** HWR: 0.015 MHTGR: 1.5×10^{-3} Large ALWR: 0.02 Small ALWR: 0.042 APT (He-3): 1.3×10^{-7} APT (SILC): 2.2×10^{-6}	**Cancer Fatality** HWR: 0.010 MHTGR: 1.0×10^{-3} Large ALWR: 0.015 Small ALWR: 0.029 APT (He-3): 9.0×10^{-8} APT (SILC): 1.4×10^{-6}	**Cancer Fatality** HWR: 6.6×10^{-4} MHTGR: 6.3×10^{-5} Large ALWR: 1.3×10^{-3} Small ALWR: 1.9×10^{-3} APT (He-3): 5.7×10^{-9} APT (SILC): 1.0×10^{-7}

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 35 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological Impacts from Accidents—Tritium Supply Technology				
• The estimated cancer risk (fatalities per year) and, if the accident ocurred, the total cancer fatalities for the population residing within 50 miles for a high consequence/ low probability accident of a tritium supply technology would be:	The estimated cancer risk (fatalities per year) and, if the accident ocurred, the total cancer fatalities for the population residing within 50 miles for a high consequence/ low probability accident of a tritium supply technology would be:	The estimated cancer risk (fatalities per year) and, if the accident ocurred, the total cancer fatalities for the population residing within 50 miles for a high consequence/ low probability accident of a tritium supply technology would be:	The estimated cancer risk (fatalities per year) and, if the accident ocurred, the total cancer fatalities for the population residing within 50 miles for a high consequence/ low probability accident of a tritium supply technology would be:	The estimated cancer risk (fatalities per year) and, if the accident ocurred, the total cancer fatalities for the population residing within 50 miles for a high consequence/ low probability accident 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 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 Risk (per year)** HWR: 1.2×10^{-4} MHTGR: 2.3×10^{-5} Large ALWR: 9.4×10^{-7} Small ALWR: 5.1×10^{-6} APT (He-3): 6.8×10^{-11} APT (SILC): 7.4×10^{-10}	**Cancer Risk (per year)** HWR: 1.5×10^{-5} MHTGR: 3.0×10^{-6} Large ALWR: 1.1×10^{-7} Small ALWR: 6.7×10^{-7} APT (He-3): 8.9×10^{-12} APT (SILC): 9.6×10^{-11}	**Cancer Risk (per year)** HWR: 5.1×10^{-5} MHTGR: 1.0×10^{-5} Large ALWR: 2.6×10^{-7} Small ALWR: 2.3×10^{-6} APT (He-3): 2.8×10^{-11} APT (SILC): 2.7×10^{-10}
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}	**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}	**Cancer Fatality** HWR: 13 MHTGR: 1.4 Large ALWR: 6.2 Small ALWR: 33 APT (He-3): 9.6×10^{-5} APT (SILC): 1.0×10^{-3}	**Cancer Fatality** HWR: 1.7 MHTGR: 0.19 Large ALWR: 0.72 Small ALWR: 4.3 APT (He-3): 1.3×10^{-5} APT (SILC): 1.3×10^{-4}	**Cancer Fatality** HWR: 5.5 MHTGR: 0.63 Large ALWR: 1.7 Small ALWR: 14 APT (He-3): 3.9×10^{-5} APT (SILC): 3.8×10^{-4}

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 36 of 50]

INEL	NTS	ORR	PANTEX	SRS
Radiological Impacts from Accidents—Tritium Supply Technology				
• The estimated cancer risk to a worker located 1,000 meters from the release and, if the accident ocurred, the increase in likelihood of cancer fatality for a high consequence/low probability accident of a tritium supply technology would be:	• The estimated cancer risk to a worker located 1,000 meters from the release and, if the accident ocurred, the increase in likelihood of cancer fatality for a high consequence/low probability accident of a tritium supply technology would be:	• The estimated cancer risk to a worker located 1,000 meters from the release and, if the accident ocurred, the increase in likelihood of cancer fatality for a high consequence/low probability accident of a tritium supply technology would be:	• The estimated cancer risk to a worker located 1,000 meters from the release and, if the accident ocurred, the increase in likelihood of cancer fatality for a high consequence/low probability accident of a tritium supply technology would be:	• The estimated cancer risk to a worker located 1,000 meters from the release and, if the accident ocurred, the increase in likelihood of cancer fatality for a high consequence/low probability accident 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 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 Risk (per year)** HWR: 3.2×10^{-7} MHTGR: 1.1×10^{-7} Large ALWR: 4.9×10^{-9} Small ALWR: 1.6×10^{-8} APT (He-3): 4.3×10^{-13} APT (SILC): 6.2×10^{-12}	**Cancer Risk (per year)** HWR: 2.2×10^{-7} MHTGR: 5.0×10^{-8} Large ALWR: 3.5×10^{-9} Small ALWR: 1.1×10^{-8} APT (He-3): 1.9×10^{-13} APT (SILC): 2.7×10^{-12}	**Cancer Risk (per year)** HWR: 2.1×10^{-7} MHTGR: 5.1×10^{-8} Large ALWR: 3.4×10^{-9} Small ALWR: 1.1×10^{-8} APT (He-3): 1.9×10^{-13} APT (SILC): 2.7×10^{-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}	**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}	**Cancer Fatality** HWR: 0.035 MHTGR: 7.1×10^{-3} Large ALWR: 0.032 Small ALWR: 0.10 APT (He-3): 6.0×10^{-7} APT (SILC): 8.7×10^{-6}	**Cancer Fatality** HWR: 0.024 MHTGR: 3.1×10^{-3} Large ALWR: 0.023 Small ALWR: 0.070 APT (He-3): 2.6×10^{-7} APT (SILC): 3.8×10^{-6}	**Cancer Fatality** HWR: 0.023 MHTGR: 3.2×10^{-3} Large ALWR: 0.023 Small ALWR: 0.067 APT (He-3): 2.7×10^{-7} APT (SILC): 3.8×10^{-6}
• The impacts of tritium extraction and recycling are presented in appendix I.	• The impacts of tritium extraction and recycling are presented in appendix I.	• The impacts of tritium extraction and recycling are presented in appendix I.	• The impacts of tritium extraction and recycling are presented in appendix I.	• The impacts of tritium extraction and recycling are presented in appendix I.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 37 of 50]

INEL	NTS	ORR	PANTEX	SRS
Waste Management—No Action				
• 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, ORR would continue to manage spent nuclear fuel and the following waste types: TRU, low-level, mixed TRU and low-level, hazardous, and nonhazardous.	• Under No Action, Pantex would continue to manage the following waste types: low-level, mixed low-level, hazardous, and nonhazardous.	• Under No Action, SRS 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.
Waste Management—Collocated Tritium Supply and Recycling				
• For collocated tritium supply and recycling facilities, spent nuclear fuel would be generated by all technologies, except APT. New spent fuel storage facilities would be required. For tritium recycling phaseout at SRS, no change for spent nuclear fuel.	• For collocated tritium supply and recycling facilities, spent nuclear fuel would be generated by all technologies, except APT. New spent fuel storage facilities would be required. For tritium recycling phaseout at SRS, no change for spent nuclear fuel.	• For collocated tritium supply and recycling facilities, spent nuclear fuel would be generated by all technologies, except APT. New spent fuel storage facilities would be required. For tritium recycling phaseout at SRS, no change for spent nuclear fuel.	• For collocated tritium supply and recycling facilities, spent nuclear fuel would be generated by all technologies, except APT. New spent fuel storage facilities would be required. For tritium recycling phaseout at SRS, no change for spent nuclear fuel.	• For collocated tritium supply and upgraded recycling facilities, spent nuclear fuel would be generated by all technologies, except APT. New spent fuel storage facilities would be required.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 38 of 50]

INEL	NTS	ORR	PANTEX	SRS
Waste Management—Collocated Tritium Supply and Recycling				
• For collocated tritium supply and recycling facilities, liquid LLW would be generated by 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 Existing/planned treatment facilities may be adequate for all technologies, except the Large ALWR, which would require a new treatment facility. For tritium recycling phaseout at SRS, no change for liquid LLW.	• For collocated tritium supply and recycling facilities, liquid LLW would be generated 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 New treatment facilities would be required. For tritium recycling phaseout at SRS, no change for liquid LLW.	• For collocated tritium supply and recycling facilities, liquid LLW generation would increase for all technologies except APT. The increase over No Action (587,000 GPY) would be: HWR: 2,100,000 GPY MHTGR: 525,000 GPY Large ALWR: 5,000,000 GPY Small ALWR: 790,000 GPY New treatment facilities would be required. For tritium recycling phaseout at SRS, no change for liquid LLW.	• For collocated tritium supply and recycling facilities, liquid LLW generation would increase for all technologies except APT. The increase over No Action (400 GPY) would be: HWR: 2,100,000 GPY MHTGR: 525,000 GPY Large ALWR: 5,000,000 GPY Small ALWR: 790,000 GPY New treatment facilities would be required. For tritium recycling phaseout at SRS, no change for liquid LLW.	• For collocated tritium supply and upgraded recycling facilities, liquid LLW would be generated 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 New treatment facilities would be required.

TABLE 3.6-1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 39 of 50]

INEL	NTS	ORR	PANTEX	SRS
Waste Management—Collocated Tritium Supply and Recycling				
• For collocated tritium supply and recycling facilities, solid LLW generation would increase and require additional onsite LLW disposal area. The increase over No Action (5,100 yd^3 per year) and the additional LLW disposal area would be: HWR: 5,550 yd^3 per year - 0.6 acres per year MHTGR: 1,650 yd^3 per year - 0.2 acres per year Large ALWR: 1,060 yd^3 per year - 0.2 acres per year Small ALWR: 1,010 yd^3 per year - 0.1 acres per year APT: 894 yd^3 per year - 0.1 acres per year For tritium recycling phaseout at SRS, 350 yd^3 per year decrease in solid LLW at SRS. LLW disposal facility life extended.	• For collocated tritium supply and recycling facilities, solid LLW generation would increase and require additional onsite LLW disposal area. The increase over No Action (42,400 yd^3 per year) and the additional LLW disposal area would be: HWR: 5,550 yd^3 per year - 0.6 acres per year MHTGR: 1,650 yd^3 per year - 0.2 acres per year Large ALWR: 1,060 yd^3 per year - 0.2 acres per year Small ALWR: 1,010 yd^3 per year - 0.1 acres per year APT: 894 yd^3 per year - 0.1 acres per year For tritium recycling phaseout at SRS, 350 yd^3 per year decrease in solid LLW at SRS. LLW disposal facility life extended.	• For collocated tritium supply and recycling facilities, solid LLW generation would increase and require additional onsite LLW disposal area. The increase over No Action (9,300 yd^3 per year) and the additional LLW disposal area would be: HWR: 5,550 yd^3 per year - 1.2 acres per year MHTGR: 1,650 yd^3 per year - 0.35 acre per year Large ALWR: 1,060 yd^3 per year - 0.4 acres per year Small ALWR: 1,010 yd^3 per year - 0.2 acres per year APT: 894 yd^3 per year - 0.2 acres per year For tritium recycling phaseout at SRS, 350 yd^3 per year decrease in solid LLW at SRS. LLW disposal facility life extended.	• For collocated tritium supply and recycling facilities, solid LLW generation would increase and require additional onsite LLW disposal area at NTS. The increase over No Action (25 yd^3 per year) and the additional LLW shipments to NTS would be: HWR: 5,550 yd^3 per year - 92 shipments per year MHTGR: 1,650 yd^3 per year - 27 shipments per year Large ALWR: 1,060 yd^3 per year - 32 shipments per year Small ALWR: 1,010 yd^3 per year - 18 shipments per year APT: 894 yd^3 per year - 16 shipments per year Additional LLW disposal area at NTS would be the same as in NTS alternatives. For tritium recycling phaseout at SRS, 350 yd^3 per year decrease in solid LLW at SRS. LLW disposal facility life extended.	• For collocated tritium supply and recycling facilities, solid LLW generation would increase for all technologies and require additional onsite LLW disposal area. The increase over No Action (5,100 yd^3 per year) and the additional LLW disposal area would be: HWR: 5,200 yd^3 per year - 0.4 acres per year MHTGR: 1,300 yd^3 per year - 0.1 acres per year Large ALWR: 710 yd^3 per year - 0.06 acres per year Small ALWR: 660 yd^3 per year - 0.05 acres per year APT: 544 yd^3 per year - 0.05 acre per year

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 40 of 50]

INEL	NTS	ORR	PANTEX	SRS
Waste Management—Collocated Tritium Supply and Recycling				
• For collocated tritium supply and recycling facilities, 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 no longer generated at SRS.	• For collocated tritium supply and recycling facilities, small quantity (6 GPY) of liquid mixed LLW from recycling facility would be generated. Organic mixed waste treatment capability would be required. For tritium recycling phaseout at SRS, 6 GPY of liquid mixed LLW no longer generated at SRS.	• For collocated tritium supply and recycling facilities, small quantity (6 GPY) in liquid mixed LLW generation over No Action (470,000 GPY) would be generated from recycling facility. Existing/planned treatment facilities would be adequate. For tritium recycling phaseout at SRS, 6 GPY of liquid mixed LLW no longer generated at SRS.	• For collocated tritium supply and recycling facilities, small quantity (6 GPY) in liquid mixed LLW generation over No Action (403 GPY) would be generated from recycling facility. Existing/planned treatment facilities would be adequate. For tritium recycling phaseout at SRS, 6 GPY of liquid mixed LLW no longer generated at SRS.	• For collocated tritium supply and upgraded recycling facilities, no increase in liquid mixed LLW generation from upgraded recycling facility.
• For collocated tritium supply and recycling facilities, solid mixed LLW generation would increase. The increase over No Action (655 yd^3 per year) would be: HWR: 122 yd^3 per year MHTGR: 3 yd^3 per year Large ALWR: 8 yd^3 per year Small ALWR: 8 yd^3 per year APT: 9 yd^3 per year	• For collocated tritium supply and recycling facilities, solid mixed LLW generation would increase. The increase over No Action (5,460 yd^3 per year) would be: HWR: 122 yd^3 per year MHTGR: 3 yd^3 per year Large ALWR: 8 yd^3 per year Small ALWR: 8 yd^3 per year APT: 9 yd^3 per year Organic mixed waste treatment capability would be required. For tritium recycling phaseout at SRS, 2 yd^3 per year decrease in solid mixed LLW at SRS.	• For collocated tritium supply and recycling facilities, solid mixed LLW generation would increase. The increase over No Action (11,100 yd^3 per year) would be: HWR: 122 yd^3 per year MHTGR: 3 yd^3 per year Large ALWR: 8 yd^3 per year Small ALWR: 8 yd^3 per year APT: 9 yd^3 per year Existing/planned treatment facilities would be adequate. For tritium recycling phaseout at SRS, 2 yd^3 per year decrease in solid mixed LLW at SRS.	• For collocated tritium supply and recycling facilities, solid mixed LLW generation would increase. The increase over No Action (5 yd^3 per year) would be: HWR: 122 yd^3 per year MHTGR: 3 yd^3 per year Large ALWR: 8 yd^3 per year Small ALWR: 8 yd^3 per year APT: 9 yd^3 per year	• For collocated tritium supply and recycling facilities, solid mixed LLW generation would increase. The increase over No Action (151 yd^3 per year) would be: HWR: 120 yd^3 per year MHTGR: 1 yd^3 per year Large ALWR: 6 yd^3 per year Small ALWR: 6 yd^3 per year APT: 7 yd^3 per year

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 41 of 50]

INEL	NTS	ORR	PANTEX	SRS
Waste Management—Collocated Tritium Supply and Recycling				
HWR may require new or expanded treatment and storage facilities. For tritium recycling phaseout at SRS, 2 yd^3 per year decrease in solid mixed LLW at SRS.			HWR would require new or expanded treatment and storage facilities. For tritium recycling phaseout at SRS, 2 yd^3 per year decrease in solid mixed LLW at SRS.	HWR may require new or expanded treatment and storage facilities. Other technologies may require expanded treatment capacity.
• For collocated tritium supply and recycling facilities, hazardous waste generation would increase. The increase over No Action (308 yd^3 per year) would be: HWR: 41 yd^3 per year MHTGR: 101 yd^3 per year Large ALWR: 36 yd^3 per year Small ALWR: 36 yd^3 per year) APT: 4 yd^3 per year	• For collocated tritium supply and recycling facilities, hazardous waste generation would increase. The increase over No Action (20 yd^3 per year) would be: HWR: 41 yd^3 per year MHTGR: 101 yd^3 per year Large ALWR: 36 yd^3 per year Small ALWR: 36 yd^3 per year) APT: 4 yd^3 per year	• For collocated tritium supply and recycling facilities, solid hazardous waste generation would increase. The increase over No Action (1,150 yd^3 per year) would be: HWR: 41 yd^3 per year MHTGR: 101 yd^3 per year Large ALWR: 36 yd^3 per year Small ALWR: 36 yd^3 per year) APT: 4 yd^3 per year	• For collocated tritium supply and recycling facilities, solid hazardous waste generation would increase. The increase over No Action (63 yd^3 per year) would be: HWR: 41 yd^3 per year MHTGR: 101 yd^3 per year Large ALWR: 36 yd^3 per year Small ALWR: 36 yd^3 per year) APT: 4 yd^3 per year	• For collocated tritium supply and recycling facilities, hazardous waste generation would increase. The increase over No Action (13 yd^3 per year) would be: HWR: 40 yd^3 per year MHTGR: 100 yd^3 per year Large ALWR: 35 yd^3 per year Small ALWR: 35 yd^3 per year) APT: 3 yd^3 per year
Use of existing/planned hazardous waste facilities may be feasible. For tritium recycling phaseout at SRS, 1 yd^3 per year decrease in hazardous waste at SRS. Decrease in offsite hazardous waste shipments.	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 phaseout at SRS, 1 yd^3 per year decrease in hazardous waste at SRS. Decrease in offsite hazardous waste shipments.	Existing/planned hazardous waste facilities would be adequate. For tritium recycling phaseout at SRS, 1 yd^3 per year decrease in hazardous waste at SRS. Decrease in offsite hazardous waste shipments.	Use of existing/planned hazardous waste facilities would be adequate. For tritium recycling phaseout at SRS, 1 yd^3 per year decrease in hazardous waste at SRS. Decrease in offsite hazardous waste shipments.	Additional hazardous waste storage facilities may be required except for APT. APT may require expansion of existing/planned hazardous waste storage facilities.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 42 of 50]

INEL	NTS	ORR	PANTEX	SRS
Waste Management—Collocated Tritium Supply and Recycling				
• For collocated tritium supply and recycling facilities, liquid sanitary waste would be generated (260 MGY) and require new treatment facilities. For tritium recycling phaseout at SRS, 32 MGY decrease in liquid sanitary waste at SRS. Decrease would occur over time as recycling facilities are transitioned.	• For collocated tritium supply and recycling facilities, liquid sanitary waste would be generated (260 MGY) and require new treatment facilities. For tritium recycling phaseout at SRS, 32 MGY decrease in liquid sanitary waste at SRS. Decrease would occur over time as recycling facilities are transitioned.	• For collocated tritium supply and recycling facilities, liquid sanitary waste generation would increase. The increase over No Action (483 MGY) would be: 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. For tritium recycling phaseout at SRS, 32 MGY decrease in liquid sanitary waste at SRS. Decrease would occur over time as recycling facilities are transitioned.	• For collocated tritium supply and recycling facilities, liquid sanitary waste generation would increase. The increase over No Action (39.9 MGY) would be: HWR: 62.3 MGY MHTGR: 44.3 MGY Large ALWR: 104 MGY Small ALWR: 64.3 MGY APT: 260 MGY New treatment facilities would be required. For tritium recycling phaseout at SRS, 32 MGY decrease in liquid sanitary waste at SRS. Decrease would occur over time as recycling facilities are transitioned.	• For collocated tritium supply and upgraded recycling facilities, liquid sanitary waste generation would increase. The increase over No Action (186 MGY) would be: HWR: 2,350 MGY MHTGR: 1,630 MGY Large ALWR: 6,290 MGY Small ALWR: 2,850 MGY APT: 245 MGY New treatment facilities would be required.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 43 of 50]

INEL	NTS	ORR	PANTEX	SRS
Waste Management—Collocated Tritium Supply and Recycling				
• For collocated tritium supply and recycling facilities, solid sanitary waste generation would increase. The increase over No Action (68,000 yd^3 per year) would be: HWR: 15,000 yd^3 per year MHTGR: 14,800 yd^3 per year Large ALWR: 14,300 yd^3 per year Small ALWR: 11,600 yd^3 per year APT: 8,640 yd^3 per year Onsite landfill design life would be reduced or require expansion. For tritium recycling phaseout at SRS, 7,800 yd^3 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 collocated tritium supply and recycling facilities, solid sanitary waste generation would increase. The increase over No Action (7,000 yd^3 per year) would be: HWR: 15,000 yd^3 per year MHTGR: 14,800 yd^3 per year Large ALWR: 14,300 yd^3 per year Small ALWR: 11,600 yd^3 per year APT: 8,640 yd^3 per year Onsite landfill design life would be reduced or require expansion. For tritium recycling phaseout at SRS, 7,800 yd^3 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 collocated tritium supply and recycling facilities, solid sanitary waste generation would increase. The increase over No Action (77,000 yd^3 per year) would be: HWR: 15,000 yd^3 per year MHTGR: 14,800 yd^3 per year Large ALWR: 14,300 yd^3 per year Small ALWR: 11,600 yd^3 per year APT: 8,640 yd^3 per year Onsite landfill design life would be reduced or require expansion. For tritium recycling phaseout at SRS, 7,800 yd^3 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 collocated tritium supply and recycling facilities, solid sanitary waste generation would increase. The increase over No Action (734 yd^3 per year) would be: HWR: 15,000 yd^3 per year MHTGR: 14,800 yd^3 per year Large ALWR: 14,300 yd^3 per year Small ALWR: 11,600 yd^3 per year APT: 8,640 yd^3 per year Offsite (city of Amarillo) landfill design life would be reduced or require expansion. For tritium recycling phaseout at SRS, 7,800 yd^3 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 collocated tritium supply and upgraded recycling facilities, solid sanitary waste generation would increase. The increase over No Action (80,000 yd^3 per year) would be: HWR: 7,600 yd^3 per year MHTGR: 7,400 yd^3 per year Large ALWR: 6,900 yd^3 per year Small ALWR: 4,200 yd^3 per year APT: 1,240 yd^3 per year Onsite landfill design life would be reduced or require expansion.
• For collocated tritium supply and recycling facilities, other solid nonhazardous waste would be recycled. For tritium recycling phaseout at SRS, 6,800 yd^3 per year decrease in other solid nonhazardous waste at SRS. Decrease in shipments to offsite recyclers.	• For collocated tritium supply and recycling facilities, other solid nonhazardous waste would be recycled. For tritium recycling phaseout at SRS, 6,800 yd^3 per year decrease in other solid nonhazardous waste at SRS. Decrease in shipments to offsite recyclers.	• For collocated tritium supply and recycling facilities, other solid nonhazardous waste would be recycled. For tritium recycling phaseout at SRS, 6,800 yd^3 per year decrease in other solid nonhazardous waste at SRS. Decrease in shipments to offsite recyclers.	• For collocated tritium supply and recycling facilities, other solid nonhazardous waste would be recycled. For tritium recycling phaseout at SRS, 6,800 yd^3 per year decrease in other solid nonhazardous waste at SRS. Decrease in shipments to offsite recyclers.	• For collocated tritium supply and recycling facilities, other solid nonhazardous waste would be recycled. No tritium recycling phaseout.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 44 of 50]

INEL	NTS	ORR	PANTEX	SRS
Waste Management—Tritium Supply Alone				
• For tritium supply alone there would be no change to the impacts for spent nuclear fuel. For tritium recycling upgrade at SRS there would be no change over No Action for spent nuclear fuel.	• For tritium supply alone there would be no change to the impacts for spent nuclear fuel. For tritium recycling upgrade at SRS there would be no change over No Action for spent nuclear fuel.	• For tritium supply alone there would be no change to the impacts for spent nuclear fuel. For tritium recycling upgrade at SRS there would be no change over No Action for spent nuclear fuel.	• For tritium supply alone there would be no change to the impacts for spent nuclear fuel. For tritium recycling upgrade at SRS there would be no change over No Action for spent nuclear fuel.	• No tritium supply alone.
• For tritium supply alone there would be no change to the impacts for liquid LLW. For tritium recycling upgrade at SRS there would be no change over No Action for liquid LLW.	• For tritium supply alone there would be no change to the impacts for liquid LLW. For tritium recycling upgrade at SRS there would be no change over No Action for liquid LLW.	• For tritium supply alone there would be no change to the impacts for liquid LLW. For tritium recycling upgrade at SRS there would be no change over No Action for liquid LLW.	• For tritium supply alone there would be no change to the impacts for liquid LLW. For tritium recycling upgrade at SRS there would be no change over No Action for liquid LLW.	• No tritium supply alone.
• For tritium supply alone solid LLW generation would increase and require additional onsite LLW disposal area. The increase over No Action (5,100 yd^3 per year) and the additional LLW disposal area would be: HWR: 5,200 yd^3 per year - 0.6 acres per year MHTGR: 1,300 yd^3 per year - 0.2 acres per year Large ALWR: 710 yd^3 per year -0.2 acres per year Small ALWR: 660 yd^3 per year -0.08 acres per year APT: 544 yd^3 per year - 0.07 acres per year	• For tritium supply alone solid LLW generation would increase and require additional onsite LLW disposal area. The increase over No Action (42,400 yd^3 per year) and the additional LLW disposal area would be: HWR: 5,200 yd^3 per year - 0.6 acres per year MHTGR: 1,300 yd^3 per year - 0.15 acres per year Large ALWR: 710 yd^3 per year -0.2 acres per year Small ALWR: 660 yd^3 per year -0.09 acres per year APT: 544 yd^3 per year - 0.07 acres per year	• For tritium supply alone solid LLW generation would increase and require additional onsite LLW disposal area. The increase over No Action (9,300 yd^3 per year) and the additional LLW disposal area would be: HWR: 5,200 yd^3 per year - 1.1 acres per year MHTGR: 1,300 yd^3 per year - 0.3 acres per year Large ALWR: 710 yd^3 per year -0.3 acres per year Small ALWR: 660 yd^3 per year -0.2 acres per year APT: 544 yd^3 per year - 0.1 acres per year	• For tritium supply alone solid LLW generation would increase and require additional onsite LLW disposal area. The increase over No Action (25 yd^3 per year) and the additional LLW shipments to NTS would be: HWR: 5,200 yd^3 per year - 86 shipments per year MHTGR: 1,300 yd^3 per year - 22 shipments per year Large ALWR: 710 yd^3 per year -26 shipments per year Small ALWR: 660 yd^3 per year -13 shipments per year APT: 544 yd^3 per year - 10 shipments per year	• No tritium supply alone.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 45 of 50]

INEL	NTS	ORR	PANTEX	SRS
Waste Management—Tritium Supply Alone				
For tritium recycling upgrade at SRS there would be no change over No Action for solid LLW.	For tritium recycling upgrade at SRS there would be no change over No Action for solid LLW.	For tritium recycling upgrade at SRS there would be no change over No Action for solid LLW.	Additional LLW disposal area at NTS would be the same as in NTS tritium supply alone alternatives. For tritium recycling upgrade at SRS there would be no change over No Action for solid LLW.	• No tritium supply alone.
• For tritium supply alone liquid mixed LLW would no longer be generated. For tritium recycling upgrade at SRS there would be no change over No Action for liquid mixed LLW.	• For tritium supply alone liquid mixed LLW would no longer be generated. For tritium recycling upgrade at SRS there would be no change over No Action for liquid mixed LLW.	• For tritium supply alone liquid mixed LLW would no longer be generated. For tritium recycling upgrade at SRS there would be no change over No Action for liquid mixed LLW.	• For tritium supply alone liquid mixed LLW would no longer be generated. For tritium recycling upgrade at SRS there would be no change over No Action for liquid mixed LLW.	• No tritium supply alone.
• For tritium supply alone, solid mixed LLW generation would increase. The increase over No Action (655 yd^3 per year) would be: HWR : 120 yd^3 per year MHTGR: 1 yd^3 per year Large ALWR: 6 yd^3 per year Small ALWR: 6 yd^3 per year APT: 7 yd^3 per year Impacts would remain the same as collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for solid mixed LLW.	• For tritium supply alone, solid mixed LLW generation would increase. The increase over No Action (5,460 yd^3 per year) would be: HWR : 120 yd^3 per year MHTGR: 1 yd^3 per year Large ALWR: 6 yd^3 per year Small ALWR: 6 yd^3 per year APT: 7 yd^3 per year Impacts would remain the same as collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for solid mixed LLW.	• For tritium supply alone, solid mixed LLW generation would increase. The increase over No Action (11,100 yd^3 per year) would be: HWR : 120 yd^3 per year MHTGR: 1 yd^3 per year Large ALWR: 6 yd^3 per year Small ALWR: 6 yd^3 per year APT: 7 yd^3 per year Impacts would remain the same as collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for solid mixed LLW.	• For tritium supply alone, solid mixed LLW generation would increase. The increase over No Action (5 yd^3 per year) would be: HWR : 120 yd^3 per year MHTGR: 1 yd^3 per year Large ALWR: 6 yd^3 per year Small ALWR: 6 yd^3 per year APT: 7 yd^3 per year Impacts would remain the same as collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for solid mixed LLW.	

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 46 of 50]

INEL	NTS	ORR	PANTEX	SRS
Waste Management—Tritium Supply Alone				
• For tritium supply alone, hazardous waste generation would increase. The increase over No Action (308 yd^3 per year) would be: HWR: 40 yd^3 per year MHTGR: 100 yd^3 per year Large ALWR: 35 yd^3 per year Small ALWR: 35 yd^3 per year APT: 3 yd^3 per year Impacts would remain the same as collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for hazardous waste.	• For tritium supply alone, hazardous waste generation would increase. The increase over No Action (20 yd^3 per year) would be: HWR: 40 yd^3 per year MHTGR: 100 yd^3 per year Large ALWR: 35 yd^3 per year Small ALWR: 35 yd^3 per year APT: 3 yd^3 per year Impacts would remain the same as collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for hazardous waste.	• For tritium supply alone, hazardous waste generation would increase. The increase over No Action (1,150 yd^3 per year) would be: HWR: 40 yd^3 per year MHTGR: 100 yd^3 per year Large ALWR: 35 yd^3 per year Small ALWR: 35 yd^3 per year APT: 3 yd^3 per year Impacts would remain the same as collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for hazardous waste.	• For tritium supply alone, hazardous waste generation would increase. The increase over No Action (63 yd^3 per year) would be: HWR: 40 yd^3 per year MHTGR: 100 yd^3 per year Large ALWR: 35 yd^3 per year Small ALWR: 35 yd^3 per year APT: 3 yd^3 per year Impacts would remain the same as collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for hazardous waste.	• No tritium supply alone.
• For tritium supply alone liquid sanitary waste would be generated (245 MGY). Impacts would remain the same as collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for liquid sanitary waste.	• For tritium supply alone liquid sanitary waste would be generated (245 MGY). Impacts would remain the same as collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for liquid sanitary waste.	• For tritium supply alone, liquid sanitary waste generation would increase. The increase over No Action (483 MGY) would be: HWR: 2,350 MGY MHTGR: 1,630 MGY Large ALWR: 6,290 MGY Small ALWR: 2,850 MGY APT: 245 MGY Impacts would remain the same as collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for liquid sanitary waste.	• For tritium supply alone, liquid sanitary waste generation would increase. The increase over No Action (39.9 MGY) would be: HWR: 48 MGY MHTGR: 30 MGY Large ALWR: 90 MGY Small ALWR: 50 MGY APT: 245 MGY Impacts would remain the same as collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for liquid sanitary waste.	• No tritium supply alone.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 47 of 50]

INEL	NTS	ORR	PANTEX	SRS
Waste Management—Tritium Supply Alone				
• For tritium supply alone solid sanitary waste generation would increase. The increase over No Action (68,000 yd^3 per year) would be: HWR: 7,600 yd^3 per year MHTGR: 7,400 yd^3 per year Large ALWR: 6,900 yd^3 per year Small ALWR: 4,200 yd^3 per year APT: 1,240 yd^3 per year Proportionately decreasing impacts to landfill from collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for solid sanitary waste.	• For tritium supply alone solid sanitary waste generation would increase. The increase over No Action (7,000 yd^3 per year) would be: HWR: 7,600 yd^3 per year MHTGR: 7,400 yd^3 per year Large ALWR: 6,900 yd^3 per year Small ALWR: 4,200 yd^3 per year APT: 1,240 yd^3 per year Proportionately decreasing impacts to landfill from collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for solid sanitary waste.	• For tritium supply alone solid sanitary waste generation would increase. The increase over No Action (77,000 yd^3 per year) would be: HWR: 7,600 yd^3 per year MHTGR: 7,400 yd^3 per year Large ALWR: 6,900 yd^3 per year Small ALWR: 4,200 yd^3 per year APT: 1,240 yd^3 per year Proportionately decreasing impacts to landfill from collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for solid sanitary waste.	• For tritium supply alone solid sanitary waste generation would increase. The increase over No Action (734 yd^3 per year) would be: HWR: 7,600 yd^3 per year MHTGR: 7,400 yd^3 per year Large ALWR: 6,900 yd^3 per year Small ALWR: 4,200 yd^3 per year APT: 1,240 yd^3 per year Proportionately decreasing impacts to landfill from collocated tritium supply and recycling. For tritium recycling upgrade at SRS there would be no change over No Action for solid sanitary waste.	• No tritium supply alone.
• For tritium supply alone other solid nonhazardous waste would be recycled. For tritium recycling upgrade at SRS there would be no change over No Action for other solid nonhazardous waste.	• For tritium supply alone other solid nonhazardous waste would be recycled. For tritium recycling upgrade at SRS there would be no change over No Action for other solid nonhazardous waste.	• For tritium supply alone other solid nonhazardous waste would be recycled. For tritium recycling upgrade at SRS there would be no change over No Action for other solid nonhazardous waste.	• For tritium supply alone other solid nonhazardous waste would be recycled. For tritium recycling upgrade at SRS there would be no change over No Action for other solid nonhazardous waste.	• No tritium supply alone.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 48 of 50]

INEL	NTS	ORR	PANTEX	SRS
Intersite Transport—No Action				
• Under No Action negligible tritium transport.	• Under No Action negligible tritium transport.	• Under No Action negligible tritium transport.	• Under No Action the cancer fatalities per year of transporting limited-life components under accident conditions to and from SRS would be $1x10^{-8}$ from radiological affects..	• Under No Action the cancer fatalities per year of transporting limited-life components to/from Pantex is negligible under normal operation. Under accident conditions, the cancer fatalities per year of transporting limited-life components to/from Pantex would be $1.0x10^{-8}$ from radiological affects.
Intersite Transport—Collocated Tritium Supply and Recycling				
• The relative transportation risk of tritium for collocating supply and recycling is 29 percent lower than the existing No Action case for all technologies.	• The relative transportation risk of tritium for collocating supply and recycling is 30 percent lower than the existing No Action case for all technologies.	• The relative transportation risk of tritium for collocating supply and recycling is 13 percent lower than the existing No Action case for all technologies.	• The relative transportation risk of tritium for collocating supply and recycling is 0.	• The relative transportation risk of tritium supply and upgraded recycling is the same as the existing (No Action) case for all technologies.
• The potential cancer fatalities per year for transporting tritiated heavy water for collocated supply and recycling is $3.57x10^{-5}$ for the HWR and $6.63x10^{-6}$ for APT.	• The potential cancer fatalities per year for transporting tritiated heavy water for collocated supply and recycling is $3.57x10^{-5}$ for the HWR and $6.63x10^{-6}$ for APT.	• The potential cancer fatalities per year for transporting tritiated heavy water for collocated supply and recycling is $3.57x10^{-5}$ for the HWR and $6.63x10^{-6}$ for APT.	• The potential cancer fatalities per year for transporting tritiated heavy water for collocated supply and recycling is $3.57x10^{-5}$ for the HWR and $6.63x10^{-6}$ for APT.	• There is no intersite transport of tritiated heavy water, therefore no transport cancer fatalities.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 49 of 50]

INEL	NTS	ORR	PANTEX	SRS
Intersite Transport—Collocated Tritium Supply and Recycling				
• No intersite transport of LLW.	• No intersite transport of LLW.	• No intersite transport of LLW.	• Credible accidents associated with intersite transport of LLW for collocated tritium supply and recycling would result in 5.2×10^{-9} to 3.0×10^{-8} fatal cancers per year from radiological releases and 6.9×10^{-5} to 4.0×10^{-4} fatal cancers per year from non radiological causes. The cancer fatalities year for each technology would be: **Radiological** HWR: 3.0×10^{-8} MHTGR: 8.8×10^{-9} Large ALWR: 1.0×10^{-8} Small ALWR: 5.9×10^{-9} APT: 5.2×10^{-9} **Nonradiological** HWR: 4.0×10^{-4} MHTGR: 1.2×10^{-4} Large ALWR: 1.4×10^{-4} Small ALWR: 7.7×10^{-5} APT: 6.9×10^{-5}	• No intersite transport of LLW.
Intersite Transport—Tritium Supply Alone				
• The risk of transporting new tritium for a tritium supply alone is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	• The risk of transporting new tritium for a tritium supply alone is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	• The risk of transporting new tritium for a tritium supply alone is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	• The risk of transporting new tritium for a tritium supply alone is about 2 percent greater than No Action due to transporting virgin tritium to SRS.	• No tritium supply alone.

TABLE 3.6–1.—*Summary Comparison of Environmental Impacts of Tritium Supply and Recycling Alternatives* [Page 50 of 50]

INEL	NTS	ORR	PANTEX	SRS
Intersite Transport—Tritium Supply Alone				
			• Credible accidents associated with intersite transport of LLW for tritium supply alone would result in 3.3×10^{-9} to 2.8×10^{-8} fatal cancers per year from radiological releases and 4.3×10^{-5} to 3.7×10^{-4} fatal cancers per year from nonradiological releases. The cancer fatalities per year for each technology would be: **Radiological** HWR: 2.8×10^{-8} MHTGR: 7.15×10^{-9} Large ALWR: 8.5×10^{-9} Small ALWR: 4.2×10^{-9} APT: 3.3×10^{-9} **Nonradiological** HWR: 3.7×10^{-4} MHTGR: 9.46×10^{-5} Large ALWR: 1.1×10^{-4} Small ALWR: 5.6×10^{-5} APT: 4.3×10^{-5}	
• The potential cancer fatalities per year for transporting tritiated heavy water for tritium supply alone is 1.4×10^{-5} for the HWR and 6.63×10^{-6} for APT.	• The potential cancer fatalities per year for transporting tritiated heavy water for tritium supply alone is 1.4×10^{-5} for the HWR and 6.63×10^{-6} for APT.	• The potential cancer fatalities per year for transporting tritiated heavy water for tritium supply alone is 1.4×10^{-5} for the HWR and 6.63×10^{-6} for APT.	• The potential cancer fatalities per year for transporting tritiated heavy water for tritium supply alone is 1.4×10^{-5} for the HWR and 6.63×10^{-6} for APT.	
• The annual risk from transporting highly enriched uranium fuel feel material for the HWR and MHTGR alternatives from ORR to INEL is 5.1×10^{-4}.	• The annual risk from transporting highly enriched uranium fuel feel material for the HWR and MHTGR alternatives from ORR to NTS is 5.1×10^{-4}.	• No intersite transport of highly enriched uranium fuel feed material.	• The annual risk from transporting highly enriched uranium fuel feel material for the HWR and MHTGR alternatives from ORR to Pantex is 5.1×10^{-4}.	• The annual risk from transporting highly enriched uranium fuel feel material for the HWR and MHTGR alternatives from ORR to SRS is 5.1×10^{-4}.

TABLE 3.6–2.—*Summary Comparison of Environmental Impacts of the Commercial Light Water Reactor Alternative* [Page 1 of 2]

Advanced Light Water Reactor[a]	Complete Construction of a Commercial Reactor	Purchase Existing Reactor or Single Reactor Irradiation Services	Purchase Irradiation Services – Multiple (2) Reactors
Construction			
• Construction would result in short-term exceedance of 24-hour PM_{10} and TSP standards.	• Construction related air emissions would increase but would be smaller than ALWR and of shorter duration. Emissions would be temporary and would not be expected to significantly affect air quality in the project site area.	• There would be no impacts related to construction from this alternative at the plant site. A new extraction and target fabrication facility would be constructed at SRS. Emissions would be temporary and would not be expected to significantly affect air quality in the project site area.	• There would be no impacts related to construction from this alternative at the plant site. A new extraction and target fabrication facility would be constructed at SRS. Emissions would be temporary and would not be expected to significantly affect air quality in the project site area.
• 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.	• Construction of the extraction facility and target fabrication facility would require 326 worker-years over a 3 year period.	• Construction of the extraction facility and target fabrication facility would require 326 worker-years over a 3 year period.
• 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 average volume of hazardous waste generated from construction of the extraction and target fabrication facilities would be approximately 6 yd^3.	• The annual average volume of hazardous waste generated from construction of the extraction and target fabrication facilities would be approximately 6 yd^3.
Advanced Light Water Reactor[a]	**Complete Construction of a Commercial Reactor**	**Purchase Existing Reactor or Single Reactor Irradiation Services**	**Purchase Radiation Services – Multiple (2) Reactors**
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 tritium production mission to an operating commercial reactor would require no additional water consumption.	• Adding the tritium production mission to an operating commercial reactor would require no additional water consumption.
• Operation would require approximately 830 workers.	• Operation would require approximately 830 workers.	• Operation would require 72 additional workers over the existing plant workforce.	• Operation would require a total of 127 additional workers over the existing plant workforce.
• 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.	• Approximately 137 dry storage assemblies of spent fuel would be generated and: – 160 yd^3 of LLW – no additional mixed waste would be generated.	• Approximately 137 dry storage assemblies of spent fuel would be generated and: – 160 yd^3 of LLW – no additional mixed waste would be generated.

TABLE 3.6–2.—*Summary Comparison of Environmental Impacts of the Commercial Light Water Reactor Alternative* [Page 2 of 2]

• 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 would increase for all personnel by 48 person-rem.	• Worker exposure would increase for all personnel by 48 person-rem.
• 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 would result in the emission of 5,740 curies per year of gaseous tritium and 1,460 curies per year of liquid tritium over the existing plant emissions.	• Tritium production would result in the emission of 3,680 curies per year per reactor of gaseous tritium and 935 curies per year per reactor of liquid tritium over the existing plant 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 releases associated with production of tritium would result in an annual dose increase of 0.5 person-rem to the 50-mile population.	• Radioactive releases associated with production of tritium would result in an annual dose increase of 0.5 person-rem to the 50-mile 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 increase in consequences or risk from accidents is expected.	• No substantial increase in consequences or risk from accidents is expected.

[a] For comparative purposes only, Large ALWR at SRS is presented.

3.7 AGENCY PREFERRED ALTERNATIVE

The Council on Environmental Quality (CEQ) Regulations require an agency to identify its preferred alternative(s) in the Final Environmental Impact Statement (40 CFR 1502.14(e)). The preferred alternative is the alternative which the agency believes would fulfill its statutory mission, giving consideration to environmental, economic, technical, and other 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 and Recycling Technical Reference Report which is available in the appropriate DOE Reading Rooms for public review.

Based upon the analysis presented in the documents identified above, the Department's 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 activities is to remain at the Savannah River Site with appropriate consolidation and upgrading of current facilities, and construction of a new extraction facility.Tritium Supply. Among the new facility alternatives, the accelerator has the highest probability to meet earlier production requirements because of less regulatory uncertainty. It also has the least environmental impact because it does not use fissile material, generates no high-level wastes, and while the risk from a severe accident is very small for all of the alternatives, the risk for the accelerator is the smallest. While all of the components of the accelerator have been proven, the entire system needs to be demonstrated to assure the components work together as a complete system.

If the Department should select the accelerator as its primary production option, the SRS is the preferred site for the new facility because of its existing mission and infrastructure for tritium recycling. The principal discriminator among sites is mission related: of the four sites that have continuing defense missions (NTS, Pantex, ORR, and SRS) only SRS has a current tritium mission and an existing tritium recycling infrastructure. It should be noted that the analysis found all of the sites acceptable for an accelerator from a cost and environmental perspective.

Policy and regulatory issues regarding the use of a commercial reactor(s) must be resolved including, for example, nonprolification and licensing. Since commercial reactors are already constructed and operating, adding the tritium mission to an existing reactor does not significantly increase any existing environmental impact. Using existing commercial reactors appears to offer the least expensive approach.

In light of these uncertainties and the advantages of both alternatives a dual track, proving feasibility of both, is the preferred strategy. After proof of feasibility one alternative would be pursued as the primary means of production. The other alternative, if determined feasible, would be developed to the point where it would provide a fall back alternative or be available to meet increased production requirements at some future time. In any case, tritium targets for a commercial reactor would be developed and qualified to support the use of an existing commercial reactor as a contingency in the event of a national emergency.

The dual track strategy for meeting tritium supply requirements with these two alternatives provides the following advantages:

- Major uncertainties resolved (technical with accelerator, policy and regulatory for the commercial reactor, cost for both)

over the next three years, before selection of the primary alternative;

- For a new facility, lowest estimated environmental impacts for an accelerator and minor increase in environmental impact for an operating commercial reactor;

- Lessens programmatic risk by

  – providing fall back through use of two technically different and independent alternatives in the event either alternative develops significant problems,

  – providing proven independent capability to increase production,

  – developing and protecting the ability to support a contingency in the event of a national emergency,

  – selecting a strategy providing for production alternatives that include the greatest probability to meet earlier production requirements (accelerator), and the least cost option (irradiation services);

- Preserves an option for simultaneous reactor "burning" of excess weapons plutonium, if the Storage and Disposition of Weapons - Usable Fissile Materials Record of Decision selects reactor burning of that material.

Tritium Recycling. Analysis of siting for the tritium recycling and extraction facilities led to the conclusion that keeping both of these functions at the SRS provides both lowest cost and least environmental impact. Therefore, both of these functions remain at the SRS with appropriate consolidation and upgrading of current recycling facilities, and a new extraction facility.

CHAPTER 4

Chapter 4

CHAPTER 4: AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

Chapter 4 describes the affected environment and the environmental impacts associated with construction and operation of tritium supply and recycling alternatives. The chapter begins with a brief introduction, followed by an overview of applicable environmental assessment methodologies. The affected environment and environmental impacts of tritium supply and recycling facilities are then discussed for each of the following sites: the Idaho National Engineering Laboratory, Nevada Test Site, Oak Ridge Reservation, Pantex Plant, and Savannah River Site. Each discussion begins with a brief site description and overview of the tritium supply technologies and recycling facilities being considered for that site, continues with a description of the affected environment at the site, and concludes with a description of environmental impacts and potential mitigation of each alternative. The commercial reactor alternative affected environment and potential environmental impacts are discussed in a section by itself. Following the sections that address individual sites are discussions of potential impacts from intersite transportation, sale of steam, power plant for the Accelerator Production of Tritium, and multipurpose reactor. Lastly, this section discusses cumulative impacts and several issues that are common to all sites: unavoidable adverse environmental impacts; relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; irreversible and irretrievable commitments of resources; facility transition; and environmental justice.

Discussions of the environment that may be affected at each candidate site, and the associated environmental impacts that would result from the proposed action make up the core of this chapter. In accordance with Council on Environmental Quality (CEQ) regulations (40 CFR 1508.14), the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." The environmental impacts sections provide the analytical basis for the comparisons of potential impacts of the various tritium supply technologies and recycling facilities and No Action that are presented in chapter 3.

Affected Environment. The descriptions of the affected environment provide a basis for understanding the direct, indirect, and cumulative effects of the proposed action and alternatives. The localities and characteristics of each potentially affected environmental resource are described for each site. The scope of the discussions varies by resource to ensure that all relevant issues are included.

For land resources, geology and soils, biotic resources, and cultural and paleontological resources, discussions of each Department of Energy (DOE) site and its surroundings are included along with descriptions of the representative area within that site that could be affected by the proposed action. This information provides a basis for understanding both direct effects and the overall resource base that could be affected by ancillary activities that may be defined in later stages of program development.

Ambient conditions are described for air, noise, and water resources. Discussions focus on air and noise conditions at site boundaries and the surface water bodies and groundwater aquifers that could be affected. This information serves as a basis for analyzing key air and water quality parameters to obtain results that can then be compared to regulatory standards.

Socioeconomic conditions are described for the counties and communities that could be affected by regional population changes associated with the proposed tritium supply technologies and recycling facilities. The affected environment discussions include projections of regional growth and related socioeconomic indicators. Each region is large enough to account for growth related to direct project

employment as well as secondary jobs that may be induced by the project.

In addition to those natural and human environmental resources discussed above, the affected environment sections include a number of issues related to ongoing DOE activities at each site. These issues involve facility operations/site infrastructure, intersite transport of tritium, waste management, and radiological and hazardous chemical impacts during normal operation and accidents. Where reasonably foreseeable changes to any of these factors can be predicted, they are discussed.

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 *National Environmental Policy Act* of 1969 (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 appendixes. 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 4.6) that follow.

The site-specific impacts to site infrastructure, air quality, water resources, biotic resources, socioeconomics, and waste management of a conceptual dedicated gas-fired power plant to support the Accelerator Production of Tritium (APT) is also presented in sections 4.2 through 4.6.

4.1 Environmental Resource Methodologies

The environmental impact assessment methodologies discussed in this section address the full range of natural and human resource and issue areas pertinent to the sites considered for constructing and operating tritium supply and recycling facilities. These resource areas are: land resources, air quality and acoustics, water resources, geology and soils, biotic resources, cultural and paleontological resources, and socioeconomics. Also included in the discussion are additional issue areas that, although not specifically resources, are important to consider in assessing the environmental effects of the alternative tritium facilities. These issue areas are facilities operation/site infrastructure, intersite transport of tritium, waste management, radiological and hazardous chemical effects during normal operation and accidents, and cumulative effects.

As part of the impact assessment process, each analysis provides mitigation measures that could be used to reduce and minimize potential impacts. Detailed mitigation strategies that might be needed would be addressed in site-specific tiered NEPA documents.

4.1.1 Land Resources

This section considers land use plans and policies, zoning regulations, specially protected lands, and existing land use as appropriate for all sites. In addition, the visual character of each site is described. The potential impacts associated with changes to land use and visual resources as a result of the alternatives are discussed.

Land Use. Land use changes associated with the tritium supply technologies and recycling facilities could occur in both rural and urban settings and could affect both developed and undeveloped land. The analysis of land use considers impacts that could result from the modification of existing facilities or the construction of new facilities on or adjacent to each site. Changes in land use are expected to occur within the existing boundaries of most, if not all, DOE sites. However, the use of lands adjacent to or in the vicinity of the DOE sites (i.e., non-DOE land) could be affected by these changes, including new or expanded safety zones.

The degree to which the alternatives affect future use or development of land at each DOE site are considered. Land use impacts are assessed based on the extent and type of land that would be affected. The land use analysis also considers potential direct impacts resulting from the conversion of, or the incompatibility of, land use changes with special status lands such as prime and unique farmlands, and other protected lands such as Federal- and state-controlled lands (e.g., public land administered by the Bureau of Land Management or other government agencies).

Visual Resources. Visual resources are defined as natural and human-created features that give a particular landscape its visually aesthetic qualities. Visual resource assessments are conducted to identify and evaluate the impacts on the aesthetics of the landscape from tritium supply technologies and recycling facilities. 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 those changes would be.

The qualitative visual resource analysis, adapted from the Bureau of Land Management's *Visual Contrast Rating System* (BLM Manual 8431), is conducted to: identify key viewing positions, such as public travel routes, nearby residential/commercial areas, and public uses such as parks, recreation areas, and scenic areas; assess the degree of visibility of new or modified facilities from these key viewing positions; and assess the compatibility of such facilities with the existing physical setting. Classification of the physical settings, existing and modified, for each proposed site was based on the Bureau of Land Management Visual Resource Management (VRM) classes. Class 1 would apply to wilderness areas and similar situations; Class 2 would apply to areas with very limited land development activity resulting in visual contrasts which do not attract attention, such as solitary small buildings or dirt roads; Class 3 would apply to areas where contrasts caused by development activity are evident, but the natural landscape still dominates buildings, utility lines, and secondary roads; Class 4 would apply to areas where contrasts caused by human activities attract attention and are a dominant feature of the landscape, such as a small cluster of two-story buildings, primary roads, and limited clear cutting for utility lines. Class 5 would apply to areas where contrasts caused by cultural activities are the dominant feature of the landscape, such as large industrial/office complexes, landfills, and large expanses of clear cutting or ground disturbance. The analysis provides a qualitative comparison of the characteristics of the existing landscape with those of the proposed facilities and a determination of the resulting level of contrast. Facility characteristics examined include buildings, stacks, access roads, parking areas, facility and perimeter lighting, and steam and emission plumes. Impacts are assessed based on the sensitivity of the affected environment to changes in its visual character. Sensitivity is assessed based on the potential for public concern regarding adverse effects on specific views within the affected environment. More detailed analysis of visual impacts would be conducted in site-specific tiered NEPA documents.

4.1.2 Site Infrastructure

Changes to site infrastructure are assessed by overlying the support requirements of the respective tritium supply technologies and recycling facilities upon the projected site infrastructure capacities. These assessments focus upon power requirements, road networks, rail interfaces, and fuel requirements. Projections of electricity availability, site development plans, and other DOE mid- and long-range planning documents are utilized to project site infrastructure conditions. Tables are presented that depict the additional infrastructure requirements to be generated by the alternatives. Mitigation considerations are identified that could reduce impacts due to changes in infrastructure on a site-by-site basis.

Detailed assessments of the tritium facilities' electrical power requirements in the 2010 time-frame are not considered practical. Electric utilities would not be expected to reliably project how they would meet the needs of these facilities (i.e., whether by new power generation, power imports, or demand side management). Therefore, the basis for this PEIS assessment is the supply and demand projections of the U.S. electric utilities published annually by the North American Electric Reliability Council.

For purposes of analysis, electricity generation is based on the assumption that electricity would be supplied by the power pool currently supplying the facility in question by using a mix of fuels and gen-

erating sources representative of those projected. These data are used to determine whether or not there would be enough reserve margin within a particular power pool to accommodate electrical requirements, or whether additional power is required. A detailed quantitative analysis, based on the proportional contributions from each fuel source, would be conducted in site-specific tiered NEPA documents.

Two of the technologies in question, specifically the Modular High Temperature Gas-Cooled Reactor (MHTGR) and the Advanced Light Water Reactor (ALWR), have the ability to produce electricity from steam as well as tritium. The environmental effects of this steam production is included in the analysis of the basic technologies since designs of these reactors include steam turbines for electrical production. The environmental impacts of additional power line construction to distribute this electrical production to the grid are not addressed in detail for each site but are discussed in general in section 4.8.1.

The electricity required for the APT would be provided by the power pool which services each site or a dedicated power plant. The environmental effects of each option are included in the analysis. A separate cost analysis of buying this power versus the option of building a dedicated power plant to provide it is considered in the cost study being prepared to support the Record of Decision (ROD).

4.1.3 Air Quality and Acoustics

Potential effects on the environment associated with air pollutant emissions and noise from normal operations are evaluated for tritium supply technologies and recycling facilities. The assessment of air quality and acoustic impacts includes identification of applicable criteria for assessing impacts, the development of emission inventories, and the estimation of air pollutant concentrations. The assessment of impacts is based on the estimated concentrations, data on the existing environment, and assessment criteria. Human health effects due to air pollutant emissions are discussed in a separate section and include consideration of airborne radioactive chemical releases.

Air Quality. The assessment of potential impacts to air quality is based on the 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 for particulate matter of aerodynamic diameter less than 10 micrometers, sulfur dioxide, or nitrogen dioxide.

Assessment criteria for pollutants include the Environmental Protection Agency (EPA) primary and secondary ambient air quality standards for criteria pollutants and those established by each state. The more stringent of either the EPA or state standards serve as the assessment criteria. The assessment criteria for toxic pollutants include guidelines or standards adopted or proposed by each state.

Ambient air monitoring data are used to determine maximum background concentrations of pollutants for each DOE site. Baseline concentrations of pollutants from DOE sites are calculated by modeling site emissions during the baseline year and adding to these calculated concentrations the maximum background concentration for a given pollutant and averaging time. The baseline concentration is a conservative estimate of pollutant concentrations at each DOE site during a period considered representative of recent site activity.

No Action concentrations of pollutants from DOE site emissions are calculated by modeling projected site emissions for 2010 and adding to these calculated concentrations the maximum background concentration for a given pollutant and averaging time. Both the baseline and No Action concentrations are compared to applicable Federal and state standards for criteria pollutants and state guidelines and regulations for air toxics to provide an estimate of the potential effects on air quality.

Pollutant concentrations associated with tritium supply technologies and recycling facilities are added to the No Action concentration. These pollutant concentrations are then compared to applicable Federal and state guidelines or standards.

Modeling of site-specific emissions using the EPA-recommended Industrial Source Complex Short-Term model was performed in accordance with the EPA's *Guideline on Air Quality Models* (EPA-450/2-78-027R). The air quality modeling analysis performed for the candidate sites is a "screening level" analysis incorporating conservative assumptions applied to each of the sites such that the impacts

associated with the respective alternatives could be compared among the sites. These conservative assumptions will overestimate the pollutant concentrations at each of the sites.

The assumptions incorporated into the air quality modeling at each site are as follows: major source criteria pollutant emissions were modeled using actual source locations and stack parameters to determine environmental baseline and No Action criteria pollutant concentrations; toxic/hazardous pollutant emissions were modeled from a single source centrally located within the complex of facilities on each site assuming a 10 meter stack height, a stack diameter of 1 foot, stack exit temperature equal to ambient temperature, and a stack exit velocity equal to 0.01 meters per second.

Emissions from the tritium supply and recycling facilities were located at the tritium supply site (TSS) identified for each site assuming a single stack 10 meters in height, a stack diameter of 1 foot, stack exit temperature equal to ambient temperature, and stack exit velocity equal to 0.01 meters per second. Onsite and/or representative National Weather Service meteorological data is used to define the dispersion characteristics of the site. Actual terrain heights are used for those sites not considered "flat." The potential effects on air quality are described by comparing expected concentrations to air quality standards.

Acoustics. Acoustic impacts are assessed on the basis of the potential degree of change in noise levels at sensitive receptors (i.e., residences near the DOE site boundary) with respect to ambient conditions. Most nontraffic noise sources associated with the five candidate site facilities are located at sufficient distances from offsite noise-sensitive receptors that the contribution to offsite noise levels is expected to be small. Therefore, a qualitative discussion of construction and operation noise sources and the potential for onsite and offsite noise impacts is provided. The analysis uses available information on the potential types of noise sources and the location of proposed alternative facilities relative to the site boundary and noise-sensitive locations. The potential for exposure of workers to noise and the measures taken to protect worker hearing are included. Quantitative analysis of noise impacts is deferred to the site-specific tiered NEPA documents, including noise impacts associated with traffic.

Uncertainties. The performance of the Industrial Source Complex Short-Term model has not been validated with field data. However, the performance of the Industrial Source Complex Short-Term model has been evaluated with field data for its point source submodel (EPA 1977a; EPRI 1983a; EPRI 1985a; EPRI 1988a) and for its special features, such as gravitational settling/dry deposition option (EPA 1981a; EPA 1982a) and building downwash option (APCA 1986a; EPA 1981a). The Industrial Source Complex Short-Term model is an extended version of the Single Source (CRSTER) model. From the validation studies for the Single Source (CRSTER) model, based on field data measured at four large power plants, it was concluded that the model acceptably predicts the upper percentile of the frequency distributions of 1-hour concentrations and of the corresponding distributions of 24-hour concentrations. The second-highest 1-hour concentrations were predicted within a factor of 2 at two-thirds of the field sampling sites for elevated power plant plumes. The second-highest 24-hour concentration tended to be underpredicted by the model, with the ratio of predicted concentration to measured concentration ranging from about 0.2 to 2.7 at about 90 percent of the sampling sites (EPA 1977a:F-31).

In other validation studies for the point source model, the CRSTER model predicted peak short-term (1-,3-, and 24-hour) concentration values within 30 to 70 percent at a plain site (EPRI 1983a:7-1). The CRSTER model predicted peak 1-hour concentrations within 2 percent and underpredicted peak 3-hour concentrations by about 30 percent at a moderately complex terrain site (EPRI 1985a:7-1). The Industrial Source Complex Short-Term model overpredicted 1-hour concentrations by about 60 percent with better predictions for longer time periods at an urban site (EPRI 1988a:5-2). Uses of gravitational settling/dry deposition and building downwash options were found to improve the model performance significantly over that of the model without such features (APCA 1986a; EPA 1981a; EPA 1982a).

The concentrations presented in this document are the highest concentrations predicted by the model in

order to present conservative estimates of pollutant concentrations.

4.1.4 Water Resources

The quality and quantity of surface water and groundwater resources are described using available data. Potential effects on surface water and groundwater availability and quality are assessed.

Surface Water. Local surface water resources in the project region, flow characteristics and relationships, and stream classifications are used to describe current conditions. Data used for impact assessments include rates of water consumption and wastewater discharge for both construction and operation phases. Changes in the annual low flows of surface water resulting from proposed withdrawals and discharges are determined. In cases where low flow data are unavailable, average flow data are used. 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 water quality of potentially affected receiving waters is determined by reviewing current monitoring data for nonradiological parameters. Potential impacts from radiological parameters are discussed in the radiological and hazardous chemical impacts during normal operation and accidents section. Focus is given to parameters that exceed applicable water quality criteria, as determined by the individual states. Monitoring reports for discharges permitted under the National Pollutant Discharge Elimination System (NPDES) program are examined for compliance with permit limits and requirements. The performance of each candidate DOE site in complying with the permit requirements is presented. In most cases, current design data do not include information on the constituents present or the rate of discharge. The assessment of water quality impacts from wastewater (sanitary and process) and stormwater runoff qualitatively addresses potential impacts to the receiving waters' minimum or average flow, as available and appropriate. Suitable mitigation measures for potential impacts such as stream channel erosion and sedimentation, stream bank flooding, and thermal impacts are identified. Water quality management practices are also reviewed. If effluent constituent data are available, parameters with the potential to further degrade existing receiving water quality along with parameters exceeding existing NPDES permit limits are identified.

Floodplains are identified to determine 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. Where these data are unavailable, potential impacts associated with the 500-year floodplain are addressed in terms of design and siting mitigation measures. Specific facility locations will be addressed in site-specific tiered NEPA documents.

Groundwater. Groundwater resources are analyzed for effects on aquifers, groundwater usage, and groundwater quality within the regions. Groundwater resources are defined as the aquifers underlying the site and their extensions down the hydraulic gradients to, and including, discharge points and/or the first major users. The affected environment discussion includes a description of the potentially affected groundwater basins. The local aquifers are described in terms of the extent, thicknesses, character of rock formations, and quality of the groundwater. Recharge areas are also noted. Total baseline groundwater use at the facility is compiled using the best available data. Groundwater usage is described and projections of future usage are made based on changing patterns of usage and anticipated growth patterns, whenever site-specific groundwater availability issues are identified.

Drawdown estimates are made both onsite and offsite. Short- and long-term impacts associated with construction withdrawals and dewatering are estimated. Both proposed facilities and existing facilities are considered in determining cumulative impacts.

Available data on existing groundwater quality conditions are compared to Federal and state groundwater quality standards, effluent limitations, and safe drinking water standards. Additionally, Federal and state permitting requirements for groundwater withdrawal and discharge are identified. Impacts of groundwater withdrawals on existing contaminant plumes because of construction and facility operation

are assessed to determine the potential for changes in their rates of migration and the effects of any changes in the plumes on groundwater users. Impacts are assessed by the degree to which groundwater quality, drawdown of groundwater levels, and groundwater availability to other users would be affected. Impacts on groundwater quality are presented when effluent constituent data are available.

4.1.5 Geology and Soils

Geology. Impacts to the geological environment considers destruction of or damage to unique geological features, subsidence caused by groundwater withdrawal, and landslides or shifting caused by loading or removal of supporting rock or soil. The local geology that could affect the alternatives including geomorphology, stratigraphy, structural attitude of rocks, faults and seismicity, general foundation, and boring conditions are described as appropriate for each candidate site. The locations of capable faults are identified and an overview of the seismicity of the site areas, including the history and significance of earthquakes, along with their intensity and ground acceleration, is presented. Areas of potentially unstable slopes and impacts to the stability of slopes by the removal or addition of large volumes of earth in construction are characterized.

Soils. Soil types at the proposed project sites are described and the capability of supporting construction of the proposed facilities assessed. Shrinking or swelling of ground as a result of landscaping, irrigation, or construction dewatering and soil erosion susceptibility associated with construction is also addressed.

4.1.6 Biotic Resources

Potential impacts to biotic resources are addressed for the following categories: terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. During construction, impacts may result from land-clearing activities, erosion and sedimentation, human disturbance and noise, and dewatering of foundations. Operation may affect biotic resources as a result of changes in land use, emission of salt drift (residual salts left behind as a result of the evaporation of cooling tower water) or radionuclides, water withdrawal, wastewater discharge, and human disturbance and noise. In general, the potential impacts are assessed based on the degree to which various habitats or species could be affected by the project. Where appropriate, impacts are evaluated with respect to Federal and state protection regulations and standards.

Terrestrial Resources. Potential impacts to terrestrial resources include loss and disturbance of wildlife and wildlife habitats as well as exposure of flora and fauna to emissions of salt drift. Two considerations in assessing the impact of habitat loss are the presence and regional importance of affected habitats, and size of habitat area to be temporarily disturbed by construction activities and permanently disturbed during the operational phase. The loss of important or sensitive habitats is considered more important than the loss of a regionally abundant type. Impacts to wildlife are based to a large extent on plant community loss, which is closely associated with animal habitat. Also evaluated is the disturbance, displacement, or loss of wildlife in accordance with wildlife protection laws such as the *Migratory Bird Treaty Act* and *Bald and Golden Eagle Protection Act.* Cooling tower deposition rates are not calculated; however, potential effects of salt drift are addressed in a qualitative manner.

Very small concentrations of radionuclides would be released into the atmosphere during operation of the proposed tritium supply and recycling facilities. These releases, when added to those associated with other site activities, would be well below natural background levels and would also be within regulatory limits established to protect workers and the public. Since humans have been shown to be the most sensitive organism to radiation, these levels should also be protective of biota (AEC 1968a:220; NAS 1972a:34). Studies conducted at Idaho National Engineering Laboratory (INEL) have detected sublethal effects in individual animals at contaminated areas; however, no population or community-level impacts resulting from radionuclides have been identified. Monitoring of radionuclide levels outside the boundaries of various INEL facilities and off the INEL site has detected radionuclide concentrations above background levels in individual plants and animals, but the data suggest that the exposed populations are not at risk (DOE 1995v: 4.9-6,4.9-7). Thus, based on expected releases and the results of past studies, impacts of radionuclides on site biota were not evaluated.

Impacts to biota from hazardous chemicals during normal operations are unlikely since all hazardous and toxic materials will be handled, stored, transported, and disposed of in accordance with the requirements of the *Resource Conservation and Recovery Act* (RCRA). Thus, since biota are unlikely to be exposed to hazardous chemicals, impacts are not discussed.

Wetlands. Most construction impacts on wetlands are related to displacement of wetlands by filling, draining, or clearing activities. Other impacts could potentially occur from construction activities conducted outside of wetland areas. Operational impacts to wetlands may occur from effluents, surface or groundwater withdrawals, or creation of new wetlands. Wetlands on each candidate site are identified using best available published information such as Federal and state wetland reports, National Wetland Inventory maps, aerial photographs, and topographic maps.

The direct loss of wetlands resulting from construction and operation is addressed in a similar fashion as for terrestrial plant communities, by comparing data on site wetlands to proposed land requirements. Sedimentation impacts are evaluated based on the nearness of wetlands to project areas and with the knowledge that standard construction erosion and sedimentation control measures would be implemented. Impacts resulting from increased flows are evaluated based on a comparison of expected discharge rates with present stream flow rates. Impacts resulting from the introduction of thermal and chemical pollution into a wetland system are evaluated recognizing that effluents will be required to meet Federal and state standards.

Aquatic Resources. Aquatic resources could be impacted as a result of sedimentation, increased flows, effluent discharge, impingement, and entrainment. Impacts to aquatic resources, such as loss of spawning habitat resulting from sedimentation, increased flows, and the introduction of waste heat and chemicals, are evaluated as described for wetlands.

Impingement and entrainment impacts are evaluated based on a comparison of stream flow and intake volumes, recognizing that when intake volumes represent a large percentage of stream flow, the possibility of impingement and entrainment impacts exists. Compliance with protective measures, such as the *Anadromous Fish Protection Act*, are addressed.

Although aquatic species could be exposed to radionuclides from cooling tower blowdown at wet sites, previous studies of a proposed tritium reactor at the Savannah River Site (SRS) that was larger than the proposed current design have shown that calculated doses were well below limits established by DOE Order 5400.5, *Radiation Protection of the Public and the Environment* for the protection of aquatic organisms (DOE 1992e:5-220). Although impacts to aquatic life are unlikely based on the conservative nature of the calculations and the size difference between the previous and current reactor designs, further assessments may be required in site-specific NEPA documentation.

Threatened and Endangered Species. Impacts to threatened and endangered species of wildlife and plants, including critical habitat, state-listed species, and species proposed for listing, are determined. A list of species potentially present on each site is developed using information obtained from the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service, and appropriate state agencies. This list, along with site environmental and engineering data, is used to evaluate whether the various tritium supply technologies and recycling facilities would impact any plant or animal (or its habitat). Impacts are determined in a manner similar to that described for terrestrial and aquatic resources since the sources of potential impacts are similar.

Uncertainties. Due to the nature of this *Programmatic Environmental Impact Statement* (PEIS), a number of factors which may impact biotic resources are not known with certainty. These include site location, placement and performance of wet cooling towers, routing of rights-of-way, and wastewater discharge characteristics and location. Each of these factors introduced uncertainties in the analysis of impacts to biotic resources. For example, not knowing the exact location of the proposed tritium supply site (TSS) prevents an exact analysis of impacts on terrestrial habitat and wetlands, as well as threatened and endangered species. When more information becomes available as this PEIS project planning progresses, analyses presented in tiered

NEPA documentation at a selected site will not be so limited by uncertainties.

4.1.7 Cultural and Paleontological Resources

Included in these sections are evaluations of the impacts of the tritium supply technologies and recycling facilities on prehistoric, historic, Native American, and paleontological resources. The effects considered include those resulting directly from land disturbance during construction, visual intrusion to the settings or environmental context of historic structures, visual and audio intrusions on Native American sacred sites, reduced access to Native American traditional use areas, unauthorized artifact collecting, and vandalism.

Prehistoric Resources. Prehistoric resources are physical properties resulting from human activities that predate written records. They are generally identified as either isolated artifacts or sites. Sites may contain concentrations of artifacts (e.g., stone tools and ceramic sherds), features (e.g., campfires and houses), and plant and animal remains. Depending on their age, complexity, integrity, and relationship to one another, sites may be important for and capable of yielding information about past populations and adaptive strategies. The affected environment section for prehistoric resources includes a brief overview of the number and types of prehistoric sites in the project areas, if known, and their status on both the National Register of Historic Places (NRHP) and appropriate state registers. The overview consists of a summary of existing information about prehistoric resources in the region and a discussion of types of sites that are likely to occur.

Impact assessments for prehistoric resources focus mainly on those properties likely to be eligible for the NRHP. Impacts are assessed by considering whether the proposed action could substantially add to existing disturbance of resources in the project areas, adversely affect NRHP-eligible resources, or cause loss of or destruction to important prehistoric resources.

Historic Resources. Historic resources consist of physical properties that postdate the existence of written records. Historic resources include architectural structures (e.g., buildings, dams, and bridges) and archaeological features (e.g., foundations, trails, and trash dumps). Ordinarily, sites less than 50 years old are not considered historic for analytical purposes, but exceptions can be made for younger properties if they are of exceptional importance; i.e., structures associated with World War II, the Manhattan Project, or Cold War themes (36 CFR 60.4). The affected environment section for historic resources includes a brief overview, the number and types of historic sites in the project areas, if known, and their status on both the NRHP and appropriate state registers. The overview consists of a summary of existing information about historic resources in the region and a discussion of the types of sites that likely exist.

Impact assessments for historic resources focus mainly on those properties likely to be eligible for the NRHP. Impacts are assessed by considering whether the proposed action could substantially add to existing disturbance of resources in the project areas, could adversely affect NRHP-eligible resources, or could cause loss of or destruction to important historic resources.

Native American Resources. Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various Native American groups. Of primary concern are concepts of sacred space that create the potential for land use conflicts. Native American concerns would be identified through direct consultation with tribal representatives and field visits with tribal religious specialists during site-specific tiered NEPA documents. Contacts will be identified by reference to the ethnographic literature, by state and national pantribal organizations, and by agency and academic anthropologists.

The individual resource type, the proximity of impact areas to the resources, and the likely duration of impacts are considered in the analysis of Native American resources. Specific concerns include the relative importance of the resource in the Native American physical universe or belief system; the distance at which activities in the vicinity of a sacred area constitute a disturbance; the extent to which affected resources may be restored; and the extent to which alternative sources for raw materials are available and/or suitable. Impacts to Native

American resources are assessed by considering whether the proposed action 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. Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age. They include casts, molds, and trace fossils such as burrows or tracks. Fossil localities typically include surface outcrops, areas where subsurface deposits are exposed by ground disturbance, and special environments favoring preservation, such as caves, peat bogs, and tar pits. Paleontological resources are important mainly for their potential to provide scientific information on paleoenvironments and the evolutionary history of plants and animals. The affected environment section for paleontological resources includes a description of known paleontological localities and geological formations in the project areas that may be fossil bearing.

Impact assessments for paleontological resources are based on the numbers and kinds of resources that could be affected as well as the quality of fossil preservation in a given deposit, particularly in deposits with high research potential. Such deposits include poorly known fossil forms; well-preserved terrestrial vertebrates; unusual depositional contexts; assemblages containing a variety of fossil forms, particularly associations of vertebrates, invertebrates, and plants; or deposits recovered from poorly studied regions or in unusual concentrations.

4.1.8 Socioeconomics

Potential impacts are assessed for local and regional socioeconomic conditions and factors including population, employment, economy, housing, public finance, and transportation. This PEIS assesses the socioeconomic impacts of both the gains and losses of missions at each site. Geographically, the potential for socioeconomic effects is greatest in those local jurisdictions immediately adjacent to each site and those that are the residential locations of the majority of DOE site employees. A region of influence (ROI), comprised of those local jurisdictions likely to experience the greatest socioeconomic impacts, is defined for each site. The ROI is defined as those areas where approximately 90 percent of the current DOE and contractor employees reside. The evaluation of impacts 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 2030 because it is assumed that after 2030 the impacts associated with the alternatives are negligibly different from the 2030 conditions. The following sections discuss each of the socioeconomic conditions and factors considered.

Employment. The construction and operation of tritium supply technologies and recycling facilities could affect employment at DOE sites. Changes in site employment would, in turn, directly affect local and regional populations, economies, housing, public finance, and transportation. Current employment at each site is described as well as projected employment associated with other planned DOE initiatives. Socioeconomic trends and the relationship of site employment to these trends are examined for each potentially affected socioeconomic region. Emphasis is placed on evaluating total direct and indirect employment changes and impacts associated with potential mission relocations.

Economy. The regional economies surrounding each site are characterized. Emphasis is placed on the measurement of the relative contribution and importance of each site's employment payroll and purchases to the economy. Changes to local economic conditions are evaluated based on each site's relative contribution and changes to employment. Emphasis is placed on the economic effects of mission changes associated with the tritium supply technologies and recycling facilities.

Population. The demographic changes in the regions surrounding each site are described and assessed. Demographic characteristics are presented for the site's ROI to support the assessment of socioeconomic impacts. Trends are identified and used to project demographic changes over the environmental baseline period. Cumulative population impacts include the population impacts of other DOE actions under consideration, including planned environmental restoration activities.

Housing. Changes in employment at each site would affect the demand and supply of housing units,

including the need for temporary housing (e.g., rental units) to support in-migrating construction workers. Trends in the housing availability within each site's socioeconomic ROI are characterized and evaluated. Numbers of in-migrating and out-migrating site employees associated with each of the tritium facility alternatives are then used to evaluate housing impacts.

Public Finance. Each site is located on land owned by the Federal government; this exempts these lands from state and local taxation. However, all employee income, property, and purchases are subject to applicable Federal, state, and local taxation requirements.

Changes in community finances as a result of the alternatives could affect the community's need and ability to provide community infrastructure and services that include utility, water, and sewage facilities, as well as education, health care, and police and fire protection. The fiscal impacts of the alternatives on the counties, cities, and school districts within the site's ROI are assessed.

Local Transportation. The transportation systems in the region surrounding each site, including roads and highways, rail systems, and airports, are characterized. Major planned improvements to regional transportation systems are identified as part of the environmental baseline characterization. Changes in site employment associated with the alternatives are used to identify potential impacts to the existing traffic conditions at each site.

4.1.9 Radiation and Hazardous Chemical Environment

Nuclear facilities use a broad variety of processes involving both radioactive and chemical materials that can be hazardous to people who may be exposed to them. The degree of hazard is directly related to the type and quantity of the particular radioactive or chemical material to which the person may be exposed. The health effects are determined for tritium supply and recycling facilities by identifying the types and quantities of material to which one is exposed, estimating doses, and then calculating the resultant health effects.

The impacts on human health for workers and the public during normal operation and postulated accidents from the various alternatives are assessed. Models are used to project the impacts on the health of workers and the public due to normal operation and postulated accidents. These models include: GENII and Melcor Accident Consequence Code System (MACCS) for airborne and liquid radioactive releases; CHEM-PLUS for fire and explosions; and ISCST for hazardous chemical releases. Atmospheric dispersion modeling performed for the air quality section is also utilized in the evaluation of impacts to workers from radiological and hazardous chemicals.

Health Impacts on Plant Workers During Normal Operation. Because radiation workers are individually monitored, experience from past and current operation that are similar to future operation are used to estimate the radiological health impacts to workers. Health impacts from chemicals are discussed qualitatively. There are no individual exposure data on workers for chemicals; therefore, models are used to estimate the worker's chemical exposure dose.

General Health Impacts on the Public During Normal Operation. Public health impacts could result from exposure to radioactive or hazardous chemical materials released during operation. The effect is the sum of internal exposure resulting from breathing air, eating food, and drinking water. External exposure could be from standing on contaminated ground, being exposed to the air, and being submerged in water.

Modeling is used to estimate the type and amount of material released and the associated radiological and chemical doses. These doses are converted to health effects using appropriate health risk estimators.

Epidemiological Studies. In March 1990, the Secretary of Energy announced that DOE would turn over responsibility to the Department of Health and Human Services for analytical epidemiologic research on long-term health effects on workers at DOE facilities and the public in surrounding communities. Further, DOE directed that this worker and public health and exposure data be released. A Memorandum of Agreement with the Department of Health and Human Services was signed in January 1991. The Department of Health and Human Services is now conducting the ongoing health

effects research program. The National Institute for Occupational Safety and Health also initiated a study in 1994 but does not expect the results before 1997.

Emergency Preparedness. Emergency preparedness and planning has the effect of mitigating the consequences of facility accidents. Emergency preparedness plans exist for all sites and are summarized for each site.

Accident Analysis for Postulated Accident Scenarios. The relative consequences of postulated accidents in the evaluation of each alternative are considered. In evaluating the magnitude and consequences of each alternative, a suitable accident analysis is performed to produce results for decision-making purposes. Although the concepts used are analogous to a formal Probabilistic Risk Assessment, which would be appropriate for a project-level analysis, the accident analysis involves considerably less detail and only addresses a representative spectrum of beyond design-basis 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 which recommends consideration of two major categories of accidents: within design-basis accidents and beyond design-basis accidents.

For the purpose of this assessment, risk is defined as the mathematical product of the probability and consequences of an accident. Both probability and consequences are presented in this PEIS. The risk-contributing scenarios consider both design-basis and severe accidents. The specific accidents consider the types of facilities. Examples of accidents include those resulting from operator errors, spills, criticality, fire, explosions, airplane crash, common-cause failures, collocated facilities, severe weather, earthquakes, and transportation. Information on potential accidents includes those that have been postulated and analyzed for similar facilities. The risks of the various tritium supply technologies and recycling facilities are evaluated in terms of the incremental increase in risk and the cumulative effect of that risk with respect to normal day-to-day risks to which the general population is exposed.

Accident risk to collocated workers was calculated for a hypothetical worker at 1,000 meters and 2,000 meters from the facility. The estimated number of collocated workers that may be similarly exposed is also provided. Risk to workers from radiological accidents would be addressed in greater detail in site-specific tiered NEPA documents when more detailed information is available.

Uncertainties. The sequence of analyses performed to generate the radiological impact estimates from normal operation and facility accidents include: (1) selection of normal operational modes and accident sequences, (2) estimation of source terms, (3) estimation of environmental transport and uptake of radionuclides, (4) calculation of radiation doses to exposed individuals, and (5) estimation of health effects. There are uncertainties associated with each of these steps. Uncertainties exist in the way the physical systems being analyzed are represented by the computational models and in the data required to exercise the models (due to measurement errors, sampling errors, or natural variability).

In principle, one can estimate the uncertainty associated with each source and predict the remaining uncertainty in the results of each set of calculations. Thus, one can propagate the uncertainties from one set of calculations to the next and estimate the uncertainty in the final results. However, conducting such a full-scale quantitative uncertainty analysis is neither practical nor a standard practice for a study of this type. Instead, the analysis is designed to ensure—through judicious selection of release scenarios, models, and parameters—that the results represent the potential risks. This is accomplished by making conservative assumptions in the calculations at each step. The models, parameters, and release scenarios used in the calculations are selected in such a way that most intermediate results and consequently, the final estimates of impacts are greater than what would be expected. As a result, even though the range of uncertainty in a quantity might be large, the value calculated for the quantity is close to one of the extremes in the range of possible values, so that the chance of the actual quantity being greater than the calculated value is low (or the chance of the quantity being less than the calculated value if the

criteria are such that the quantity has to be maximized). This has been the goal of the radiological assessment for normal operation and facility accidents in this study (i.e., to produce results that are conservative).

The degree of conservatism in the calculated results is closely related to the range of possible values the quantity can have. This range is determined by what can be expected to realistically occur. Thus, the only processes, events, and accidents considered are those credible for the conditions under which the physical system being modeled operates. This consideration has also been employed for both normal operation and facility accident analyses.

Uncertainties are also derived from the lack of engineering design data for facilities that are only conceptual. Uncertainties are also introduced when accident analyses performed for similar existing facilities have been used as a major source of data. Although the radionuclide composition of source terms are reasonable estimates, there are uncertainties in the radionuclide inventory and release reactions which affect the estimated consequences. Accident frequencies for low probability sequences of events are always difficult to estimate, even for operating facilities, because there is little or no record of historical occurrences. For a new facility, such as the Heavy Water Reactor (HWR), MHTGR, ALWR, and APT any use of accident frequencies that are estimated from similar existing facilities would tend to further compound the effects of uncertainties.

There are also uncertainties attributed to differences in information sources. For the HWR and MHTGR a considerable amount of information on source terms and accident scenarios is based on 1992 documentation from the New Production Reactor program. For the ALWR, there are four technologies with documentation and analyses prepared independently by different vendors. For the APT, there are two technologies with documentation and analyses prepared by a team led by Sandia National Laboratories, New Mexico, Los Alamos National Laboratory, Brookhaven Laboratory, and private contractors.

The risk analysis presented in this PEIS is not a complete risk assessment in the sense of identifying and analyzing all physically possible accidents including those high consequence accidents whose probability is so remote as to render them not reasonably foreseeable. The accident analyses do include, however, a spectrum of reasonably foreseeable accidents including high consequence accidents and their associated risks for the technologies and facilities. These severe accidents have low accident frequencies, often less than 1.0×10^{-6} per year. The accident analyses also include higher frequency accidents (design-basis and other operational accidents) that typically have lower consequences. These design-basis and other operational accidents have accident frequencies that are greater than 1.0×10^{-6} per year.

In summary, the radiological and hazardous chemical impact estimates presented in this document were obtained by:

- Using the best available data.
- Using state-of-the-art computational tools.
- Considering the processes, events, and accidents that are reasonably foreseeable for the tritium supply and recycling facilities described in this study and the environment.
- Making conservative assumptions when there is doubt about the exact nature of the processes and events taking place.

4.1.10 Waste Management

A major thrust of the Tritium Supply and Recycling Program effort has been, and will continue to be, the minimization of wastes. The proposed action would consider and incorporate waste minimization and pollution prevention practices. Alternative processes and technologies used in the production and recycling of tritium are being reviewed to determine whether proven technologies could accomplish significant reductions in the generation of waste. Waste minimization efforts and the management of tritium-related wastes are discussed for each DOE site. Tritium facilities would treat and package waste into forms that would enable long-term storage or disposal. Pantex is the only site under consideration that does not have existing or planned onsite low-level waste (LLW) disposal; the number of additional

shipments required to transport LLW from Pantex to a DOE LLW disposal facility is estimated. The risks associated with additional shipments are addressed as part of the intersite transport assessment (section 4.7). Long-term disposition of wastes and other methods of waste minimization is expected to be addressed by the DOE Office of the Assistant Secretary for Environmental Management (EM) as part of an overall waste management strategy. The PEIS prepared by EM will evaluate the environmental impacts of transporting wastes. Both this document and the PEIS prepared by EM are intended to provide environmental input into development of long-term strategies that, when decided on, provide a basis for assessing and implementing site-specific and facility-specific actions.

The construction and operation of tritium facilities could generate spent nuclear fuel and several types of wastes. Generation points are different dependent upon siting of various facilities. Construction wastes are similar to those generated by any construction project of comparable scale. Wastes generated during the operation of tritium supply and recycling facilities consist of four primary types: low-level radioactive waste, low-level mixed waste, hazardous waste, and nonhazardous waste. The types and amounts of waste and spent nuclear fuel vary according to the tritium supply technology.

The nuclear weapons mission provides for the short-term management and onsite storage of wastes and spent nuclear fuel, including the means to minimize waste generation, until DOE either disposes of the wastes or places them in long-term storage. To provide a framework for addressing the impacts of waste management for tritium supply technologies and recycling facilities, descriptive information is presented on waste management activities anticipated for each DOE site and tritium facility combination. The volumes of each waste type generated are estimated by facility and DOE site for tritium supply technologies and recycling facilities and vary according to technologies analyzed for the facilities. These estimates include consideration of concepts for waste minimization. The impact assessment addresses the waste types and projected waste volumes from the various tritium supply technologies and recycling facilities at each site versus No Action. Impacts are assessed in the context of site practices for treatment, storage, and disposal including the applicable regulatory setting.

The volumes of wastes to be generated by tritium supply technologies and recycling facilities were provided for inclusion, consideration, and evaluation of alternative waste management configurations in the PEIS being prepared by EM. The evaluation of waste management for tritium supply and recycling facility-generated waste are presented in both documents.

D&D activities are greatly dependent upon the final disposition of a facility and its design. D&D could range from performing a simple radiological survey to completely dismantling and removing a radioactively-contaminated facility. Because the tritium supply technology and recycling facility designs are preconceptual, estimates of D&D waste volumes have not been made; however, a relative comparison between the tritium supply technologies was made.

4.1.11 Intersite Transportation

The intersite transport assessment addresses the transport of tritium, highly-enriched uranium, plutonium, and heavy water since these materials pose the primary health concern in this PEIS. A transportation baseline, using historical and projected shipment information, is established for evaluating potential environmental impacts. The existing transportation modes that serve each candidate site and the transportation links to those modes for the intersite transport of hazardous materials are described. The packagings required for the shipment of materials is also described. Risks are also calculated for transporting LLW generated from tritium activities.

The potential environmental impacts of transporting tritium, highly-enriched uranium, plutonium, heavy water, and LLW are qualitatively determined using existing health and accident risk data. Quantitative data are included, as appropriate. For evaluating risk, the following elements are considered: transport mode, weight of material, curies, proximity dose rates (transport index), type of package, number of shipments, and/or distance. Transportation health impacts are summarized for the alternatives.

4.1.12 Cumulative Impacts

Cumulative impacts address the incremental effects of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (43 FR 55978; 40 CFR 1500-1508).

Other DOE programs (including environmental management missions) and other Federal, state, and local development programs all have the potential to contribute to cumulative effects on DOE sites. "Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). To the extent information was available for these other actions at a given site, the cumulative impacts are presented.

Continuing Department of Energy Missions. Continuing DOE missions and any reasonably foreseeable changes to these missions are addressed as part of the affected environment baseline. Continuing missions at each site are discussed in the Site Infrastructure section of the affected environment discussion for each DOE site. These missions provide the baseline against which the tritium supply technologies and recycling facilities are compared. For example, water requirements for the tritium supply technologies and recycling facilities are combined with requirements of continuing missions to assess the total impact to water resources.

Environmental Management Missions. Any planned and reasonably foreseeable new or modified waste handling facilities are discussed in the waste management section for each site. In addition, to the extent that other environmental management missions or strategies are planned and defined, they are also discussed as are bounding environmental impacts of waste management actions. Specific waste management activities will be addressed in the PEIS being prepared by EM.

Other Federal and State Programs. Other Federal and state programs are identified but only planned, reasonably foreseeable programs are considered. Typical programs in this category include public works projects and military base closures and reuse projects. Potential consequences of any major programs that accumulate effects when combined with the tritium supply and recycling alternatives are presented.

Local Development Programs. Local development programs are not specifically identified. However, socioeconomic projections take into account anticipated regional growth. Local development programs are a part of this growth and are addressed collectively using growth as a surrogate. Socioeconomic projections form the baseline for much of the environmental analysis presented in this document.

Approach for Cumulative Impact Assessments. There is no generic methodology for the assessment of cumulative impacts. Therefore, the following approach represents a design for analyzing programmatic cumulative impacts relative to past, present, and probable future activities. It incorporates a wide ranging view of DOE defense programs, environmental management, and other outside interactions. This strategy is integrated with detailed resource-specific assessment methods where appropriate, and can be developed further in tiered project-specific NEPA documentation to ensure compatibility across defense programs, environmental management, and other programs.

The rationale for this approach reflects that this PEIS is a programmatic document. The reference condition for cumulative effects is the No Action alternative. The strategy has four major components:

- Focus analysis primarily on the impacts at each tritium supply candidate site where other defense programs and/or environmental management activities are reasonably anticipated. Past, baseline, and future defense programs and environmental management activities are more clearly defined and have a higher degree of certainty than offsite activities. These activities tend to be much more speculative the further into the future they are planned.

- Address quantitatively cumulative impact analyses associated with offsite activities in tiered, site-specific NEPA documentation.

- Coordinate efforts between defense programs and environmental management activities through the Memorandum of Agreement between defense programs and environmental management activities.

- Focus on site-specific cumulative effects from tritium supply and recycling, addressing them in terms of both the temporal and spatial aspects of defense programs activities, as well as, the level, phasing, and site-specific locations of proposed environmental management facilities and activities. This is appropriate due to the uncertainty and lack of specificity associated with offsite activities that could result in significant incremental, indirect, or synergistic cumulative impacts; these activities are more effectively addressed in tiered site-specific NEPA documentation.

The method is flexible and allows for the assessment of cumulative impacts to regulated resources at a lower level of analysis due to the protection afforded to them through applicable regulations. In addition, the method recognizes that the focus on a given resource may vary according to site-specific characteristics of the local environment. Where these type of variations are identified, a level of analysis would be performed commensurate to the importance of the potential cumulative impacts on that resource.

4.1.13 Environmental Justice

This PEIS assesses the potential disproportionately high and adverse human health or environmental effects on minority and low income populations in accordance with Executive Order 12898 *Federal Action to Address Environmental Justice in Minority Populations and Low Income Populations*. Because both the Federal Working Group on Environmental Justice and DOE are still in the process of developing guidance on criteria for identifying effects to these populations, the approach taken in the PEIS analysis may somewhat differ from whatever guidance may be issued.

The PEIS 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, or 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 for a family of two based on 1990 census data). Impacts are assessed based on the analysis presented for each resource and issue area for each tritium supply technology at each site. Any disproportionately high and adverse human health or environmental effects on minority and low-income populations are discussed.

4.2 IDAHO NATIONAL ENGINEERING LABORATORY

The Idaho National Engineering Laboratory (INEL) was established in 1949, and currently occupies approximately 570,000 acres near Idaho Falls, ID. As discussed in section 3.3.2, 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 development; and is a naval reactor training site. There are currently no DOE defense program missions at INEL. The DOE property boundaries for INEL are illustrated in figure 4.2–1.

4.2.1 Description of Alternatives

Under the proposed action, any one of the four tritium supply technologies (Heavy Water Reactor (HWR), Modular High Temperature Gas-Cooled Reactor (MHTGR), Advanced Light Water Reactor (ALWR), or Accelerator Production of Tritium (APT)) alone or collocated with a new tritium recycling facility could be sited at INEL. Section 3.4.2 provides a description of the tritium supply technologies and section 3.4.3.1 describes the tritium recycling facility. Figure 4.2.1–1 shows the location of existing facilities within INEL and the proposed TSS.

Under No Action, INEL would continue to perform the missions described in section 3.3.2. There are no facilities at INEL that would be phased out as a result of any of the proposed action alternatives discussed in this PEIS.

4.2.2 Affected Environment

The following sections describe the affected environment at INEL for land resources, air quality and acoustics, water resources, geology and soils, biotic resources, cultural and paleontological resources, and socioeconomics. In addition, the infrastructure at INEL, the radiation and hazardous chemical environment, and the waste management conditions are described.

4.2.2.1 *Land Resources*

The discussion of land resources at INEL includes land use and visual resources.

Land Use. INEL is located within Bingham, Bonneville, Butte, Clark, and Jefferson Counties, 22 miles west of downtown Idaho Falls in southeastern Idaho. The site covers approximately 570,000 acres, all of which is owned by the Federal government and is administered, managed, and controlled by DOE. The Federal government also owns approximately 75 percent of the land bordering INEL; this land is administered by the Bureau of Land Management. Twenty-four percent of adjacent land is privately owned, with the remaining 1 percent held by the State of Idaho. Generalized land uses at INEL and in the vicinity are shown in figure 4.2.2.1–1. Only 2 percent of the land within INEL has been developed for the nine operating areas and facilities. The developed INEL facilities are sited within a central core area of 225,000 acres designated as open space.

A buffer zone consisting of 345,000 acres surrounding the central core area has been created within INEL boundaries. The Bureau of Land Management has entered into a Memorandum of Understanding with DOE to permit private individuals to graze livestock on the buffer zone rangeland. However, the grazing of livestock is prohibited within the central core area and within 2 miles of any nuclear facilities. Other agricultural activities consist of approximately 140 acres of irrigated cropland located adjacent to State Routes 28 and 33, and just west of the Mud Lake community. No prime farmland lies within the INEL boundaries.

In 1975, DOE designated most of INEL as a National Environmental Research Park. It is used by the national scientific community as an outdoor laboratory for environmental sciences research on changes to the natural environment caused by human activities.

The proposed 600-acre TSS would be located within INEL's Prime Development Land Zone. This designation applies to land most suitable for development due to an absence of physical constraints such as steep slopes, faults, and floodplains, and because of the land's proximity to site infrastructure such as roads, utilities, and INEL support facilities.

Offsite land use within 2 miles of INEL is shown in figure 4.2.2.1–1. This offsite land is primarily used for livestock and agricultural purposes. The closest

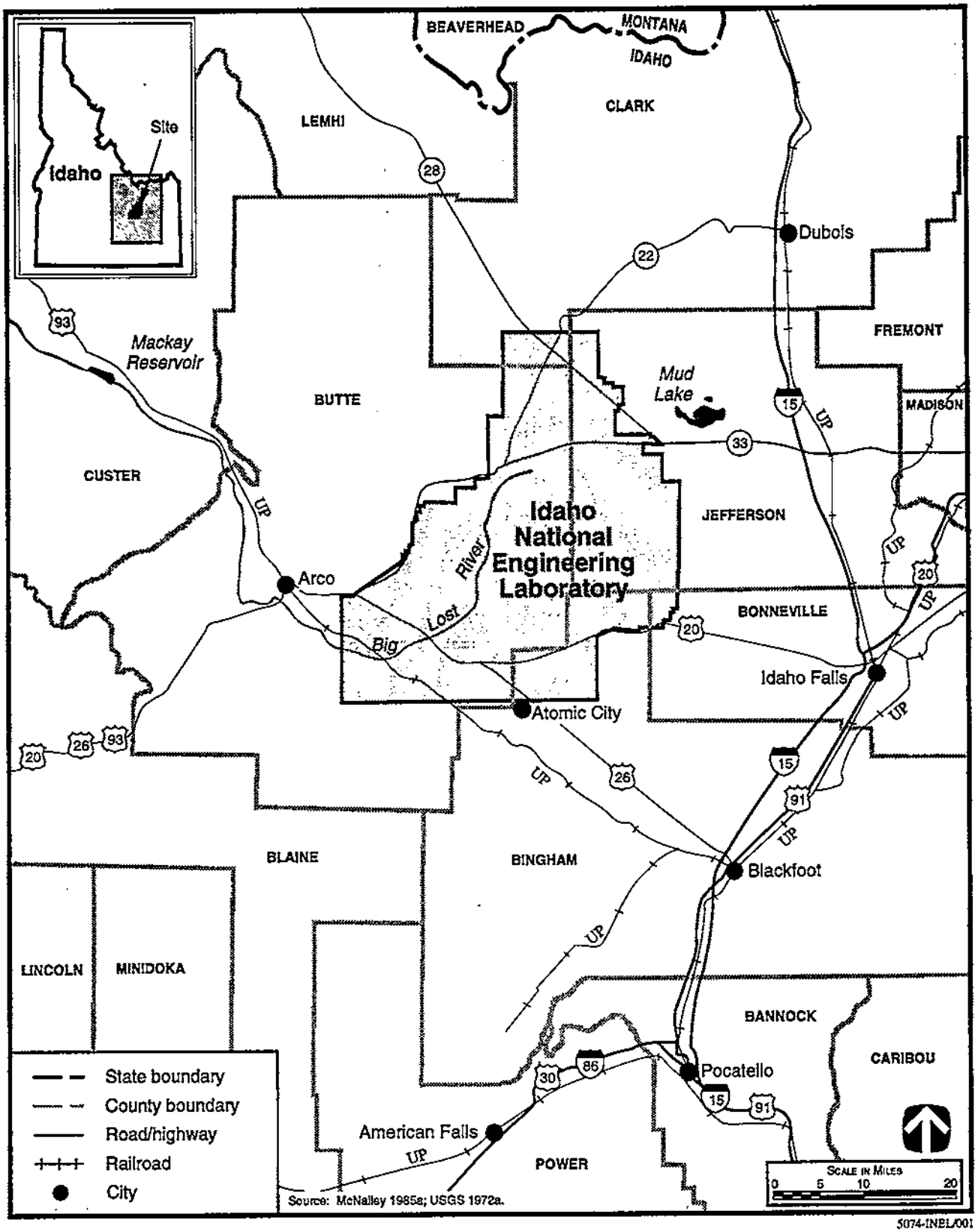


FIGURE 4.2–1.—*Idaho National Engineering Laboratory, Idaho, and Region.*

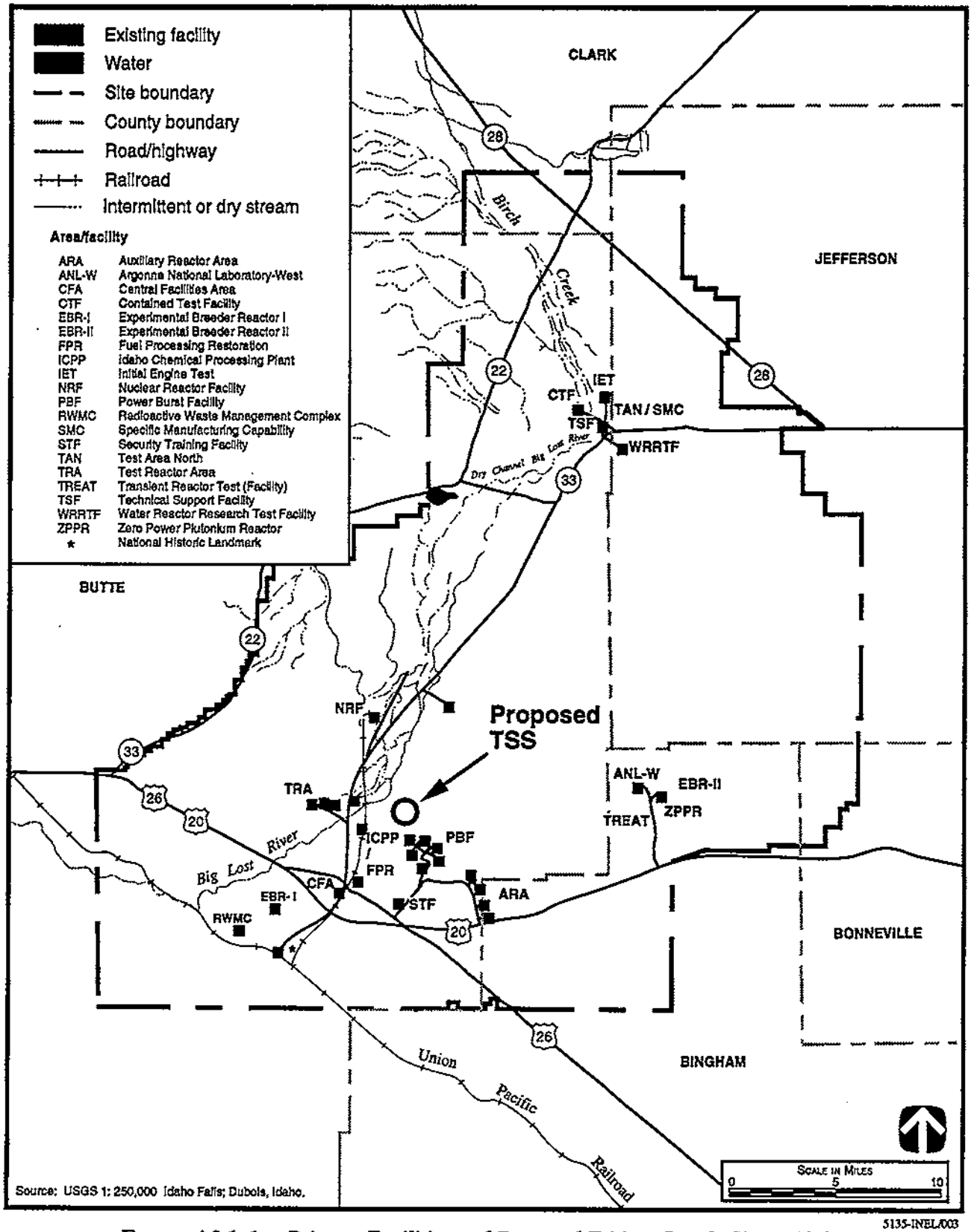


FIGURE 4.2.1–1.—*Primary Facilities and Proposed Tritium Supply Site at Idaho National Engineering Laboratory.*

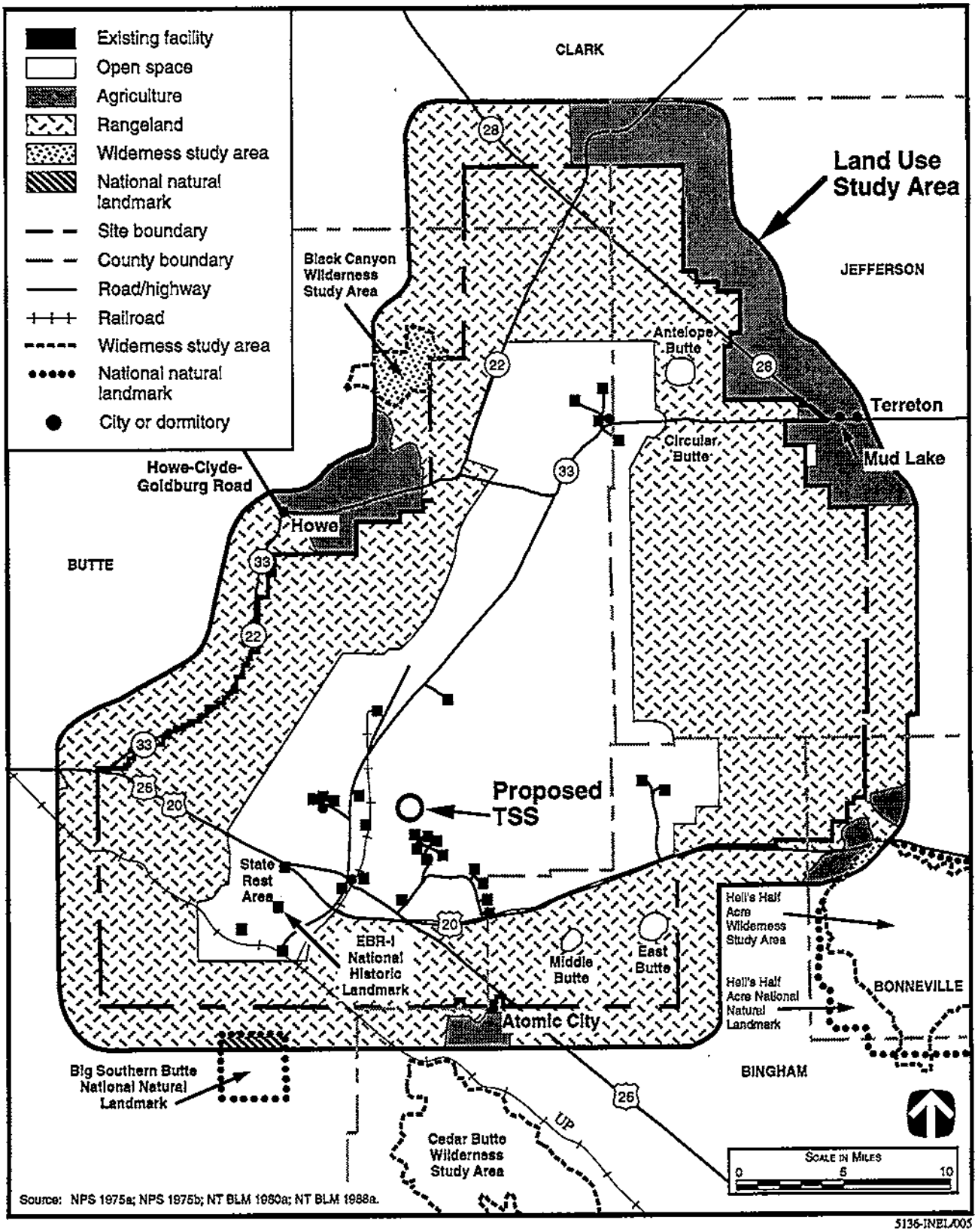


FIGURE 4.2.2.1–1.—*Generalized Land Use at Idaho National Engineering Laboratory and Vicinity.*

residence to the INEL boundary is 1,000 feet east of the facility (approximately 7 miles northwest of the unincorporated community of Mud Lake).

Two National Natural Landmarks border INEL: Big Southern Butte, 1.5 miles south and Hell's Half Acre Lava Field, 1.6 miles southeast. The Bureau of Land Management has also recommended that Congress consider designating Hell's Half Acre Lava Field as a wilderness area (BLM 1986a:388).

Visual Resources. INEL generally consists of open desert land containing sagebrush. The surrounding volcanic cones, domes, and mountain ranges are visible throughout INEL. The proposed TSS consists of the typical open, undeveloped desert landscape characteristic of the Snake River Plain. The Bureau of Land Management has classified the acreage within INEL as VRM Class 3 (mixed use) and Class 4 (industrial use). INEL facilities and operating areas maintain industrial uses consistent with these classifications.

The Lost River State Rest Area, located along U.S. Route 20/26 (figure 4.2.2.1–1), is approximately 3 miles southwest of the Test Reactor Area, the closest INEL facility. This viewpoint provides the public the best view of the proposed TSS. The Black Canyon Wilderness Study Area is located adjacent to INEL and 9.4 miles west-northwest of Test Area North (figure 4.2.2.1–1). Views from this Wilderness Study Area include agricultural land use and the facilities of INEL, including the proposed TSS. Views of the facilities from these points are distant and therefore the facilities have a minor effect on the overall natural appearance of the area. Craters of the Moon National Monument and Wilderness Study Area are both approximately 12.5 miles southwest from the closest INEL boundary and 34 miles from the proposed TSS.

4.2.2.2 *Site Infrastructure*

Section 3.3.2 describes the current missions at INEL. To support these missions, an extensive infrastructure exists as shown in table 4.2.2.2–1. Of critical importance to the proposed action is the electrical power infrastructure at each potential site. INEL is located in the Western Systems Coordinating Council Regional Power Pool and draws its power from the Northwest Power Pool Subregion. Characteristics of this subregion are listed in table 4.2.2.2–2.

TABLE 4.2.2.2–1.—*Baseline Characteristics for Idaho National Engineering Laboratory*

Current Characteristics	Value
Land	
Area (acres)	570,000
Roads (miles)	277
Railroads (miles)	30
Electrical	
Energy consumption (MWh per year)	232,500
Peak load (MWe)	42
Fuel	
Natural gas (ft^3 per year)	0
Oil (GPY)[a]	1,538,800
Coal (ton per year)	12,500
Steam (lb per hour)	90,000

[a] Amount includes fuel oil and propane.
Source: INEL 1993a:5.

TABLE 4.2.2.2–2.—*Subregional Power Pool Electrical Summary for Idaho National Engineering Laboratory*

Type Fuel	Production[a] (percent)
Coal	34
Nuclear	3
Hydro/geothermal	46
Oil/gas	7
Other[b]	11
Total Annual Production: 256,404,000 MWh	
Total Annual Load: 250,045,000 MWh	
Energy Exported Annually: 6,359,000 MWh	
Generating Capacity: 53,206 MWe	
Peak Demand: 33,325 MWe	
Capacity Margin[c]: 13,655 MWe	

[a] Percentage does not total 100 percent due to round-off error.
[b] Includes power from both utility and nonutility sources.
[c] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.
Source: NERC 1993a.

4.2.2.3 *Air Quality and Acoustics*

The following describes existing air quality and acoustics and includes a review of the meteorology and climatology in the vicinity of INEL. More detailed discussions of the air quality and acoustics methodologies, input data, and atmospheric dispersion characteristics are presented in appendix section B.1.3.2.

Meteorology and Climatology. The climate at INEL and in the surrounding region is characteristically that of a semiarid steppe (Trewartha 1954a). The annual average temperature is 42 °F; average daily temperatures vary from 16 °F in January to 68 °F in July. The average annual precipitation is 8.7 inches (IN DOE 1989b:55,77). Prevailing winds are from the southwest through west-northwest with a secondary maximum frequency from the north-northeast to northeast. The annual average wind speed is 7.5 mph. Additional information related to meteorology and climatology at INEL is presented in appendix section B.1.3.2.

Ambient Air Quality. INEL is located within the Eastern Idaho Intrastate Air Quality Control Region (AQCR) 61. None of the areas within INEL and its surrounding counties are designated as nonattainment areas (40 CFR 81.313) with respect to any of the NAAQS for criteria pollutants (40 CFR 50). The nearest nonattainment area for particulate matter is in Pocatello, about 50 miles to the south. A nonattainment area is an area that has air quality worse than the NAAQS for one or more criteria pollutant. Applicable NAAQS and Idaho State ambient air quality standards are presented in appendix table B.1.3.1–1.

Three Prevention of Significant Deterioration (40 CFR 52.21) Class I areas have been designated in the vicinity of INEL: Craters of the Moon National Monument, ID, approximately 33 miles west-southwest from the center of the site; Yellowstone National Park, Idaho-Wyoming, approximately 89 miles east-northeast from the center of the site; and Grand Teton National Park, WY, approximately 90 miles east from the center of the site (IN DOE 1991b:4-11).

Since the promulgation of Prevention of Significant Deterioration regulations (40 CFR 52.21) in 1977, Prevention of Significant Deterioration permits were obtained by INEL for two major emission sources: the Coal-Fired Steam-Generating Facility next to the Idaho Chemical Processing Plant (IN DOE 1980a) and the Fuel Processing Restoration Facility (IN ES 1988a), which is not expected to be operated.

Historically, the primary emission sources of criteria air pollutants at INEL are: the calcination of liquid waste, the combustion of coal for steam generation at the Idaho Chemical Processing Plant, and the combustion of fuel oil for heating at various INEL facilities. Other emissions and sources include fugitive particulates from waste-burial activities and coal piles, other processes, vehicles, and temporary emissions from various construction activities. Emission estimates for these sources are presented in appendix table B.1.3.2–2.

Ambient air quality monitoring data collected during the last few years are summarized in appendix table B.1.3.2–1. Data indicate that ambient air concentrations are in compliance with applicable guidelines and regulations. The Idaho Department of Health and Welfare no longer monitors ambient O_3, NO_2, and lead (Pb) in the vicinity of INEL because previous monitoring indicated that ambient concentrations were very low (IN DHW 1988a:3-4).

The annual emission rates of hazardous/toxic air pollutants from existing INEL facilities during 1989 and estimates of maximum annual average ground-level concentrations at the INEL boundary are listed in appendix table B.1.3.2–4. These concentrations are in compliance with respective acceptable ambient concentrations listed in *Rules for the Control of Air Pollution in Idaho*.

Table 4.2.2.3–1 presents the baseline ambient air concentrations for criteria pollutants and other pollutants of concern at INEL. With the exception of the 24-hour TSP standards, baseline concentrations are in compliance with applicable guidelines and regulations.

Acoustics Conditions. Major noise emission sources within INEL include various industrial facilities, equipment, and machines. At the site boundary, away from most of the industrial facilities, noise emitted from the site is barely distinguishable from background noise levels.

The acoustic environment along the INEL boundary is assumed to be that of a rural location with typical

TABLE 4.2.2.3–1.—*Comparison of Baseline Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines at Idaho National Engineering Laboratory, 1989-1991*

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutant			
Carbon monoxide (CO)	8-hour	10,000[a]	284
	1-hour	40,000[a]	614
Lead (Pb)	Calendar quarter	1.5[a]	0.001
Nitrogen dioxide (NO_2)	Annual	100[a]	9
Ozone (O_3)	1-hour	235[a]	[b]
Particulate matter (PM_{10})	Annual	50[a]	19
	24-hour	150[a]	112
Sulfur dioxide (SO_2)	Annual	80[a]	6
	24-hour	365[a]	143
	3-hour	1,300[a]	593
Mandated by Idaho			
Total suspended particulates (TSP)	Annual	60[c]	45
	24 -hour	150[c]	168
Hazardous and Other Toxic Compounds			
Acetaldehyde	Annual	0.45[c,d]	0.011
Ammonia	Annual	180[c,d]	6
Arsenic	Annual	2.3×10^{-4}[c,d]	9.0×10^{-5}
Benzene	Annual	0.12[c,d]	0.029
Butadiene	Annual	3.6×10^{-3}[c,d]	0.001
Carbon tetrachloride	Annual	0.067[c,d]	0.006
Chloroform	Annual	0.043[c,d]	4.0×10^{-4}
Cyclopentane	Annual	17,000[c,d]	2.7
Formaldehyde	Annual	0.077[c,d]	0.012
Hexavalent chromium	Annual	8.3×10^{-5}[c,d]	6.0×10^{-5}
Hydrazine	Annual	3.4×10^{-4}[c,d]	1.0×10^{-6}
Hydrochloric acid	Annual	7.5[c,d]	0.98
Mercury	Annual	1[c,d]	0.042
Methylene chloride	Annual	0.24[c,d]	6.0×10^{-3}
Naphalene	Annual	500[c,d]	18
Nickel	Annual	4.2×10^{-3}[c,d]	2.7×10^{-3}
Nitric acid	Annual	50[c,d]	0.64
Perchloroethylene	Annual	2.1[c,d]	0.11
Phosphorus	Annual	1[c,d]	0.3
Potassium hydroxide	Annual	20[c,d]	0.2
Proprionaldehyde	Annual	4.3[c,d]	0.3
Styrene	Annual	1,000[c,d]	1.3
Toluene	Annual	3,750[c,d]	370
Trichloroethylene	Annual	0.077[c,d]	9.7×10^{-4}
Trimethylbenzene	Annual	1,230[c,d]	100
Trivalent chromium	Annual	5[c,d]	0.036

[a] Federal standard (40 CFR 50).

[b] No longer monitored since previous monitoring indicated very low ambient concentrations.

[c] State standard

[d] Acceptable ambient concentrations listed in *Rules for the Control of Air Pollution in Idaho*. Acceptable ambient concentrations are increments that apply to new sources and are used here only as reference levels.

Source: DOE 1995v; IN DHW 1995a; IN DHW 1956b.

residual noise levels of 35 to 50 dBA (EPA 1974a:B-4). Along highways, traffic contributes to ambient noise levels, especially during peak hours, resulting in significantly higher noise levels than at remote locations. Except for the prohibition of nuisance noise, neither the State of Idaho nor its local governments have established specific numerical environmental noise standards applicable to INEL.

4.2.2.4 *Water Resources*

This section describes the surface water and groundwater resources at INEL.

Surface Water. Flowing surface water in the INEL area consists of three intermittent streams that drain the adjacent mountains: Big Lost River, Little Lost River, and Birch Creek. The streams usually begin to flow in the spring and are dry by early to midsummer. The Big Lost River and Birch Creek are the only surface waters that enter the site on a regular basis. The Little Lost River does not enter the site under normal flow conditions. Since much of the flow in these streams is diverted upstream for irrigation, it is possible that several years can pass without any flow entering the INEL boundaries (DOE 1991a). There has been no onsite flow of the three streams since 1987 (USGS 1992a). The U.S. Geological Survey (USGS) is responsible for monitoring the streams; however, the only onsite monitoring station is for the Big Lost River. Surface waters near INEL are depicted in figure 4.2.2.4–1.

The proposed TSS lies within the drainage basin of the Big Lost River. The Big Lost River flows onto the site at the southern part of its western boundary and flows northeastward to the Big Lost River sinks (Playas 1 through 3) (IN DOE 1985a). Water flow in the Big Lost River is controlled by the MacKay Dam located approximately 45 miles upstream from INEL. Local rainfall and snowmelt are the primary contributors to the surface water flows. Most precipitation is rapidly infiltrated into the soil.

Surface water is not used on INEL as a source of water, nor is it used for wastewater discharge. Nonradioactive liquid effluents are disposed of primarily to a waste ditch, a lined evaporation pond, an industrial waste pond, five different seepage ponds, and sewage treatment facilities (IN DOE 1992d).

Several areas, such as Test Area North, Test Reactor Area, and Central Facilities Area, currently divert stormwater into drainage ditches and discharge flow into soils away from the work area. A large drainage ditch equipped with an automatic sampler surrounds the Radioactive Waste Management Complex to ensure that radionuclides are not transported from the area by stormwater (DOE 1991a).

Flooding at INEL by the Big Lost River has been averted by a flood diversion system constructed in 1958 and upgraded in 1984. The flood diversion system consists of a small dam to direct flow through a diversion channel into four spreading areas. The flood diversion system is designed to contain a 300-year flood.

Surface Water Quality. The Big Lost River (from its source to the playas) is designated by the Idaho Department of Health and Welfare's Water Quality Standards and Wastewater Treatment Requirements for the following uses: agricultural and domestic water supply, cold water biota, salmonid spawning, primary and secondary contact recreation, and special resource waters (IN DHW 1992a).

The USGS is responsible for monitoring the surface water quality at INEL. The most recent water samples collected within the facility boundaries were collected from the Big Lost River below the diversion dam in 1985. The results of the analysis and the Idaho Water Quality Standards for the Protection of Domestic Water Supplies are presented in table 4.2.2.4–1. More recent samples are not available because of the intermittent nature of these water bodies. The analytical results indicate that there are no parameters in exceedance of the water quality criteria.

Surface Water Rights and Permits. Surface water rights are not an issue because INEL facilities do not withdraw surface water for use, nor do they discharge effluents directly to natural surface waters.

Groundwater. The Snake River Plain aquifer, classified by EPA as a Class I sole-source aquifer, is located beneath the entire INEL site and covers a total area of approximately 9,600 square miles in Southeastern Idaho. The aquifer serves as a primary source for drinking water and crop irrigation in the Snake River Basin. It is composed of 2,000 to

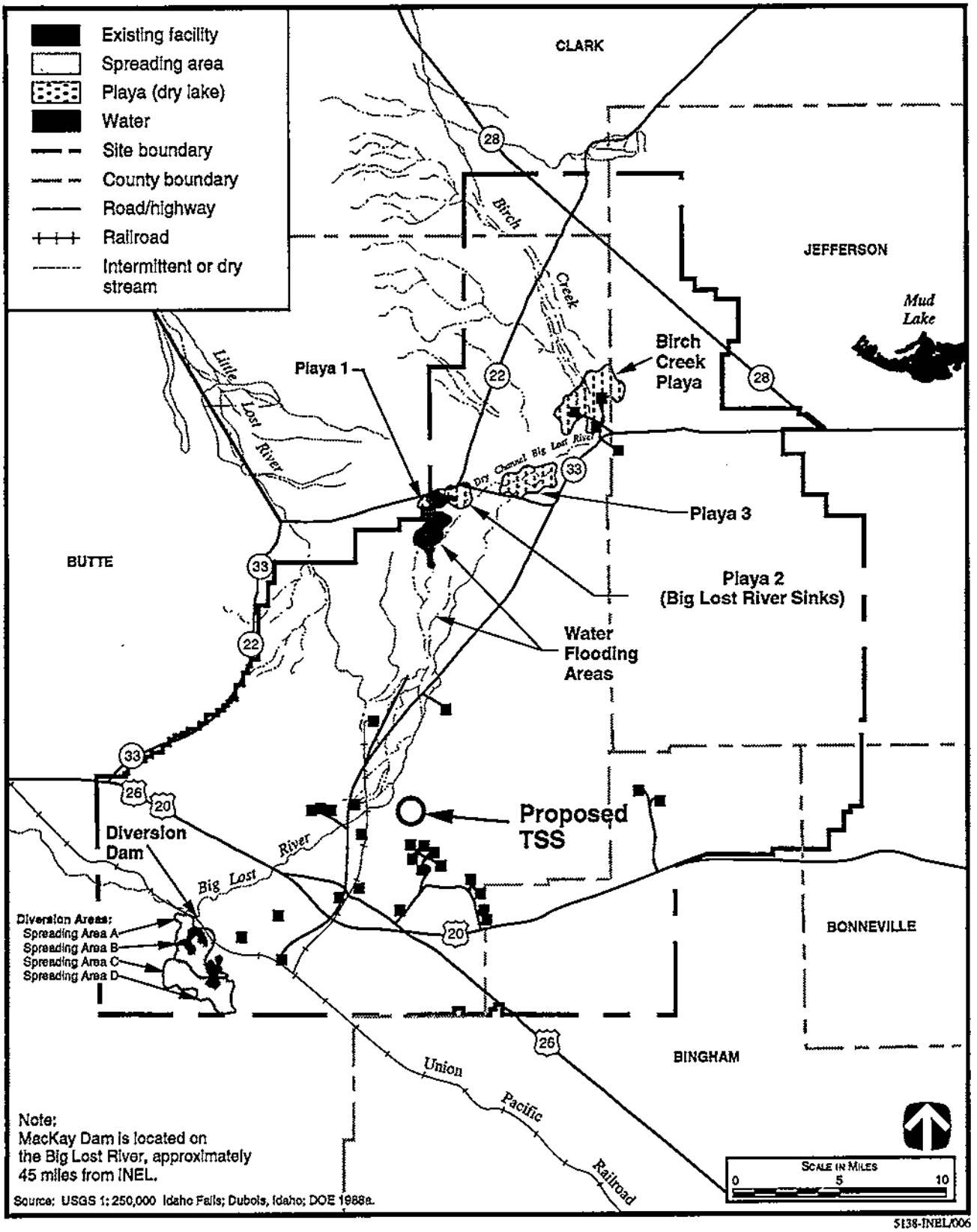


FIGURE 4.2.2.4–1.—*Surface Water Features at Idaho National Engineering Laboratory.*

TABLE 4.2.2.4–1.—*Summary of Surface Water Quality Monitoring Data for Big Lost River at Idaho National Engineering Laboratory, 1985*

Parameter	Unit of Measure	Water Quality Criteria[a]	Maximum Water Body Concentration
Arsenic	mg/l	0.05	0.002
Barium	mg/l	1	0.2
Cadmium	mg/l	0.01	0.003
Chromium	mg/l	0.05	0.001
Lead	mg/l	0.05	0.001
Mercury	mg/l	0.002	<0.0001
pH	pH units	6.5 to 8.5[a]	8.3
Selenium	mg/l	0.01	<0.001
Silver	mg/l	0.05	<0.001
Temperature	°C	22	20

[a] State of Idaho water quality criteria.
Source: IN DHW 1992a; IN USGS 1985a.

10,000 feet of lava flows, rhyolite, and interbedded sediments (IN Barraclough 1978a) and is believed to contain 1 to 2 billion acre-feet of water.

Groundwater underflow from the Henry's Fork of the Snake River supplies a significant amount of water to the Snake River Plain aquifer below INEL. Additional recharge to the aquifer comes from the Big Lost River, Little Lost River, and Birch Creek, which originate in the mountains to the northwest of INEL, flow onto the site during a few months of the year during wet years, and sink into its porous soils. Precipitation and snow melt also contribute to its recharge. Local groundwater movement is complicated, but overall groundwater flows laterally at an average rate of 5 to 20 feet per day to the south and west as shown in figure 4.2.2.4–2. The groundwater emerges in springs (6.5 million acre-feet annually) along the Snake River from Milner to Bliss, ID, and from Blackfoot to American Falls Reservoir in the region west of Pocatello, ID (DOE 1992e). Depth to the water table ranges from 200 feet below the ground surface in the northeast corner of INEL to 1,000 feet in the southeast corner and approximately 476 feet below the ground surface of the proposed TSS (IN DOE 1986a).

Perched water tables occur in the INEL area. The presence of these perched water bodies is believed to be beneficial to water quality in the Snake River Plain aquifer. These perched water bodies slow waste migration, allow for radioactive decay, and spread any waste plumes over a wider area for greater dilution (DOE 1992e).

Groundwater Quality. There are several "networks" of monitoring wells drilled and maintained by USGS. These include the INEL-wide facility groundwater monitoring group and well networks for RCRA- and CERCLA-required monitoring. Groundwater beneath INEL is monitored by groups including USGS, DOE's site contractor, LITCO, other DOE contractors, and the State of Idaho. USGS has drilled more than 120 wells in the Snake River Plain aquifer and 100 in the perched zone on the site and near INEL. Water supply wells, wells that monitor the migration of constituents from INEL facilities, and offsite water supply wells are routinely sampled for chemical and radiological constituents.

Historically, there has been radionuclide contamination of the Snake River Plain aquifer. Between 1952 and 1988, approximately 30,900 curies (Ci) of tritium were disposed of into wells and infiltration ponds at INEL (mainly from Idaho Chemical Processing Plant and Test Reactor Area). No tritium is currently disposed of to the groundwater at INEL; however, tritium plumes are present in the Snake River Plain aquifer and in perched groundwater under these sites (figure 4.2.2.4–2). Tritium occurs at elevated levels in some monitoring wells and has been detected in groundwater near the southern boundary of INEL, 9 miles south of the Idaho Chemical Processing Plant and Test Reactor Area. The average concentration of tritium in water from 26 wells decreased from

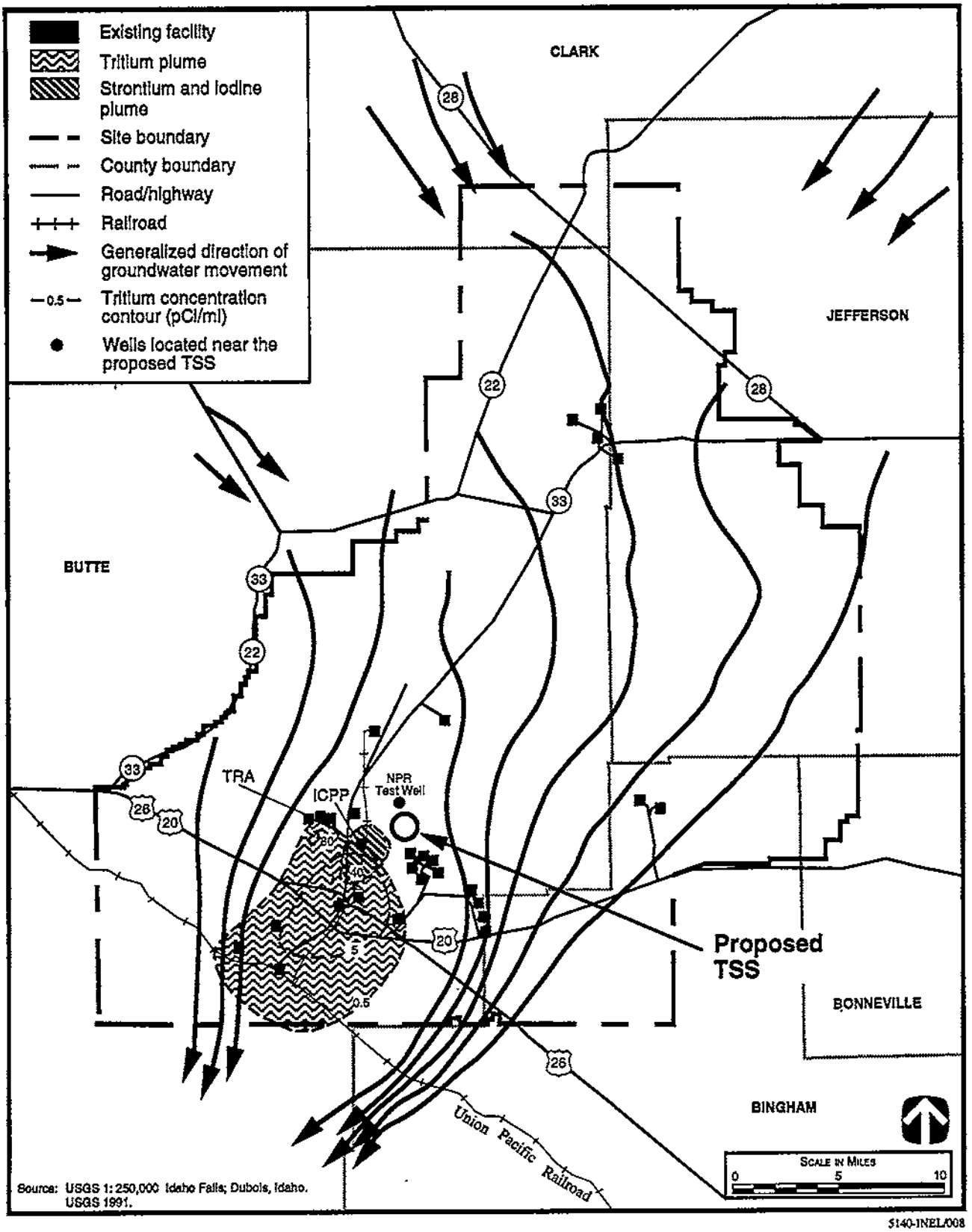


FIGURE 4.2.2.4–2.—*Generalized Groundwater Flow and Groundwater Contamination in Idaho National Engineering Laboratory Area.*

250,000 picocuries per liter (pCi/l) in 1961 to 18,000 pCi/l in 1988. In 1990, the highest tritium concentrations occurring in INEL drinking water were in the area of the Central Facilities Area; the concentration ranged from 16,000 to 18,000 pCi/l. The elimination of tritium disposal, radioactive decay, and dilution and dispersion within the groundwater reservoir are factors contributing to a 93-percent decrease in tritium concentration levels from 1961 to 1988 (IN USGS 1990a).

Other radionuclides of significance include strontium-90, cesium-137, and iodine-129. The first two, especially cesium-137, are strongly held on mineral grains in the soils so it is unlikely that either will reach the aquifer in significant amounts. As shown in figure 4.2.2.4–2, plumes have been delineated for strontium and iodine (INEL 1990b).

Samples from four offsite USGS wells beyond the southern and western site boundaries were taken in 1990. Gross alpha and gross beta concentrations of 3 and 5 pCi/l, respectively, were measured (DOE 1990a). The concentrations are within the values expected due to leaching of natural radionuclides in the local soil and rock. None of the samples showed detectable concentrations of tritium or gamma-emitting radionuclides.

Nonradioactive wastes, including sodium chloride, sulfuric acid, sodium hydroxide, and organics, have also been discharged to ponds within many of the operating areas. In the past, wastewater also has been injected into deep disposal wells at the Test Reactor Area and Idaho Chemical Processing Plant. The total dissolved solids concentrations of the injected wastewaters were approximately twice those present in the natural groundwater (IN USGS 1988a). There are no plans to use injection wells for disposal. Monitoring of the Snake River Plain aquifer for nonradiological constituents, including sodium chloride, total chromium, trace metals, and nitrates, showed concentrations for these contaminants to be at or below background levels at least 2.5 miles inside the nearest site boundary (DOE 1992e).

Only nonradioactive and nonhazardous liquid wastes are currently discharged into the sanitary and service waste disposal systems. All hazardous and radioactive wastes are stored or disposed of in approved facilities designed to preclude groundwater contamination.

The 1991 groundwater data indicate that water quality at the proposed TSS is good with no significant radionuclide or nonradionuclide contamination as shown in table 4.2.2.4–2.

Groundwater Availability, Use and Rights. The Snake River Plain aquifer is the source of all water used at INEL (IN DOE 1991b). The combined pumpage of the 27 onsite production wells average approximately 2,000 MGY (IN DOE 1991b). This is 0.3 percent of the 645,000 MGY of groundwater withdrawn from the aquifer in the Eastern Snake River Plain. Most of the water withdrawn from the aquifer in the Eastern Snake River Plain (619,114 MGY) is used for agriculture (IN DOE 1986a). After use, approximately 63 percent of the quantity of groundwater withdrawn at INEL is disposed of in wells and ponds.

In the INEL ROI, Idaho Falls, Pocatello, and Rigby maintain water supply systems. All of the community drinking water systems draw their raw water from the Snake River Plain aquifer. In 1991, the combined water supply capacity for these systems was approximately 142 MGD. The combined demand averaged about 54 MGD (38 percent of capacity).

DOE has negotiated with the Idaho Department of Water Resources for water rights of 51.7 MGD, not to exceed 11,360 MGY, under the Federal Reserve Doctrine. Currently, INEL's total water usage is 5.7 MGD, representing 11 percent of the 51.7 MGD current INEL negotiated water rights.

4.2.2.5 *Geology and Soils*

Geology. INEL occupies a relatively flat area on the northwestern edge of the Eastern Snake River Plain. The INEL area consists of a broad plain that has been built up from the eruptions of multiple flows of basaltic lava. It is bordered by mountains on the north and the overthrust belt on the east. The Eastern Snake River Plain consists of Miocene and younger volcanic rocks that probably rest upon older sedimentary and plutonic rocks, as well as faulted remains of Eocene volcanic rocks.

The oldest faults in the region occur both to the north and south of INEL and are approximately 40 to 65 million years old. The Arco segment of the Lost

TABLE 4.2.2.4–2.—*Groundwater Quality Monitoring Data at Idaho National Engineering Laboratory, 1990-1991*

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Well No. NPR Test[b]
1,1-Dichloroethylene	mg/l	0.007[c]	< 0.0002
1,1,2-Trichloroethane	mg/l	0.005[d]	< 0.0002
Alpha (gross)	pCi/l	15[d]	3.1
Beta (gross)	pCi/l	50[d]	2.2
Barium	mg/l	2[d]	0.084
Beryllium	mg/l	0.004[d]	< 0.0005
Carbon tetrachloride	mg/l	0.005[d]	< 0.0002
Chromium	mg/l	0.1[d]	0.006
Tritium	pCi/l	20,000[d]	74
Radon	pCi/l	NA	160
Strontium	mg/l	NA	300
Tetrachloroethylene	mg/l	0.005[d]	< 0.0002
Trichloroethylene	mg/l	0.005[d]	< 0.0002

[a] For comparison only.
[b] USGS 1991; water quality data.
[c] National Primary Drinking Water Regulations (40 CFR 141).
[d] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).
Note: NA - not applicable.

River fault and the Howe segment of the Lemhi fault are range-front normal faults associated with the Basin and Range Province and have been active during recent geologic time (100,000 to 15,000 years ago). They are considered to be the closest capable faults to INEL within the definition of 10 CFR 100, Appendix A. These faults terminate approximately 19 miles from the INEL boundary (figure 4.2.2.5–1).

INEL is located in Seismic Zone 2 (figure 4.2.2.5–2). Historically there have been several earthquakes in the region surrounding INEL (figure 4.2.2.5–1). However, none of these occurred within approximately 30 miles of the site. The largest historic earthquake that has occurred near INEL took place in 1983, approximately 67 miles to the northwest near Borah Peak in the Lost River Range. The earthquake had a Richter magnitude of 7.3 and a modified Mercalli intensity of VI, with ground acceleration of 0.022 to 0.078 g at INEL (table 4.2.2.5–1) (IN DOE 1991e; INEL 1985a). An earthquake of greater than 5.5 magnitude is to be expected approximately every 10 years within a 200-mile radius of INEL.

No major earthquake activity has occurred on the Eastern Snake River Plain. The only recorded earthquake on the Eastern Snake River Plain with a magnitude greater than 5.5 was the 1905 event that had a magnitude of 5.7. Recent interpretations of the event, however, have suggested that its epicenter was more likely to have been in Utah or Nevada.

The Snake River Plain region has been volcanically active for 400,000 years. The most recent volcanism in the region consisted of lava flows that occurred approximately 1,500 to 2,000 years ago at the present site of Craters of the Moon National Monument. The Hell's Half Acre lava flow, which crosses INEL east of the proposed TSS, dates to 4,100 years ago.

Possible future volcanic occurrences are postulated to be of the same type that took place in the recent past, mainly lava flows. The mean recurrence interval for all types of volcanic activity in the Arco-Big Southern Butte area is suggested to be 3,000 years (IN USGS 1978a).

Soils. INEL soils are derived from volcanic and clastic rocks from nearby highlands (IN DOE 1986a). In the southern part of INEL, the soils are gravelly to rocky and generally shallow. The northern portion is composed mostly of unconsolidated clay, silt, and sand. There is no Soil Conservation Service soil survey of Butte County. Consequently, there are few

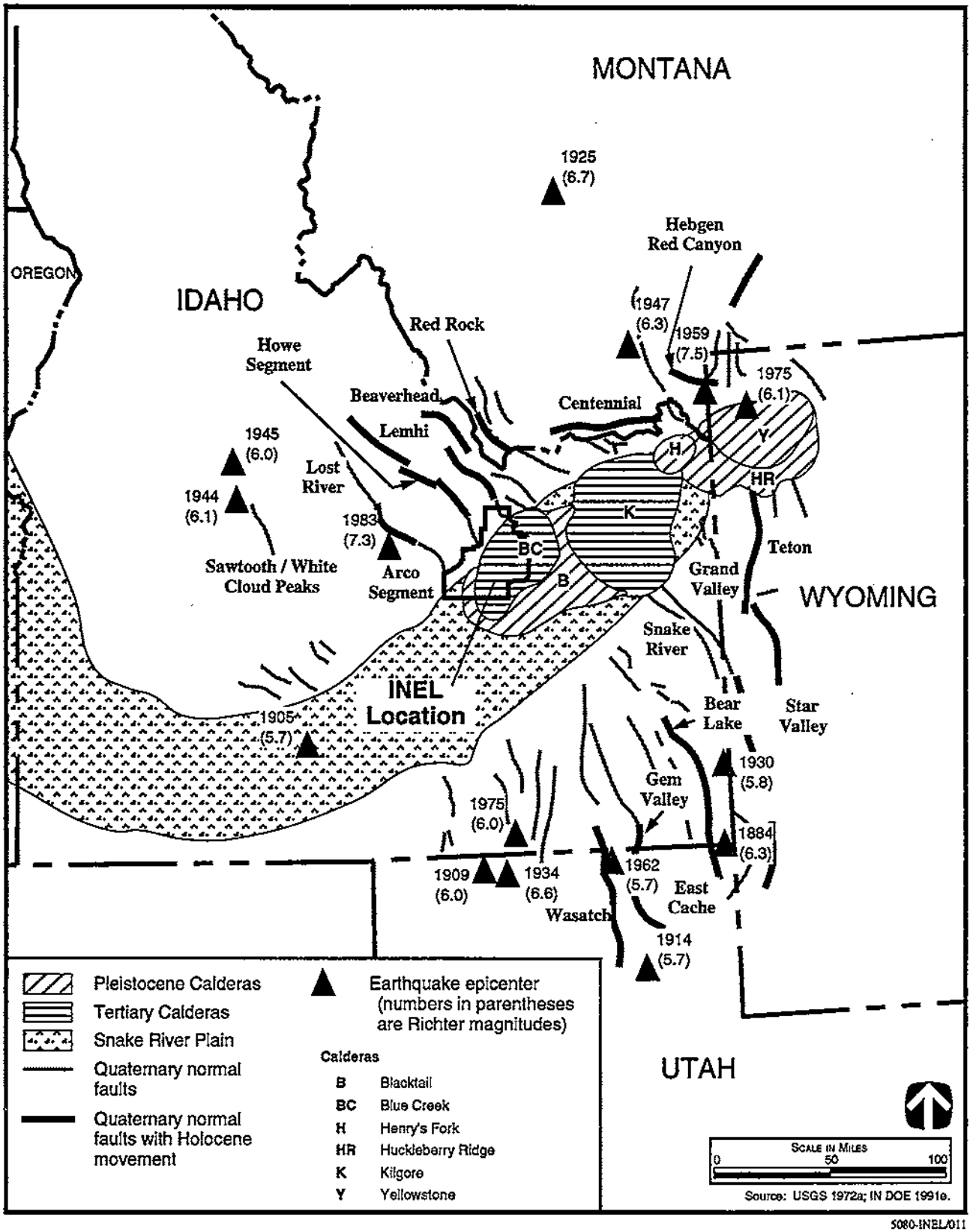


FIGURE 4.2.2.5–1.—***Major Fault Systems and Historic Earthquakes in Idaho National Engineering Laboratory Region.***

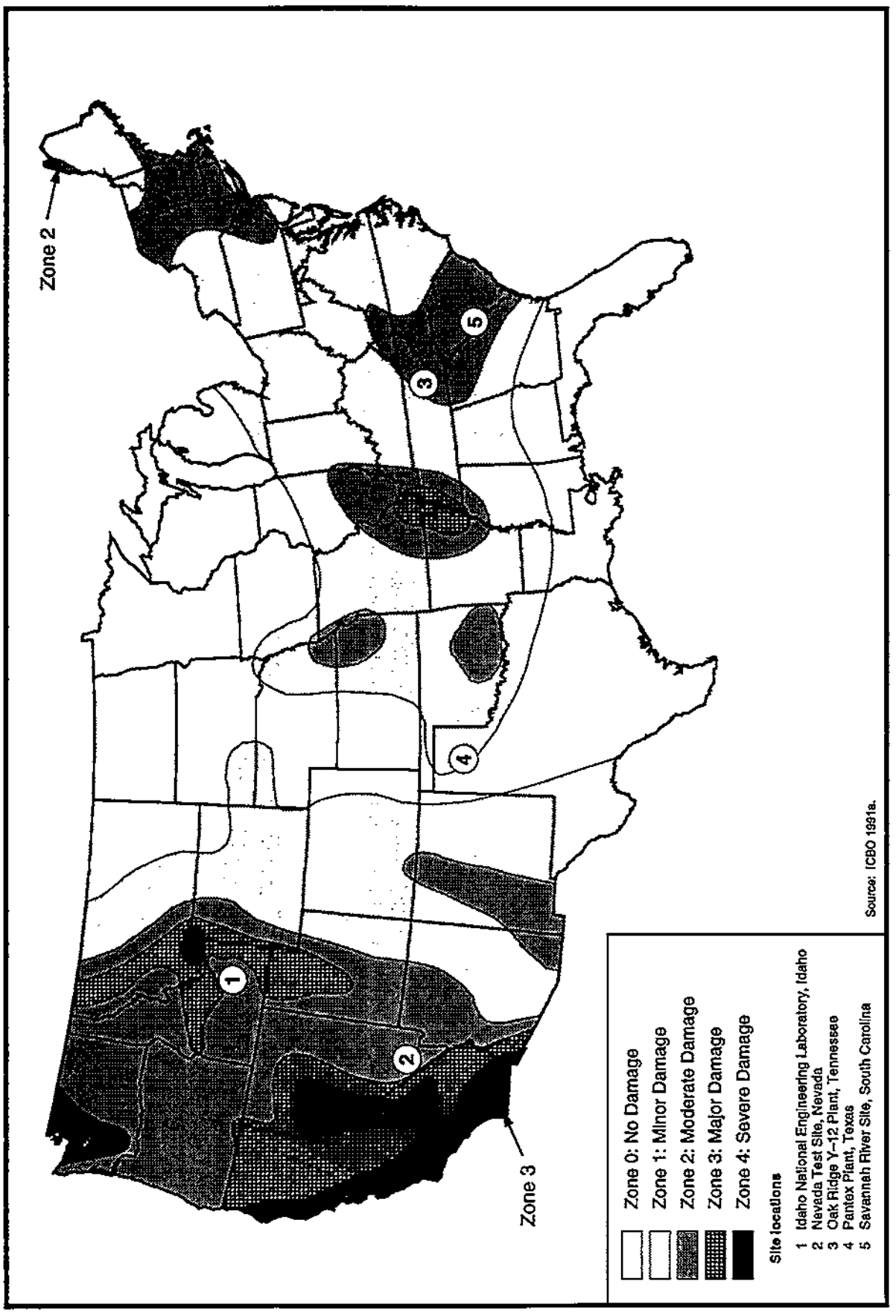


FIGURE 4.2.2.5-2—*Seismic Zone Map of the United States.*

TABLE 4.2.2.5–1.—*The Modified Mercalli Scale of 1931, with Approximate Correlations to Richter Scale and Maximum Ground Acceleration*

Modified Mercalli Intensity[a]	Observed Effects of Earthquake	Approximate Richter Magnitude[b]	Maximum Ground Acceleration[c]
I	Usually not felt	2	negligible
II	Felt by persons at rest, on upper floors or favorably placed	2-3	<0.003g
III	Felt indoors; hanging objects swing; vibration like passing of light truck occurs; might not be recognized as earthquake	3	0.003 to 0.007g
IV	Felt noticeably by persons indoors, especially in upper floors; vibration occurs like passing of heavy truck; jolting sensation; standing automobiles rock; windows, dishes, and doors rattle; wooden walls and frames may creak	4	0.007 to 0.015g
V	Felt by nearly everyone; sleepers awaken; liquids disturbed and may spill; some dishes break; small unstable objects are displaced or upset; doors swing; shutters and pictures move; pendulum clocks stop or start	5	0.015 to 0.03g
VI	Felt by all; many are frightened; persons walk unsteadily; windows and dishes break; objects fall off shelves and pictures fall off walls; furniture moves or overturns; weak masonry cracks; small bells ring; trees and bushes shake	6	0.03 to 0.09g
VII	Difficult to stand; noticed by car drivers; furniture breaks; damage moderate in well built ordinary structures; poor quality masonry cracks and breaks; chimneys break at roof line; loose bricks, stones, and tiles fall; waves appear on ponds and water is turbid with mud; small earthslides; large bells ring	7	0.07 to 0.22g
VIII	Automobile steering affected; some walls fall; twisting and falling of chimneys, stacks, and towers; frame houses shift if on unsecured foundations; damage slight in specially designed structures, considerable in ordinary substantial buildings; changes in flow of wells or springs; cracks appear in wet ground and steep slopes		0.15 to 0.3g
IX	General panic; masonry heavily damaged or destroyed; foundations damaged; serious damage to frame structures, dams and reservoirs; underground pipes break; conspicuous ground cracks	8	0.3 to 0.7g
X	Most masonry and frame structures destroyed; some well built wooden structures and bridges destroyed; serious damage to dams and dikes; large landslides; rails bent		0.45 to 1.5g
XI	Rails bent greatly; underground pipelines completely out of service		0.5 to 3g
XII	Damage nearly total; large rocks masses displaced; objects thrown into air; lines of sight distorted	8+	0.5 to 7g

[a] Intensity is a unitless expression of observed effects.
[b] Magnitude is an exponential function of seismic wave amplitude, related to the energy released.
[c] Acceleration is expressed in relation to the earth's gravitational acceleration (g).
Source: ICSSC 1985a; PPI 1994a.

data available for the soils found at the proposed TSS. Generally, the soils are acceptable for standard construction techniques and consist of wind-blown sand and silt lying in patches over a bedrock of basaltic lava. These soils have a low-to-moderate water erosion hazard and a moderate-to-high wind erodibility. Shrink-swell potential is generally low-to-moderate.

4.2.2.6 *Biotic Resources*

The following describes biotic resources at INEL including terrestrial resources, wetlands, aquatic

resources, and threatened and endangered species. Within each biotic resource area, the discussion focuses first on INEL as a whole and then on the proposed TSS. Scientific names of species identified in the text are presented in appendix C. Also presented in appendix C is a list of threatened and endangered species that may be found on the site or in the vicinity of INEL.

Terrestrial Resources. INEL lies in a cool desert ecosystem dominated by shrub-steppe communities. Most land within the site is relatively undisturbed and provides important habitats for species native to the region. Facilities and operating areas occupy 2 percent of INEL; approximately 60 percent of the areas around the periphery of the site is grazed by sheep and cattle (DOE 1992e:4-76). Although sagebrush communities occupy about 80 percent of INEL, a total of 20 plant communities have been identified (figure 4.2.2.6–1). The interspersion of low and big sagebrush communities in the northern portion of INEL, and the juniper communities located in the northwestern and southeastern portions of the site, are considered sensitive habitats (IN DOE 1986a:4,8). The former provides critical winter and spring range for sage grouse and pronghorn, while the latter is important to nesting raptors and songbirds. These sensitive habitats are located no closer than 8 miles from the proposed TSS. Riparian vegetation, primarily cottonwood and willow, along the Big Lost River and Birch Creek also provides nesting habitat for hawks, owls, and songbirds (DOE 1992e:4-76). In total, 399 plant species have been documented on INEL (IN DOE 1978a:129-223; IN DOE 1984a).

Within the proposed TSS, shallow soils (which occupy most of the area) are dominated by big sagebrush. In low-lying areas of deep soil, the dominant vegetation is perennial grasses. Isolated stands of juniper also exist in the area (DOE 1992e:4-76). Cheatgrass, an aggressive European annual which readily replaces native species in disturbed areas, is also present.

INEL supports numerous animal species, including 1 amphibian, 9 reptile, 184 bird, and 37 mammal species (DOE 1992e:4-76). Common animals on INEL include the short-horned lizard, gopher snake, sage sparrow, Townsend's ground squirrel, and black-tailed jackrabbit. Important game animals include the sage grouse, mule deer, elk, and pronghorn. During some winters 4,500 to 6,000 pronghorn, or about 30 percent of Idaho's total population, may be found on INEL. Pronghorn wintering areas are located in the northeastern portion of the site, in the area of the Big Lost River sinks, in the west central portion of the site along the Big Lost River, and in the south central portion of the site (IN DOE 1978a:222). The latter two areas are both about 4 miles from the proposed TSS. Hunting is permitted only within one-half mile of the northern site boundary. Pronghorn, which is the only species taken, are hunted in order to control damage to agricultural land (INEL 1992a:2). Numerous raptors and carnivores are also found on INEL and include the golden eagle and prairie falcon, and coyote and mountain lion, respectively (IN DOE 1986a:7). A variety of migratory birds has been found at INEL. Migratory birds, their nests and eggs, are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Extensive wildlife surveys of the proposed TSS have not been conducted. However, due to the similarity of habitat conditions on the site to other areas of INEL, animal species composition would be expected to closely resemble that of the rest of INEL. Pronghorn use of the area is relatively low (DOE 1992h:4-76).

Wetlands. The Big Lost River spreading areas and Big Lost River sinks are seasonal wetlands and are located approximately 10 miles southwest and 12 miles north of the proposed TSS, respectively (figure 4.2.2.4–1). These areas can provide more than 2,000 acres of wetland habitat during wet years. Riparian wetland vegetation exists along the Big Lost River and along Birch Creek. Plants found along the Big Lost River, which is located 1.5 miles west of the proposed TSS, are in poor condition due to recent years of only intermittent flows. The river has flowed onsite most recently in 1986 and 1993.

National Wetland Inventory maps prepared by the U.S. Fish and Wildlife Service (USFWS) have been completed for most of INEL. The National Wetland Inventory maps indicate that the primary wetland areas are associated with the Big Lost River, the Big Lost River Spreading Areas, and the Big Lost River sinks (figure 4.2.2.4–1), although smaller (less than 1 acre) isolated wetlands also occur. Wetlands associated with the Big Lost River are classified as riverine/intermittent, indicating a defined stream channel

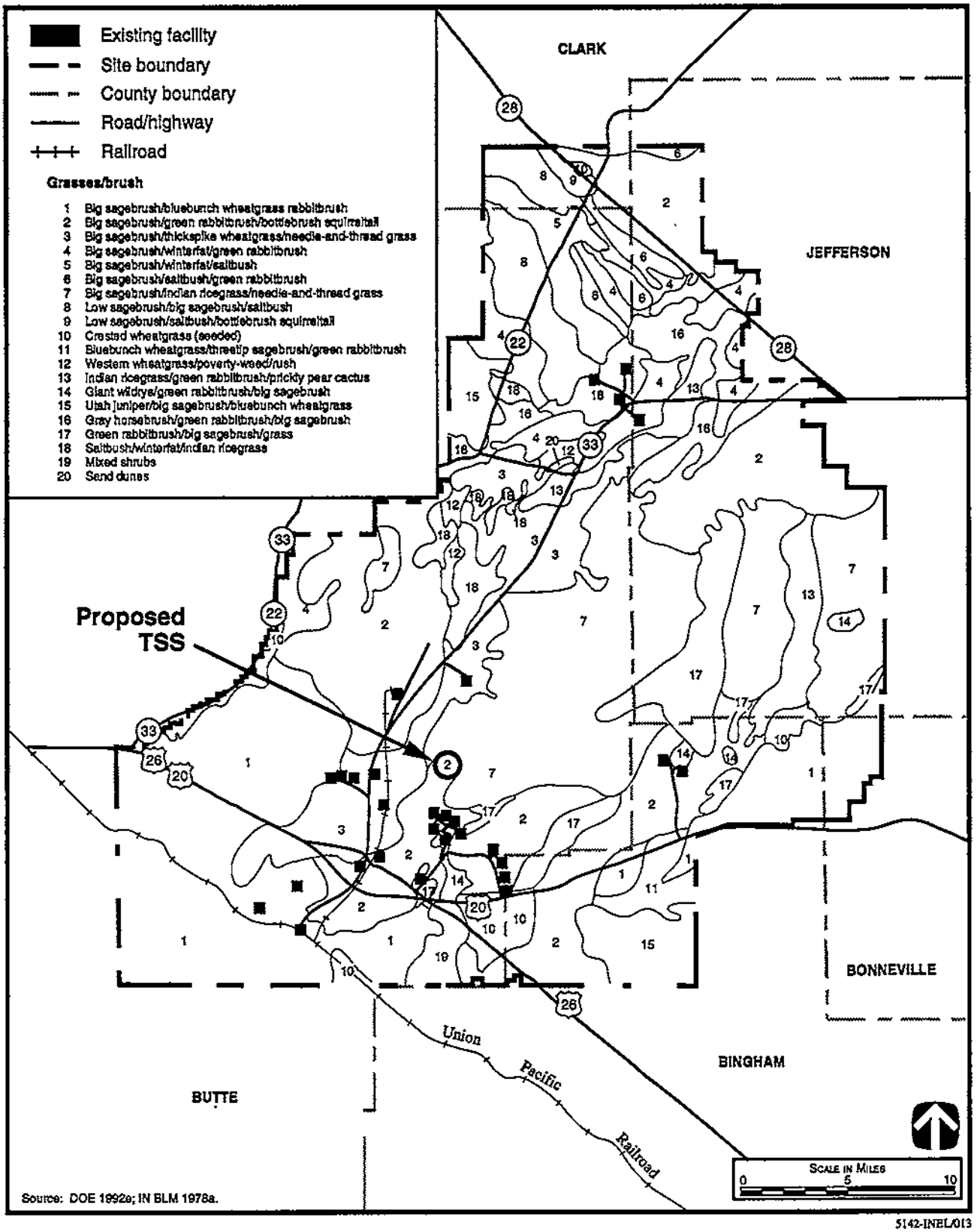


FIGURE 4.2.2.6–1.—*Distribution of Plant Communities at Idaho National Engineering Laboratory.*

with flowing water during only part of the year. The National Wetland Inventory maps indicate that there are no designated wetlands in the area of the proposed TSS.

Aquatic Resources. Aquatic habitat is limited to the Big Lost River, Little Lost River, Birch Creek, and a number of liquid-waste disposal ponds (figure 4.2.2.4–1). All three streams are intermittent and drain into 4 sinks in the north-central part of INEL. Five species of fish have been observed in the Big Lost River including trout, mountain whitefish, speckled dace, shorthead sculpin, and kokanee salmon (DOE 1992e:4-78; DOE 1992h:6-11). Due to drought and upstream diversions, the Big Lost River has flowed onto the site only once since 1986 (i.e., in 1993).

The Little Lost River, located west of the site, and Birch Creek, located north of the proposed TSS, enter INEL only during periods of high flow (IN DOE nda:22). Surveys of fish in these surface water bodies have not been conducted. The liquid waste disposal ponds on INEL, while considered aquatic habitat, do not support fish (INEL 1992a:4). No aquatic habitat occurs on the proposed TSS, located about 1.5 miles east of the Big Lost River.

Threatened and Endangered Species. Twenty-five Federal- and state-listed threatened, endangered, and other special status species have been identified on and in the vicinity of INEL (appendix table C–2). Five of these species may occur in the vicinity of the proposed TSS (table 4.2.2.6–1). No critical habitat for threatened or endangered species, as defined in the *Endangered Species Act* (50 CFR 17.11; 50 CFR 17.12), exists on INEL (DOE 1992e:4-78).

The pygmy rabbit is common on INEL, but its distribution is patchy (DOE 1994e:4.9–4). The Townsend's western big-eared bat, which roosts in caves on INEL, has not been observed in the area of the proposed TSS, but could potentially occur. The ferruginous hawk is expected to use the proposed site area on a regular basis (DOE 1992e:5-137, 5-138). Nesting habitat exists for the loggerhead shrike, which is found throughout the site. Federal candidate species do not receive legal protection under the *Endangered Species Act*, but USFWS recommends that impacts to these species be considered in project planning since these species may become listed in the future.

The State of Idaho does not maintain a list of threatened or endangered plant species. Plants that are considered rare in Idaho are included in a State Watch List. Only the tree-like oxytheca, listed by the state as a sensitive species, has been found in the area of the proposed TSS (DOE 1992e:4-79).

4.2.2.7 *Cultural and Paleontological Resources*

Prehistoric Resources. Prehistoric site types identified on INEL include residential bases, campsites, rockshelters, hunting blinds, rock alignments, lithic quarries, and limited activity locations including lithic and ceramic scatters, hearths, and concentrations of fire-affected rock. Since 1984, 93 cultural resource surveys have been conducted, and approximately 4 percent of INEL has been inventoried for cultural resources. Of the 803 prehistoric sites that have been recorded, approximately 95 percent are lithic scatters or locations. Most have not been formally evaluated and are considered potentially eligible for the NRHP.

Cultural resources surveys of the proposed TSS and potential access corridors have identified 14 sites with buried remains, 3 stone circle sites, 42 lithic scatters, and 1 prehistoric/historic site (INEL 1991a:4). Approximately 19 percent of the proposed TSS has been intensively surveyed and the remaining area has received only reconnaissance-level study. Based on current studies, additional sites are likely to occur and are regarded as potentially eligible for the NRHP, pending further evaluation.

Historic Resources. About 30 historic resources have been identified; most are related to either agriculture (e.g., homesteads and canals) or ranching (e.g., sheep and cattle camps). The Experimental Breeder Reactor I, the first reactor to achieve a self-sustaining chain reaction using plutonium instead of uranium as the principal fuel component, is listed on the NHRP and is designated a National Historic Landmark. Goodale's Cutoff, a spur of the Oregon Trail, is still recognizable in the southwestern corner of INEL. Various other nuclear reactors and associated buildings, such as those at Auxiliary Reactor Area-I, -II, -III, the Borax Reactor, Materials Test Reactor, Engineering Test Reactor, and the Hot Shop,

TABLE 4.2.2.6–1.—*Federal- and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found On the Site or In the Vicinity of the Proposed Tritium Supply Site at Idaho National Engineering Laboratory*

Species	Status[a]		Known or Potential Habitat/Location
	Federal	State	
Mammals			
Pygmy rabbit	C2	NL	Tall sagebrush clumps
Townsend's western big-eared bat	C2	SSC	Cave roost, forage throughout
Birds			
Ferruginous hawk[b]	C2	SSC	Dry, open country - forage/nest
Loggerhead shrike	C2	NL	Semi-open areas with lookout perch
Plants			
Tree-like oxytheca	NL	S	Sandy areas in sagebrush zone

[a] Status: C2 - candidate, Category 2 (possible appropriate for protection); NL - not listed; S - sensitive (designated by the Idaho Native Plant Society); SSC - state, special concern.

[b] Species known to occur on proposed TSS

Source: 50 CFR 17.11; 50 CFR 17.12; 55 FR 6184; 56 FR 58804; DOE 1992e; DOE 1994e; IN DFG 1992a; IN DOE 1984a.

are considered eligible for the NRHP (INEL 1991a:1). Although such facilities are not 50 years old, they are of exceptional scientific and engineering significance and have played major roles in the development of nuclear science since World War II.

Only one site with historic content has been identified on the proposed TSS. The historic content consists of early household debris and may be potentially eligible for the NRHP, pending further evaluation. Based on current studies, additional historic sites are likely to occur in unsurveyed portions of the proposed TSS.

Native American Resources. At the time of Euro-American contact, the area was inhabited by nomadic hunters and gatherers consisting of two linguistically distinct groups: the Shoshone and the Bannock. Horses enabled the Shoshone and the Bannock to increase their foraging range, congregate in larger groups, and protect their possessions from other groups. Winter camps were reportedly scattered along major river drainages. Groups dispersed during the other seasons, probably moving across what is now INEL as they utilized floral and faunal resources and obsidian from Big Southern Butte or Howe Point.

Important Native American resources that might be found in the proposed TSS include buttes, caves, village shrines, rock art, burials, and vision quest sites. It is worth noting that many natural resources at INEL are viewed as cultural resources by Native Americans. As one example, sagebrush is used as a tool, and for clothing and medicinal purposes. INEL recently initiated general consultation with the Shoshone and Bannock tribes. While specific sites or traditional use areas have not yet been identified, the Shoshone and Bannock tribes consider INEL part of their ancestral homeland and have expressed support for the use of scientific methods to preserve cultural resources.

Paleontological Resources. No paleontological localities have been identified within the proposed TSS. No lava tubes, caves, or rock shelters that might be expected to contain fossils are visible on the surface. However, lava tubes and caves containing paleontological materials may be buried beneath the aeolian sediments. Because these assemblages may contain both vertebrate and floral remains, such localities would have high research potential.

4.2.2.8 *Socioeconomics*

Socioeconomic characteristics described for INEL include employment and local economy, population, housing, public finance, and local transportation. Statistics for economy characteristics are presented for the regional economic area that encompasses 13 counties around INEL (appendix table D.2.1–2). The regional economic area is a broad labor and product market-based region linked by trade among

economic sectors within the region. Statistics for population and housing, public finance, and local transportation are presented for the ROI, a 5-county area in which 98 percent of all INEL employees reside: Bannock County (5 percent), Bingham County (9 percent), Bonneville County (76 percent), Butte County (2 percent), and Jefferson County (6 percent). (See figure 4.2–1 for a map of counties and cities.) Fiscal characteristics of the jurisdictions in the INEL ROI are presented in the public finance section in appendix tables D.3–11 and D.3–12. The school districts most likely to be affected by the proposed action include Arco, Blackfoot, Bonneville, Idaho Falls, Jefferson, Pocatello, Ririe, Shelley, Snake River, and West Jefferson. Assumptions, assessment methodologies, and supporting data are presented in appendix D.

Regional Economy Characteristics. Employment and local economy statistics for the INEL regional economic area are presented in appendix table D.3–2 and summarized in figure 4.2.2.8–1. Between 1970 and 1990, the civilian labor force in the regional economic area increased 53 percent. The unemployment rate in the regional economic area in 1990 was slightly higher than the State of Idaho rate and the 1990 per capita income was slightly lower than the state per capita income.

As shown in figure 4.2.2.8–1, the percentage of total employment involving farming and governmental activities in the regional economic area was approximately the same as in the state. Nonfarm private sector activities of manufacturing, retail trade, and services were similar in the regional economic area and the state overall, except that the state had a higher percentage of employment in manufacturing while the regional economic area had a higher percentage in services.

In 1990, INEL employed 11,100 persons (8.7 percent of the total regional economic area employment), increasing from 6,755 persons in 1970. Historical and future employment at INEL and the distribution of INEL employees by place of residence in the ROI are presented in appendix tables D.2.1–1 and D.3.–1, respectively.

Population and Housing. Population and housing distribution in the ROI is presented in appendix tables D.3–5 and D.3–8 and summarized in figure 4.2.2.8–2. Overall, the percent increase in population in the ROI from 1970 to 1990 was 9 percent lower than the state population increase.

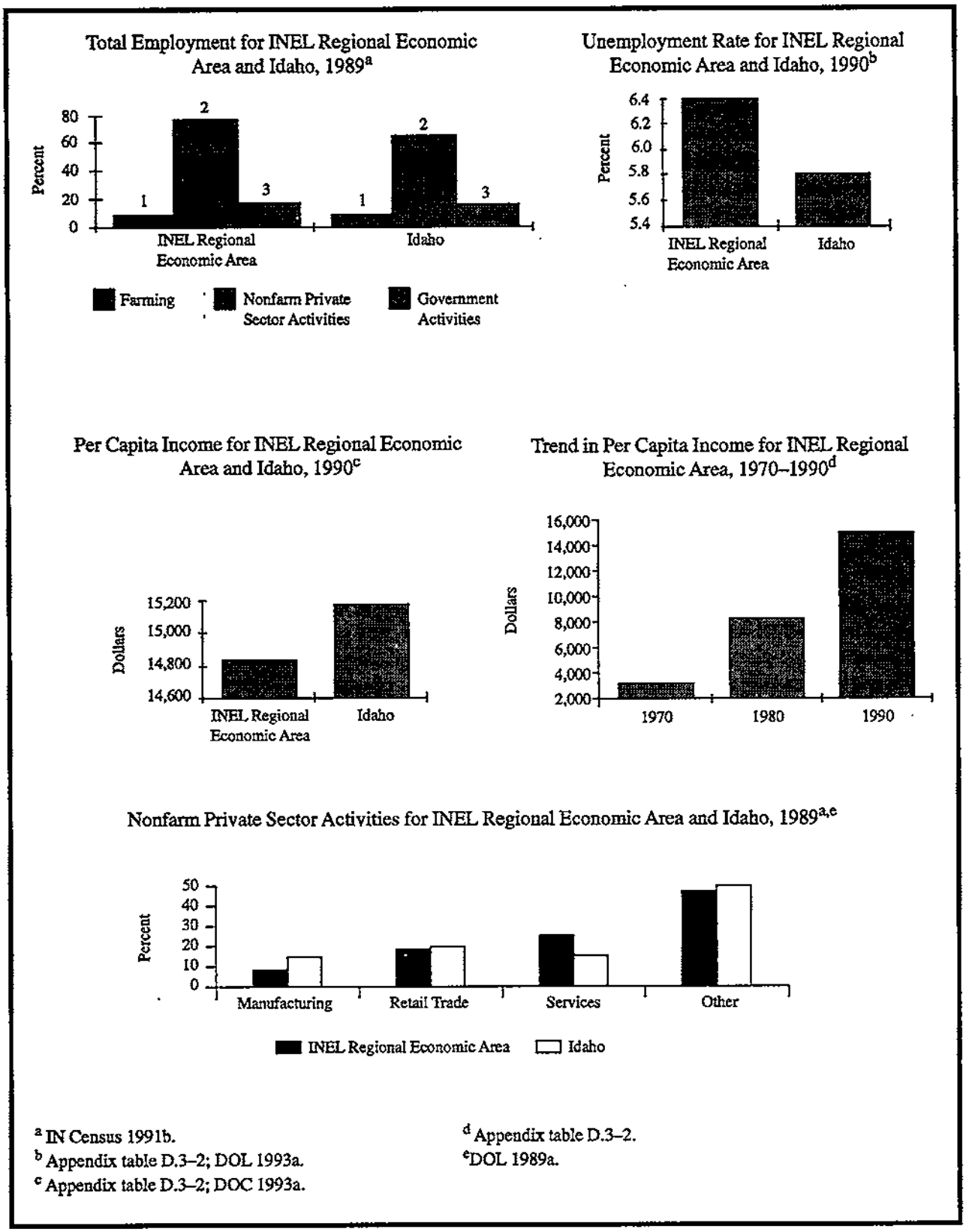
The counties of Bonneville and Jefferson experienced population increases between 1970 and 1990 approximately equal to that of the state, while the counties of Bannock and Bingham experienced a growth rate 15 percent lower than that of the state. Butte County experienced a slight population decrease (less than 1 percent) between 1970 and 1990.

Between 1970 and 1990, housing units in the ROI experienced a slightly lower (8 percent) increase compared to state housing unit increases. Homeowner and rental vacancy rates in the ROI in 1990 were similar to those of the state.

Public Finance. Financial characteristics of the local jurisdictions in the ROI that are most likely to be affected by the proposed action include total revenues and expenditures of each jurisdiction's general fund, special revenue funds, and, as applicable, debt service, capital project, and expendable trust funds. School district boundaries may or may not coincide with county or city boundaries, but the districts are presented under the county where they primarily provide services. Major revenue and expenditure fund categories for counties, cities, and school districts are presented in appendix tables D.3–11 and D.3–12, and figure 4.2.2.8–3 summarizes local governments' revenues less their expenditures.

Local Transportation. Vehicular access to INEL is provided by U.S. Routes 20 and 26 to the south and State Routes 22 and 33 to the north. Both U.S. Routes 20 and 26 and State Routes 22 and 33 share rights-of-way adjacent to INEL (figure 4.2–1). Road segments providing access to INEL experience varying levels of traffic congestion. Potential disruptions to the traffic flow caused by accidents or maintenance activities are usually minor. No major improvements are scheduled for those roadway segments providing immediate access to INEL (figure 4.2.1–1) (IN DOT 1991a).

A fleet of government-owned, contractor-operated passenger buses operates between INEL facilities and communities within the ROI. Approximately 4,000 employees use this transportation daily. The



[a] IN Census 1991b.
[b] Appendix table D.3–2; DOL 1993a.
[c] Appendix table D.3–2; DOC 1993a.
[d] Appendix table D.3–2.
[e] DOL 1989a.

FIGURE 4.2.2.8–1.—*Economy for Idaho National Engineering Laboratory Regional Economic Area.*

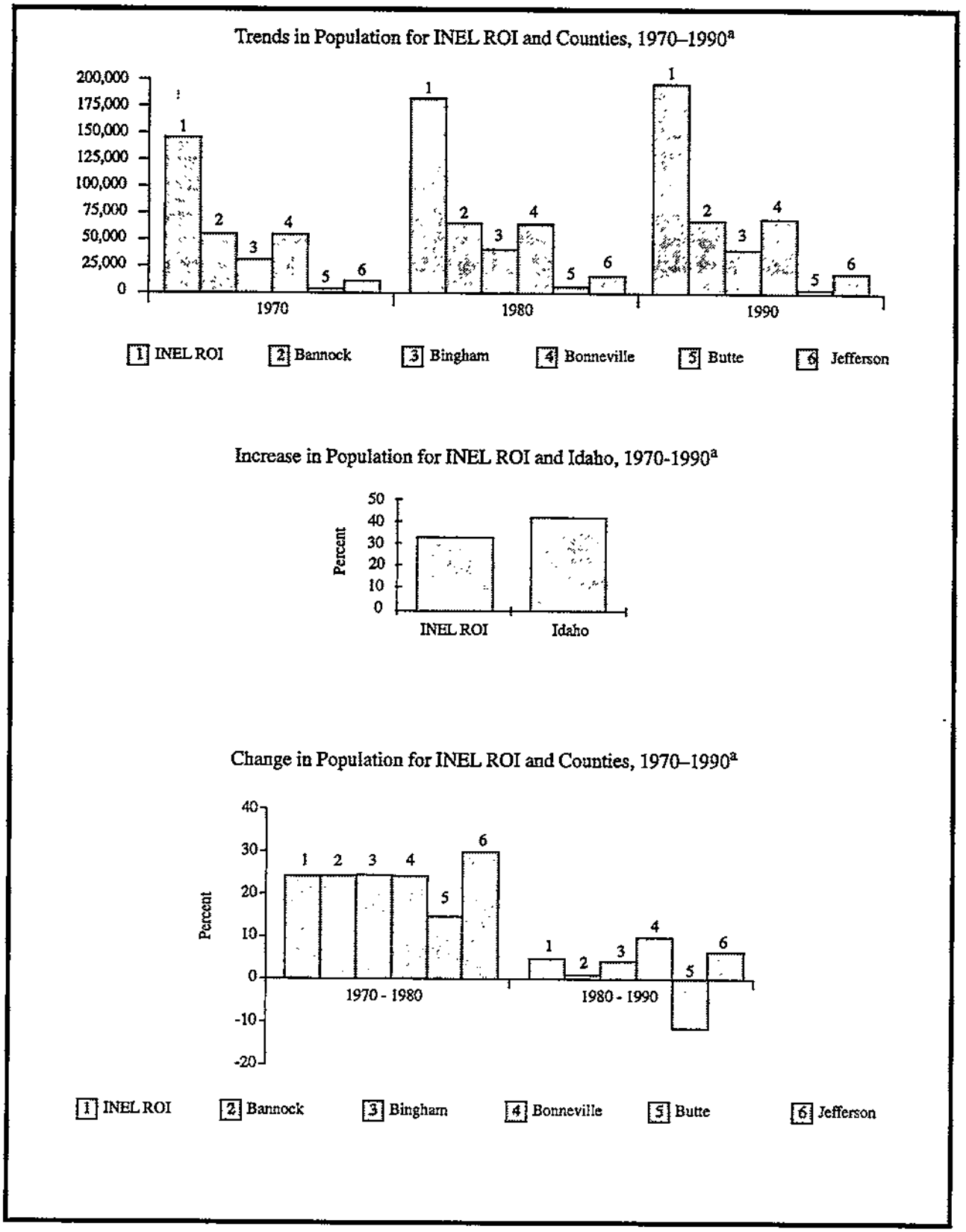
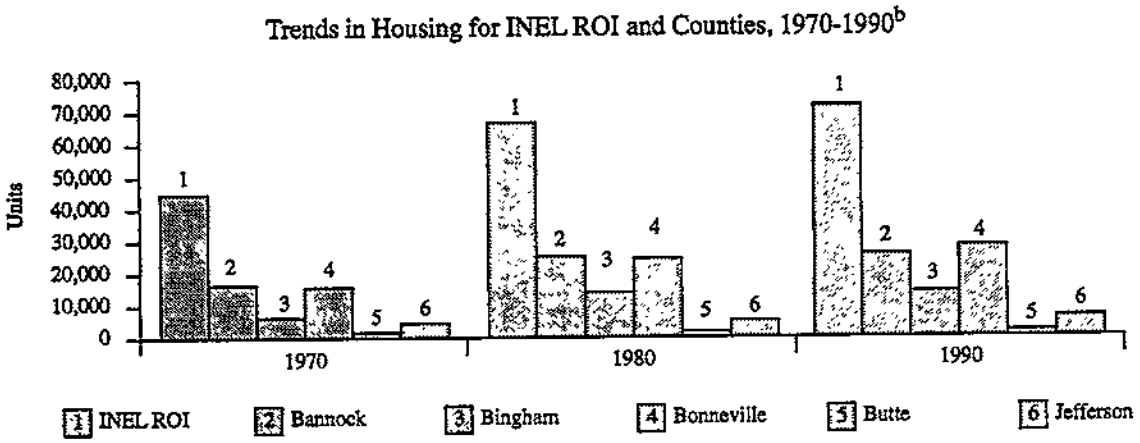
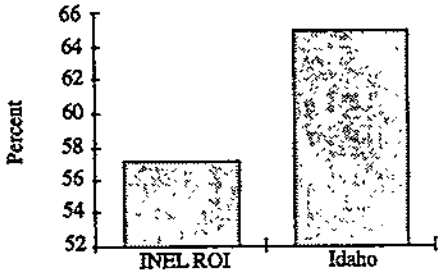
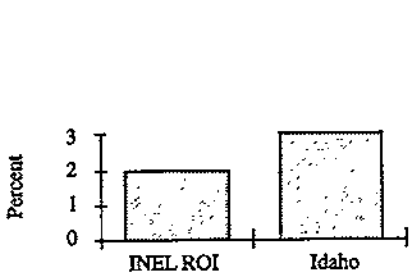
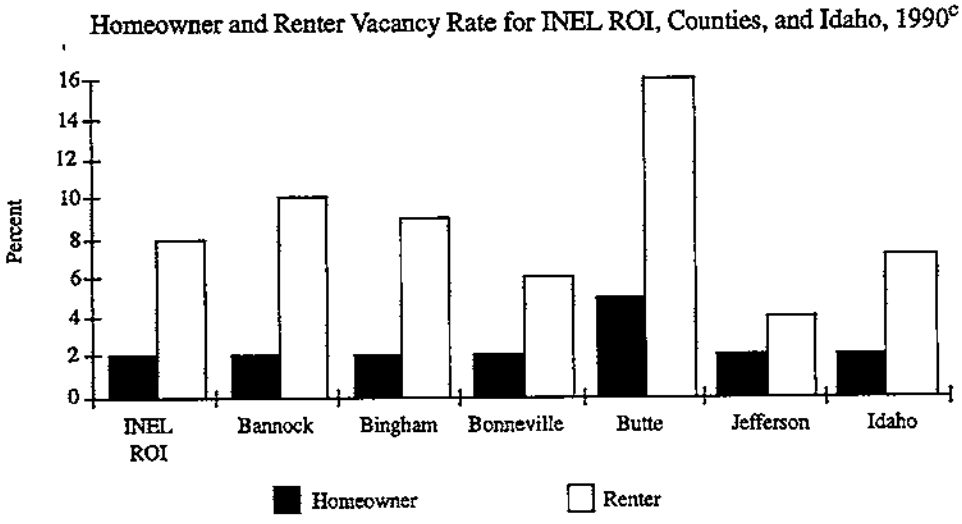


FIGURE 4.2.2.8–2.—*Population and Housing for Idaho National Engineering Laboratory Region of Influence* [Page 1 of 2].









[a] Appendix table D.3–5.
[b] Appendix table D.3–8.
[c] Census 1972a; Census 1982a; IN Census 1991a.

FIGURE 4.2.2.8–2.—*Population and Housing for Idaho National Engineering Laboratory Region of Influence* [Page 2 of 2].

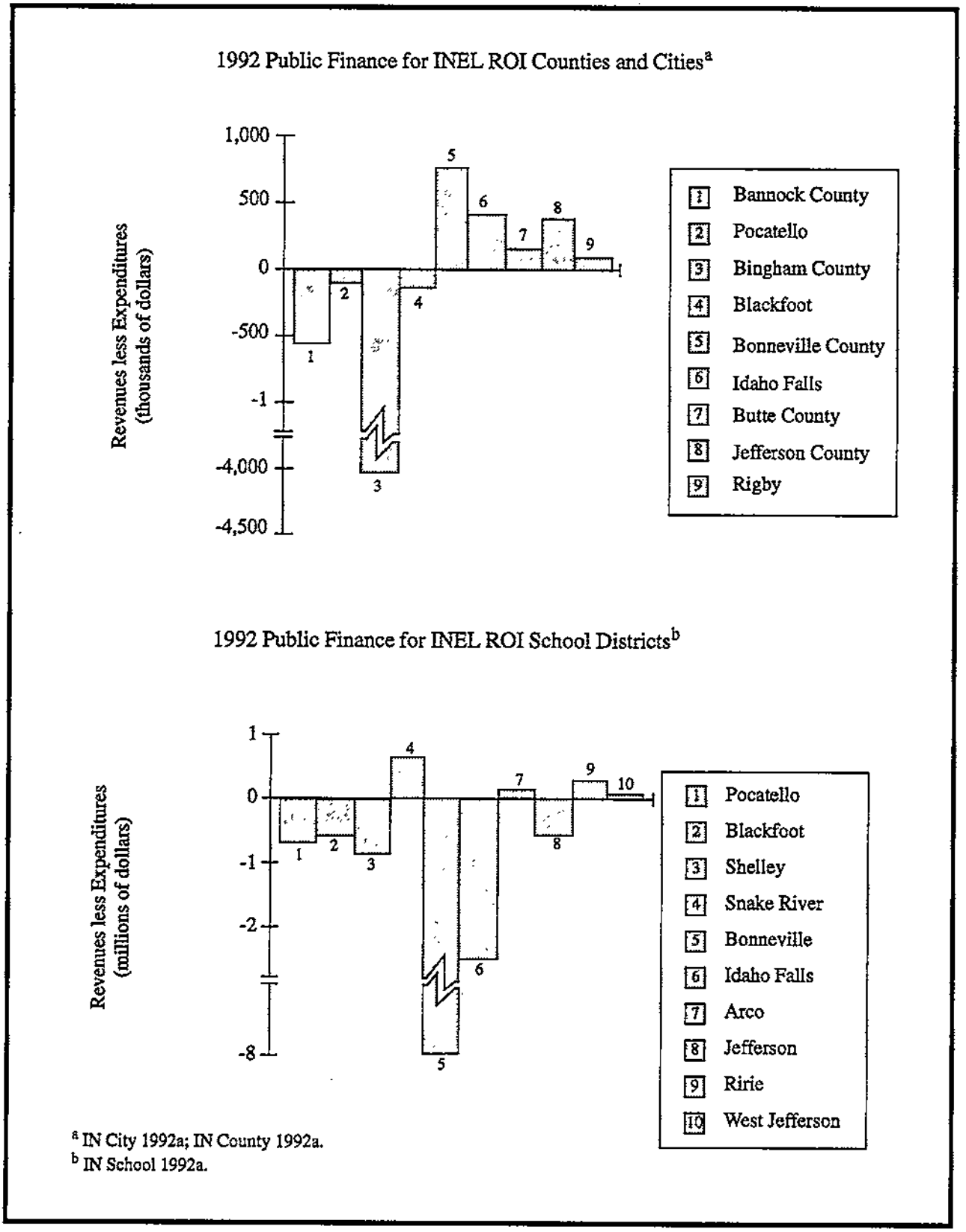


FIGURE 4.2.2.8–3.—*1992 Local Government Public Finance for Idaho National Engineering Laboratory Region of Influence.*

major railroad in the ROI is the Union Pacific Railroad. The railroad's MacKay branch provides rail service to the southern portion of INEL. A DOE-owned spur connects the Union Pacific Railroad to INEL by a junction at Scoville Siding. There are no navigable waterways within the ROI capable of accommodating waterborne transportation of material shipments to INEL.

Fanning Field in Idaho Falls and Pocatello Municipal Airport in Pocatello provide jet air passenger and cargo service from both national and local carriers. Numerous smaller private airports are located throughout the ROI (IN DOT 1991a).

4.2.2.9 *Radiation and Hazardous Chemical Environment*

The following provides a description of the radiation and hazardous chemical environment at INEL. Also included are discussions of health effects studies, emergency preparedness considerations, and an accident history.

Radiation Environment. Major sources of background radiation exposure to individuals in the vicinity of INEL are shown on table 4.2.2.9–1. All annual doses to individuals from background radiation are expected to remain constant over time. Accordingly, the incremental total dose to the population would result only from changes in the size of the population. Background radiation doses are unrelated to INEL operations.

Releases of radionuclides to the environment from INEL operations provide another source of radiation exposure to individuals in the vicinity of INEL. The radionuclides and quantities released from INEL operations in 1992 are listed in *The Idaho National Laboratory Site Environmental Report for Calendar Year 1992* (DOE/ID-12082 (92)). The doses to the public resulting from these releases are presented in table 4.2.2.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1992 report were used in the development of the reference environment (No Action) radiological releases at INEL in the year 2010 (section 4.2.3.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (appendix section E.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from INEL operations in 1992 is estimated to be approximately 2.0×10^{-9}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of INEL operations is about 2 chances in 1 billion. (Note that it takes several to many years from the time of exposure to radiation for a cancer to manifest itself.) Approximately 1.5×10^{-5} excess fatal cancers were estimated from normal operations in 1992 to the population living within 50 miles of INEL. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate, associated with cancer, for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national mortality rate, the number of fatal cancers from all causes expected during 1992 in the population living within 50 miles of INEL was 243. This number of expected fatal cancers is much higher than the estimated 1.5×10^{-5} fatal cancers that could result from INEL operations in 1992.

Workers receive the same dose as the general public from background radiation, but also receive an addi-

TABLE 4.2.2.9–1.—*Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Idaho National Engineering Laboratory Operations, 1992*

Source	Committed Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic radiation	39
External terrestrial radiation	74
Internal terrestrial radiation	40
Radon in homes (inhaled)	200
Other Background Radiation[b]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	418

[a] IN DOE 1993b. Value for radon is an average for the United States.
[b] NCRP 1987a.

TABLE 4.2.2.9–2.—*Doses to the General Public from Normal Operations at Idaho National Engineering Laboratory, 1992 (committed effective dose equivalent)*

Affected Environment	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual[b]	Standard[a]	Actual[b]	Standard[a]	Actual
Maximally exposed individual (mrem)	10	0.004	4	0	100	0.004
Population within 50 miles[c] (person-rem)	None	0.03	None	0	100	0.03
Average individual within 50 miles[d] (mrem)	None	0.00025	None	0	None	0.00025

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem per year limit from airborne emissions is required by the *Clean Air Act*, the 4 mrem per year limit is required by the *Safe Drinking Water Act*, and the total dose of 100 mrem per year is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 58 FR 16268 (10 CFR 834). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] IN DOE 1993b.

[c] In 1992, this population was approximately 121,500.

[d] Obtained by dividing the population dose by the number of people living within 50 miles of the site.

tional dose from working in the facilities. Table 4.2.2.9–2 includes the average, maximum, and total occupational doses to INEL workers from operations in 1992. These doses fall within radiological limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (appendix section E.2), the number of excess fatal cancers to INEL workers from operations in 1992 is estimated to be 0.030.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in *The Idaho National Laboratory Site Environmental Report for Calendar Year 1992* (DOE/ID-12082(92)). The concentrations of radioactivity in various environmental media (air, water, and soil) in the site region (onsite and offsite) are also presented in that document.

TABLE 4.2.2.9–3.—*Doses to the Worker Onsite from Normal Operations at Idaho National Engineering Laboratory, 1992 (committed effective dose equivalent)*

Affected Environment	Onsite Releases and Direct Radiation	
	Standard[a]	Actual[b]
Average worker (mrem)	None	14.2
Maximally exposed worker (mrem)	5,000	1,000
Total workers (person-rem)	None	75

[a] 10 CFR 835. DOE's goal is to maintain radiological exposure as low as reasonably achievable.

[b] DOE 1993n:7. The number of badged workers in 1992 was approximately 5,270.

INEL operations contribute negligible radioactivity to these media.

Chemical Environment. The background chemical environment important to human health consists of: the atmosphere, which may contain toxic chemicals which can be inhaled; drinking water, which may contain toxic chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., surface waters during swimming and soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in sections 4.2.2.3 and 4.2.2.4.

Health impacts to the public can be minimized through effective administrative and design controls for decreasing pollutant releases to the environment and achieving compliance with permit requirements, (e.g., air emissions and NPDES permit requirements). The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operation via inhalation of air containing pollutants released to the atmosphere by INEL operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway. The risk to public health from water ingestion and direct exposure pathways is low because the surface water resource (Big Lost River) is not used either for drinking or as a receptor for wastewater discharges

and because monitoring of groundwater contaminated from INEL operations indicates contamination is generally below threshold levels of concentration. If concentrations are above threshold levels of concentration, appropriate treatment is performed.

Baseline air emission concentrations for hazardous/toxic air pollutants and their applicable standards are presented in section 4.2.2.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous/toxic chemicals is presented in appendix section E.3.

Health impacts to INEL workers during normal operation may include those from: inhalation of the workplace atmosphere, drinking INEL potable water, and possible other contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. INEL workers are also protected by adherence to occupational standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Monitoring ensures that these standards are not exceeded. Additionally, DOE requirements (DOE Order 3790.1B) ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at INEL are expected to be substantially better than required by the standards.

Health Effects Studies. Two epidemiological studies have been conducted on the communities that surround INEL to determine if there are any excess cancers in the general population; no occupational epidemiological studies have been conducted at INEL to date. No excess cancer mortality was reported, although excess cancer incidence was observed. However, no association of the excess cancer incidence with INEL was established. For a more detailed description of the study findings reviewed, refer to appendix section E.4.2.

Accident History. A recent study was conducted by DOE *Idaho National Engineering Laboratory Historical Dose Evaluation* (DOE/ID-12119) to estimate the potential offsite radiation doses for the entire operating history of INEL. Releases resulted from a variety of tests and experiments as well as a few accidents at INEL. The study concluded that these releases have made a substantial contribution to the total radiation dose during test programs of the 1950s and early 1960s. The frequency and size of releases has declined since that time. Based on information reported in the study, there have been no serious unplanned or accidental releases of radioactivity or other hazardous substance at INEL facilities in the last 10 years of operation.

Emergency Preparedness. In the event of an accident, each DOE site has established an emergency management program. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response. Section 4.1.9 provides a description of DOE's emergency preparedness program.

Participating government agencies whose plans are interrelated with the INEL Emergency Plan for Action include the State of Idaho, Bingham County, Bonneville County, Butte County, Clark County, Jefferson County, the Bureau of Indian Affairs, and Fort Hall Indian Reservation. INEL contractors are responsible for responding to emergencies that occur at their facilities. When an emergency condition exists at a contractor facility, the Emergency Action Director is responsible for recognition, classification, notifications, and protective action recommendations. At INEL, emergency preparedness resources include fire protection from onsite and offsite locations and radiological and hazardous chemical material response. Emergency response facilities include an emergency control center at each facility, the INEL warning communication center, and the INEL site emergency operations center. There are also seven INEL medical facilities available to

provide routing and emergency service (INEL 1991a:2).

4.2.2.10 *Waste Management*

This section outlines the major environmental regulatory structure and ongoing waste management activities for INEL. A more detailed discussion of the ongoing waste management operations is provided in appendix section H.2.1. Table 4.2.2.10–1 presents a summary of waste management activities at INEL for 1992.

The Department is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at INEL. The Department is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed upon milestones.

EPA placed INEL on the NPL on December 21, 1989. DOE has entered into a Federal Facility Agreement and Consent Order with EPA and the State of Idaho to coordinate cleanup activities at INEL under a comprehensive strategy. This agreement integrates DOE's CERCLA response obligations with RCRA and *Hazardous Waste Management Act* corrective action obligations. In this process, INEL has been divided into 10 waste area groups. Each group is subdivided into separate operable units which are groupings of potential release sites that are considered together for assessment and cleanup activities. Ongoing assessments are characterizing the nature and extent of contamination. Aggressive plans are in place to achieve early remediation of sites that represent the greatest risk to workers and the public. The goal is to complete remediation of contaminated sites at INEL to support delisting from the NPL by 2019.

INEL manages spent nuclear fuel and the following waste categories: high-level, transuranic (TRU), low-level, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

Spent Nuclear Fuel. Spent nuclear fuel had been stored and processed at the Idaho Chemical Processing Plant. Processing was terminated with DOE's decision not to reprocess spent nuclear fuel to recover useful isotopes. INEL has received spent fuel from Three Mile Island, reactor tests, and the gas-cooled reactor and naval reactors programs. Spent nuclear fuel from these programs and from reactor experiments at INEL is in storage in various locations. The bulk of the fuel is stored at the Idaho Chemical Processing Plant. Interim management of the spent nuclear fuel (pending the availability of a geologic repository) will be in accordance with the ROD published in the *Federal Register* (60 FR 28680) on June 1, 1995, for the *DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs EIS* (DOE/EIS-0203-F). Preparations will be made to implement the ROD and consolidate nonaluminum clad spend nuclear fuel at INEL on a basis consistent with risk priorities and budget constraints.

High-Level Waste. High-level waste (HLW) at INEL was generated in the process of extracting useful isotopes from spent nuclear fuel at the Idaho Chemical Processing Plant. Most of this fuel was from the naval reactors program. Most aqueous solutions from spent fuel processing and isotope extraction were concentrated by evaporation and separated into low-level and high-level waste streams in the Process Equipment Waste Evaporator. The liquid HLW is stored in subsurface tanks and then transformed into solid metallic oxides in a granular form by calcination. The majority of the waste in storage tanks contains sodium and cannot be calcined directly. New equipment is being installed to permit resumption of calcination in 1996. The calcine is stored in stainless steel bins in near-surface concrete vaults where it awaits further processing into a form suitable for emplacement in a Federal repository. Technologies are being tested that would convert the calcine into an immobilized form suitable for storage under RCRA Land Disposal Restrictions, and meeting waste acceptance criteria for a Federal repository. The Idaho Operations Office has prepared a No-Migration Variance Petition to be submitted to EPA for the continued storage of calcine. Calcination will continue and new storage facilities will be added as necessary until all the liquid HLW is stabilized.

Transuranic Waste. TRU wastes are stored at the Radioactive Waste Management Complex. The inventory represents more than one-half of the total

TABLE 4.2.2.10–1.—*Spent Nuclear Fuel and Waste Management at Idaho National Engineering Laboratory* [Page 1 of 2]

Category	1992 Generation (yd^3)	Treatment Method	Treatment Capacity (yd^3/yr)	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity (yd^3)
Spent Nuclear Fuel	0.4 metric ton heavy metal[a]	Conditioning and stabilization	Under assessment[b]	Pools, dry facility	Under assessment[b]	None, federal repository in the future	None
High-level							
Liquid	1,570 (317,059 gal)	Evaporation, calcination	3,000 (606,000 GPY)	Tank farm, after evaporation prior to calcination	17,500 (3,530,000 gal)	NA	NA
Solid[c]	None	Under development	Planned	Bins inside concrete vaults	9,267	None, federal repository in the future	None
Transuranic							
Liquid	None	NA	NA	NA	NA	NA	NA
Solid	1	Under development	Expandable as required	Asphalt pads and vaults in the ground or under earthen cover or tarps	Under assessment[b]	None, federal repository in the future	None
Low-level							
Liquid	None	Evaporation	15,993 (3,230,365 GPY)	Tank farm after evaporation prior to calcination	Included in HLW	NA	NA
Solid	14,757	Incineration and compaction	2,300	NA	NA	Onsite burial	235,345[d]
Mixed							
Liquid	6.6 (1,341 gal)	Evaporation, fractionation, and calcination	14,400 (2,900,000 GPY)	Tank farm	Included in HLW	None	None
Solid	67	Incineration and compaction[d]	64,900	Mixed waste and WERF storage facilities, radioactive sodium storage facilities	2,300	None	None

TABLE 4.2.2.10–1.—*Spent Nuclear Fuel and Waste Management at Idaho National Engineering Laboratory* [Page 2 of 2]

Category	1992 Generation (yd^3)	Treatment Method	Treatment Capacity (yd^3/yr)	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity (yd^3)
Hazardous							
Liquid	Included in solid	Offsite and percolation ponds	Under assessment[b]	Percolation ponds	Under assessment[b]	Offsite[f]	NA
Solid	1,092[c]	Offsite	NA	Hazardous waste storage facility	Under assessment[b]	Offsite[f]	NA
Nonhazardous (Sanitary)							
Liquid	66,446 (13,422,173 gal)	Percolation ponds	NA	NA	NA	NA	NA
Nonhazardous (Other)							
Liquid	Included in sanitary	Recycle	NA	NA	NA	NA	NA
Solid	81,058	Segregate and recycle	NA	NA	NA	Industrial and asbestos waste landfills	2,400,000 to 4,000,000[g]

[a] Does not include naval reactor fuel; data not available.

[b] Capacity will be developed to implement the ROD (60 FR 28680) from the *DOE Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs EIS* to consolidate non-aluminum clad spent fuel at INEL.

[c] Solid HLW produced by calcination of liquid HLW.

[d] 48,000 yd^3 available as of 1991. Additional 88,000 yd^3 expansion capacity potentially available.

[e] 980 yd^3 recyclable.

[f] DOE has placed a moratorium on shipping any hazardous waste that could possibly be contaminated with radioactive components. The moratorium will not be lifted until procedures are in place to minimize liability posed by offsite disposal.

[g] Remaining capacity.

Note: WERF - Waste Experimental Reduction Facility; NA - not applicable.

Source: DOE 1992f; DOE 1993d; DOE 1993f; DOE 1994f; IN DOE 1992b; IN DOE 1992c; INEL 1993a:1; INEL 1993a:2; INEL 1993a:5.

DOE inventory. There is very little TRU waste generation at INEL. Most of the TRU waste in storage was received from the Rocky Flats Environmental Technology Site (formerly known as the Rocky Flats Plant). Since 1989, there has been a moratorium on the receipt of TRU wastes from out-of-state facilities; however, shipments may be accepted on a case-by-case basis. TRU wastes are currently being stored pending the outcome of the Waste Isolation Pilot Plant (WIPP) Test Program to determine the suitability of WIPP to serve as a repository for these wastes. Assuming WIPP is determined to be a suitable repository for these wastes, pursuant to the requirements of 40 CFR 191 and 40 CFR 268, these wastes will be treated to meet the WIPP Waste Acceptance Criteria and packaged in accordance with DOE and NRC requirements for transport to WIPP for disposal.

Prior to 1970, when the Atomic Energy Commission required segregation of TRU waste from other wastes, TRU wastes were buried in earthen trenches at the Radioactive Waste Management Complex. This waste must be retrieved and repackaged to meet the current WIPP Waste Acceptance Criteria. Wastes generated or received from offsite since 1970 are stored in a form designed for eventual retrieval. Since 1972, TRU wastes have been stored on Pad A in the Radioactive Waste Management Complex. Most of this waste will require certification and repackaging. A new facility, the Idaho Waste Processing Facility, is being designed to accomplish this task. Some waste has radioactivity levels high enough that there are no certified or licensed transportation capabilities for it. Further study will be required for its eventual disposal. While the EPA has issued a Notice of Noncompliance for TRU waste stored at the Radioactive Waste Management Complex, a proposed plan for the treatment and storage of TRU wastes has been documented in the Federal Facility Agreement and Consent Order, which addresses EPA and State of Idaho concerns, while also meeting DOE's concerns for worker protection.

Most of the mixed TRU waste at INEL requires retrieval, treatment, and repackaging in order to meet the WIPP Waste Acceptance Criteria. Additional facilities at other areas of INEL are planned for the treatment of mixed waste, rendering it acceptable for disposal. The specifics of their Site Treatment Plan will be detailed pursuant to the requirements of the Federal Facility Compliance Act and as negotiated with the State of Idaho and EPA. Some of the waste now handled as TRU or mixed TRU is alpha-contaminated LLW and mixed LLW. A strategy for treatment and disposal of this waste has yet to be established. Onsite and offsite treatment is being investigated.

Low-Level Waste. The bulk of LLW generated at INEL is the result of work in contaminated areas, and consists of materials such as rags, bags, scrap metal, and used protective clothing. A large volume of LLW is generated in the decontamination and decommissioning activities associated with environmental restoration. These materials must be treated by the operating facility to meet the waste acceptance criteria of the receiving facility, and their conformity to these criteria must be inspected by the receiving facility. Solid LLW at INEL is sent to the Waste Experimental Reduction Facility for compaction, sizing, incineration, and stabilization prior to shipment for disposal at the Radioactive Waste Management Complex. The Waste Experimental Reduction Facility, shut down while undergoing a revision of processes and procedures, is currently in startup and is expected to be in operation in 1996.

Mixed Low-Level Waste. The volume of mixed LLW waste generated at INEL is small. This mixed waste is stored in several areas onsite awaiting treatment capacities to be developed to treat the specific nature of a wide variety of different mixed waste streams. Organic mixed LLW is planned to be processed through the Waste Experimental Reduction Facility incinerator to the established Land Disposal Restrictions treatment standards. The resulting ash will be immobilized and disposed of as LLW. The use of commercial treatment facilities is also being considered. Large volumes of wastewater are processed in the Process Equipment Waste Evaporator, resulting in a concentrated mixed waste that is sent to the HLW tank farm and eventually stabilized in a fluidized bed calciner. Condensate from the Process Equipment Waste Evaporator is converted into a concentrated acidic solution in the Liquid Effluent Treatment Facility. This concentrate is either recycled as a scrubber solution for the calciner or sent to the HLW tank farm for storage. The Liquid Effluent Treatment Facility eliminates residual discharge of hazardous/radioactive contaminants into wastewater percolation ponds, which was the former

practice, in accordance with a Consent Order signed on October 7, 1992. Stored and newly generated mixed LLW will be treated at the Waste Experimental Reduction Facility incinerator, the Nonincinerable Mixed Waste Treatment Project, and the Sodium Processing Facility through generator treatment plans developed under 40 CFR 262.34.

Hazardous Waste. Hazardous wastes are generated at the widely separated facilities at INEL and sent to the Hazardous Waste Storage Facility in the Central Facilities Area. There it is staged for shipment offsite to commercial RCRA-permitted treatment and disposal facilities. DOE has temporarily prohibited offsite shipments pending development of a system for the certification that the wastes have no radioactive content (are not mixed waste). Facilities to convert sodium hydroxide to a disposable waste form are planned at Argonne National Laboratory-West.

Nonhazardous Waste. Nonhazardous waste generated at INEL facilities is disposed of onsite in a landfill complex in the Central Facilities Area and at the Bonneville County landfill. The current landfill complex contains separate areas for sanitary, industrial, and asbestos waste. In accordance with terms of the Consent Order dated October 7, 1992, sewage is directed to surface impoundments and the water is allowed to evaporate. The resulting sludge is placed in the landfill. Solids are separated and reclaimed where possible. The goal of the INEL waste minimization program is to reduce the nonhazardous waste quantities generated by 50 percent over the next 5 years. Continuation of existing programs will require expansion of the industrial/commercial landfill, adding 225 acres to provide capacity for the next 30 years.

4.2.3 Environmental Impacts

This section describes the environmental impacts of constructing and operating various tritium supply technologies and recycling facilities at INEL, which are described in sections 3.4.2 and 3.4.3. The section begins by describing potential impacts to existing and planned facilities at INEL, followed by descriptions of potential impacts and the environmental impacts of the proposed alternatives on potentially affected environmental resources. The section concludes by describing the potential impacts of tritium supply and recycling on human health during normal operation, the consequences of facility accidents, and regulatory considerations and waste management. Each description addresses the effects of No Action and the potential impacts and environmental impacts of constructing and operating any of the tritium supply technologies and collocated recycling facilities or tritium supply facilities alone at INEL.

4.2.3.1 *Land Resources*

Construction and operation of tritium supply and recycling facilities at INEL would affect land resources, including land use and visual resources. Potential impacts to these resources are summarized below.

INEL has sufficient land area to accommodate any of the proposed tritium supply technologies and collocated recycling facilities or tritium supply facilities alone. These facilities would be located within the proposed 600-acre TSS. The construction and operation of any of the facilities would be consistent with the external views of INEL. The following sections present the effects of proposed alternatives on land resources.

Land Use

No Action. Under No Action, no additional land use impacts are anticipated at INEL beyond the effects of existing and future activities that are independent of the proposed action.

Tritium Supply and Recycling. Any one of the tritium supply technologies and collocated tritium recycling facilities (section 3.4) or tritium supply alone could be sited within the proposed TSS (figure 4.2.2.1–1). Land requirements for the tritium facilities are presented in table 4.2.3.1–1. The land area affected ranges from 360 acres for the MHTGR to 173 acres for the APT. An additional 196 acres would be required if the tritium supply facility is collocated with a new recycling facility. Construction and operation of the tritium facilities would be consistent with the INEL Landlord Site Development Plan, and would not affect prime farmland, grazing allotments, other agricultural activities, or other land uses on the site.

No tritium facilities would be constructed offsite, and offsite land use would not be directly affected. Offsite undeveloped land is available and could be converted to residential developments to house workers. Such development would be subject to local land use controls and zoning ordinances, which vary by jurisdiction.

Less Than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced capacity to meet a tritium supply requirement less than baseline, or the construction and operation of a Phased APT would not change potential baseline tritium requirement land use impacts described above. Land

TABLE 4.2.3.1–1.—*Potential Changes to Land Use Resulting from Tritium Supply Technologies and Recycling at Idaho National Engineering Laboratory*

	Tritium Supply Technologies and Recycling				
Indicator	HWR	MHTGR	ALWR[a]	APT[b]	Tritium Recycling
Land requirements[c] (acres)	260	360	350	173	196
Available land[d,e] (percent)	0.05	0.06	0.06	0.03	0.04

[a] Land requirements for both Large and Small ALWR are the same.
[b] Land requirements for both Full and Phased APT are the same.
[c] Land area requirements are estimated to be the same for construction and operation.
[d] Undeveloped land is approximately 559,000 acres.
[e] Any land requirement less than 100 percent means sufficient land.
Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; SNL 1995a.

requirements would be the same in both operation scenarios.

Multipurpose Reactor. The land requirements for the multipurpose MHTGR and ALWR (see section 4.8.3.2 and 4.8.3.3) with recycling would be 925 and 675 acres, respectively. The site requirements for both the multipurpose MHTGR and ALWR exceed the 600-acre TSS study area; however, the proposed TSS is in an area where the additional land requirements would not result in potential conflicts with site land use or development plans. The 925 and 675 acres represent less than 0.2 percent of the available land at INEL. Construction and operation of the multipurpose MHTGR or ALWR would not affect prime farmland, grazing allotments, other agricultural activities, or other land uses on the site.

Potential Mitigation Measures. No mitigation measures are proposed.

Visual Resources

No Action. Under No Action, the existing landscape character would remain unchanged, with a Bureau of Land Management VRM Class 4 (industrial use) designation.

Tritium Supply and Recycling. The construction and operation of either the proposed tritium supply and recycling facilities or tritium supply alone would be consistent with the existing views of INEL, which consist of large industrial facilities and plumes from cooling towers. The existing VRM Class 4 industrial use landscape character would remain unchanged. The proposed facilities, except for the APT which is mostly low profile structures, would be visible in the background (approximately 7 miles away) with the existing INEL facilities from the Lost River State Rest Area along U.S. Route 20/26. Impacts would be negligible. The impacts of the tritium supply technologies and recycling facilities on the Environmental Breeder Reactor I National Historic Landmark would be similar to the Lost River State Rest Area. Impacts to the view from Black Canyon Wilderness Study Area, approximately 16 miles away, would be less than the previously mentioned viewpoints because of greater distance. The Craters of the Moon National Monument, located 37 miles away from the proposed TSS, would also incur virtually no visual impacts because of greater distance. Because a nonevaporative cooling system is proposed for reactor technologies at INEL, there would be little visual impact from plumes.

Less Than Baseline Operations. Baseline requirement visual impacts would not change due to operation of the HWR, MHTGR or ALWR at reduced capacity or the construction and operation of a Phased APT.

Potential Mitigation Measures. No mitigation measures are proposed.

4.2.3.2 *Site Infrastructure*

This section discusses the site infrastructure for No Action and the modifications needed for actions due to construction and operation of new tritium supply and recycling facilities. Construction and operation of each alternative at INEL would affect the site infrastructure in varying degrees, depending upon the specific tritium supply technology chosen. All of the tritium supply technologies would require major modifications to the electrical power infrastructure at the site. A comparison of the site infrastructure and facility resource needs for No Action and the proposed tritium supply alternatives is presented in table 4.2.3.2–1.

No Action. Missions discussed in section 3.3.2 would continue under No Action. There are no defense program activities being performed at INEL, and none are being considered other than tritium supply; therefore, under No Action, there would be no impacts to INEL.

Tritium Supply and Recycling. The modifications to the infrastructure at INEL to support the various tritium supply technologies are summarized in table 4.2.3.2–1. The additional peak electrical power loads added to No Action for the various alternatives range from 62 MWe to 566 MWe (table 4.2.3.2–2). All tritium supply alternatives would require additional power that could be supplied by the Northwest Regional Power Pool Subregion through the local Idaho Power Company. The alternatives would utilize between 0.45 and 4.15 percent of the subregional Northwest Regional Power Pool capacity margin as shown in table 4.2.3.2–2, and between 0.21 and 1.95 percent of the Western Systems Coordinating Council regional power pool capacity margin.

TABLE 4.2.3.2–1.—*Modifications to Site Infrastructure for Tritium Supply Technologies and Recycling at Idaho National Engineering Laboratory*

Alternative	Transportation		Electrical		Fuel		
	Road (miles)	Railroad (miles)	Energy (MWh/yr)	Peak Load (MWe)	Oil (GPY)[a]	Natural Gas (million ft^3/yr)	Coal (tons/yr)
Current Resources	277	30	232,500	93	1,538,800	0	12,500
No Action							
Total site requirement	277	30	232,500	42	1,538,800	0	12,500
Change from current resources	0	0	0	-51	0	0	0
Heavy Water Reactor							
Total site requirement	285	32	860,500	127	3,295,000	0	12,500
Change from current resources	8	2	628,000	34	1,757,000	0	0
Modular High Temperature Gas-Cooled Reactor							
Total site requirement	285	32	680,500	104	1,754,500	0	12,500
Change from current resources	8	2	448,000	11	216,500	0	0
Large Advanced Light Water Reactor							
Total site requirement	285	32	1,420,500	198	1,834,000	0	12,500
Change from current resources	8	2	1,188,000	105	296,000	0	0
Small Advanced Light Water Reactor							
Total site requirement	285	32	900,500	133	1,744,000	0	12,500
Change from current resources	8	2	668,000	40	206,000	0	0
Full Accelerator Production of Tritium							
Total site requirement	288	32	4,060,500	608	1,647,200	0	12,500
Change from current resources	11	2	3,828,000	515	109,200	0	0
Phased Accelerator Production of Tritium							
Total site requirement	288	32	2,720,500	413	1,647,200	0	12,500
Change from current resources	11	2	2,488,000	320	109,200	0	0

[a] Oil is the primary utility fuel at INEL and all natural gas requirements have been converted to an oil equivalent; natural gas is assumed to be 1,000 British thermal units per ft^3, and fuel oil (8lb/gal) is assumed to be 19,000 British thermal units per pound.

Note: A negative number (-) indicates that sufficient resources exist to meet the demands.

Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; NERC 1993a; SNL 1995a; INEL 1993a:5.

TABLE 4.2.3.2–2.—*Impacts on Subregional Electrical Power Pool from Tritium Supply Technologies and Recycling at Idaho National Engineering Laboratory*

Tritium Supply Technology and Recycling	Peak Power Required (MWe)	Capacity Margin (percent)	Annual Energy Required (MWh)	Total Electricity Production (percent)
Heavy Water Reactor	85	0.62	628,000	0.25
Modular High Temperature Gas-Cooled Reactor	62	0.45	448,000	0.18
Large Advanced Light Water Reactor	156	1.14	1,188,000	0.46
Small Advanced Light Water Reactor	91	0.67	668,000	0.26
Full Accelerator Production of Tritium	566	4.15	3,828,000	1.49
Phased Accelerator Production of Tritium	371	2.72	2,488,000	0.97

Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; NERC 1993a; SNL 1995a; INEL 1993a:5.

For all technologies, approximately 6 miles of connecting transmission lines from the central facilities area would be required to provide power to the proposed TSS. Some of the tritium supply and recycling facilities use natural gas as a primary fuel source. Currently, INEL does not use natural gas; therefore, the equivalent amount of fuel oil was used to determine fuel impacts where natural gas is used.

In order to connect the proposed TSS with the INEL road network, approximately 8 miles of additional primary and secondary access roads would be required and a small railroad spur, approximately 2 miles, could be necessary to support new tritium supply and recycling facilities transportation requirements. The APT would require an additional 3 miles of access road. Interconnection requirements for facilities with the TSS are not expected to change appreciably when specific site adaptations are completed.

Tritium Supply Alone. If new tritium recycling facilities were not collocated with the tritium supply facilities at INEL, and the upgraded recycling facilities at SRS were utilized, the overall impact at INEL would be reduced. Onsite transportation network and electrical transmission line requirements would not be affected. The electrical power requirements associated with each of the technologies would decrease by 88,000 MWh per year, with the peak load decreasing by 16 MWe. This represents a reduction in the total site peak power requirement of between 2 and 15 percent with no appreciable change to the capacity margin of the regional power pool. Even with these reductions, additional power would still be required from the Northwest Regional Power Pool Subregion through the Idaho Power Company, but the impact would be marginally less than previously discussed. The fuel oil requirement, which is primarily for heating, ventilation and air conditioning of the recycling facility, would decrease by approximately 96,000 gal per year.

Less than Baseline Operations. In the event that only the steady-state component of the baseline tritium requirement is required, the impacts on the site infrastructure would change for some technologies. There would be no appreciable change for the HWR, MHTGR, and ALWR technologies. The Phased APT would reduce electrical consumption by approximately 35 percent but the fuel, onsite transportation infrastructure, and power line requirements would not change.

Multipurpose Reactor. The MHTGR or the ALWR multipurpose reactor option described in section 4.8.3 could be sited at INEL. The site infrastructure impacts would vary depending on the technology.

The MHTGR multipurpose reactor option would require construction of the Pit Disassembly/Conversion Facility described in section 4.8.3.1 along with three additional MHTGR reactor modules. Fabrication of the plutonium-oxide fuel could be accomplished in the fuel fabrication facility already included in the tritium supply MHTGR design. Operation of this facility along with the six module MHTGR multipurpose reactor would increase the total site electrical requirement by about 373,000 MW per year (55 percent) and the total site fuel requirement by about 651,000 GPY (16 percent) over that for operation of the three module tritium supply MHTGR.

The ALWR multipurpose reactor option would require construction of the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility described in section 4.8.3.1. Operation of this facility along with the ALWR multipurpose reactor would increase the total site electrical requirement by about 20,000 MWh per year (less than 2 percent) and the total site fuel requirement by about 830,000 GPY (20 percent) over that for operation of the tritium supply ALWR.

Accelerator Production of Tritium Power Plant. A dedicated gas-fired power plant at INEL to provide the necessary power for the APT could be constructed (section 4.8.2.2). This would decrease the annual amount of electricity required to be purchased from commercial sources by up to 3,740,000 MWh per year for the Full APT and 2,400,000 MWh for the Phased APT. Although INEL now has no natural gas supply, a pipeline could be installed within existing rights-of-way. This gas-fired plant would require 54,200 million ft^3 per yr of natural gas to provide the Full APT requirement of 3,740,000 MWh per year and 34,800 million ft^3 per yr of natural gas to provide the Phased APT requirement of 2,400,000 MWh per year.

Potential Mitigation Measures. Siting of new roads, railroad spurs, and utility infrastructure could follow existing rights-of-way to minimize impacts to natural resources. Where new rights-of-way would need to be constructed, alignments should consider existing sensitive habitat (e.g., wetlands, streams, and vegetation) to minimize the potential for impacting these resources.

4.2.3.3 *Air Quality and Acoustics*

Construction and operation of a tritium supply and recycling facility at INEL would generate criteria and toxic/hazardous pollutants that have the potential to exceed Federal and state ambient air quality standards and guidelines. To determine the air quality impacts, criteria and toxic/hazardous concentrations from each technology have been compared with Federal and state standards and guidelines. Impacts for radiological airborne emissions are discussed in section 4.2.3.9.

In general, all of the proposed technologies would emit the same types of air pollutants during construction. Emissions would typically not exceed Federal, state, or local air quality regulations or guidelines, except that PM_{10} and TSP concentrations may be close to or exceed the 24-hour PM_{10} and TSP standard during peak construction periods, which is not uncommon for large construction projects.

During operation, impacts from each of the tritium supply and recycling technologies with respect to the concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, state, and local air quality regulations or guidelines. The estimated pollutant concentrations presented in table 4.2.3.3–1 for each of the tritium supply technologies and recycling facilities indicate little difference between technologies with respect to impacts to air quality.

The Prevention of Significant Deterioration regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modifications to existing sources. Based on the emission rates presented in appendix table B.1.4–1, Prevention of Significant Deterioration permits may be required for each of the proposed alternatives at INEL. This may require "offsets," reductions of existing emissions, to permit any additional or new emission source.

Noise emissions during either construction or operation are expected to be low. Air quality and acoustic impacts for each technology are described separately. Supporting data for the air quality and acoustics analysis, including modeling inputs, are presented in appendix B.

Air Quality

An analysis was conducted of the potential air quality impacts of emissions from each of the tritium supply technologies and recycling facilities. The air quality modeling analysis used the Industrial Source Complex Short-Term model recommended by EPA. The resulting air quality concentrations were then evaluated against local and state air quality regulations, and NAAQS (40 CFR 50). The potential exceedance of Prevention of Significant Deterioration (40 CFR 52.21) increments for PM_{10}, SO_2, or NO_2 was also determined.

No Action. No Action utilizes estimated air emissions data from operations at INEL in the year 2010 assuming continuation of site missions as described in section 3.3.1. These data reflect conser-

TABLE 4.2.3.3–1.—*Estimated Cumulative Concentrations of Pollutants Resulting from Tritium Supply Technologies and Recycling Including No Action at Idaho National Engineering Laboratory* [Page 1 of 2]

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	2010 No Action ($\mu g/m^3$)	Tritium Supply Technologies and Recycling				
				HWR ($\mu g/m^3$)	MHTGR ($\mu g/m^3$)	ALWR ($\mu g/m^3$)	APT ($\mu g/m^3$)	Tritium Recycling ($\mu g/m^3$)
Criteria Pollutant								
Carbon monoxide (CO)	8-hour	10,000	284	316	391	324	296	12
	1-hour	40,000	614	712	947	738	652	38
Lead (Pb)	Calendar Quarter	1.5	0.001	0.001	0.001	0.001	0.001	[a]
Nitrogen dioxide (NO_2)	Annual	100	9	10	12	12	9	0.4
Ozone (O_3)	1-hour	235	[a]	[a]	[a]	[a]	[a]	[a]
Particulate matter (PM_{10})[b]	Annual	50	19	19	19	19	19	0.1
	24-hour	150	112	115	113	114	113	1.5
Sulfur dioxide (SO_2)	Annual	80	6	6	6	6	6	0.01
	24-hour	365	143	143	143	144	143	0.1
	3-hour	1,300	593	594	594	596	593	0.4
Mandated by Idaho								
Total suspended particulates (TSP)[b]	Annual	60	45	45	45	45	45	0.1
	24-hour	150	168	171	170	170	169	1.5
Hazardous and Other Toxic Compounds								
1,1,1-Trichloroethane	Annual	19,000[c]	[a]	0.01	<0.01	0.27	[a]	[a]
Acetaldehyde	Annual	0.45[c]	0.011	0.011	0.011	0.011	0.011	[a]
Acetone	Annual	17,800[c]	[a]	[a]	[a]	0.12	[a]	[a]
Acetylene	Annual	150[c]	[a]	0.04	0.04	0.04	0.04	0.04
Ammonia	Annual	180[c]	6	6	6	6.06	6	[a]
Arsenic	Annual	2.3×10^{-4}[c]	9.0×10^{-5}	9.0×10^{-5}	9.0×10^{-5}	9.0×10^{-5}	9.0×10^{-5}	[a]
Benzene	Annual	0.12[c]	0.029	0.029	0.029	0.029	0.029	[a]
Butadiene	Annual	3.6×10^{-3}[c]	1.0×10^{-3}	1.0×10^{-3}	1.0×10^{-3}	1.0×10^{-3}	1.0×10^{-3}	[a]
Carbon tetrachloride	Annual	0.067[c]	6.0×10^{-3}	6.0×10^{-3}	6.0×10^{-3}	6.0×10^{-3}	6.0×10^{-3}	[a]
Chloroform	Annual	0.043[c]	4.0×10^{-4}	4.0×10^{-4}	4.0×10^{-4}	4.0×10^{-4}	4.0×10^{-4}	[a]
Cyclopentane	Annual	17,000[c]	2.7	2.7	2.7	2.7	2.7	[a]
Ethyl alcohol	Annual	18,800[c]	[a]	0.01	0.01	0.01	0.01	0.01
Formaldehyde	Annual	0.077[c]	0.012	0.012	0.012	0.012	0.012	[a]
Hexavalent chromium	Annual	8.3×10^{-5}[c]	6.0×10^{-5}	6.0×10^{-5}	6.0×10^{-5}	6.0×10^{-5}	6.0×10^{-5}	[a]
Hydrazine	Annual	3.4×10^{-4}[c]	1.0×10^{-6}	1.0×10^{-6}	1.0×10^{-6}	1.0×10^{-6}	1.0×10^{-6}	[a]
Hydrochloric acid	Annual	7.5[c]	0.98	0.98	0.988	0.98	0.98	[a]

TABLE 4.2.3.3–1.—*Estimated Cumulative Concentrations of Pollutants Resulting from Tritium Supply Technologies and Recycling Including No Action at Idaho National Engineering Laboratory* [Page 2 of 2]

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	2010 No Action ($\mu g/m^3$)	Tritium Supply Technologies and Recycling				
				HWR ($\mu g/m^3$)	MHTGR ($\mu g/m^3$)	ALWR ($\mu g/m^3$)	APT ($\mu g/m^3$)	Tritium Recycling ($\mu g/m^3$)
Mercury	Annual	1[c]	0.042	0.042	0.042	0.042	0.042	[a]
Methane	Annual	[d]	[a]	0.04	0.04	0.04	0.04	0.04
Methyl alcohol	Annual	2,600[c]	[a]	0.01	0.01	0.01	0.01	0.01
Methylene chloride	Annual	0.24[c]	$6.0x10^{-3}$	$6.0x10^{-3}$	$6.0x10^{-3}$	$6.0x10^{-3}$	$6.0x10^{-3}$	[a]
Naphalene	Annual	500[c]	18	18	18	18	18	[a]
Nickel	Annual	$4.2x10^{-3}$[c]	$2.7x10^{-3}$	$2.7x10^{-3}$	$2.7x10^{-3}$	$2.7x10^{-3}$	$2.7x10^{-3}$	[a]
Nitric acid	Annual	50[c]	0.64	0.71	0.64	1.46	0.64	[a]
Perchloroethylene	Annual	2.1[c]	0.11	0.11	0.11	0.11	0.11	[a]
Phosphorus	Annual	1[c]	0.3	0.3	0.3	0.3	0.3	[a]
Potassium hydroxide	Annual	20[c]	0.2	0.2	0.2	0.2	0.2	[a]
Proprionaldehyde	Annual	4.3[c]	0.3	0.3	0.3	0.3	0.3	[a]
Styrene	Annual	1,000[c]	1.3	1.3	1.3	1.3	1.3	[a]
Toluene	Annual	3,750[c]	370	370	370	370	370	[a]
Trichloroethylene	Annual	0.077[c]	$9.7x10^{-4}$	$9.7x10^{-4}$	$9.7x10^{-4}$	$9.7x10^{-4}$	$9.7x10^{-4}$	[a]
Trichlorotrifluoroethane	Annual	[d]	[a]	0.5	[a]	[a]	[a]	[a]
Trimethylbenzene	Annual	1,230[c]	100	100	100	100	100	[a]
Trivalent chromium	Annual	5[c]	0.036	0.036	0.036	0.036	0.036	[a]

[a] No sources indicated.

[b] It is conservatively assumed that all PM_{10} concentrations are TSP concentrations.

[c] Acceptable ambient concentrations listed in Rules for the Control of Air Pollution in Idaho. Acceptable ambient concentrations are increments that apply only to new sources and are used here only as reference levels.

[d] There is no standard.

Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; DOE 1995v; SNL 1995a; IN DHW 1992b; IN DHW 1995a; IN DHW 1995b.

vative estimates of criteria and toxic/hazardous emissions at INEL. The emission rates for the criteria and toxic/hazardous pollutants for No Action are presented in appendix table B.1.4–1. Table 4.2.3.3–1 presents the No Action concentrations. With the exception of the 24-hour TSP standards, pollutant concentrations are in compliance with all air quality regulations and guidelines. It is conservatively assumed that PM_{10} concentrations are equal to TSP concentrations.

Tritium Supply and Recycling. Alternatives for INEL consist of four candidate technologies: HWR, MHTGR, ALWR and APT, alone and collocated with tritium recycling facilities. Air pollutants would be emitted during construction of the tritium supply and recycling facilities. The principal sources of such emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and operation of a concrete batch plant.
- Exhaust from, and road dust raised by, construction equipment, vehicles delivering construction material, and vehicles carrying construction workers.

PM_{10} and TSP concentrations are expected to be close to or exceed the 24-hour ambient standard during the peak construction period. Exceedances would also be expected to occur during dry and windy conditions. Appropriate control measures would be followed, such as watering to reduce emissions. With the exception of PM_{10} and TSP, it is expected that concentrations of all other pollutants at the INEL boundary or public access highways would remain within applicable Federal and state ambient air quality standards during construction.

Air pollutant emission sources associated with the operation of each of the technologies include all or part of the following:

- Increased operation of existing boilers to generate additional steam for space heating.
- Operation of diesel generators and periodic testing of emergency diesel generators.
- Recycling operations.
- Exhaust from, and road dust raised by, vehicles delivering supplies and bringing employees to work.

Appendix table B.1.4–1 presents emissions from each of the proposed tritium supply technologies and recycling facilities. There are no gaseous releases associated with the APT (SNL 1995a), although emissions are associated with operation of the tritium supply facility included with the APT and with recycling facilities. Emissions from the Large ALWR were used to determine pollutant concentrations since these represent the maximum emission rates from either the Large or Small ALWR. Consequences from operation of the tritium supply and recycling facilities at INEL are presented in table 4.2.3.3–1. With the exception of the 24-hour TSP standards, pollutant concentrations, combined with the No Action concentrations, are in compliance with Federal and state standards.

Pollutant emissions resulting from the operation of tritium supply technologies alone (HWR, MHTGR, ALWR and APT) consist of criteria pollutants from the operation of boilers and diesel generators and toxic/hazardous pollutant emissions from facility processes. Criteria pollutant emissions from the MHTGR are the highest among the other tritium supply technologies and would increase existing total site criteria pollutant emissions by less than 5 percent above No Action emissions. Concentrations of criteria and toxic/hazardous pollutants, added to No Action concentrations, are in compliance with Federal and state standards except for 24-hour TSP standards.

Less Than Baseline Operations. Air emissions from the HWR would be reduced slightly when operated at reduced capacity. However, the reduction would be negligible since most emissions are attributed to support equipment and facilities that are not related to the reactor operating level. The MHTGR or ALWR would have no change in air emissions because it would continue to operate at the same level as the baseline requirement to maintain power levels

for steam or electrical production. The Phased APT construction and operation emissions and impacts would be the same as the Full APT.

Accelerator Production of Tritium Power Plant. Operation of a 500 to 600 MWe natural gas electric generating facility (section 4.8.2.2) would generate a substantial amount of emissions consisting of sulfur dioxide, particulate matter, nitrogen oxides, carbon monoxide, and volatile organic compounds.

These emissions would be controlled using the best available control technology to minimize impacts and comply with the NAAQS and state mandated emission standards. Estimated emissions are based upon emission factors for a large controlled gas turbine (EPA 1995a; SPS 1995a). Table B.1.3.1–3 presents the emission factors and resulting annual emission rates for a 600 MWe natural gas-fired turbine power plant.

For a natural gas-fired power plant located at INEL, the increase in carbon monoxide emissions with respect to the 2010 No Action emissions at INEL would be approximately 3 percent (75 tons per year); for nitrogen oxides the increase would be approximately 10 percent (314 tons per year); for particulate matter the increase would be approximately 18 percent (179 tons per year); for sulfur dioxide the increase would be less than 0.3 percent (5 tons per year); and for volatile organic compounds the increase would be approximately 239 percent (215 tons per year). In addition, the gas turbine generating facility would generate 126 tons per year of methane, 58 tons per year of ammonia, 29 tons per year of nonmethane hydrocarbons, and 24 tons per year of formaldehyde.

Any power plant facility constructed to meet the power needs of the APT would be required to meet the Federal NAAQS and state mandated regulations for toxic/hazardous pollutants. Appropriate pollution control equipment would be incorporated into the design of that facility to meet these standards.

Potential Mitigation Measures. Potential mitigation measures during construction include: watering to reduce dust emissions; applying non-toxic soil stabilizers to all inactive construction areas; covering, watering, or applying non-toxic soil binders to exposed piles (i.e., gravel, sand, and dirt); suspending all excavation and grading operations when wind speeds warrant; paving construction roads that have a traffic volume of more than 50 daily trips by construction equipment; and using electricity from power poles rather than temporary gasoline and diesel power generators. Potential mitigation measures during operation include incorporating additional HEPA filters to reduce particulate emissions from processing facilities; substituting cleaning solvents for those which present health hazards or exceed the applicable standards; and switching from coal or fuel oil, to produce electricity or steam, to natural gas to reduce criteria pollutants.

Acoustics

The location of the tritium supply technologies and recycling facilities relative to the site boundary and sensitive receptors was examined to determine the contribution to noise levels at these locations and the potential for onsite and offsite impacts.

No Action. The continuation of operations at INEL would result in no appreciable change in traffic noise and onsite operational noise sources from current levels (section 4.2.2.3). Sources of nontraffic noise associated with current operations are located at sufficient distances from offsite noise sensitive receptors that the contribution to offsite noise levels would continue to be small.

Tritium Supply and Recycling. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along offsite major transportation routes used to bring construction material and workers to the site.

Most nontraffic noise sources associated with operation of tritium supply and recycling facilities would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from construction equipment and operations activities would not be expected to cause annoyance to the public.

Noise impacts associated with increased traffic on access routes would be considered in tiered NEPA documents. Some nontraffic noise sources associated with construction and operation of the tritium

supply technologies and recycling facilities may be located close enough to offsite noise receptors that they could experience some increase in noise levels.

Less Than Baseline Operations. Baseline noise impacts would not change due to reactors operating at reduced tritium capacity or the construction and operation of a Phased APT.

Potential Mitigation Measures. Potential measures to minimize noise impacts on workers include the use of standard silencing packages on construction equipment and providing workers in noisy environments with appropriate hearing protection devices meeting OSHA standards. As required, noise levels would be measured in worker areas, and a hearing protection program would be conducted.

4.2.3.4 *Water Resources*

Environmental impacts associated with the construction and operation of the proposed tritium supply technologies and recycling facilities at INEL would affect surface water and groundwater resources. No surface water would be withdrawn for construction or for operation. Instead, groundwater from the Snake River Plain aquifer would be used, which is a sufficient source. Water requirements for operation of all tritium supply technologies would fall within INEL's current allotment. The site proposed for the tritium supply and recycling facilities would be outside the floodplain that could result from failure of McKay Dam during a probable maximum flood.

During construction, treated sanitary wastewater would be discharged to lined evaporation ponds. While the potential impacts to surface waters during the construction phase would be erosion and sedimentation of drainage channels, the relatively dry climate and application of appropriate controls should preclude adverse impacts. No wastewater would be discharged to surface waters during operation of tritium supply and recycling facilities, nor would there be impacts to surface water quality from these types of activities. All wastewater would be treated and either recycled for cooling system makeup or discharged to lined evaporation ponds. Stormwater runoff would be collected and treated if necessary before discharge to natural drainage channels.

Table 4.2.3.4–1 presents existing surface water and groundwater resources and the potential changes to water resources at INEL resulting from the proposed tritium supply technologies and recycling facilities. Resource requirements for each tritium supply technology shown in this table represent the total requirements at the site, including No Action. Resource requirements for tritium recycling are added to these values to obtain the water resource requirements for assessing impacts associated with combined tritium supply and recycling.

Surface Water

No Action. Under No Action, no additional impacts to surface water resources are anticipated beyond the effects of existing and future activities that are independent of and unaffected by the proposed action. A description of the activities that would continue at INEL is provided in section 3.3.2.

Tritium Supply and Recycling. No surface water would be withdrawn for any construction or operation activities associated with any of the tritium supply technologies and recycling facilities; consequently, no impacts to surface water availability or surface water quality are expected. The potential impacts to surface waters during the construction phase would be erosion of disturbed land and sedimentation in drainage channels. To minimize soil erosion impacts, stormwater management and standard erosion control measures would be employed. In most cases, impacts from runoff would be temporary and manageable. Nonhazardous wastewater, including sanitary wastewater, generated during the construction of either the collocated tritium supply and recycling facilities (which ranges from 1.2 MGY for the APT to 28.4 MGY for the Large ALWR) or tritium supply alone (which ranges from 0.3 MGY for the APT and 27.5 MGY for the Large ALWR) would be discharged to either a leach field or lined evaporation ponds.

During operation, no effluents would be discharged to natural surface waters. Utility, process and sanitary wastewater from the HWR, MHTGR, or ALWR would be treated prior to discharge into lined evaporation ponds. However, cooling system blowdown and sanitary wastewater from the APT would be treated and recycled for reuse as cooling system makeup. The treated effluent from the

TABLE 4.2.3.4–1.—*Potential Changes to Water Resources Resulting from Tritium Supply Technologies and Recycling at Idaho National Engineering Laboratory*

Affected Resource Indicator	No Action	Tritium Supply Technologies and Recycling						
		HWR	MHTGR[a]	Large ALWR[a]	Small ALWR[a]	Full APT	Phase APT	Tritium Recycling[b]
Construction (2005)								
Water Availability and Use								
Water source	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground
Total water requirement[c] (MGY)	2,000	2,021	2,018	2,033	2,020	2,008	2,008	1.5
Percent increase in projected water use[d]	0	1	1	2	1	<1	<1	NA
Percent of groundwater allotment (11,360 MGY)	18	<1	<1	<1	<1	<1	<1	NA
Water Quality								
Wastewater discharge to surface waters or groundwater (MGY)	0	0	0	0	0	0	0	0
Percent change in stream flow from wastewater	NA	NA	NA	NA	NA	NA	NA	NA
NPDES permit required[e]	NA	Yes	Yes	Yes	Yes	Yes	Yes	NA
Operation (2010)								
Water Availability and Use								
Water source	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground
Total water requirement[f] (MGY)	2,000	2,048	2,030	2,090	2,050	3,200	2,770	14
Percent increase in projected water use[d]	0	3	2	5	3	61	39	NA
Percent of groundwater allotment (11,360 MGY)	18	<1	<1	<1	<1	11	7	NA
Water Quality								
Wastewater discharge to surface waters or groundwater (MGY)	0	0	0	0	0	0	0	0
Percent change in stream flow from wastewater	NA	NA	NA	NA	NA	NA	NA	NA
NPDES permit required[e]	No	Yes	Yes	Yes	Yes	Yes	Yes	NA
Floodplain								
Actions in 100-year floodplain	NA	No	No	No	No	No	No	NA
Critical actions in 500-year floodplain	NA	No	No	No	No	No	No	NA
Floodplain assessment required	NA	No	No	No	No	No	No	NA

[a] Operation water requirements for MHTGR and ALWR include utilization of steam turbine generators.

[b] Resource requirements for tritium recycling do not include No Action. The values presented in this column are added to the requirements for each tritium supply technology to assess the impacts associated with combined tritium supply and recycling.

[c] Total water requirements at INEL are calculated by adding No Action requirements (2,000 MGY) with that for each tritium supply technology: HWR (21 MGY), MHTGR (18 MGY), ALWR (33 MGY for Large and 20 MGY for Small), and APT (8.3 MGY for Full and Phased).

[d] Percent increase in projected water use at INEL includes the tritium recycling water requirement.

[e] NPDES permit is required for stormwater discharges.

[f] Total water requirements at INEL are calculated by adding No Action requirements (2,000 MGY) with that for each tritium supply technology: HWR (48 MGY), MHTGR (30 MGY), ALWR (90 MGY for Large and 50 MGY for Small), and APT (1,200 MGY for Full and 770 MGY for Phased).

Note: NA - not applicable.

Note: Construction impacts are considered to be temporary, lasting only throughout the construction period.

Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; SNL 1995a; INEL 1993a:5; SR DOE 1995a.

process wastewater treatment would be discharged to lined evaporation ponds. Treated effluent would be monitored to comply with the NPDES permit and other discharge requirements. The extent to which treated effluents or stormwaters would be recycled for reuse within the plant would be determined during site-specific studies.

Stormwater runoff from either the collocated tritium supply and recycling facilities or tritium supply alone would be collected in detention ponds. Runoff from site support facilities outside the main facility, except those that require onsite management measures by regulation such as sanitary wastewater plants and landfill areas, would be discharged directly to natural drainage channels. Uncontaminated stormwater runoff would be released to natural drainage channels, while contaminated stormwater runoff would be retained, treated in the radioactive waste treatment system, and released. All stormwater discharges to natural channels would be subject to compliance with NPDES permit requirements.

The site proposed for construction of the tritium supply facility is outside the flood zone of the Big Lost River that could develop as a result of the failure of MacKay Dam during a probable maximum flood. This flood event would be more critical than either the 100- or 500-year flood. The 1-mile buffer zone between the boundary of the proposed site and the location of the new facilities would provide an additional measure of flood protection. Where a potential exists for flooding impacts, design mitigation measures will be considered and discussed in site-specific tiered NEPA documents.

Less Than Baseline Operations. Baseline tritium requirement surface water impacts described above for the construction and operation phases would not change due to changes in the reactor operating capacity, or construction and operation of a Phased APT.

Multipurpose Reactor. The MHTGR or an ALWR multipurpose reactor option at INEL would require a Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility or a Pit Disassembly/Conversion Facility to be constructed in conjunction with the reactors. Water used for both of the reactors and support facilities would be obtained from groundwater resources.

During construction and operation, no effluents would be discharged to natural surface waters. Utility, process, and sanitary wastewater not recycled would be treated prior to discharge into lined evaporation ponds. Treated effluent would be monitored to comply with the NPDES permit and other discharge requirements.

Accelerator Production of Tritium Power Plant. If the APT technology is selected, a dedicated power plant as discussed in section 4.8.2.2 could be used to support the technology at INEL. Water requirements (80 MGY) for the natural gas-fired power plant would be obtained from groundwater resources, with no impact to surface water.

Demineralized backwash generated during operation would contain dilute concentrations of trace metals and low-to-moderate concentrations of calcium, sodium, and sulfate and would be treated prior to discharge to lined evaporation ponds. No impacts to surface waters would be anticipated.

Potential Mitigation Measures. No mitigation measures in addition to those implemented during construction to comply with the NPDES stormwater regulations have been identified. Stormwater measures include stabilization practices that cover soils with materials such as vegetation, riprap, or mulch in order to prevent direct exposure of soils to runoff, and structural controls, such as silt fences, dikes, and sediment traps, that divert runoff away from disturbed areas. The dry climate and application of management measures should preclude potential adverse impacts during operation from stormwater runoff. Similarly, during operation, releases of stormwater runoff would be monitored and subject to NPDES regulations.

Groundwater

No Action. Under No Action, no additional impacts to groundwater resources are anticipated beyond the effects of existing and future activities that are independent of and unaffected by the proposed action.

Groundwater Availability and Use

Tritium Supply and Recycling. Groundwater required for construction of either a collocated tritium supply and recycling facility or a tritium

supply facility alone would represent approximately a 2-percent maximum increase over the projected groundwater withdrawal, and would be less than 1 percent of INEL's current allotment. Thus no additional allotments or permits would be required and it would not cause depletion of the aquifer or affect recharge. Groundwater required for both construction and operation of the tritium supply technologies and recycling facilities and the percent increase in projected water use are shown in table 4.2.3.4–1. As discussed in section 4.2.2.4, a groundwater allotment, not to exceed 11,360 MGY, has been negotiated by DOE with the Idaho Department of Water Resources under the Federal Reserve Doctrine. Additionally, 35,386 MGY of water statewide could be available for non-farm development under the Idaho-Swan Falls agreement (INEL 1993a:5). As shown in table 4.2.3.4–1, operating an HWR, MHTGR, ALWR, or APT, whether collocated with recycling facilities or alone, would not exceed current groundwater allotments.

Previous studies, using a steady-state model of groundwater withdrawals of up to 7,300 MGY from wells located in the area of the proposed TSS, have estimated that for a continuous pumping well drawdowns in the unconfined aquifer at the well would be approximately 13 feet (5 percent of saturated thickness in this area). At a distance of 984 feet from the pumping area, drawdowns would be approximately 12 feet whereas at the INEL southern boundary, the drawdown would be approximately 3.6 feet. Recharge studies indicate that it would take approximately 10 years for offsite springs near Hagerman, Idaho to show signs of decline caused by pumping. Other studies indicate that pumping at a rate of 11,624 MGY for 50 years would cause a decline in the water table near the springs of less than 1 foot.

In comparison, operation of an HWR, MHTGR, ALWR, or APT would use less water than the groundwater withdrawals used in the model discussed above and no impacts on recharge or to nearby springs are anticipated.

Less Than Baseline Operations. Operation of the HWR at reduced capacity to meet a tritium supply requirement less than baseline would not change the operating water requirements or the quantity of water discharges. The MHTGR or ALWR water requirements and discharges would not change from the baseline; therefore, the potential impacts would remain the same.

Construction of the Phased APT would require 2,010 MGY, an increase of 2 MGY over that required by the Full APT (table 4.2.3.4-1). The construction water requirement of the Phased APT represents an increase of less than 1 percent over projected No Action water use. Operation of the Phased APT (with tritium recycling) would require 784 MGY of water, a 39-percent increase over projected No Action water use. This is approximately two-thirds of the 61-percent increase required by the Full APT. The additional 784 MGY would not exceed current groundwater allotments. All other requirements of the Phased APT are identical to those of the Full APT.

Multipurpose Reactor. For the multipurpose MHTGR, a Pit Disassembly/Conversion Facility would be constructed and operated to support the 6 reactors. The construction of the multipurpose MHTGR and the Pit Disassembly/Conversion Facility would use approximately 24.33 MGY, which would be a 35 percent increase over the water use for the MHTGR tritium supply facility and 0.2 percent of INEL's current allotment. Water use during operation of the MHTGR multipurpose reactor (54 MGY) and the Pit Disassembly/Conversion Facility (10 MGY), would total 64 MGY and would be a 113 percent increase over the water use for the MHTGR tritium supply facility, and 0.56 percent of INEL's current allotment (11,360 MGY).

During construction and operation of a multipurpose MHTGR, all wastewater generated and not recycled would be treated prior to being released to lined evaporation ponds. Treated effluent would be monitored to comply with the NPDES permit and other discharge requirements.

Water requirements during construction and operation of an ALWR multipurpose reactor would be the same as previously discussed for an ALWR tritium supply facility. However, as discussed in section 4.8.3, a Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would have to be constructed and operated in conjunction with an ALWR multipurpose reactor. A Pit Disassembly/Conversion/Fuel Fabrication Facility would require an additional 0.5 MGY of groundwater during construction, which would be a 1.5 percent

increase over the groundwater use for the ALWR tritium supply facility and 0.3 percent of INEL's current allotment (11,360 MGY). During operation, approximately 10 MGY of water would be used, which would be an 11 percent increase over the groundwater use for the ALWR tritium supply facility and 0.8 percent of INEL's current allotment (11,360 MGY).

During construction and operation of a Pit Disassembly/Conversion/Fuel Fabrication Facility approximately 10 MGY of sanitary wastewater would be generated and treated prior to discharge into lined evaporation ponds. Treated effluent would be monitored to comply with the NPDES permit and other discharge requirements.

Accelerator Production of Tritium Power Plant. If the APT technology is selected, a dedicated power plant, as discussed in section 4.8.2.2, could be used to support the technology at INEL. Water requirements for the natural gas-fired power plant would be approximately 80 MGY in addition to the groundwater requirements previously discussed for the APT. Operation of the Full APT with tritium recycling and the dedicated power plant would require total site groundwater withdrawals of 3,294 MGY; which would be a 2.5-percent increase over the total site groundwater requirements for the Full APT with tritium recycling (3,214 MGY), a 65-percent increase over projected No Action water use of 2,000 MGY, and 29 percent of INEL's current allotment of 11,360 MGY.

Demineralized backwash generated during operation would contain dilute concentrations of trace metals, and low-to-moderate concentrations of calcium, sodium, and sulfate and would be treated prior to discharge to lined evaporation ponds. No impacts to groundwater quality would be expected.

· Groundwater Quality

Tritium Supply and Recycling. During construction, no water would be discharged directly to the environment and thus would not affect groundwater quality. During operation, treated utility, process, and sanitary wastewater would be treated and discharged to evaporation ponds. Therefore, no impacts to groundwater quality would be anticipated.

Existing tritium plumes in groundwater and in perched groundwater south of the proposed tritium facilities are expected to continue to migrate southwesterly, away from the proposed TSS. Studies showed that water withdrawals could change the existing plumes' southwesterly direction to the east, but would not draw the plume into the proposed TSS.

Because dry cooling towers would be used, salt would not be released from the cooling tower. Blowdown recycle would couple reverse osmosis with an evaporator and crystallizer system that would remove the dissolved solids from blowdown so the water could be recycled to the cooling tower. This system would reduce requirements for makeup water, and discharge would not require disposal. The solids from the crystallization processes would be disposed of as waste. This system would reduce the salt from blowdown.

Less Than Baseline Operations. Potential groundwater quality impacts described above would not change due to changes in reactor operating capacities, or the construction and operation of a Phased APT.

Potential Mitigation Measures. Potential groundwater withdrawals could influence existing southwesterly direction of the tritium plume to the east. Mitigation measures to protect drinking water sources in the vicinity of the affected aquifer could include a monitoring well program to detect changes in contaminate direction or rate of movement, the deepening of existing walls, or the drilling of new wells.

4.2.3.5 *Geology and Soils*

Construction of tritium supply and recycling facilities at INEL would have no impact on geological resources described in section 4.2.2.5. A moderately low seismic risk exists, which would be considered in the design of the structures. The existing seismic risk does not preclude safe construction and operation of the facilities. The only other geological hazard present is volcanic activity, which is improbable and is not anticipated to impact the project. Construction would disturb up to a few hundred surface acres of soil, the amount depending on the tritium supply technology and recycling facilities. Control measures would be used to minimize soil erosion. Impacts would depend on the specific soil units in the disturbed area, the extent of land disturbing

activities, and the amount of soil disturbed. Potential changes to geology and soils associated with the construction and operation of tritium supply and recycling facilities are discussed in the following sections.

No Action. Under No Action, DOE would continue existing and planned activities at INEL. Any impacts to geology and soils from these actions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Construction activities would not affect geological conditions. Design of the facilities would ensure that they would not be adversely affected by geological conditions.

Because there are no known capable faults at or near the proposed TSS, there is little potential for ground rupture as a result of an earthquake during the life of the tritium facilities. Ground shaking is more likely. Intensities of approximately VII on the modified Mercalli scale are possible at INEL which would not affect newly designed facilities. Based on the seismic history of the area, a moderately low seismic risk exists at INEL that should not preclude safe construction and operation of the facilities. In addition, facilities would be designed for earthquake-generated ground accelerations in accordance with DOE Order 5480.28 *Natural Phenomena hazards Mitigation* and accompanying safety guides.

Although there is a history of volcanism in the INEL area, explosive volcanic eruptions are improbable (section 4.2.2.5). Lava extrusion could recur with recurrence probabilities at about once in every 3,000 years. Precursors, such as shallow earthquakes, gas venting activity, and increase in groundwater temperatures provide advance warning of most eruptions of this type; no such activity is currently indicated at INEL.

It is highly unlikely that landslides, sinkhole development, or other nontectonic events would affect project activities. Slopes and underlying foundation materials are stable.

Properties and conditions of the soils underlying the proposed site have no limitations on construction. Soils, therefore, would not adversely affect the safe operation of the facilities. Soils would be impacted by construction and operation of the facilities. The amount of acreage that would be potentially disturbed by the tritium supply technologies is shown in table 4.2.3.1–1. For tritium recycling facilities, the amount of land that would be disturbed is 202 acres.

The soil disturbance from construction of new facilities would be as much as 562 acres for a MHTGR collocated with recycling facilities. Disturbance would occur at building, parking, and construction laydown areas, destroying the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil losses would depend on frequency of storms; wind velocities; size and location of the facilities with respect to drainage and wind patterns; slopes, shape, and area of the tracts of ground disturbed; and, particularly during the construction period, the duration of time the soil is bare. Construction of both the MHTGR and the APT would also necessitate deep excavations to accommodate reactor modules and an accelerator tunnel, respectively (sections 3.4.2.2 and 3.4.2.4). A considerable volume of soil would be removed as a result of excavations. Most of the material removed would be basaltic bedrock and could be stockpiled for use as fill. Some of this material could be used to cover the accelerator tunnel of the APT. Site-specific NEPA studies would evaluate in detail impacts to geology and soils at INEL resulting from deep excavations required for the MHTGR and the APT and would identify appropriate mitigation measures.

Net soil disturbance during operation would be less than for construction, because areas temporarily used for laydown would be restored. Although erosion from stormwater runoff and wind action could occur occasionally during operation, they are anticipated to be minimal.

Appropriate erosion and sediment control measures would be used to minimize soil loss. Wind erosion is likely to occur on an intermittent basis, depending on the wind velocities, the amount of soil exposed, and the effectiveness of control measures.

Less Than Baseline Operations. Under the less than baseline operations, geology and soil impacts would not change for the HWR, MHTGR, or ALWR technologies. Disturbed acreage for the Phased APT would be the same as the Full APT; therefore, impacts would be the same.

Multipurpose Reactor. The multipurpose MHTGR would disturb an additional 270 acres of land to accommodate the construction of three additional reactor modules and a Pit Disassembly/Conversion Facility. The additional land area disturbances would result in the destruction of the soil profile and potential temporary increase in erosion as a result of stormwater runoff and wind action. The three additional reactor modules would also double the excavation requirements over that for the tritium supply MHTGR. The excavated soil would substantially increase the volume of soil needing storage and/or disposal. Impacts on ground water resources from the excavation are not expected.

Construction impacts for the multipurpose ALWR would be the same as those described for the tritium supply ALWR. Additional soil impacts would be expected from the construction of the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility needed to support the multipurpose ALWR. Approximately 129 acres would be disturbed for the new facility, destroying the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil losses would depend on frequency of storms; wind velocity; location of the facility with respect to drainage and wind pattern; slope, shape, and area of the tracts of ground disturbed; and the duration of time the soil is bare.

Soil impacts during operation are expected to be minimal. Appropriate erosion and sediment control measures would be used to minimize any long-term soil losses.

Potential Mitigation Measures. Mitigation measures would be required to control erosion from exposed areas of soil during construction. Potential mitigation measures include accepted standard practices for erosion, sediment, and dust control from construction sites such as silt fences, sediment traps, runoff diversion dikes, drainageways, sedimentation ponds, establishment of ground cover and windbreaks, grading of slopes, construction of berms and drainageways, or other controls appropriate to the sites. Standard control for wind erosion, such as wetting the surface, would be done on a day-to-day basis. Exposing only small areas for limited periods of time could also reduce erosional effects. After the construction period, long-term control measures could include grading, revegetation, or landscaping.

4.2.3.6 *Biotic Resources*

Construction and operation of tritium supply technology and recycling facilities at INEL would affect biotic resources. Impacts resulting from the construction of the HWR, MHTGR, ALWR, or Full APT to meet the baseline tritium requirement would occur only at the beginning of the project lifecycle. The less than baseline tritium requirement and Phased APT could incur some additional construction-related impacts if expansion is needed to meet baseline tritium requirements. The potential impacts would be minor since the expansion would occur in the already developed main plant site. Impacts to terrestrial resources would result from the loss of habitat during construction and operation. Impacts to wetlands and aquatic resources would not occur since these resources are not located on the proposed TSS. No Federal-listed threatened or endangered species would be affected by the proposed action. Several special-status species could be affected, primarily through the loss of potential foraging habitat. However, the viability of populations of these species is not likely to be impacted. Where potential conflicts could occur, mitigation measures would be developed in consultation with USFWS. Consultation would be conducted at the site-specific level in tiered NEPA reviews. Table 4.2.3.6–1 summarizes the potential changes to biotic resources at INEL resulting from the proposed action. As noted in the table, no major differences in impact to biotic resources exist between the four tritium supply technologies and recycling facilities.

The following discussion of impacts from a multipurpose reactor and a dedicated power plant for the APT applies to the biotic resources at INEL as a whole. Where potential impacts to a specific biotic resource are notable for the tritium supply technologies, the discussion on multipurpose reactors identifies the potential impacts to the same resource.

Multipurpose Reactor. The selection of the multipurpose reactor option could result in additional impacts to biotic resources at INEL. The MHTGR Pit Disassembly/Conversion Facility and the ALWR Pit Disassembly/Conversion/Mixed-Oxide Full Fabrication Facility would require an additional 129 acres of

TABLE 4.2.3.6–1.—*Potential Impacts to Biotic Resources During Construction and Operation Resulting from Tritium Supply Technologies and Recycling at Idaho National Engineering Laboratory*

Affected Resource Indicator	No Action	Tritium Supply Technologies and Recycling				
		HWR	MHTGR	ALWR	APT	Tritium Recycling
Acres of habitat disturbed	0	462[a]	562[a]	552[a]	375[a]	202
Wetlands potentially impacted	None	None	None	None	None	None
Aquatic resources potentially impacted	None	None	None	None	None	None
Number of threatened and endangered species potentially affected[b]	0/0	0/5	0/5	0/5	0/5	0/5

[a] Acreage disturbed by each tritium supply technology may be obtained by subtracting the acreage for the tritium recycling facility from the tritium supply technologies and recycling acreage.

[b] The number of threatened and endangered species is represented by two data inputs (a/b) where: a - the number of Federal-listed threatened and endangered species, and b - the number of all other special status species (i.e., Federal candidate and/or state-listed species) that are potentially impacted.

Source: DOE 1993a.

land. However, it is expected that during the design phase, land requirements for this facility would be substantially reduced when integrated into the reactor and recycling facility design. In addition, an MHTGR would require three additional modules which would displace about 240 acres. Thus, total land requirements for the MHTGR and ALWR multipurpose reactors would be 931 and 691 acres, respectively. In general, impacts to terrestrial resources and threatened and endangered species would be similar to, but greater than, those described for the tritium supply and recycling facility. Impacts to wetlands and aquatic resources would not be expected on the proposed TSS since these resources do not occur on the site.

Accelerator Production of Tritium Power Plant. A dedicated natural gas-fired power plant, similar to that described in section 4.8.2.2, could be an option to support an APT at INEL. This facility, which would be constructed on the proposed TSS, would occupy 25 acres of land. Construction of the gas-fired power plant would increase the land disturbance associated with the APT from 375 to 400 acres. This would result in a slight increase in impacts to biotic resources over those described for the tritium supply and recycling facility. Infrastructure requirements, such as parking and laydown areas, would be incorporated into and take advantage of similar requirements associated with the APT. Rights-of-way would be sited to take advantage of existing corridors to the maximum extent practical.

Terrestrial Resources

No Action. Under No Action, the missions described in section 3.3.1 would continue at INEL. This would result in no changes to current terrestrial conditions at the site described in section 4.2.2.6.

Tritium Supply and Recycling. Construction and operation of the HWR, MHTGR, ALWR, or APT and recycling facilities would take place on the proposed TSS and would result in the disturbance of approximately 462, 562, 552, or 375 acres, respectively, of terrestrial resources, or less than 0.1 percent of INEL (table 4.2.3.6–1). These acreages include areas on which plant facilities would be constructed, as well as areas revegetated following construction. Vegetation within the proposed TSS would be destroyed during land clearing operations. Big sagebrush is the dominant plant within the proposed TSS (figure 4.2.2.6–1). Plant communities in which big sagebrush is the dominant overstory species are well represented on INEL, but are relatively uncommon regionally because of widespread conversion of shrub-steppe habitats to agriculture.

Constructing any of the tritium supply technologies and recycling facilities would have some adverse effects on animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would be destroyed during land-clearing activities. Construction activities would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. Because pronghorn use of the proposed TSS is relatively low

(DOE 1992e:4-76), the tritium supply and recycling facility should not have a lasting impact on this species. Nests and young animals living within the proposed TSS could be lost during construction. Areas disturbed by construction but not occupied by facility structures would be of minimal value to wildlife because they would be maintained as landscaped areas.

Activities associated with facility operations, such as noise and human presence, could affect wildlife living immediately adjacent to the tritium supply and recycling facility. These disturbances may cause some species to move from the area. A nonevaporative cooling design is proposed for all tritium supply technologies at INEL except for the APT. While there would be no impacts to vegetation from salt drift from an HWR, MHTGR, or ALWR, this may not be the case for the APT. A total of 10 separate cooling towers would be located along the length of the facility (section 3.4.2.4). Since design parameters for these towers are not known at this time, it is not possible to estimate impacts. This would be determined in future tiered NEPA documentation.

Construction and operation of a tritium supply facility alone would result in similar impacts to terrestrial resources but less than those described for a collocated tritium supply and recycling facility. Impacts would be less since 202 fewer acres of habitat would be disturbed.

Less Than Baseline Operations. Operation of the HWR, MHTGR or ALWR at reduced tritium production capacity would have the same impacts described above for production at baseline tritium requirements.

Construction-related impacts of the less than baseline tritium requirement Phased APT would be similar to those described above. Some additional construction-related impacts could occur if expansion is needed to meet baseline tritium requirements. The potential impacts would be minor since the expansion activities would occur in the already developed main plant site.

Potential Mitigation Measures. The loss of habitat other than the facility footprint itself may be mitigated by revegetating with native species. This is particularly important since disturbed areas in shrub-steppe communities are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants (DOE 1992e:5-134). Disturbance to wildlife living in areas adjacent to the new facilities may be reduced by preventing workers from entering undisturbed areas. It may be necessary to survey the TSS for the nests of migratory birds or eagles prior to construction and/or avoid clearing operations during the breeding season.

Wetlands

No Action. Under No Action, the missions described in section 3.3.1 would continue at INEL with no changes to wetlands at INEL.

Tritium Supply and Recycling. Because there are no wetlands in the proposed TSS, construction and operation of any of the tritium supply technologies and recycling facilities would not impact this resource. Wetlands associated with the Big Lost River are located 1.5 miles from the site; therefore, impacts to these wetlands are not expected. Construction and operation of a tritium supply facility alone would not affect wetlands because there are no wetlands in the proposed TSS.

Less than Baseline Operations. Operation of the HWR, MHTGR or ALWR at reduced tritium production capacity would have no wetland impact. Construction and operation of a Phased APT would also not affect wetlands because there are no wetlands in the proposed TSS.

Potential Mitigation Measures. Mitigation measures are not anticipated.

Aquatic Resources

No Action. Under No Action, the missions described in section 3.3.1 would continue at INEL with no changes to aquatic resources at INEL.

Tritium Supply and Recycling. Construction and operation of any of the tritium supply technologies and recycling facilities would not impact aquatic resources since there are no surface water bodies in the proposed TSS. The nearest surface water body is the Big Lost River which is located 1.5 miles from the site. Temporary aquatic habitat may develop in evaporation and retention ponds, as well as in natural channels in the immediate vicinity of NPDES-permitted outfalls. Construction and operation of a tritium supply facility alone would not affect aquatic

resources because there are no surface water bodies in the proposed TSS.

Less than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced tritium production capacity would have no impact on aquatic resources at INEL. Construction and operation of a Phased APT would also not impact aquatic resources because there are no aquatic resources in the proposed TSS.

Potential Mitigation Measures. Mitigation measures are not anticipated.

Threatened and Endangered Species

No Action. Under No Action, the missions described in section 3.3.1 would continue at INEL with no change to the current conditions of threatened and endangered species at INEL.

Tritium Supply and Recycling. Although the acreage of disturbed habitat would vary (table 4.2.3.6–1), no Federal-listed species would be affected by constructing any of the tritium supply technologies and recycling facilities at the proposed TSS, but several Federal candidate or state-listed species may be affected. Up to 462 acres of foraging habitat for the ferruginous hawk (Category 2) would be lost and the species would be discouraged from areas in close proximity to the construction site. However, the loss of foraging habitat is not expected to affect the viability of the population. Suitable nesting sites for this species are relatively rare on INEL and should be avoided (DOE 1992e:5-138). Construction activities could destroy the nests of the loggerhead shrike and disrupt foraging birds. Likewise, burrows and foraging habitat for the pygmy rabbit would be lost. The Townsend's western big-eared bat (Category 2) may roost in caves and forage throughout the proposed TSS (INEL 1992a:5). One state-listed sensitive plant species could potentially be affected by construction of the tritium supply and recycling facility. The plant species, tree-like oxytheca, has been collected at eight sites on INEL and at only two other sites in Idaho. If present, individual plants of this species could be destroyed during land clearing activities. Preactivity surveys would be required prior to construction to determine the occurrence of these species in the area to be disturbed. During operation of the new facilities, the Townsend's western big-eared bat could forage at evaporation and stormwater retention ponds. No adverse impacts are expected due to facility operation.

Construction and operation of a tritium supply facility alone would result in similar impacts to threatened and endangered species but less than those described for a collocated tritium supply and recycling facility. Impacts would be less since fewer acres of habitat would be disturbed.

Less than Baseline Operations. Operation of the HWR, MHTGR or ALWR at reduced tritium production capacity would not be expected to result in adverse impacts to threatened, endangered, or sensitive species as described for the baseline tritium production requirement. Construction and operation of a Phased APT would have similar impacts on the Federal candidate and state-listed species discussed above for the baseline tritium production requirement.

Potential Mitigation Measures. Disturbance of threatened and endangered and special-status species would be avoided where possible. Land clearing activities could be planned to avoid nesting seasons or areas where oxytheca occur. A habitat restoration or propagation program would be developed for oxytheca if disturbance is unavoidable.

Consultation with the USFWS would be required if INEL is selected as the location for a tritium supply and recycling facilities and, if necessary, a detailed plan to mitigate impacts to Federal listed threatened and endangered species would be developed. Currently, no critical habitat has been designated for threatened and endangered species at INEL.

4.2.3.7 *Cultural and Paleontological Resources*

Cultural and paleontological resources may be affected directly through ground disturbance during construction, visual intrusion of the project into the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, and unauthorized artifact collecting and vandalism. Intensive cultural resources inventories and site evaluations have not been conducted for the

majority of the proposed TSS. Site-specific surveys and evaluations would be conducted in conjunction with tiered NEPA documentation. Although the location and acreage for proposed tritium facilities will vary, the effects on cultural and paleontological resources are based primarily on the amount of ground disturbance; therefore, the facilities with the greatest ground disturbance will have the greatest potential effect on cultural and paleontological resources. Some NRHP-eligible prehistoric and historic sites, important Native American resources, and scientifically important paleontological resources may be affected by the proposed action.

Multipurpose Reactor. Total land requirements for the MHTGR and ALWR multipurpose reactors would be 931 and 691 acres, respectively. NRHP-eligible prehistoric and historic sites, Native American resources, and paleontological resources occurring in deeply buried lava tubes or blisters may occur within these acreages and may be affected by the construction of a multipurpose reactor. In general, impacts to prehistoric and historic resources, Native American resources, and paleontological resources would be similar to, but potentially greater than, those described for the tritium supply and recycling facility.

Prehistoric and Historic Resources

No Action. Under No Action, DOE would continue existing and planned missions at INEL. Any impacts to prehistoric and historic resources from these missions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Land disturbance for construction of the proposed tritium facilities (section 3.4) would range from 360 acres for the MHTGR to 173 acres for the APT (section 4.2.3.1). Acreages for the HWR and ALWR would be 260 and 350, respectively. Acreage required by the recycling facilities would be an additional 196 acres. Some NRHP-eligible prehistoric and historic sites are expected to occur within the acreages that would be disturbed during construction. The prehistoric sites could include residential bases, campsites, and limited activity locations. The historic sites could include homesteads, trash scatters, cattle camps, and ditches or canals. NRHP-eligible resources will be identified through project-specific inventories and evaluations, and any project-related effects would be addressed in tiered NEPA documentation. Operation of new facilities would not involve additional ground disturbance or increased activity; therefore, prehistoric and historic sites would not be affected.

Less Than Baseline Operations. No change in impacts to prehistoric and historic resources would be expected from operating the HWR at reduced capacity. Impacts for the MHTGR or ALWR would also not change from those described for the baseline requirement because the MHTGR or ALWR would not be a reduced size or operate at reduced capacity.

Construction and operation of the Phased APT would not change the expected impacts from the Full APT since the disturbed area would be the same in both scenarios.

Potential Mitigation Measures. If NRHP-eligible sites cannot be avoided through project design or siting, and would result in an adverse effect, then a Memorandum of Agreement may need to be negotiated between DOE, the Idaho State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation describing and implementing intensive inventory and evaluation studies, data recovery plans, site treatments, and monitoring programs. The appropriate level of data recovery for mitigation would be determined through consultation with the Idaho SHPO and the Advisory Council on Historic Preservation, in accordance with Section 106 of the *National Historic Preservation Act*. Mitigation measures for specific NRHP-eligible sites would be identified during tiered NEPA documentation.

Native American Resources

No Action. Under No Action, DOE would continue existing and planned missions at INEL. Any impacts to Native American resources from these missions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Some Native American resources may occur within the acreages which would be disturbed during construction of the tritium facilities. Native American resources may include rock art and burials. Operation of facilities may create audio or visual intrusions on Native American sacred sites in the vicinity. Specific

concerns about the presence, type, and locations of Native American resources would be identified through consultation with the potentially affected tribes, and any project-related effects would be addressed in tiered NEPA documentation.

Less Than Baseline Operations. Impacts to Native American resources would not change due to less than baseline tritium operation of the HWR, MHTGR or ALWR. Construction and operation of a Phased APT would have similar impacts on Native American resources as those described for the Full APT.

Potential Mitigation Measures. If Native American resources cannot be avoided through project design or siting, then acceptable mitigation measures to lessen the effect on these resources would be determined in consultation with all potentially affected Native American groups. In accordance with the *Native American Graves Protection and Repatriation Act* and the *American Indian Religious Freedom Act*, such mitigations may include, but not be limited to, appropriate relocation of human remains and planting vegetation screens to reduce visual and audio intrusion. However, impacts to some Native American resources such as rock art sites may be mitigated as appropriate.

Paleontological Resources

No Action. Under No Action, DOE would continue existing and planned missions at NTS. Any impacts to paleontological resources from these missions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Surface exposures of fossiliferous formations do not occur within areas designated for the proposed TSS. However, deep project-related excavation could encounter buried lava tubes or blisters which may have served as faunal traps. The only tritium supply technologies that would require excavations exceeding 50 feet would be the MHTGR and APT. In such a case, monitoring could be an appropriate mitigation. A certified paleontologist would be onsite during excavation to document any findings.

Less Than Baseline Operations. No change in impacts to paleontological resources would be expected due to reduced operation of the HWR, MHTGR, ALWR, or construction of a Phased APT.

Potential Mitigation Measures. Because scientifically important buried paleontological materials could be affected, paleontological monitoring of construction activities and data recovery of fossil remains would be appropriate mitigation measures.

4.2.3.8 *Socioeconomics*

Locating any of the tritium supply technologies alone or with recycling facilities at INEL would affect socioeconomics in the region. Section 3.2 provides descriptions for No Action, the tritium supply technologies, and tritium recycling. Siting tritium supply technology with or without a recycling facility at INEL would create changes in some of the communities in both the ROI and the regional economic area. The in-migrating population could increase the demand for housing units. Additionally, there would be an associated increased burden on community infrastructure and subsequent effects on the public finances of local governments in the ROI. The increase of population could also burden transportation routes in the ROI.

During the construction period, the greater changes in socioeconomic characteristics would result from the ALWR and APT. During operation, the HWR, MHTGR, and ALWR would exhibit similar characteristics. The APT would result in the smallest changes during operation. None of these tritium supply technologies with a recycling facility would increase population, the need for additional housing, or local government spending in the ROI beyond 9 percent over No Action during peak construction or operation. Although the greatest percent increases in employment, population and housing, and public finance during construction and operation occur in the peak years of 2005 and 2010, respectively, the annual average increases over the construction period (2001 to 2005) are between less than 1 percent and 4 percent average growth annually, and 1 percent or less average annual growth during operation (2010 to 2050). From peak construction to full operation (2005 to 2010), annual average increases vary from decreases of 1 percent to increases of 1 percent.

The effects of locating any of the tritium supply technologies alone or with recycling facilities at INEL are summarized in section 4.2.3. The following sections describe the effects that locating one of these technologies would have on the local region's economy and employment, population, housing, public finances, and local transportation.

Employment and Local Economy

Changes in employment and levels of economic activity in the 13-county regional economic area from the proposed action at INEL are described in this section. Although specialized personnel, materials, and services required for construction and operation would be imported from outside the area, a significant portion of these requirements would be available in this regional economic area. Figures 4.2.3.8–1 and 4.2.3.8–2 present the potential changes in employment and local economy that would occur with each of the technologies.

No Action. Under No Action, employment at INEL decreased to approximately 10,100 persons in 1994. This is a decrease of about 1,000 persons from the 1990 employment. INEL employment is projected to total almost 10,100 persons in 2010 and remain at this level through 2020. Historical and future employment projections at INEL are presented in appendix table D.2.1–1. The total INEL payroll was approximately $436 million in 1994 and is expected to remain at this level through 2010 (IN ISU 1994a).

Total employment in the regional economic area is projected to grow less than 1 percent annually between 2001 and 2009 reaching 143,700 persons. Between 2010 and 2020, employment is expected to decrease annually by much less than 1 percent reaching 140,800 persons. The unemployment rate in the regional economic area is expected to remain at 6.4 percent between 2001 and 2020. Per capita income is projected to increase from $17,800 to $20,900 during this 20-year period. No Action estimates are presented in appendix table D.3–2.

Tritium Supply and Recycling. Construction activities would begin between 2001 and 2003 and would be completed between 2007 and 2009. Phasing in of employment for the operation of the new facilities would begin in 2007, peak at full employment by 2010, and continue at this level into the future.

Locating any of the tritium supply technologies with a recycling facility at INEL would create new jobs (direct) at the site. Indirect job opportunities, such as community support services, would also be created in the regional economic area as a result of these new jobs. The total new jobs (direct and indirect) created would reduce unemployment and increase income in

the economic region surrounding INEL during both the construction and operation periods of the proposed action.

Construction. Siting a tritium supply technology and recycling facility at INEL would require a total of approximately 7,400 to 13,600 worker-years of activity over a 5- to 9-year construction period. This construction-related employment would indirectly create other jobs in the regional economic area and total employment would grow at an annual average rate of 2 to 3 percent until the peak year of 2005. Between peak construction (2005) and full operation (2010) average annual growth in employment would decrease by less than 1 percent under the ALWR and APT. Under the HWR and MHTGR, employment growth would be flat between 2005 and 2010. Figure 4.2.3.8–1 gives the estimates of total jobs (direct and indirect) that would be created during peak construction (year 2005) for each of the tritium supply technologies with recycling and the recycling facility's contribution to employment growth.

As employment opportunities grow in the regional economic area due to the proposed action, the unemployment rate would be reduced from the No Action estimate of 6.4 percent. Figure 4.2.3.8–2 presents a comparison of unemployment rates for the different tritium supply technologies with recycling during peak construction in 2005. During the project's peak construction phase, the unemployment rate would be 4.5 percent, for any of the tritium supply technologies collocated with recycling. The contribution to the unemployment rate resulting from the tritium recycling facility is also indicated.

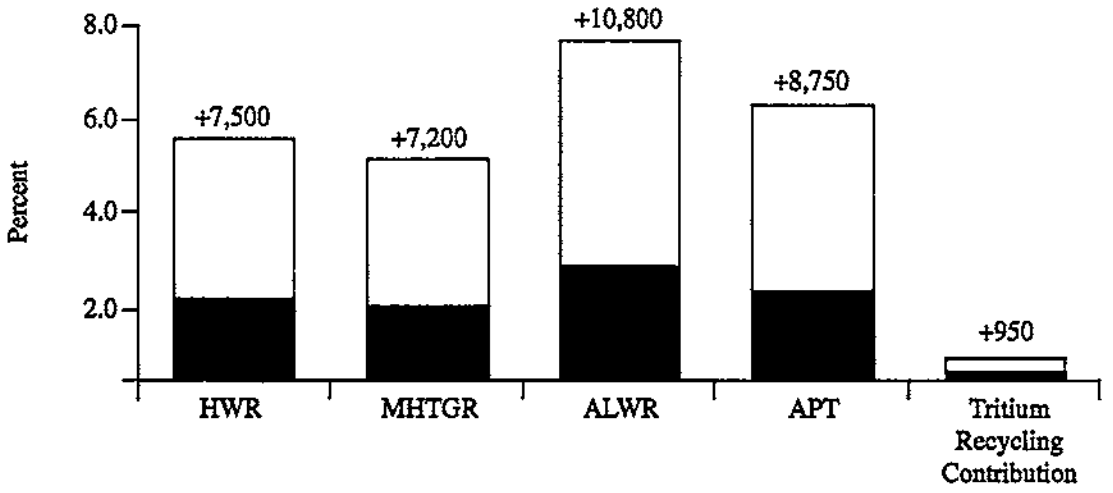
Income in the regional economic area would also increase, particularly during peak construction as shown in Figure 4.2.3.8–2. Per capita income is expected to increase at an annual average of 1 to 2 percent until the peak year of construction, 2005. Between 2005 and 2010 annual average growth in per capita income is expected to increase by 1 percent for all of the tritium supply technologies with recycling. In comparison, under No Action, per capita income is expected to increase 1 percent annually during both periods.

Operation. Siting of tritium supply and recycling facilities would help offset the employment and income losses at INEL from the approximate 1,000 jobs lost between 1990 and 1994. Employment for operation would begin phasing in as construction neared completion and construction-related employment began phasing out. It is expected that full operation employment would peak in 2010 and continue at this level into the future. Figure 4.2.3.8–1 presents the total project-related jobs projections (direct and indirect) for each of the tritium supply technologies and recycling facilities for 2010. However, the addition of these new project-related jobs would not dramatically affect future employment growth in the regional economic area. Overall employment growth is expected to be flat from 2010 through 2020.

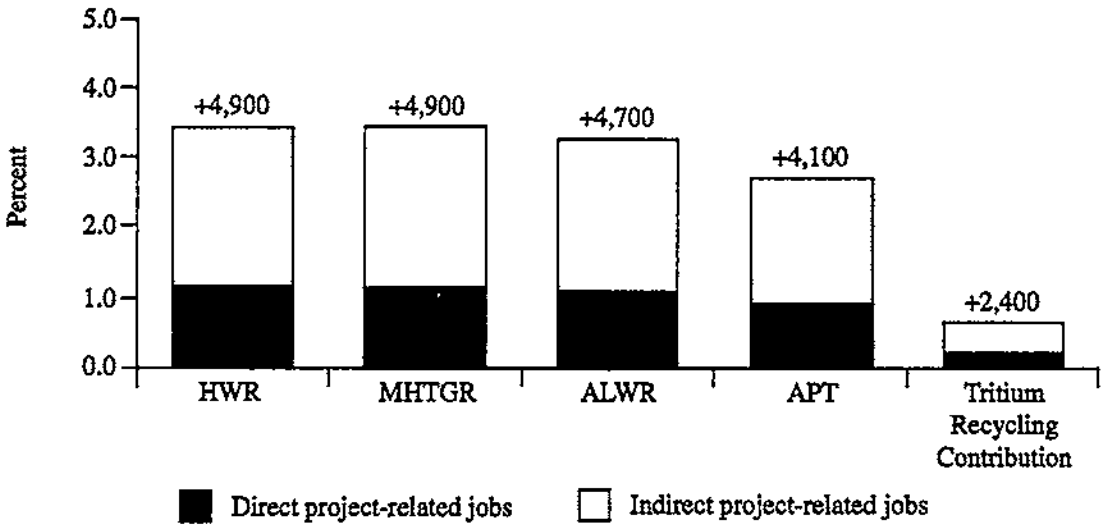
Creation of additional job opportunities would reduce the unemployment rate to below that projected for No Action. Figure 4.2.3.8–2 presents the differences in unemployment rates during the first year of full operation employment (2010) for each of the tritium supply technologies and recycling facilities. From 2010 to 2020, unemployment would be reduced from the No Action projection of 6.4 percent to a range of 4.6 to 4.9 percent for all of the technologies.

Income would also increase slightly in the regional economic area as a result of the proposed action. Per capita income differences for tritium supply technologies and recycling facilities for 2010 are given in Figure 4.2.3.8–2. Per capita income annual average increases would be about 1 percent between 2010 and 2020 for all of the tritium supply technologies and recycling facilities considered for location at INEL. The No Action projected annual average increase during the same period would also be approximately 1 percent.

Tritium Supply Alone. Construction of the tritium supply technologies without recycling facilities would begin between 2001 and 2003 and would be completed between 2007 and 2009. Employment for the operation of the facility would begin in 2007 and reach full employment by 2010. Locating any of the tritium supply technologies at INEL would create new jobs at the site and indirectly create other jobs in the region. However, this job creation and the additional economic effects would be less than the effects that would occur with the collocation of the tritium supply technologies with the recycling facilities.



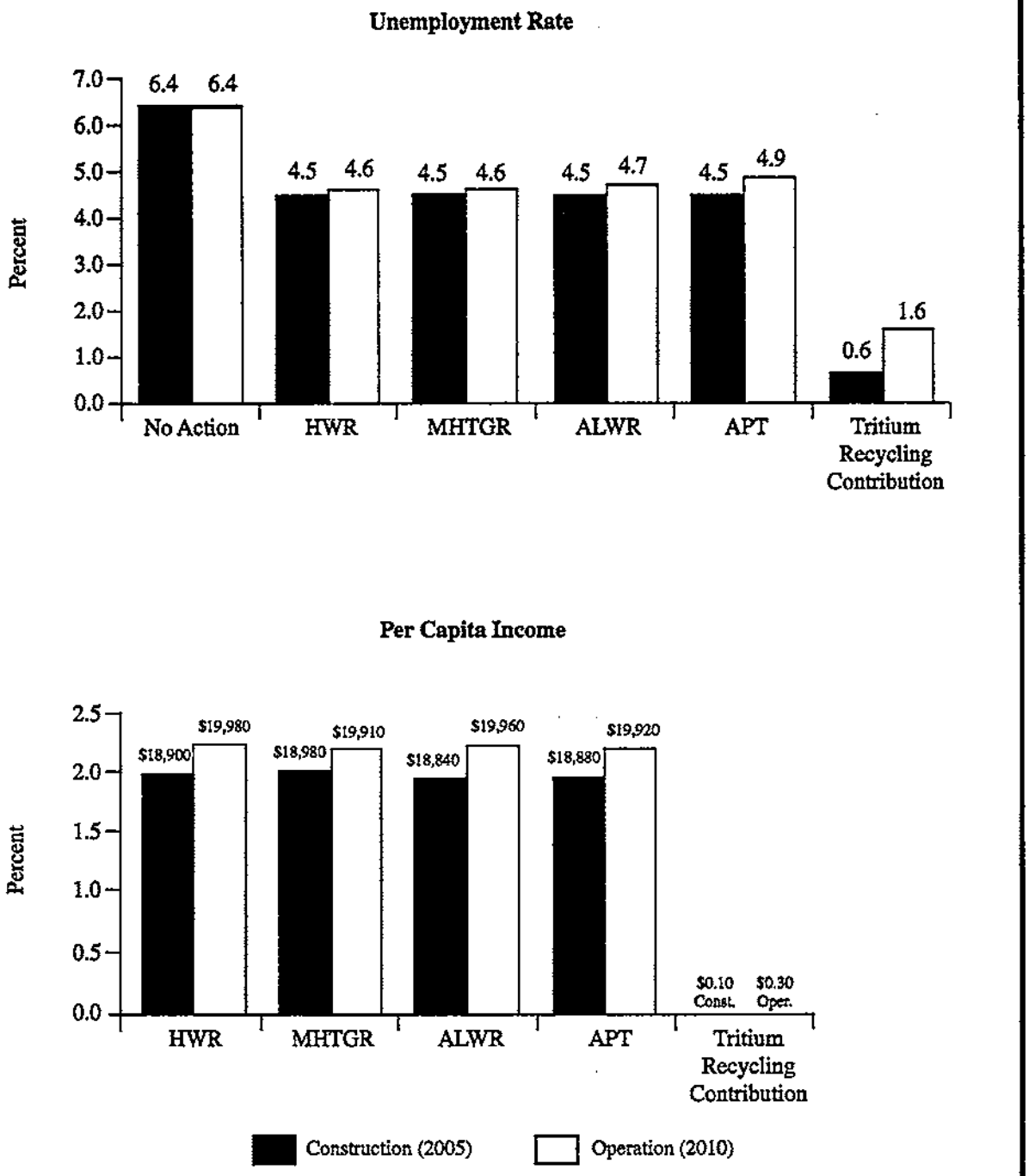
Note: For No Action, total employment is 141,500 jobs.



Note: Tritium supply alternatives include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For No Action, total employment is 144,300 jobs. The percent increase in total employment during peak construction and operations was calculated by dividing the total project-related jobs by the total employment for No Action.

Source: Appendix table D.3–4.

FIGURE 4.2.3.8–1.—*Total Project-Related Employment (Direct and Indirect) and Percentage Increase Over No Action from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Regional Economic Area.*



Note: For No Action, per capita income is projected to be $18,570 in 2005 and $19,570 in 2010.
Note: Tritium supply alternatives include recycling. To calculate tritium supply only, subtract tritium recycling contribution.
Source: Appendix table D.3–4.

FIGURE 4.2.3.8–2.—*Unemployment Rate, Per Capita Income, and Percentage Increase from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Regional Economic Area.*

Construction. Construction of a tritium supply technology alone would require a total of approximately 6,380 to 12,700 worker-years of activity over a 5- to 9-year period. New jobs would be created at annual average rates ranging from 1 percent to 3 percent until the peak year of construction, 2005. Between 2005 and 2010, employment would generally decrease by less than one percent annually for the four technologies, however, the rates would be greater than the No Action estimates. Appendix table D.3–3 presents the estimates of employment that would be created during peak construction in 2005, or the number of new jobs can be calculated by subtracting tritium recycling contribution from tritium supply technologies and recycling in Figure 4.2.3.8–1.

Although the construction of the tritium supply technology alone would create new jobs, the effects of constructing this facility would not be enough to greatly affect the unemployment rate projected for No Action. Additionally, per capita income in the region would rise only slightly above that estimated for No Action. Estimates of unemployment rate and per capita income are presented in appendix table D.3–3, or can be derived for tritium supply alternatives by subtracting tritium recycling contribution in Figure 4.2.3.8–2.

Operation. Operation employment for the tritium supply technologies alone would begin phasing in at the end of the construction period and be at full employment in 2010. Full employment is expected to be maintained for the life of the facility. Estimates for full employment in 2010 are presented in appendix table D.3–3. Total project related jobs created by the tritium supply technologies alone can be calculated by subtracting the tritium recycling contribution in Figure 4.2.3.8–1.

The addition of new jobs during operation would reduce the unemployment rate below the projection for No Action. The unemployment rate for 2010, the first year of full operation employment, is presented in appendix table D.3–3, or can be derived by subtracting tritium recycling contribution in Figure 4.2.3.8–2. Unemployment would be reduced from the No Action projection of 6.4 percent to a range of 5.4 to 5.6 percent from 2010 to 2020 depending upon the technology selected.

The creation of new jobs as a result of tritium supply operation would also increase income slightly over the No Action estimates. Appendix table D.3–3 presents the per capita income for the facility for 2010. From 2010 to 2020, per capita income annual increases would be 1 percent, the same annual increase projected under No Action.

Less Than Baseline Operations. Tritium supply technologies that provide less than the baseline tritium requirement are described in section 3.1. These options may or may not be collocated with the tritium recycling facilities. The options include lowering the power in the HWR, using fewer target rods in the MHTGR and ALWR, and the phased approach for the APT.

Construction. The less than baseline operations case for the HWR, ALWR, and MHTGR would have the same construction workforce requirements as discussed in the tritium supply and recycling and tritium supply only sections. Therefore, employment and economic effects in the region would be the same.

The Phased APT would require the same total number of construction workers as the Full APT, but the construction period would span from 1999 to 2008 instead of from 2003 to 2007. Additionally, peak construction would occur in 2003 instead of 2005. The effects on the regional economic area's employment, unemployment rate, and per capita income as a result of constructing the Phased APT are presented in appendix table D.3–3. Appendix table D.3–4 presents the effects on employment, unemployment rate, and per capita income for constructing the Phased APT with tritium recycling facilities. Generally, average annual increases in employment and income are similar to those for the Full APT, but these increases are over a longer period of time. These increases are between less than 1 percent and 2 percent.

Operation. Operation workforce requirements for the less than baseline tritium case for the HWR, MHTGR, ALWR, and the Phased APT would be the same as those described in the tritium supply and recycling and tritium supply only sections. Thus, regional employment and economic effects would be the same.

Multipurpose Reactor. Construction activities for the multipurpose reactor would begin in 2001 and would be completed by 2009. Phasing in of employment for

the operation of the multipurpose reactor would begin in 2007, peak at full employment by 2010, and continue at that level into the future. Because this option would perform three processes, it would result in greater changes in employment and local economy characteristics than any of the four tritium supply technologies.

Construction. Siting the multipurpose reactor and a recycling facility at INEL would require 19,140 worker-years of activity over a 9-year period. The multipurpose reactor alone would require 18,150 worker-years of activity over a 9-year period. Employment characteristics, unemployment rates, and per capita income characteristics during construction of the multipurpose reactor alone and with a tritium recycling facility are presented in appendix tables D.3–3A and D.3–4A, respectively. From the first year of construction to the peak year (2005), annual average increases in employment and per capita income would range from 2 to 3 percent. Between 2005 and 2010, employment would decrease annually at an average rate of less than 1 percent and per capita income would increase on an annual average of 1 percent. The unemployment rate during peak construction for this option with or without a recycling facility would be 4.5 percent.

Operation. Operation employment for the multipurpose reactor would begin phasing in toward the end of the construction period and reach full employment in 2010. Full employment is expected to be maintained for the life of the facility. Employment characteristics, unemployment rates, and per capita income characteristics during operation of the multipurpose reactor alone and with a tritium recycling facility are presented in appendix tables D.3–3A and D.3–4A, respectively. During operation annual employment growth would be flat and annual average growth in per capita income would be less than 1 percent. The unemployment rate for the multipurpose reactor alone and with a recycling facility would be 5.5 percent and 5 percent, respectively.

Accelerator Production of Tritium Power Plant. Construction activities for the APT power plant would begin in 2003 and would be completed by 2007. Phasing in of employment for the operation of the APT power plant would begin in 2007, peak at full employment by 2010, and continue at that level into the future. This option is similar to the APT with an addition of a gas-power plant. The changes in employment and local economy would be similar, but greater than those resulting from the APT.

Construction. Siting this option with a recycling facility at INEL would require 7,600 worker-years of activity over a 5-year period. The APT power plant alone would require 6,600 worker-years of activity of a 5-year period. Employment characteristics, unemployment rates, and per capita income characteristics during construction of this option alone and with a tritium recycling facility are presented in appendix tables D.3–3A and D.3–4A, respectively. From the first year of construction to the peak year (2005), annual average increases in employment and per capita income would range from 2 to 3 percent. Between 2005 and 2010, employment would decrease annually at an average rate of less than 1 percent and per capita income would increase on an annual average of 1 percent. The unemployment rate during peak construction for this option with or without a recycling facility would be 4.3 percent.

Operation. Operation employment for the APT power plant would begin phasing in toward the end of the construction period and reach full employment in 2010. Full employment is expected to be maintained for the life of the facility. Employment characteristics, unemployment rates, and per capita income characteristics during operation of the APT power plant alone and with a tritium recycling facility are presented in appendix tables D.3–3A and D.3–4A, respectively. During operation annual employment growth would be flat and annual average growth in per capita income would be less than 1 percent. The unemployment rate for the APT power plant alone and with a recycling facility would be 5.6 percent and 4.8 percent, respectively.

Population and Housing

Changes to ROI population and housing expected from the proposed action at INEL are described in this section. Additional population could be expected to in-migrate to the INEL region and these people would be expected to reside in cities and counties within the ROI in the same relative proportion as the existing population. Increases to population could lead to a demand for additional housing units beyond existing vacant housing available during construction or operation phases of the proposed action.

Figures 4.2.3.8–3 and 4.2.3.8–4 present changes in population and housing for all of the tritium supply technologies and recycling facilities.

No Action. Population and housing annual average increases between 2001 and 2005 are projected to be less than 1 percent. Annual average increases are also projected to be less than 1 percent between 2005 and 2010. Population in the ROI is estimated to reach 207,300 in 2010 and 215,200 in 2020. Total housing units in the ROI are estimated to reach 75,400 in 2010 and 78,300 in 2020. No Action estimates are given in appendix tables D.3–5 and D.3–8.

Tritium Supply and Recycling. It is expected that the greatest increase caused by the proposed action would increase population and housing demands in the ROI by 9 percent over No Action projections during peak construction. The effects are expected to be fewer (2 percent) during the operation phase of the proposed action.

Construction. Construction activities would be phased over a 5- to 9-year period. Figure 4.2.3.8–3 illustrates that during peak construction (2005), the ALWR and APT would create the largest population and housing demand increases over No Action, and the HWR and MHTGR would have the fewest effects. The increase in population could require some additional housing units beyond what is currently available in the existing housing mix. However, any requirements for additional housing units in the ROI would be at annual average increases of 3 percent in the first 3 years of construction of the ALWR and the APT, followed by an approximately 1 percent annual decrease until peak operation. The other tritium supply technologies would have annual average population and housing demand growth of 2 percent or less. Therefore, there would not be any major effects on any of the ROI communities.

Operation. Operation of any of the tritium supply technologies and recycling facilities is expected to reach full employment by 2010. In-migrating population is expected to demand housing units similar to the existing housing mix in the ROI. Figure 4.2.3.8–4 shows that population increases and potential demand for additional housing units over No Action projections is less than 2 percent for the ROI in this peak year. Given that the operations of the proposed action would be phased in over a 4-year period, it is expected that existing vacancies would absorb much of this new demand and that No Action requirements would be exceeded by very few units.

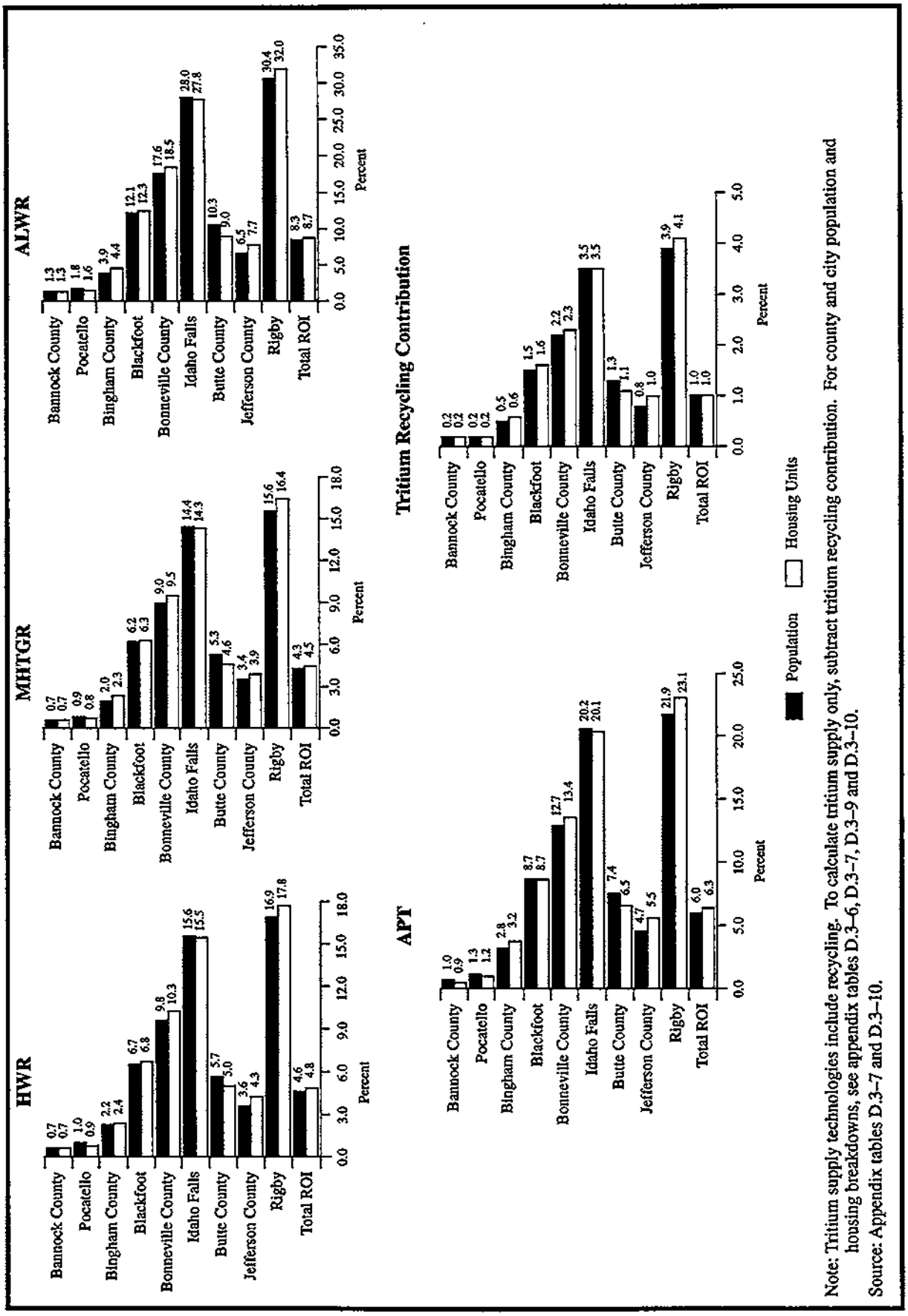
Tritium Supply Alone. Locating a tritium supply technology alone at INEL would not increase population or housing demands in the ROI more than 8 percent over No Action projections during the construction period or 1 percent during operation.

Construction. Construction activities for the tritium supply technologies alone would be lower than if collocated with the tritium recycling facilities. The greatest increase in population and housing demand would occur during peak construction in 2005. Appendix tables D.3–6 and D.3–9 show that available vacancies in the existing housing mix would probably accommodate the expected population growth.

Operation. Full employment levels for any of the tritium supply technologies alone would be reached by 2010. In-migrating population would be expected to require housing units similar to the existing mix in the ROI. These requirements would be lower than those of the tritium supply technologies collocated with the recycling facilities. Potential demand for housing units would be less than 1 percent in the first year of full employment as illustrated in appendix table D.3–9. It is expected that existing vacancies would absorb most of this new demand as employment would be phased in from 2007 through 2010.

Less Than Baseline Operations. Population increases and housing demands would be the same or lower during construction and operation of tritium supply technologies operated at less than baseline tritium requirements than the alternatives discussed in the tritium supply and recycling and tritium supply only sections.

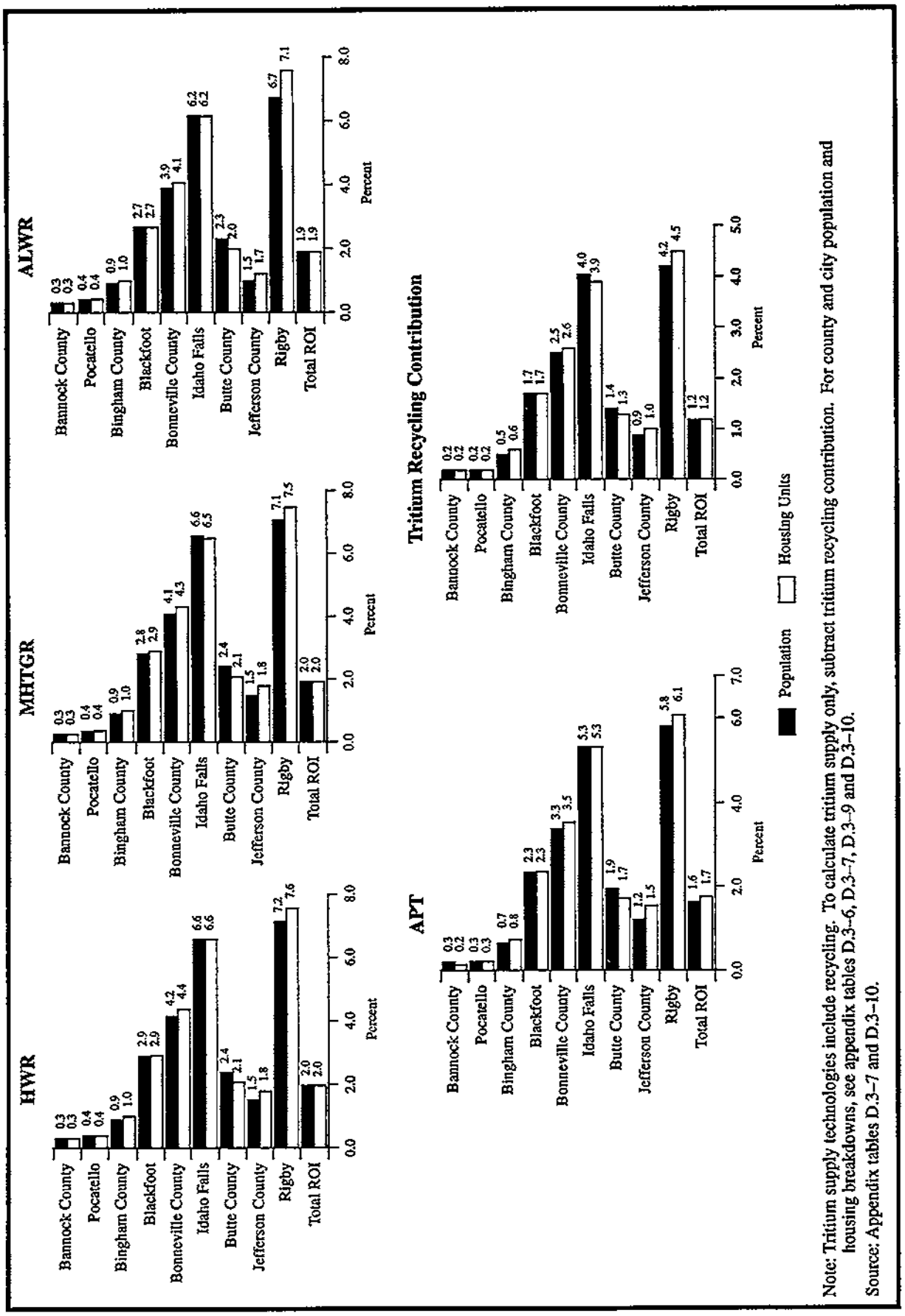
Construction. Population increases and housing demands would be the same as those given in Figure 4.2.3.8–3 for the HWR, MHTGR, and ALWR. The Phased APT would increase population and housing demand during construction to the same level as the Full APT, but this would occur over a longer construction period with lower average annual increases (1 percent or less). Also, the peak construction year would be 2003 instead of 2005. The effects of the Phased APT on population and housing are



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For county and city population and housing breakdowns, see appendix tables D.3–6, D.3–7, D.3–9 and D.3–10.

Source: Appendix tables D.3–7 and D.3–10.

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.*



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For county and city population and housing breakdowns, see appendix tables D.3–6, D.3–7, D.3–9 and D.3–10.
Source: Appendix tables D.3–7 and D.3–10.

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.*

presented in appendix tables D.3–6 and D.3–9, respectively. Appendix tables D.3–7 and D.3–10 present the results of constructing the Phased APT with the tritium recycling facilities.

Operation. The effects on population and housing of operating the HWR, MHTGR, ALWR and Phased APT at less than baseline tritium requirements would be the same as those given in Figure 4.2.3.8–4.

Multipurpose Reactor. Locating the multipurpose reactor with or without a recycling facility at INEL would not increase population and housing demands more than 12 percent over No Action projections during the construction period and 5 percent during operation.

Construction. Because this option would perform three processes, it would result in greater changes in population and housing characteristics than any of the four tritium supply technologies. Changes to population and housing characteristics resulting from multipurpose reactor with and without recycling facilities are presented in appendix tables D.3–6A, D.3–7A, D.3–9A, and D.3–10A. Population and housing growth in the ROI would be at an annual average rate of 3 percent until 2005 and less than 1 percent between 2005 and 2010.

Operation. Full employment levels for the multipurpose reactor would be reached by 2010. As illustrated in appendix tables D.3–6A, D.3–7A, D.3–9A, and D.3–10A, potential demand for housing units would be less than 5 percent in the first year of full employment. It is expected that existing vacancies would absorb most of this new demand as employment would be phased in from 2007 through 2010.

Accelerator Production of Tritium Power Plant. Locating the APT power plant with or without a recycling facility at INEL would not increase population and housing demands more than 7 percent over No Action projections during the construction period and 2 percent during operation.

Construction. This option is similar to the APT with the addition of a gas power plant. The changes in population and housing demands would be similar, but greater than those resulting from the APT. Changes to population and housing characteristics resulting from the APT power plant with and without recycling facilities are presented in appendix tables D.3–6A, D.3–7A, D.3–9A, and D.3–10A. Population and housing growth in the ROI would be at an annual average rate of 3 percent until 2005 and less than 1 percent between 2005 and 2010.

Operation. Full employment levels for the APT power plant would be reached by 2010. As illustrated in appendix tables D.3–6A, D.3–7A, D.3–9A, and D.3–10A, potential demand for housing units would be less than 2 percent in the first year of full employment. It is expected that existing vacancies would absorb most of this new demand as employment would be phased in from 2007 through 2010.

Public Finance

Fiscal changes could occur in some ROI local jurisdictions from the proposed action. Factors influencing these changes include residence of project-related employees and their dependents, cost and duration of construction, and economic conditions in the ROI once the new facilities are operational.

Adding the proposed action to INEL would increase population, resulting in more revenues for ROI local jurisdictions. Additional population would also increase public service expenditures. Figures 4.2.3.8–5 through 4.2.3.8–8 present the potential fiscal changes that would occur with the different tritium supply technologies and recycling facilities.

No Action. No Action is the reference condition against which tritium supply technologies and recycling facilities are compared. Appendix tables D.3–11 and D.3–12 present the 1992 public finance characteristics for local ROI jurisdictions. Appendix tables D.3–13 through D.3–20 present the impacts from tritium supply technologies alone or collocated with recycling facilities compared to No Action during construction and operation for the local counties, cities, and school districts. Between 2001 and 2005, ROI counties, cities, and school districts are projected to increase total revenues on an annual average of less than 1 percent. Total expenditures are also projected to increase on an annual average of less than 1 percent for ROI counties, cities, and school districts between 2001 and 2005. Between the peak year of construction (2005) and full operation (2010), total revenues and expenditures are also expected to increase by less than 1 percent.

Between 2010 and 2020, projected annual average increases in total revenues are less than 1 percent for counties, cities, and school districts in the ROI. Total expenditures are also projected to increase on an average by less than 1 percent for ROI jurisdictions between 2010 and 2020.

Tritium Supply and Recycling. The proposed action at INEL would create some fiscal benefits to local jurisdictions within the ROI. Some local government finances would be affected during the construction and operation phases of the proposed action. Construction-related effects on revenues and expenditures could span a period of 5 to 9 years with the peak occurring in 2005. The effects of the operation phase would peak in 2010 and remain at this level throughout the life of the proposed action.

Construction. The public finances of counties, cities, and school districts within the ROI would be affected by the construction-related activities associated with the proposed action. Initially, there would be slight increases to some local government jurisdictions' revenues and expenditures which would peak in 2005 and then decline as construction neared completion. Figures 4.2.3.8–5 and 4.2.3.8–7 give the revenue and expenditure changes of ROI local government jurisdictions over No Action during peak construction for the four tritium supply technologies and recycling facilities. Under the ALWR, revenues and expenditures would increase annually between 4 percent to less than 1 percent in the first 3 years of construction. After the peak construction year, there would be decreases of less than 1 to 2 percent annually until 2010. Under the HWR, MHTGR, and APT revenues and expenditures would increase annually between 2 and less than 1 percent between 2002 and 2005 and then growth would be flat until 2010. Under the No Action estimates, local government revenues and expenditures would increase on an annual average of less than 1 percent.

Operation. The effects on the ROI local government finances of phasing in operation together with phasing out construction would be fewer than the effects at peak or full operation (2010). The effects that the four tritium supply technologies and recycling facilities would have on county, city, and school district revenues and expenditures are presented in figures 4.2.3.8–6 and 4.2.3.8–8. Between 2010 and 2020, revenues are expected to increase slightly but at an average annual rate of less than 1 percent for all jurisdictions. Expenditures would also increase slightly to 2020 at an annual average of less than 1 percent. No Action local government revenues and expenditures would also increase at an average annual rate of less than 1 percent.

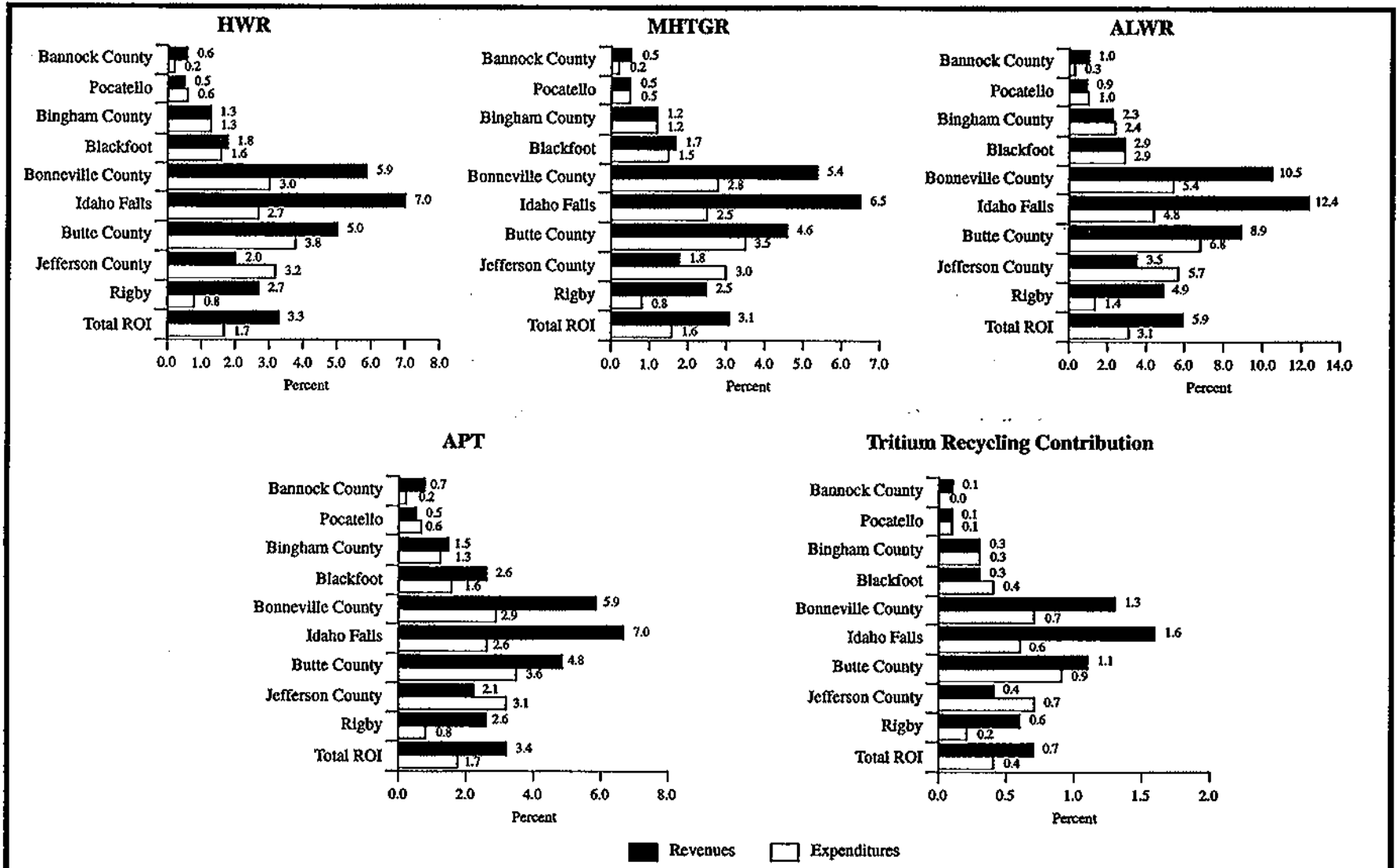
Tritium Supply Alone. Locating the tritium supply without the recycling facilities at INEL would create some fiscal benefits to local jurisdictions within the ROI, but these effects would be less than the effect of collocation with tritium recycling.

Construction. Between the first year of construction and 2005, revenues and expenditures would increase annually between less than 1 percent and 3 percent. Between 2005 and 2010, revenues and expenditures would decrease annually between less than 1 percent and 2 percent. Appendix tables D.3–13 and D.3–15 present the revenue and expenditure changes of ROI local governments over No Action during peak construction of the tritium supply technologies alone.

Operation. The operation phase of the tritium supply technologies alone would affect the public finances of counties, cities, and school districts in the ROI, but these effects would be less than those resulting from operating the tritium supply technologies with the recycling facilities. Appendix tables D.3–14 and D.3–16 present the effects that operation would have on these local jurisdictions in 2010. During 2010 to 2020, revenues and expenditures are expected to increase annually by less than 1 percent. In comparison, No Action local government revenues and expenditures would increase at an average annual rate of 1 percent.

Less Than Baseline Operations. The fiscal benefits that local jurisdictions would accrue from the location of a tritium supply technology alone or collocated with recycling would be the same or less if the tritium supply technologies is operated at less than baseline tritium requirements.

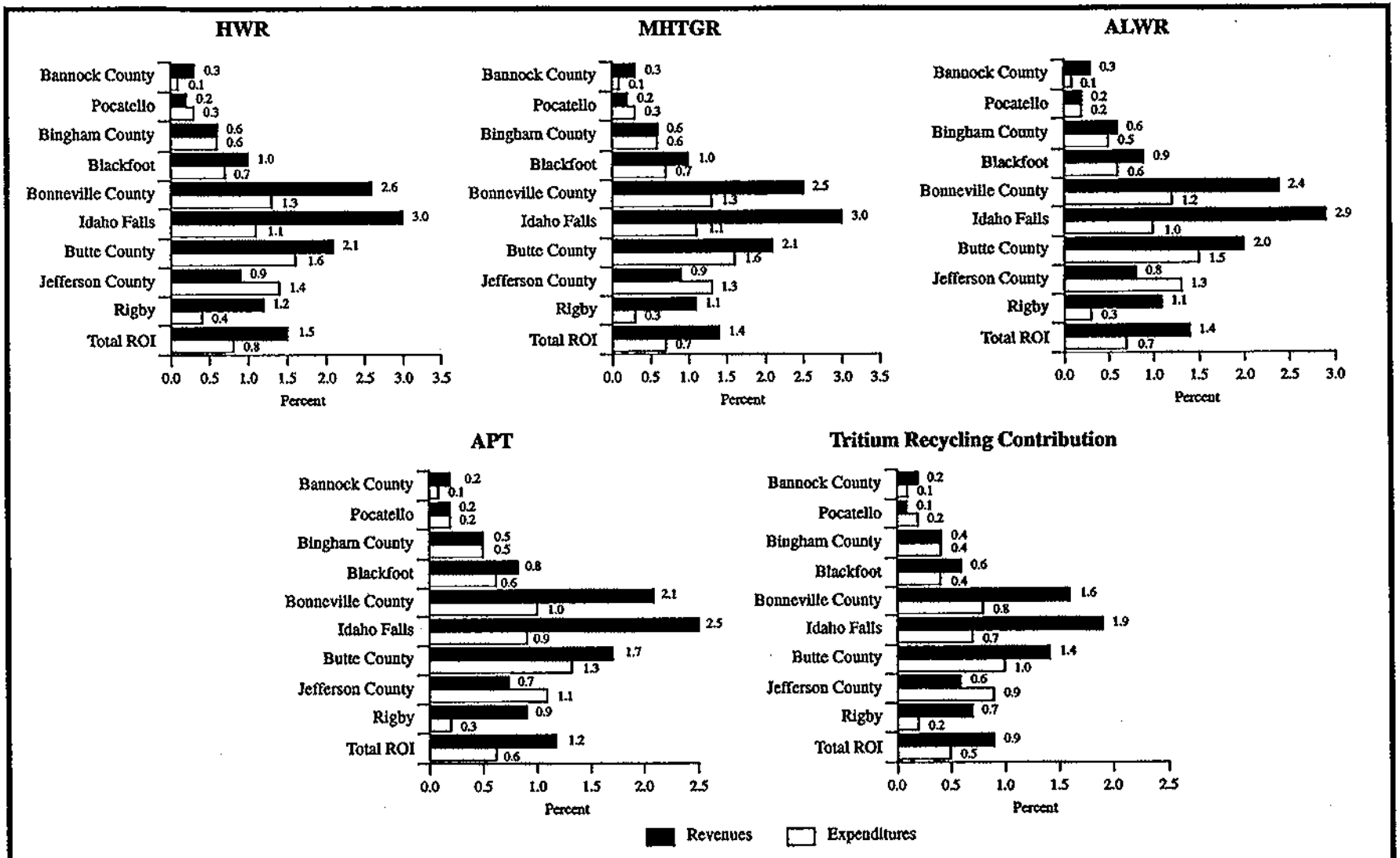
Construction. Increases in local jurisdictions' revenues and expenditures would be the same as those given in figures 4.2.3.8–5 and 4.2.3.8–7 if the HWR, MHTGR or ALWR are built. If the Phased APT is constructed, the effects would peak in 2003 instead of 2005, and the annual average increases would be lower (2 percent or less). Appendix tables



Note: Tritium supply technologies include tritium recycling. To calculate tritium supply only, subtract tritium recycling contribution. For a complete breakdown of county and city revenues and expenditures, see appendix tables D.3–13 and D.3-17.

Source: Appendix table D.3–17.

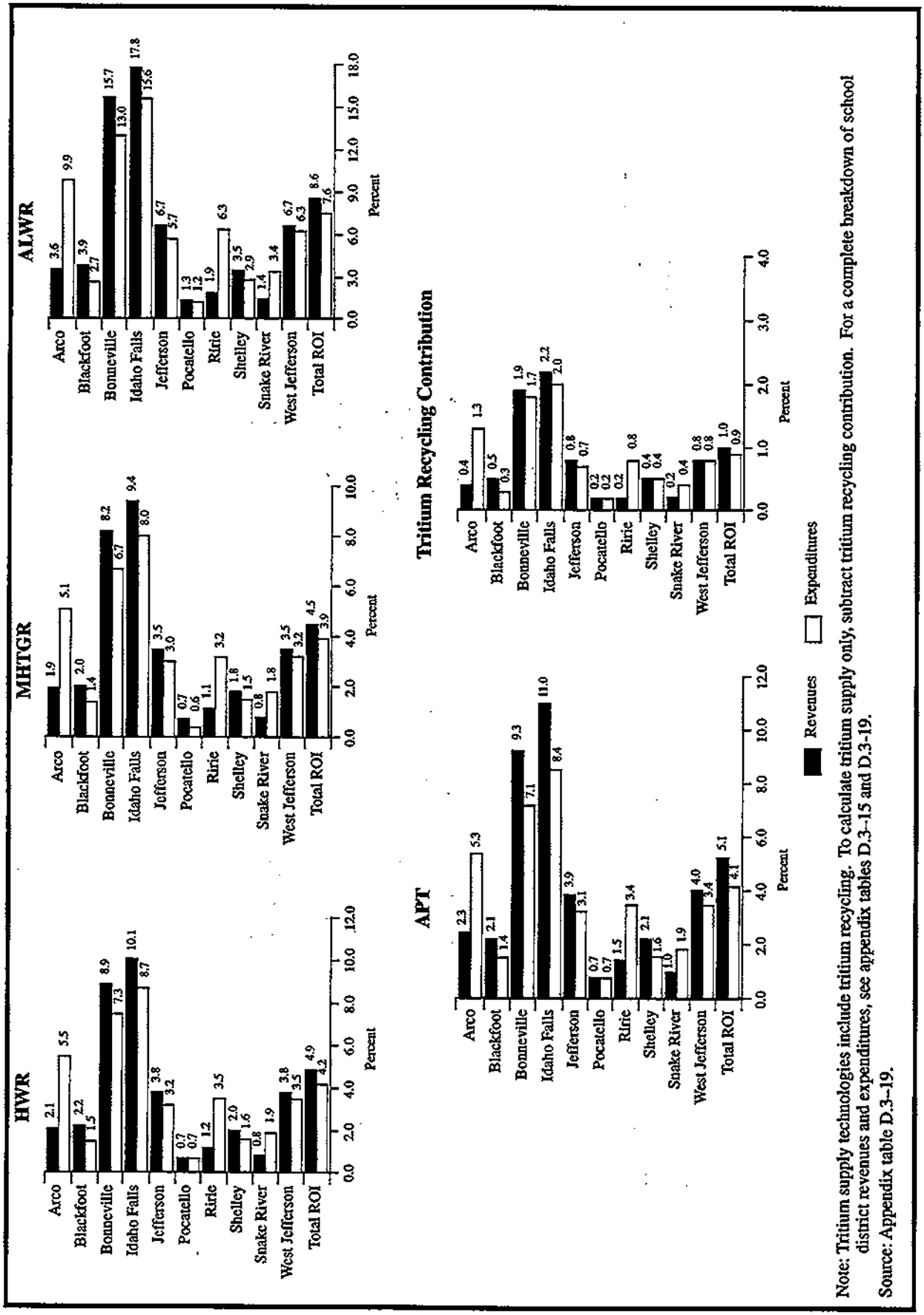
FIGURE 4.2.3.8–5.—*City and County Total Revenues and Expenditures Percentage Increase Over No Action During Peak Construction from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence, 2005.*



Note: Tritium supply technologies include tritium recycling. To calculate tritium supply only, subtract tritium recycling contribution. For a complete breakdown of county and city revenues and expenditures, see appendix tables D.3–14 and D.3-18.

Source: Appendix table D.3–18.

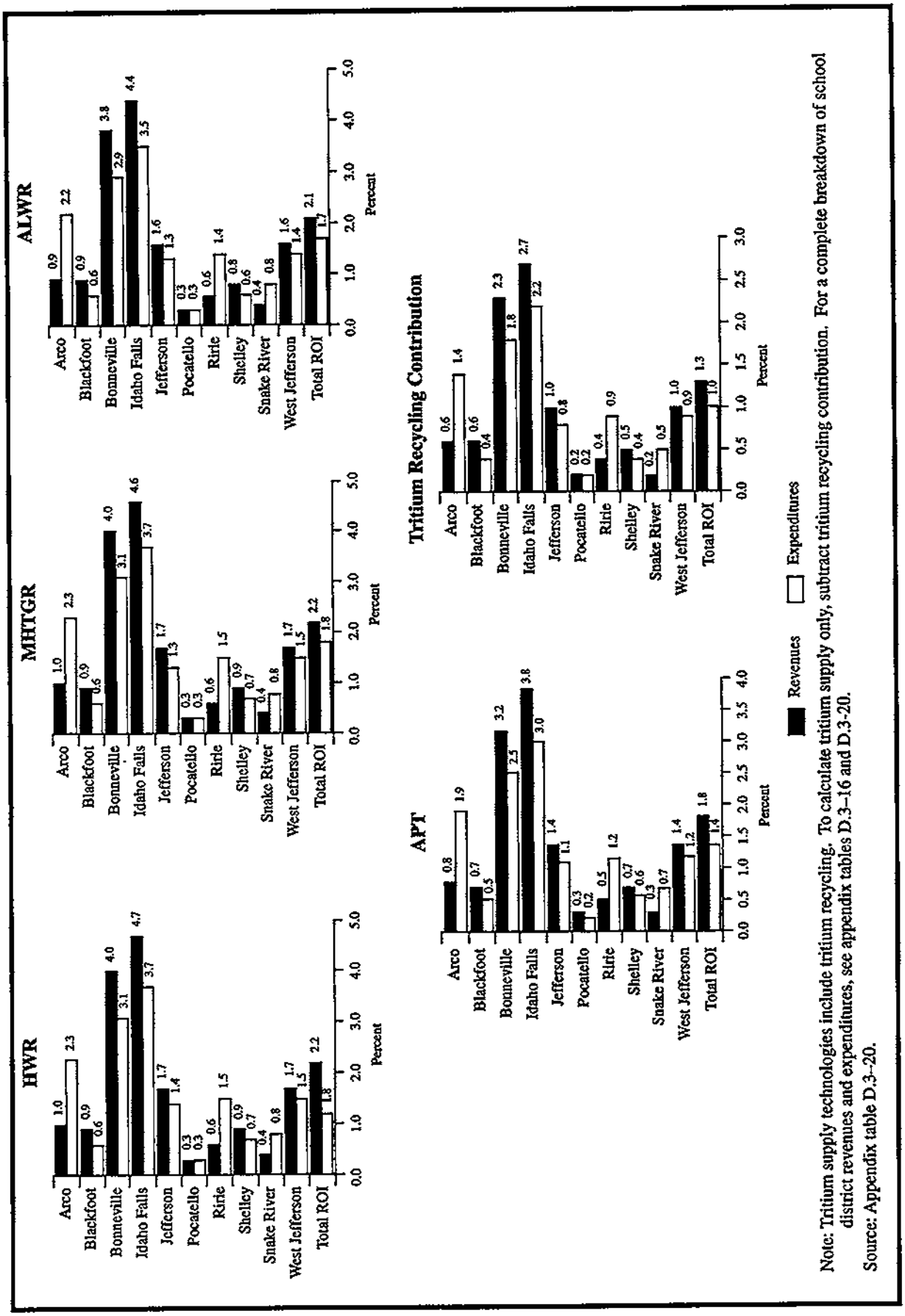
FIGURE 4.2.3.8–6.—*County and City Total Revenues and Expenditures Percentage Increase Over No Action at Full Operation from Tritium Supply Technologies and Recycling for Idaho National Engineering Laboratory Region of Influence, 2010.*



Note: Tritium supply technologies include tritium recycling. To calculate tritium supply only, subtract tritium recycling contribution. For a complete breakdown of school district revenues and expenditures, see appendix tables D.3-15 and D.3-19.

Source: Appendix table D.3-19.

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, 2005.*



Note: Tritium supply technologies include tritium recycling. To calculate tritium supply only, subtract tritium recycling contribution. For a complete breakdown of school district revenues and expenditures, see appendix tables D.3–16 and D.3-20.

Source: Appendix table D.3–20.

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.*

D.3–13 through D.3–16 present the revenue and expenditure changes as a result of constructing the Phased APT for all ROI jurisdictions. Revenue and expenditure changes resulting from the construction of the Phased APT with tritium recycling are presented in appendix tables D.3–17 through D.3–20.

Operation. Operation of the HWR, MHTGR, ALWR, and Phased APT at less than baseline tritium requirements would have the same effects on local jurisdictions' finances as those presented in figures 4.2.3.8–6 and 4.2.3.8–8.

Multipurpose Reactor. Locating the multipurpose reactor with or without a tritium recycling facility at INEL would create greater changes in public finance characteristics than the four tritium supply technologies because this option would perform three processes. Public finance characteristics for the multipurpose reactor with and without a recycling facility are presented in appendix tables D.3–13A through D.3–20A.

Construction. Between the first year of construction and the peak year (2005), revenues and expenditures in the local jurisdictions would increase annually between 1 and 5 percent. Between 2005 and 2010, revenues and expenditures would decrease annually between less than 1 and 2 percent.

Operation. From the first year of full operation, 2010, to 2020, growth in revenues and expenditures is generally expected to be flat for most cities, counties, and school districts.

Accelerator Production of Tritium Power Plant. Locating the APT power plant with or without a tritium recycling facility at INEL would create similar, but greater changes in public finance characteristics than the APT tritium supply technology. Public finance characteristics for the APT power plant with and without a recycling facility are presented in appendix tables D.3–13A through D.3–20A.

Construction. Between the first year of construction and the peak year, 2005, revenues and expenditures in the local jurisdictions would increase annually between 1 and 2 percent. Between 2005 and 2010, revenues and expenditures would decrease annually by less than 1 percent for most jurisdictions.

Operation. From the first year of full operation, 2010, to 2020, growth in revenues and expenditures is generally expected to be flat for most cities, counties, and school districts.

Potential Mitigation Measures

Adding new missions to INEL would create new jobs and generally benefit the local economy through increased earnings in the ROI. Some mitigation measures may be required, such as Federal aid to local school districts where additional school age children would attend as a result of the proposed action. These new missions at INEL would increase population and the demand for additional housing units. Temporary housing units and mobile homes would help to alleviate the demand for new housing during the construction phase of the proposed action. Generally, construction would be phased over a 5- to 9-year period with peak construction occurring in 2005. Phasing the start of operation employment and training between 2005 and 2010 would reduce the annual level of housing demand and smooth the peak and valley effect that would occur between peak construction and full operation.

Local Transportation

The following is a description of the effects on local transportation resulting from locating new missions at INEL. Construction and operation of tritium supply technologies and recycling facilities are expected to increase traffic volume and flow on site access routes.

No Action. Under No Action, the worker population at INEL would not increase. Therefore, any increases in traffic would not be the result of DOE-related activities at INEL. Segments providing access to INEL include U.S. Route 20/26, State Route 33, and State Route 22/23. Traffic conditions on site access roads would remain as described in section 4.2.2.8.

Tritium Supply and Recycling. The proposed action at INEL would result in increases, depending on the tritium supply technology, of worker population at the site. Traffic volume on site access roads leading to and from INEL would increase due to the additional workforce. The primary access route to INEL is U.S. Route 20/26. This route would carry the

greatest increase in traffic from site development. Currently this route and secondary branches leading to the various internal areas of INEL are congested during peak travel time. Locating the MHTGR or ALWR at INEL would have the greatest effect on traffic volume and flow.

Tritium Supply Alone. Locating a tritium supply technology without the recycling facility at INEL would result in increased worker population, thereby increasing traffic on site access roads. However, the effects on traffic would be less than siting the tritium recycling facility with any one of the supply technologies.

Less Than Baseline Operations. The effects on traffic flow rates would be the same whether or not the HWR, MHTGR, or ALWR were operated at baseline or less than baseline tritium requirements. Construction of the Phased APT instead of the Full APT would have reduced traffic volume and flow rates during the construction phase.

Potential Mitigation Measures. Mitigation of traffic conditions may be necessary due to the proposed action at INEL. Potential mitigation of impacts to the local transportation network could include widening and extension of U.S. Route 20/26, the primary access route to INEL, as well as possible realignment of roadways and construction of interchanges at roadway intersections overburdened by increased vehicle traffic and congestion. In addition, internal access routes connecting U.S. Route 20/26 with the project area could be upgraded to carry the increased load.

4.2.3.9 *Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents*

This section describes the impacts of radiological and hazardous chemical releases resulting from either normal operation or accidents at facilities involved with the tritium supply technologies and recycling facilities at INEL. The section first describes the impacts from normal operation followed by a description of impacts from facility accidents.

During normal operation at INEL, all tritium supply technologies and recycling facilities would result in impacts that are within regulatory limits. The risk of adverse health effects to the public and to workers would be small.

For facility accident impacts, the results indicate that for all technologies, the risk of fatal cancers (taking into account both the probability of the accident and its consequences) from an accidental release of radioactive or hazardous chemical substances at INEL is low when compared to fatal cancers from all causes, even for a severe accident.

The impact methodology is described in section 4.1.9. Summaries of the radiological and chemical impacts associated with normal operation are presented in tables 4.2.3.9–1 and 4.2.3.9–2, respectively. Summaries of impacts associated with postulated accidents are given in tables 4.2.3.9–3 and 4.2.3.9–4. Detailed results are presented in appendix E for normal operation and in appendix F for accidents.

Normal Operation

No Action. The current missions at INEL are described in section 3.3.1. Site representatives have identified those facilities that will continue to operate and others, if any, that will become operational by 2010. Based on that information, the radiological and chemical releases for 2010 and beyond were developed and used in the impacts assessments.

Radiological Impacts. As shown in table 4.2.3.9–1, No Action would result in a calculated annual dose of 6.0×10^{-3} mrem to the maximally exposed member of the public, which projects to an estimated fatal cancer risk of 1.2×10^{-7} from 40 years of total site operation. This annual dose is within radiological limits and is 1.7×10^{-3} percent of the natural background radiation dose received by the average person living near INEL.

The population dose from total site operation in 2030 was calculated to be 0.037 person-rem, which projects to an estimated 7.4×10^{-4} fatal cancers over 40 years of total site operation. This population dose would be approximately 7.0×10^{-5} percent of the annual dose received by the surrounding population from natural background radiation.

The annual average dose to a site worker from No Action would be 30 mrem, which projects to an estimated fatal cancer risk of 4.8×10^{-4} from 40 years

TABLE 4.2.3.9–1.—*Potential Radiological Impacts to the Public and Workers Resulting from Normal Operation of Tritium Supply Technologies and Recycling at Idaho National Engineering Laboratory*

Affected Environment	Tritium Supply Technologies and Recycling[a]								
	No Action	HWR	MHTGR	Large ALWR	Small ALWR	Full APT		Phased APT	Tritium Recycling
						Helium-3 Target System	SILC Target System	Helium-3 Target System	
Maximally Exposed Individual[b] (Public)									
Dose[c] (mrem/yr)	6.0×10^{-3}	0.29	0.19	0.36	0.36	0.11	0.16	0.11	0.11
Percent of natural background[d]	1.7×10^{-3}	0.084	0.053	0.10	0.10	0.032	0.047	0.032	0.031
40-year fatal cancer risk	1.2×10^{-7}	5.9×10^{-6}	3.8×10^{-6}	7.3×10^{-6}	7.3×10^{-6}	2.3×10^{-6}	3.3×10^{-6}	2.3×10^{-6}	2.2×10^{-6}
Population Within 50 Miles *Year 2030*									
Dose (person-rem)	0.037	53	37	73	71	23	32	23	22
Percent of natural background[d]	7.0×10^{-5}	0.1	0.069	0.14	0.13	0.042	0.060	0.042	0.041
40-year fatal cancers	7.4×10^{-4}	1.1	0.73	1.5	1.4	0.45	0.64	0.45	0.44
Worker Onsite									
Average site worker dose[c] (mrem/yr)	30	33	31	49	41	33	33	33	4
40-year fatal cancer risk	4.8×10^{-4}	5.2×10^{-4}	5.0×10^{-4}	7.9×10^{-4}	6.6×10^{-4}	5.2×10^{-4}	5.2×10^{-4}	5.2×10^{-4}	6.4×10^{-5}
Total site workforce dose (person-rem/yr)	220	261	250	392	322	260	262	260	1.6
40-year fatal cancers	3.5	4.2	4.0	6.3	5.2	4.2	4.2	4.2	0.026

[a] Includes impacts from No Action facilities.

[b] The location of the maximally exposed individual varies depending on the tritium supply technology.

[c] The applicable radiological limits for an individual member of the public are 10 mrem per year resulting from site operations for the air pathways, 4 mrem from the drinking water pathway, and 100 mrem per year from all pathways combined (DOE Order 5400.5). The radiological limit for an individual worker is 5,000 mrem per year (10 CFR 835).

[d] Natural background levels: to the average individual is 353 mrem per year; to the population in 2030 is 53,270 person-rem.

Note: SILC - spallation-induced lithium conversion.

Source: Model results. See appendix sections E.2.2 and E.2.4.

of site operation. The annual dose to the total site workforce would be 220 person-rem, which projects to an estimated 3.5 fatal cancers from 40 years of total site operation. These estimated worker doses are based on the measured doses at INEL from 1989 to 1992 and the projected employment for 2010.

Hazardous Chemical Impacts. No Action at INEL would result in a calculated HI of 1.7×10^{-4} and no cancer risk to the maximally exposed member of the public. The worker HI and cancer risk were calculated to be 0.021 and 0, respectively. These values are within the acceptable regulatory health limits.

Tritium Supply and Recycling. There would be no radiological releases during the construction of new tritium recycling facilities or new facilities that are associated with tritium supply technologies under consideration. Limited hazardous chemical releases are anticipated as a result of construction activities. However, concentrations would be within the regulated exposure limits and would not result in any adverse health effects. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The impacts from radiological and hazardous chemicals from each tritium supply technology considered are the summations of the impacts from the various facilities in operation for that technology. The resulting doses and potential health effects to the public and workers from each tritium supply technology are described below.

Radiological Impacts. Radiological impacts to the public resulting from normal operation from various tritium supply technologies and recycling facilities at INEL are listed in table 4.2.3.9–1. The supporting analysis is provided in appendix section E.2.4.2.

The doses to the maximally exposed member of the public from annual site operation at INEL range from 0.11 mrem for both the Full and the Phased APT with the helium-3 target option to 0.36 mrem for both the Large and Small ALWRs. From 40 years of operation, the corresponding risks of fatal cancer to this individual would range from 2.3×10^{-6} to 7.3×10^{-6}. As a result of total site operation in the year 2030, the population doses would range from 23 person-rem for the Full and Phased APT to 73 person-rem for the Large ALWR. The corresponding numbers of fatal cancers in this population from 40 years of operation would range from 0.45 to 1.5.

The annual dose to the total site workforce would range from 250 person-rem for the MHTGR to 392 person-rem for the Large ALWR. The corresponding annual average doses to a site worker would be 31 mrem for the MHTGR and 49 mrem for the Large ALWR. The risks and numbers of fatal cancers among workers from 40 years of operation are included in table 4.2.3.9–1.

Based on the radiological impacts associated with normal operation as described above, all of the tritium supply technologies and recycling facilities are acceptable for siting at INEL. All resulting doses are within radiological limits and are well below levels of natural background radiation.

Hazardous Chemical Impacts. The HIs to the maximally exposed individual of the public range from 1.8×10^{-4} (MHTGR and APT) to 4.5×10^{-4} (ALWR), whereas a cancer risk of 0 was calculated for all tritium supply technologies (table 4.2.3.9–2). The worker HIs range from 0.031 for HWR and 0.021 for MHTGR and APT to 0.11 for ALWR. There was no cancer risk for any other technology. All values are within the acceptable regulatory health limits. For details on the derivation of these HIs and cancer risks, see appendix tables E.3.4–2 through E.3.4–5 and summary table E.3.4–7.

Tritium Supply Alone

Radiological Impacts. If the tritium recycling processes are not collocated with the tritium supply, the annual dose to the maximally exposed individual would be 0.11 mrem lower than from operation of both supply and recycling. This is 0.031 percent of the dose from natural background radiation received by the average person near INEL. The estimated risk of fatal cancer to this individual would decrease by 2.2×10^{-6} over 40 years of total site operation. Not collocating the tritium recycling processes at INEL would result in a decrease of 22 person-rem to the population within 50 miles in 2030, and 0.44 less fatal cancers over 40 years of operation.

If the tritium recycling processes are not collocated with the tritium supply, the total annual workforce

TABLE 4.2.3.9–2.—*Potential Hazardous Chemical Impacts to the Public and Workers Resulting from Normal Operation at Idaho National Engineering Laboratory*

		Tritium Supply Technologies and Recycling[a, b]				
Health Impact	**No Action**	**HWR**	**MHTGR**	**ALWR**	**APT**	**Tritium Recycling**
Maximally Exposed Individual (Public)						
Hazard Index	1.7×10^{-4}	2.1×10^{-4}	1.8×10^{-4}	4.5×10^{-4}	1.8×10^{-4}	5.4×10^{-7}
Cancer risk	0	0	0	0	0	0
Worker Onsite						
Health Index[c]	0.021	0.031	0.021	0.11	0.021	4.9×10^{-5}
Cancer risk	0	0	0	0	0	0

[a] Includes impacts from No Action.

[b] To determine the contribution from any of the tritium supply technologies, subtract the tritium recycling values from the Hazard Index or the cancer risk, respectively.

[c] The Hazard Index for the worker onsite is computed by using the permissible exposure level as the denominator rather than the reference concentration which is used for the maximally exposed member of the public (appendix E).

Note: Model results. See appendix table E.3.4–7.

dose would decrease by 1.6 person-rem, resulting in 0.026 less fatal cancers over the 40 years.

Hazardous Chemical Impacts. If the tritium recycling processes are not collocated with the supply technologies at INEL, the cancer risk would not change since there is no cancer risk resulting from any option. The HIs to the public would be reduced by 0.3 percent or less and the HIs for the workers would be reduced by 0.23 percent or less. Based on the hazardous chemical impacts associated with normal operation at INEL, all values are within regulatory health limits.

Less Than Baseline Operations

Normal Operation. The normal operation radiological impacts for the HWR operating at reduced tritium production capacity to meet a less than baseline operation requirement would be proportional to the level of operation (approximately 50 percent of baseline). The MHTGR or ALWR normal operation radiological impacts would not change because the reactor would maintain power requirements to produce steam or electricity.

The Phased APT is already less than baseline tritium requirement and thus the impacts are as presently given in this PEIS.

Multipurpose Normal Operations

Potential Mitigation Measures. Radioactive and hazardous chemical airborne emissions to the general population and onsite exposures to workers could be reduced by implementing the latest technology for process and design improvements. For example, to reduce public exposure from emissions, improved methods could be used to remove radioactivity from the releases to the environment. Similarly, the use of remote, automated and robotic production methods are examples of techniques that are being developed which would reduce worker exposure. Substitution of less toxic/noncancer causing solvents would result in reductions of the HI and possible complete elimination of the cancer risk.

Facility Accidents

No Action. The Idaho Chemical Processing Plant is being phased out and there are no other DOE defense program facilities in operation at INEL. As a result, under No Action, the risk of accidents at INEL would be unchanged from that reported in safety documentation for existing facilities.

Tritium Supply and Recycling. The proposed action at INEL has the potential for accidents that may impact the health and safety of workers and the public. The potential for and associated consequences of reasonably foreseeable accidents have been assessed for each tritium supply technology and

recycling facilities at INEL and are summarized in this section and described in more detail in appendix F. The methodology used in the assessment is described in section 4.1.9.

The potential impacts from accidents, ranging from high consequence/low probability to low consequence/high probability events, have been evaluated in terms of the number of cancer fatalities that may result. The risk of cancer fatalities has also been evaluated to provide an overall measure of an accident's impacts and is calculated by multiplying the accident annual frequency (or probability) of occurrence by the consequences (number of cancer fatalities).

The analyses of postulated accidents for the tritium supply technology and recycling facilities at INEL indicate that, for the high consequence accident, the estimated risk of cancer fatalities to the public within 50 miles of the site would be 1.4×10^{-5} cancer fatalities per year (table 4.2.3.9–3). This accident risk, which corresponds with the HWR technology, is low when compared to the risk of cancer fatalities each year to the same population from all other causes.

Details on the range of accidents for the tritium supply technologies and recycling facilities at INEL are presented in appendix F. Each of the technologies has been analyzed from the standpoint of identifying the consequences of design-basis/operational accidents (using the GENII Code) and beyond design-basis, or severe accidents (using the MACCS computer code). The severe accident consequences products may have to be destroyed; the supply of drinking water may be reduced; recreational areas may be closed; industrial parks may suffer economic losses; historic sites may have to be closed to visitors; and endangered species may move closer to extinction.

In the region of the INEL, the natural background level of radiation (excluding radon) is 113 mrem per year. For a hypothetical design basis accidental release, the radiation levels exceeding 113 mrem per year would be well within the site boundary. The size of the area in which exposure levels would exceed exposures from natural background radiation is 6.7×10^{7} square meters (16,556 are shown in table 4.2.3.9–3 for each technology. The table also shows the consequences of each accident for the population within 50 miles of the site and for an individual who may be located at the site boundary. The results of the analysis indicate that the tritium technology with the highest severe accident risk is the HWR. The technology with the lowest accident risk is the APT with the helium-3 target system. These results take into account accidents that may occur in the tritium production system as well as the tritium extraction and recycling facilities. The tritium extraction and recycling facilities are common to all tritium supply technologies but, except for the APT, the consequences and risk are dominated by reactor accidents. The APT accident consequences and risks are lower than the tritium extraction facility's accident consequences.

Figure 4.2.3.9–1 shows the number of latent cancer fatalities that may result for each technology, including tritium extraction and recycling, if a high consequence accident would occur. Specifically, each curve in the figure shows the annual probability (vertical axis) that the number of cancer fatalities (horizontal axis) will be exceeded if the accident occurred. The curves reflect that probability of the accident.

The secondary impacts of accidents affect elements of the environment other than humans. For example, a radiological release may contaminate farmland, surface and underground water, recreational areas, industrial parks, historical sites, or the habitat of an endangered species. As a result, farm products may have to be destroyed; the supply of drinking water may be reduced; recreational areas may be closed; industrial parks may suffer economic losses; historic sites may have to be closed to visitors; and endangered species may move closer to extinction. In the region of the INEL, the natural background level of radiation (excluding radon) is 113 mrem per year. For a hypothetical design-basis accident release, the radiation levels exceeding 113 mrem per year would be well within the site boundary. The size of the area in which exposure levels would exceed exposures from natural background radiation is 6.7×10^{7} square meters (16,566 acres). Additional information on secondary impacts is provided in appendix section F.3.

Tritium Supply Alone. The analyses of reasonably foreseeable high consequence accidents for the tritium supply facilities at INEL are presented below.

Heavy Water Reactor. A set of five high consequence accident sequences were postulated for the HWR. These are described in appendix section F.2.1.1. In the event any of these accidents were to occur, there would

TABLE 4.2.3.9–3.—*Tritium Supply Technologies and Recycling High Consequence/Low Probability Radioactive Release Accidents and Consequences at Idaho National Engineering Laboratory*

Parameter	Tritium Supply Technologies						Tritium Target Extraction Facility	Tritium Recycling Facility[e]
	HWR[a,b]	MHTGR[b,c]	Large ALWR[b,d]	Small ALWR[b,d]	Full/Phased APT Helium-3 Target System[f,g]	Full APT SILC Target System[b,h,i]		
Consequence								
Maximally Exposed Individual								
Cancer fatalities[j]	7.1×10^{-4}	5.9×10^{-5}	2.3×10^{-3}	2.3×10^{-3}	6.2×10^{-9}	1.3×10^{-7}	6.9×10^{-6}	2.4×10^{-5}
Risk (cancer fatalities per year)	6.5×10^{-9}	9.4×10^{-10}	3.5×10^{-10}	3.6×10^{-10}	4.4×10^{-15}	9.2×10^{-14}	6.9×10^{-12}	2.4×10^{-11}
Population Within 50 Miles								
Cancer fatalities[j]	1.6	0.18	0.36	4.1	1.0×10^{-5}	9.4×10^{-5}	0.012	0.04
Risk (cancer fatalities per year)	1.4×10^{-5}	2.9×10^{-6}	5.5×10^{-8}	6.4×10^{-7}	7.4×10^{-12}	6.7×10^{-11}	1.2×10^{-8}	4.0×10^{-8}
Worker at 1,000 meters								
Cancer fatalities[j]	0.034	6.7×10^{-3}	0.033	0.094	6.1×10^{-7}	9.4×10^{-6}	6.8×10^{-4}	2.4×10^{-3}
Risk (cancer fatalities per year)	3.2×10^{-7}	1.1×10^{-7}	5.0×10^{-9}	1.5×10^{-8}	4.4×10^{-13}	6.7×10^{-12}	6.8×10^{-10}	2.4×10^{-9}
Worker at 2,000 meters								
Cancer fatalities[j]	0.017	2.3×10^{-3}	0.019	0.047	2.3×10^{-7}	3.8×10^{-6}	2.5×10^{-4}	8.8×10^{-4}
Risk (cancer fatalities per year)	1.6×10^{-7}	3.7×10^{-8}	2.9×10^{-9}	7.3×10^{-9}	1.6×10^{-13}	2.7×10^{-12}	2.5×10^{-10}	8.8×10^{-10}

[a] For detailed HWR accident discussion, see appendix section F.2.1.1

[b] The tritium target extraction facility is required for the HWR, MHTGR, ALWR, and the APT with spallation-induced lithium conversion target system tritium supply configurations and not required for the APT with helium-3 target system tritium supply configuration. For detailed tritium target extraction facility discussion, see appendix section F.2.1.6.

[c] For detailed MHTGR accident discussion, see appendix section F.2.1.2.

[d] For detailed ALWR accident discussion, see appendix section F.2.1.3.

[e] For detailed tritium recycling facility discussion, see appendix section F.2.3.

[f] For detailed APT with helium-3 target system discussion, see appendix section F.2.1.4.2.

[g] Analysis postulated the total failure of the active emergency cooling system and the loss of the heat sink.

[h] For detailed APT with spallation-induced lithium conversion (SILC) target system discussion, see appendix section F.2.1.4.3.

[i] Analysis postulated successful beam trip with the total failure of the active emergency cooling system.

[j] Increased likelihood of cancer fatality.

Source: Appendix F.

be an estimated 1.6 cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 7.1×10^{-4} to an individual located at the site boundary and 0.034 to a worker located at 1,000 meters from the accident. The risk to the population, that takes the probability of the accidents into account, is 1.4×10^{-5} cancer fatalities per year (table 4.2.3.9–3).

Modular High Temperature Gas-Cooled Reactor. A set of four high consequence accident sequences were postulated for the MHTGR. These are described in appendix section F.2.1.2. In the event that any of these accidents were to occur, there would be an estimated 0.18 cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 5.9×10^{-5} to an individual located at the site boundary and 6.7×10^{-3} to a worker located at 1,000 meters from the accident. The risk to the population, that takes the probability of the accidents into account, is 2.9×10^{-6} cancer fatalities per year (table 4.2.3.9–3).

Advanced Light Water Reactor. A range of high consequence, low probability accidents with various release categories was selected to represent the accident consequences for both the Large and Small ALWRs (appendix section F.2.1.3). In the event of such an accident, there would be an estimated 0.36 cancer fatalities for a Large ALWR and 4.1 cancer fatalities for a Small ALWR in the population within 50 miles and an increased likelihood of cancer fatality of 2.3×10^{-3} for a Large ALWR and 2.3×10^{-3} for a Small ALWR to an individual located at the site boundary and 0.033 for a Large ALWR and 0.094 for a Small ALWR to a worker located at 1,000 meters from the accident. The risk to the population, that takes the probability of the accidents into account, is 5.5×10^{-8} cancer fatalities per year for a Large ALWR and 6.4×10^{-7} cancer fatalities per year for a Small ALWR (table 4.2.3.9–3).

Accelerator Production of Tritium with Helium-3 Target System. The large break loss of coolant accident with the total loss of the active emergency cooling system and the heat sink with and without confinement were postulated as the high consequence accidents for this APT and target option. In the event that any of these accidents were to occur, there would be an estimated 1.0×10^{-5} cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 6.2×10^{-9} to an individual located at

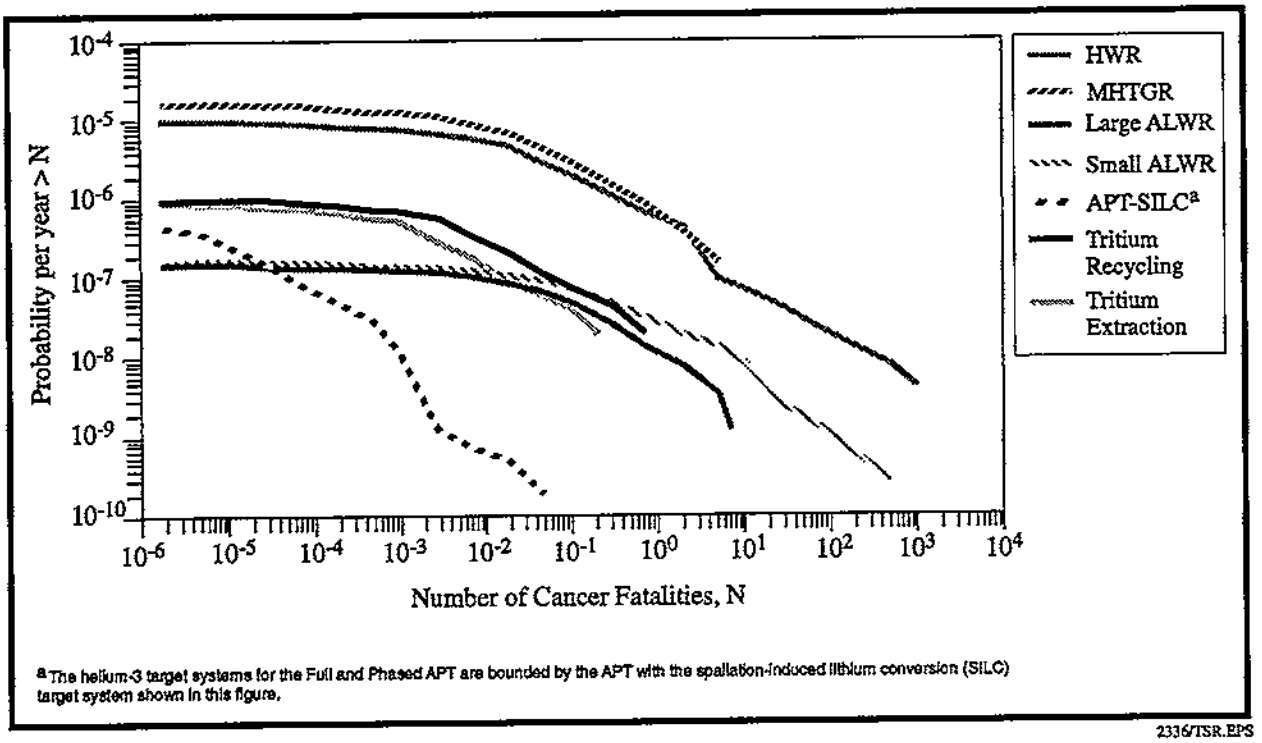


FIGURE 4.2.3.9–1.—*High Consequence Accident–Cancer Fatalities Complementary Cumulative Distribution Functions for Tritium Supply and Recycling Severe Accidents for Idaho National Engineering Laboratory.*

the site boundary and 6.1×10^{-7} to a worker located at 1,000 meters from the accident. The risk to the population, that takes the probability of the accidents into account, is on the order of 7.4×10^{-12} cancer fatalities per year (table 4.2.3.9–3).

Accelerator Production of Tritium with Spallation-Induced Lithium Conversion Target System. The large break loss of coolant accident with a successful beam trip and the total loss of the active emergency cooling system with and without confinement were postulated as the high consequence accident for this APT and target option. In the event that any of these accidents were to occur, there would be an estimated 9.4×10^{-5} cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 1.3×10^{-7} to an individual located at the site boundary and 9.4×10^{-6} to a worker located at 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is on the order of 2.7×10^{-12} cancer fatalities per year (table 4.2.3.9–3).

Tritium Extraction and Recycling. The tritium extraction facility is required to support all tritium supply technologies except the APT technology with the helium-3 target system. The tritium recycling facility is required to support all tritium supply technologies. The analyses of postulated high consequence accidents for the tritium extraction and recycling facilities at INEL are presented below.

Tritium Target Extraction Facility. An earthquake and release of process vessel tritium inventory was postulated as the high consequence accident. In the event that this accident were to occur, there would be an estimated 0.012 cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 6.9×10^{-6} to an individual located at the site boundary and 6.8×10^{-4} to a worker located at 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is on the order of 1.2×10^{-8} cancer fatalities per year.

Tritium Recycling Facility. An earthquake induced leak/ignition and fire in the unloading station carousel reservoir was postulated as the high consequence accident for the tritium recycling facility. In the event that this accident were to occur, there would be an estimated 0.04 cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 2.4×10^{-5} to an individual located at the site boundary and 2.4×10^{-3} to a worker located at 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is on the order of 4.0×10^{-8} cancer fatalities per year (table 4.2.3.9–3).

For comparison purposes, with high consequence tritium supply facility accidents, including extraction and recycling, for the same total population of 150,000 in 2050 in all sectors within 50 miles of the site, there is a risk of 300 cancer fatalities per year from all other natural causes.

The analysis of facility accidents for tritium supply at INEL shows that for high consequence accidents analyzed using the MACCS computer code, the HWR has the highest risk and the APT has the lowest risk. The risk of accidents for any of the tritium supply alternatives, tritium extraction, and tritium recycling facilities common to all alternatives is low when compared to the human risk of cancer fatalities from all other causes.

Design-Basis Accidents. The consequences of operational basis or design-basis accidents for the tritium supply technology and recycling facilities at INEL are shown in table 4.2.3.9–4. The results in table 4.2.3.9–4 should not be compared with the severe accident analysis results in table 4.2.3.9–3 because different computer codes using different calculational approaches were used. A more detailed description of design-basis accidents is included in appendix F.2.2.

Less Than Baseline Operations

Facility Accidents. Less than baseline tritium operation would have no significant change to the current accident analyses consequences for the HWR unless the baseline HWR core design was downsized. The baseline HWR configuration would adjust to the reduced target through-put requirements by reducing the time that the reactor is required to operate at 100 percent power. It is not anticipated that the overall risk from operating the reactor in this mode would decrease significantly. Accident analyses have not been performed to address accident sequences and initiating events when the reactor is in the cold shut down mode. In addition, operator error has a significant effect on facility risk and if the reactor is shutdown a high percentage of the time, operator

TABLE 4.2.3.9–4.—*Tritium Supply Technologies and Recycling Low-to-Moderate Consequence/ High Probability Radioactive Release Accidents and Consequences at Idaho National Engineering Laboratory*

Parameter	Tritium Supply Technologies					Tritium Target Extraction Facility[b]	Tritium Recycling Facility[e]
	HWR[a,b]	MHTGR[b,c]	Large ALWR[b,d]	Small ALWR[b,d]	Full/Phased APT SILC Target System[b,f]		
Accident							
Description	Fuel assembly failure during charge and discharge operations	Moderate break in primary system piping	Fuel handling	Fuel handling	Large break loss of coolant accident[g]	Deflagration[h]	Hydride Bed Rupture
Frequency (per year)	1.0×10^{-3}	0.025	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-3}	2.0×10^{-5}	2.0×10^{-4}
Consequence							
Maximally Exposed Individual							
Cancer fatalities[i]	8.1×10^{-6}	5.1×10^{-9}	5.0×10^{-6}	6.8×10^{-6}	Negligible	5.0×10^{-5}	2.1×10^{-7}
Risk (cancer fatalities per year)	8.1×10^{-9}	1.3×10^{-10}	5.0×10^{-11}	6.8×10^{-11}	Negligible	1.0×10^{-9}	4.2×10^{-11}
Population Within 50 Miles							
Cancer fatalities[i]	0.074	2.0×10^{-5}	0.038	0.062	Negligible	0.45	2.1×10^{-3}
Risk (cancer fatalities per year)	7.4×10^{-5}	5.0×10^{-7}	3.8×10^{-7}	6.2×10^{-7}	Negligible	9.0×10^{-6}	4.2×10^{-7}
Worker at 1,000 meters							
Cancer fatalities[i]	1.1×10^{-4}	1.3×10^{-7}	1.0×10^{-4}	1.3×10^{-4}	Negligible	1.7×10^{-3}	7.2×10^{-10}
Risk (cancer fatalities per year)	1.1×10^{-7}	3.3×10^{-9}	1.0×10^{-9}	1.3×10^{-9}	Negligible	3.4×10^{-8}	1.4×10^{-13}
Worker at 2,000 meters							
Cancer fatalities[i]	3.5×10^{-5}	4.2×10^{-8}	3.6×10^{-5}	4.5×10^{-5}	Negligible	5.6×10^{-4}	2.4×10^{-10}
Risk (cancer fatalities per year)	3.5×10^{-8}	1.1×10^{-9}	3.6×10^{-10}	4.5×10^{-10}	Negligible	1.1×10^{-8}	4.8×10^{-14}

[a] For detailed HWR accident discussion, see appendix section F.2.2.1.

[b] The tritium target extraction facility is required for the HWR, MHTGR, ALWR, and the APT with spallation-induced lithium conversion target system tritium supply configurations and not required for the APT with helium-3 target system tritium supply configuration. For detailed tritium target extraction facility discussion, see appendix section F.2.2.6.

[c] For detailed MHTGR accident discussion, see appendix section F.2.2.2.

[d] For detailed ALWR accident discussion, see appendix section F.2.2.3.

[e] For detailed tritium recycling facility discussion, see appendix section F.2.4.

[f] The APT with helium-3 target system bounding low-to-moderate consequence accident consequences are bounded by the APT with spallation-induced lithium conversion target system which are negligible. For detailed APT discussion, see appendix section F.2.2.4.

[g] Analysis postulated all plant protection systems functioned as designed.

[h] Intense rapid burning.

[i] Increased likelihood of cancer fatality.

SILC - spallation-induced lithium conversion.

Source: Appendix F.

error may actually increase when the reactor is at power.

Less than baseline tritium operation would have no significant change to the current accident analyses consequences for the ALWR. The reactor surplus capacity would be used to generate steam for electric power production.

Less than baseline tritium operation would have no change to the MHTGR accident analyses because the analyses assumed that only one of the reactor modules would be involved in the accident.

Less than baseline tritium operation would have no significant change to the APT accident analyses consequences. The accident consequences for Full and Phased APT accidents with low to moderate consequences were negligible. For the beyond design basis accident, there was no difference in the Full and the Phased accident consequences. Review of the source terms is identical for both accidents. Review of the MACCS computer code output data for each accident analysis indicated that the tritium component of the source term dominated the dose calculation results. The impact of the other source term isotopes on the dose calculation results is negligible.

Potential Mitigation Measures. The accidents postulated for tritium supply technologies and recycling are based on operations and safety analyses that have been performed at similar facilities. One of the major design goals for tritium supply and recycling facilities is to achieve a reduced risk to facility personnel and to public health and safety to as low as reasonably achievable.

Current estimates are that there would be no collocated workers within 2,000 meters from an accident's location. There would be approximately 4,500 collocated workers beyond 2,000 meters from an accident. Involved workers that are associated with the proposed action would be located in an around the facility.

Worker exposures that may result from the accidental release of radioactive material will be minimized through design features and administrative procedures that will be defined in conjunction with the facility design process. The radiological impacts to individual workers from accidents could not be quantitatively estimated for this PEIS because the facility design information needed to support the estimate has not yet been developed. The impacts on individual and collocated workers from accidents will be analyzed as part of subsequent project-specific NEPA documentation and in detailed safety analysis documentation that are prepared in conjunction with the facility design process.

The tritium supply and recycling facilities would be designed to comply with current Federal, state, and local laws, DOE orders, and industrial codes and standards. This would provide facilities that are highly resistant to the effects of severe natural phenomena, including earthquake, flood, tornado, high wind, as well as credible events as appropriate to the site, such as fire and explosions, and man-made threats to its continuing structural integrity for containing materials.

The tritium supply and recycling facility would be designed to resist the effects of severe natural phenomena as well as the effects of man-made threats to its continuing structural integrity. It also would be designed to provide containment of the tritium inventory at all times through the use of multiple, high quality confinement barriers to prevent the accidental release of tritium to the environment. It also would be designed to produce a lower quantity of waste materials as compared to the tritium facilities of the existing weapons complex.

In addition, DOE orders specify the requirements for emergency preparedness at DOE facilities. INEL has comprehensive emergency plans to protect life and property within the facility and the health and welfare of surrounding areas. The emergency plans would be revised to incorporate future DOE requirements and expanded to incorporate the addition of tritium supply and recycling facilities to INEL. Section 4.2.2.9 provides additional information on emergency preparedness and emergency plans at INEL.

4.2.3.10 *Waste Management*

Construction and operation of tritium supply and recycling facilities would impact existing INEL waste management operations by increasing the generation of low-level, mixed low-level, hazardous and nonhazardous wastes, and spent nuclear fuel. There are no high-level or TRU wastes associated with the

proposed action. As part of their design, all reactor technologies would provide stabilization and storage of spent fuel for the life of the facility. Spent nuclear fuel would be managed in accordance with DOE's decisions identified in the ROD of the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final EIS*. The impacts of using existing waste management facilities would range from filling 0.6 acres per year of LLW disposal area, utilizing 100 percent of the capacity of the liquid LLW treatment facilities, increasing the generation of mixed LLW by a rate that would fill existing facilities in 84 percent of their planned lifetime, and producing solid sanitary wastes at a rate that would require additional landfill capacity. The worst case for solid hazardous waste generation increases the No Action volume by one-third, and would most likely require additional RCRA-permitted storage facilities where the waste could be staged for shipment to a RCRA-permitted disposal facility. All the tritium supply technologies and recycling facilities would produce liquid sanitary wastes that would require new treatment facilities because INEL does not have central facilities for this waste and there are no surface or subsurface discharge options. This section provides a description of the waste generation, treatment, storage and disposal requirements for the tritium supply technologies and recycling facilities and the potential impacts on waste management at INEL.

No Action. Under No Action, INEL has no weapons program mission; however, INEL would continue to receive and manage naval reactor fuel and nonaluminum clad fuels and would manage high-level, TRU, low-level, mixed, hazardous, and nonhazardous wastes from the missions described in section 3.3.1. Table 4.2.3.10–1 lists the projected waste generation rates; and treatment, storage, and disposal capacities under No Action. Projections were derived from 1992 environmental data with appropriate adjustments made for those changing operational requirements where the volume of wastes generated are identifiable. The projection does not include wastes from future, yet uncharacterized, environmental restoration activities. At the time that the new tritium supply and recycling facilities would be expected to commence operations (in 2010), much of the existing wastes at INEL would have been treated and disposed of or stored in compliance with existing regulations. The waste treatment activities that are planned to be still in operation are the calcination of liquid HLW and LLW after completion of the processing of special fuels and residuals at the Idaho Chemical Processing Plant, the retrieval and repackaging of buried TRU waste, and stabilization of spent nuclear fuel for long-term storage. Spent nuclear fuel would be managed in accordance with DOE's decisions identified in the ROD from the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final EIS*. As reflected in this ROD, the DOE estimated inventory of spent nuclear fuel in 2035 is 2,742 metric tons. For comparison purposes, the commercial spent nuclear fuel inventory in 2030, assuming no reprocessing or new orders, is projected to be 85,700 metric tons of heavy metal (DOE 1994d:16). TRU waste already packaged to WIPP waste acceptance criteria would either be stored or would have been shipped. Mixed waste would have been treated and disposed of according to the INEL Site Treatment Plan, which was developed to comply with the *Federal Facility Compliance Act* of 1992, and all other wastes currently identified would have been disposed of. The processing of these legacy wastes would require new facilities, since treatment, storage, and disposal facilities either do not exist or are nearing capacity.

Tritium Supply and Recycling. Tritium supply and recycling facilities that would support the nuclear weapons stockpile requirements (both new and existing facilities) would treat and package all waste generated in support of this activity into forms that would enable long-term storage and/or disposal in accordance with the *Atomic Energy Act*, RCRA, and other relevant statutes as outlined in chapter 5 and in appendix section H.1.2. The resultant waste effluents are shown in section 3.4. Waste generated during construction would consist of wastewater, nonhazardous solids, and hazardous waste. The nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be shipped to a RCRA-permitted treatment and disposal facility. Operation of the three reactor-based tritium supply technologies and recycling facilities would generate spent fuel, and all four technologies would generate low-level, mixed low-level, hazardous, and nonhazardous

TABLE 4.2.3.10–1.—*Projected Spent Nuclear Fuel and Waste Management for No Action at Idaho National Engineering Laboratory* [Page 1 of 2]

Category	Annual Generation Rate (yd^3)	Treatment Method	Treatment Capacity (yd^3/yr)	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity (yd^3)
Spent Nuclear Fuel	None (offsite receipts as result of ROD)	Stabilization	Being designed	Pools, dry, casks	Planned[a]	Planned - Federal repository	NA
High-Level							
Liquid	981 (198,162 gal)	Calcine	1,308 (264,216 GPY)	Tanks	16,101 (3,252,000 gal)	None	None
Solid	1,439	Under development	To be designed	Bins	9,267	Planned - Federal repository	NA
Transuranic							
Liquid	None	None	None	None	None	NA	NA
Solid	< 1	Planned	Planned	TRU storage facility	Planned	Planned - Federal repository	NA
Low-Level							
Liquid	None[b]	Evaporation, fractionation	14,376[c] (2,904,000 GPY)	Tanks	47,160	NA	NA
Solid	5,101	Incineration, compact	64,910[d]	None	None	Subsurface disposal	235,345
Mixed Low-Level							
Liquid	None	Incineration, stabilize	64,910 (13,110,000 GPY)	Facility	65,580 (13,245,000 gal)	None	None
Solid	655	Incineration, stabilize	64,910	Facility	147,759	LLW burial	235,345
Hazardous							
Liquid	None	Incineration	64,910 (13,110,000 GPY)	Drums, RCRA facility	127 (25,650 gal)	None	None
Solid	308	Incineration	64,910	RCRA facility	119	RCRA facility	Planned[a]

TABLE 4.2.3.10–1.—*Projected Spent Nuclear Fuel and Waste Management for No Action at Idaho National Engineering Laboratory* [Page 2 of 2]

Category	Annual Generation Rate (yd^3)	Treatment Method	Treatment Capacity (yd^3/yr)	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity (yd^3)
Nonhazardous (Sanitary)							
Liquid	Included in solid	Evaporation	Planned	Ponds	Planned	None	None
Solid	68,000	None	Planned	None	None	Landfill	Planned[a]
Nonhazardous (Other)							
Liquid	None	None	NA	NA	NA	NA	NA
Solid	Included in sanitary	None	NA	None	None	Onsite landfill	Planned[a]

[a] Long-term storage and capacity planned as result of ROD from *DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs EIS.*

[b] No new waste. Process wastewater from legacy waste.

[c] One-shift operation.

[d] Permitted capacity. Typically 3,900 yd^3 per year.

Note: NA - not applicable.

Source: 60 FR 28680; DOE 1993a; DOE 1993b; DOE 1993o; DOE 1993r; DOE 1993s; DOE 1993t; IN DOE 1992b; IN DOE 1992c; IN DOE 1993a; IN MMES 1993a; INEL 1993a:5.

wastes. The volume of the waste streams from tritium supply would vary according to the technology chosen. Table 4.2.3.10–2 lists the total estimated waste volumes projected to be generated at INEL as a result of tritium supply technologies and recycling facilities. The incremental waste volumes from the tritium supply and recycling facilities that were added to the No Action projection can be found in appendix section A.2. Requirements for LLW disposal that would result from each of the tritium supply technologies assume the effluents listed in this appendix section and in section 3.4. Table 4.2.3.10–3 lists potential waste management impacts at INEL projected at the time of initial operation of the tritium facilities. Spent nuclear fuel storage for the life of the reactors is provided for in the reactor designs (appendix section A.2.1). Because spent nuclear fuel reprocessing is not planned, no HLW would be generated. Without plutonium production, no TRU waste would be generated. The treatment, storage, and disposal of mixed LLW would be in accordance with the INEL Site Treatment Plan which is currently being developed pursuant to the *Federal Facility Compliance Act* of 1992.

Heavy Water Reactor. Spent nuclear fuel would be generated at the rate of 7 yd^3 per year. This would add 0.3 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The HWR would be designed to provide the necessary stabilization and storage of the spent nuclear fuel while awaiting final disposition. The liquid LLW generated by the HWR would require treatment facilities to reduce its volume and stabilize the remaining concentrated radionuclides and prepare the solidified waste for disposal onsite. The generation of solid LLW would be increased to a rate that is more than twice the No Action volume. Assuming a 3,300 yd^3 per acre LLW disposal usage factor, this would require approximately 0.6 acres per year for onsite LLW disposal. There would be a small amount of liquid mixed LLW generated. Existing and planned treatment facilities could manage this small quantity. The solid mixed LLW volume would increase 19 percent over No Action, resulting in a proportional increase in the volume to be treated and stored at INEL. Hazardous waste would increase by 13 percent more than the No Action volume treated and stored. This would require a RCRA-permitted storage facility where the waste could be packaged for shipment to a RCRA-permitted treatment and disposal facility. Liquid sanitary wastes generated by the HWR would require new treatment facilities since INEL does not have centralized facilities for these wastes. The volume of solid sanitary wastes would increase the amount to be disposed of by 22 percent more than No Action. This could reduce the remaining useful life of the landfill or require an expansion.

Siting an HWR without tritium recycling facilities at INEL would not affect the generation of nor change the impacts from spent nuclear fuel or liquid LLW as described above. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.2.3.10–3. The LLW disposal area required for solid LLW would decrease by approximately 0.04 acres per year. The increase in generation rate over No Action for solid sanitary wastes would decrease from 22 percent to 11 percent; thus proportionately decreasing the impact to the landfill.

Modular High Temperature Gas-Cooled Reactor. Spent fuel would be generated at the rate of 80 yd^3 per year. This would add 0.24 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The MHTGR would be designed to provide the necessary stabilization and storage of the spent nuclear fuel while awaiting final disposition. There would be liquid LLW generation, requiring a treatment facility. Solid LLW generation at INEL would increase to a rate 32 percent greater than No Action. It would be treated and disposed of onsite, requiring 0.2 acres per year of LLW disposal. There would be some liquid mixed LLW generation from tritium recycling, and the solid mixed LLW generation would cause the rate to increase by less than 1 percent above No Action. Thus, there would be a minor impact from this waste stream. The MHTGR would generate hazardous waste, increasing the volume to by 33 percent more than that under No Action. This would require a permitted storage facility where the waste could be staged for shipment to a RCRA-permitted treatment and disposal facility. Liquid sanitary wastes generated by the MHTGR would require new treatment facilities since INEL does not have centralized facilities for these wastes. The volume of solid sanitary wastes disposed of at

TABLE 4.2.3.10–2.—*Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes for Tritium Supply Technologies and Recycling at Idaho National Engineering Laboratory*

Category	No Action[a] (yd^3)	Tritium Supply Technologies and Recycling				
		HWR (yd^3)	MHTGR (yd^3)	ALWR/Large (yd^3)	ALWR/Small (yd^3)	APT[b] (yd^3)
Spent Nuclear Fuel	None (offsite receipts as a result of ROD)	7[c]	80[d]	55[e]	36[f]	None
Low-Level						
Liquid	None	10,400 (2,100,000 gal)	2,600 (525,000 gal)	24,800 (5,000,000 gal)	3,910 (790,000 gal)	None
Solid	5,100	10,700	6,750	6,160	6,110	5,990
Mixed Low-Level						
Liquid	None	0.03 (6 gal)	0.03 (6 gal)	0.03 (6 gal)	0.03 (6 gal)	0.03 (6 gal)
Solid	655	777	658	663	663	664
Hazardous						
Liquid	None	Included in solid	Included in solid	Included in solid	Included in solid	None
Solid	308	349	409	344	344	312
Nonhazardous (Sanitary)						
Liquid	Included in solid	309,000 (62,300,000 gal)	219,000 (44,300,000 gal)	516,000 (104,000,000 gal)	318,000 (64,300,000 gal)	1,290,000 (260,000,000 gal)
Solid	68,000	83,000	82,800	82,300	79,600	76,600
Nonhazardous (Other)						
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary
Solid	Included in sanitary	12,900[g]	12,800[g]	12,200[g]	9,900[g]	6,400[g]

[a] The No Action waste volumes are from table 4.2.3.10-1. Waste volumes for tritium supply and recycling options were derived by adding the waste volumes of the various tritium supply and recycling options found in appendix section A.2 (tables A.2.1.1-4, A.2.1.2-4, A.2.1.3-5, A.2.1.4-4, and A.2.2.1-4) to the No Action volumes. Waste volumes have been rounded to three significant figures.

[b] The APT and recycling waste volumes are based on the spallation-induced lithium conversion target. The helium-3 target waste volumes are approximately the same with the exception of solid LLW which is 5,520 yd^3.

[c] Residual heavy metal content is 660 lbs (0.3 metric tons).

[d] Residual heavy metal content is 530 lbs (0.24 metric tons).

[e] Residual heavy metal content is 230,000 lbs (105 metric tons).

[f] Residual heavy metal content is 150,000 lbs (68 metric tons).

[g] Recyclable wastes.

TABLE 4.2.3.10–3.—*Potential Spent Nuclear Fuel and Waste Management Impacts from Tritium Supply Technologies and Recycling at Idaho National Engineering Laboratory* [Page 1 of 2]

	Tritium Supply Technologies and Recycling									
	HWR		MHTGR		Large ALWR		Small ALWR		APT	
	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact
Spent Nuclear Fuel	New	New storage facility	New	New storage facility	New	New storage facility	New	New storage facility	None	None
Low-Level										
Liquid	New	May be able to use existing facility	New	May be able to use existing facility	New	New treatment facility required	New	May be able to use existing facility	None	None
Solid	+109	0.6 acres/ year of LLW disposal required	+32	0.2 acres/ year of LLW disposal required	+21	0.2 acres/ year of LLW disposal required	+20	0.1 acres/ year of LLW disposal required	+18	0.1 acres/ year of LLW disposal required
Mixed Low-Level										
Liquid	New	None	New	None	New	None	New	None	New	None
Solid	+19	Additional or expansion of treatment and storage facilities may be required	+<1	None	+1	None	+1	None	+1	None
Hazardous										
Liquid	None	None	None	None	None	None	None	None	None	None
Solid	+13	Use of existing facilities feasible	+33	Use of existing facilities feasible	+12	Use of existing facilities feasible	+12	Use of existing facilities feasible	+1	Use of existing facilities feasible

TABLE 4.2.3.10–3.—*Potential Spent Nuclear Fuel and Waste Management Impacts from Tritium Supply Technologies and Recycling at Idaho National Engineering Laboratory* [Page 2 of 2]

	Tritium Supply Technologies and Recycling									
	HWR		MHTGR		Large ALWR		Small ALWR		APT	
	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact
Nonhazardous (Sanitary)										
Liquid	New	New treatment facilities required	New	New treatment facilities required	New	New treatment facilities required	New	New treatment facilities required	New	New treatment facilities required
Solid	+22	Landfill life reduced or expansion required	+22	Landfill life reduced or expansion required	+21	Landfill life reduced or expansion required	+17	Landfill life reduced or expansion required	+13	Landfill life reduced or expansion required
Nonhazardous (Other)										
Liquid	None	None	None	None	None	None	None	None	None	None
Solid	+19 percent of sanitary	None-Project wastes are recyclable	+19 percent of sanitary	None-Project wastes are recyclable	+18 percent of sanitary	None-Project wastes are recyclable	+15 percent of sanitary	None-Project wastes are recyclable	+9 percent of sanitary	None-Project wastes are recyclable

[a] This column reflects the percentage change in generation rate for No Action. Percentage change was calculated using waste volumes prior to rounding. Do not use rounded numbers in table 4.2.3.10–2 to calculate percentage change.

Source: Tables 4.2.3.10–1 and 4.2.3.10–2.

INEL would be increased by 22 percent more than No Action. This could reduce the remaining life of the landfill or require an expansion.

Siting an MHTGR without tritium recycling facilities at INEL would not affect the generation of nor change the impacts from spent nuclear fuel or liquid LLW as described above. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.2.3.10–3. The LLW disposal area required for solid LLW would decrease by approximately 0.04 acres per year. The increase in generation rate for No Action for solid sanitary wastes would decrease from 22 percent to 11 percent, thus proportionately decreasing the impact to the landfill.

Advanced Light Water Reactor (Large). Spent nuclear fuel would be generated at the rate of 55 yd^3 per year. This would add 105 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The Large ALWR would be designed to provide the necessary stabilization and storage for the spent fuel while awaiting final disposition. The liquid LLW generated by the ALWR would require new treatment facilities to reduce its volume and stabilize the remaining concentrated radionuclides to prepare the waste for disposal onsite. The volume of these wastes from the Large ALWR is the largest of all the technologies and exceeds the capacity of the Liquid Effluent Treatment Facility (appendix table H.2.1–5). The solid LLW volume would increase the rate disposed of at INEL by 21 percent more than the No Action volume. This would require 0.2 acres per year of onsite LLW disposal. There would be a small amount of liquid mixed LLW generated. The ALWR solid mixed LLW generation would cause the rate at INEL to increase only 1 percent above No Action, so there would be a small impact from this waste stream. Hazardous waste generation would increase by 12 percent over No Action. This would require a RCRA-permitted facility to prepare the waste for shipment to a RCRA-permitted treatment and disposal facility. Liquid sanitary wastes generated by the Large ALWR, are larger in volume than the other technologies, and would require new treatment facilities since INEL does not have centralized facilities for these wastes. The solid sanitary wastes generated by the ALWR would increase the disposal at INEL by 21 percent more than No Action generation. This could reduce the remaining useful life of the landfill or require an expansion.

Siting a Large ALWR without tritium recycling facilities at INEL would not affect the generation of nor change the impacts from spent nuclear fuel or liquid LLW as described above. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.2.3.10–3. The LLW disposal area required for solid LLW would decrease by approximately 1 acre per year. The increase in generation rate over No Action for solid sanitary wastes would decrease from 21 to 10 percent, thus proportionately decreasing the impact to the landfill.

Advanced Light Water Reactor (Small). Spent nuclear fuel would be generated at the rate of 36 yd^3 per year. This would add 68 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The Small ALWR would be designed to provide the necessary stabilization and storage for the spent nuclear fuel while awaiting final disposition. The liquid LLW generated by the ALWR would require treatment facilities to reduce its volume and stabilize the remaining concentrated radionuclides to prepare the waste for disposal onsite. The solid LLW volume would require 0.1 acres per year of onsite LLW disposal. There would be a small amount of liquid mixed LLW generated. The ALWR solid mixed LLW generation would cause the rate at INEL to increase by only 1 percent above No Action, so there would be a small impact from this waste stream. Hazardous waste generation would increase by 12 percent over No Action. This would require a RCRA-permitted facility to prepare the waste for shipment to a RCRA-permitted treatment and disposal facility. Liquid sanitary wastes generated would require new treatment and disposal facilities because INEL does not have centralized facilities for these wastes. The solid sanitary wastes generated would increase by 17 percent more than No Action generation. This could reduce the remaining useful life of the landfill or require an expansion.

Siting a Small ALWR without tritium recycling facilities at INEL would not affect the generation of nor change the impacts from spent nuclear fuel or liquid LLW as described above. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.2.3.10–3. The LLW disposal area required for solid LLW would decrease by approximately 0.04 acres per year. The increase in generation rate over No Action for solid sanitary wastes would decrease from 17 to 6 percent; thus proportionately decreasing the impact to the planned lifetime of the landfill.

Accelerator Production of Tritium. The APT does not generate spent nuclear fuel. Any liquid LLW can be solidified at the point of generation. The APT-generated solid LLW would increase the volume disposed of at INEL by 18 percent more than No Action. This would require 0.1 acres per year of onsite LLW disposal. Liquid and solid mixed LLW would be 1 percent of No Action, having a small impact. Hazardous waste generation would also increase by 1 percent more than No Action, resulting in a small impact. Existing/planned RCRA-permitted facilities where it could be staged for shipment to an onsite commercial RCRA-permitted treatment and disposal facility would be adequate. Liquid sanitary wastes generated by the APT would require new treatment facilities since INEL does not have centralized facilities for these wastes. The generation of solid sanitary wastes would increase by 13 percent. This could reduce the remaining useful life of the landfill or require an expansion.

Siting an APT without tritium recycling facilities at INEL would not affect the generation of or change the impacts from liquid LLW as described above and in table 4.2.3.10–3. Liquid mixed LLW would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid nonhazardous wastes would not change from those described above and in table 4.2.3.10–3. The LLW disposal area required for solid LLW would decrease by approximately 0.04 acres per year. The increase in generation rate over No Action for solid sanitary wastes would decrease from 13 to less than 2 percent. Therefore, without tritium recycling facilities, there is minimal impact to the landfill.

Less Than Baseline Operations. In the event of a reduced baseline tritium requirement the waste volumes shown in table 4.2.3.10–2 would not appreciably change as a result of the HWR operating at less power, and the MHTGR and ALWR irradiating fewer target rods. In the case of a Phased APT using the helium-3 target, the waste volumes with the exception of cooling tower blowdown, which decreases by 36 percent (86 MGY), are approximately the same as the Full APT using the helium-3 target.

Multipurpose Reactor

Multipurpose Modular High Temperature Gas-Cooled Reactor. The volume of spent nuclear fuel generated by the six-reactor module multipurpose MHTGR would be approximately double the spent nuclear fuel from the three-reactor module tritium supply MHTGR. Similar to the mixed-oxide fuel assemblies, the plutonium-oxide fuel assemblies would have greater decay heat. Because the increased decay heat reduces storage density in the pool area and increases the fuel pool dwell time before dry storage, the spent nuclear fuel storage requirement would more than double that required for the three-reactor module tritium supply MHTGR. No increases in waste generation rates or characteristics are expected due to the change from uranium-oxide reactor fuel to plutonium-oxide reactor fuel. However, there would be increases in waste generation for all waste categories due to operation of the Pit Disassembly/Conversion Facility to include the introduction of mixed TRU and TRU wastes from both the Pit Disassembly/Conversion Facility and the fabrication of plutonium-oxide fuel. These increases are in addition to those listed in table 4.2.3.10–2 for the tritium supply MHTGR. Table 4.8.3.1–8 provides the quantity of waste effluents from the Pit Disassembly/Conversion Facility.

In addition, approximately 385 yd^3 of mixed TRU and TRU wastes would result from the fabrication of plutonium-oxide fuel. The 399 yd^3 of mixed TRU and TRU wastes would require transport to a geologic repository (assuming one is available) after they have been processed to meet the WIPP waste acceptance criteria. INEL has existing and planned TRU waste handling facilities that could be used.

The transport of the mixed TRU and TRU wastes to WIPP would require 35 truck shipments per year, 18 regular train shipments per year, or six dedicated train shipments per year. One hundred gallons of liquid and 0.2 yd^3 of solid mixed LLW would require treatment in accordance with the INEL Site Treatment Plan. Approximately 0.003 acres per year of LLW disposal area would be required to dispose of the 10 yd^3 of solid LLW. Sufficient staging capacity exists to accumulate the 1,000 gallons of liquid and 1 yd^3 of solid hazardous wastes while awaiting shipment to a RCRA-permitted treatment and disposal facility. An additional 87 yd^3 of solid nonhazardous wastes would require disposal in the sanitary landfill. Additional liquid sanitary and industrial wastewater treatment facilities may be required if the Pit Disassembly/Conversion Facility is not collocated with the multipurpose reactor.

Multipurpose Advanced Light Water Reactor. Spent fuel would be generated at the same rate with approximately the same amount of residual heavy metal content as the tritium supply ALWR. The decay heat in the mixed-oxide fuel assemblies could be 10 to 20 percent greater than the heat in spent uranium-oxide fuel assemblies. The increased decay heat load could reduce the fuel assembly storage density in the fuel pool and dry storage casks or increase fuel pool dwell time before dry storage. No increases in waste generation rates or characteristics are expected due to the change from uranium-oxide reactor fuel to mixed-oxide reactor fuel. However, there would be increases in waste generation for all waste categories due to operation of the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility to include the introduction of mixed TRU and TRU wastes. These increases are in addition to those listed in table 4.2.3.10–2 for the Large and Small tritium supply ALWR. As shown in table 4.8.3.1–4, approximately 399 yd^3 of mixed TRU and TRU wastes would require transport to a geologic repository (assuming one is available) after they have been processed to meet the WIPP waste acceptance criteria.

INEL has existing and planned waste handling facilities that could be used. The transport of the mixed TRU and TRU wastes to WIPP would require 35 truck shipments per year, 18 regular train shipments per year, or six dedicated train shipments per year. Two hundred gallons of liquid and 13 yd^3 of solid mixed LLW would require treatment in accordance with the INEL Site Treatment Plan. Approximately 0.16 acres per year of LLW disposal area would be required to dispose of the 524 yd^3 of solid LLW. Sufficient staging capacity exists to accumulate the 200 gallons of liquid and 13 yd^3 of solid hazardous wastes while awaiting shipment to a RCRA-permitted treatment and disposal facility. An additional 3,920 yd^3 of solid nonhazardous wastes would require disposal in the sanitary landfill. Additional liquid sanitary and industrial wastewater treatment facilities may be required if the Pit Disassembly/Conversion/Mixed Oxide Fuel Fabrication Facility is not collocated with the multipurpose reactor.

Potential Mitigation Measures. Each tritium supply technology and recycling facility would be designed to process its own waste into forms suitable for storage or disposal and would use proven waste minimization and pollution prevention technologies to the extent possible. Some facility designs would produce waste quantities or waste forms that could undergo additional reductions by utilizing emerging technologies, thereby further reducing or mitigating impacts. Pollution prevention and waste minimization would be major factors in determining the final design of any facility constructed as part of the proposed action at INEL. Pollution prevention and waste minimization would also be analyzed as part of the site-specific analyses and tiered NEPA documents.

Utilization of existing treatment, storage, and disposal facilities described in sections 4.2.2.10 and appendix section H.2.1 could further reduce impacts. For instance, the liquid LLW processing facilities at the Idaho Chemical Processing Plant have capacity exceeding the generation rate of the HWR, and may have the potential to process those wastes. Similarly, the Waste Experimental Reduction Facility may have the capacity to treat LLW, mixed LLW, and hazardous wastes from the new tritium supply and recycling facilities. The use of existing incineration at INEL could reduce the volume of solid LLW to be disposed by a factor of up to 80. It would be possible to utilize centralized disposal facilities for solid LLW and solid sanitary, and industrial nonhazardous wastes. Utilization of these facilities would require site-specific engineering studies and NEPA analysis.

4.3 Nevada Test Site

NTS was established in 1950 and currently occupies approximately 864,000 acres located 65 miles northwest of Las Vegas, NV. The site has conducted underground testing of nuclear weapons and evaluation 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 to resume testing if authorized by the President. Section 3.3.3 provides a description of all the DOE missions and support facilities at NTS. The location of NTS within the State of Nevada is illustrated in figure 4.3–1.

4.3.1 Description of Alternatives

Under the proposed action, any one of the four tritium supply technologies (HWR, MHTGR, ALWR, or APT) alone or collocated with a new tritium recycling facility could be sited at NTS. Section 3.4.2 provides a description of the tritium supply technologies and section 3.4.3.1 describes the tritium recycling facility. Figure 4.3.1–1 shows the location of existing facilities within NTS and the proposed TSS.

Under No Action, NTS would continue its current and planned missions as described in section 3.3.3. Even though a moratorium has been placed on all underground nuclear testing, NTS will still be required to maintain the capability to resume such testing in the event it is again required for national security. No facilities at NTS would be phased out as a result of any of the proposed action alternatives discussed in this PEIS.

4.3.2 Affected Environment

The following sections describe the affected environment at NTS for land resources, air quality and acoustics, water resources, geology and soils, biotic resources, cultural and paleontological resources, and socioeconomics. In addition, NTS's infrastructure, radiation and hazardous chemical environment, and the waste management conditions are described.

4.3.2.1 *Land Resources*

The discussion of land resources at NTS includes land use and visual resources.

Land Use. NTS occupies approximately 864,000 acres in southern Nye County in southern Nevada, with the southwestern boundary located approximately 10 miles from California. The town of Indian Springs and Indian Springs Air Force Base, in northeast Clark County, NV, are 24 miles southeast of the closest NTS boundary. All of the land within NTS is owned by the Federal government and is administrated, managed, and controlled by DOE. NTS is also entirely bordered by Federal land; the land on the west, north, and east consists of the Nellis Air Force Range. The Federal land to the south is administered by the Bureau of Land Management.

Generalized land uses at NTS and its vicinity are shown on figure 4.3.2.1–1. NTS is divided into three major regions consisting of 26 areas. The north region is the underground nuclear weapons test area. Nuclear test ranges are located at Yucca Flats, Pahute Mesa, Rainier Mesa, and Buckboard Mesa. The southwest region, Area 25, provides support for nonweapons and nonnuclear weapons programs, such as the proposed high-level waste repository at Yucca Mountain Project Site, and for short-term activities such as the Nuclear Weapons Accident Exercises conducted by the Nuclear Emergency Search Team. The southeast region, Area 5, is the nonnuclear explosives test area and primary administrative and support area of NTS.

Land not used for missions or other purposes has been designated in the NTS Site Development Plan as reserve areas, available for future development. Approximately 100,000 acres of reserve areas are present within Areas 5 and 6, located in Frenchman and Yucca Flats, respectively.

As shown on figure 4.3.2.1–1, the proposed 600-acre TSS would be located within the northwest portion of Frenchman Flat. This is currently an undeveloped reserved area, with the exception of the closed Cane Spring Test Range and the combined Device Assembly Facility. The Device Assembly Facility, undergoing final construction, is designed to conduct all nuclear assembly operations at NTS in support of the Nuclear Weapons Test Program. Other nearby

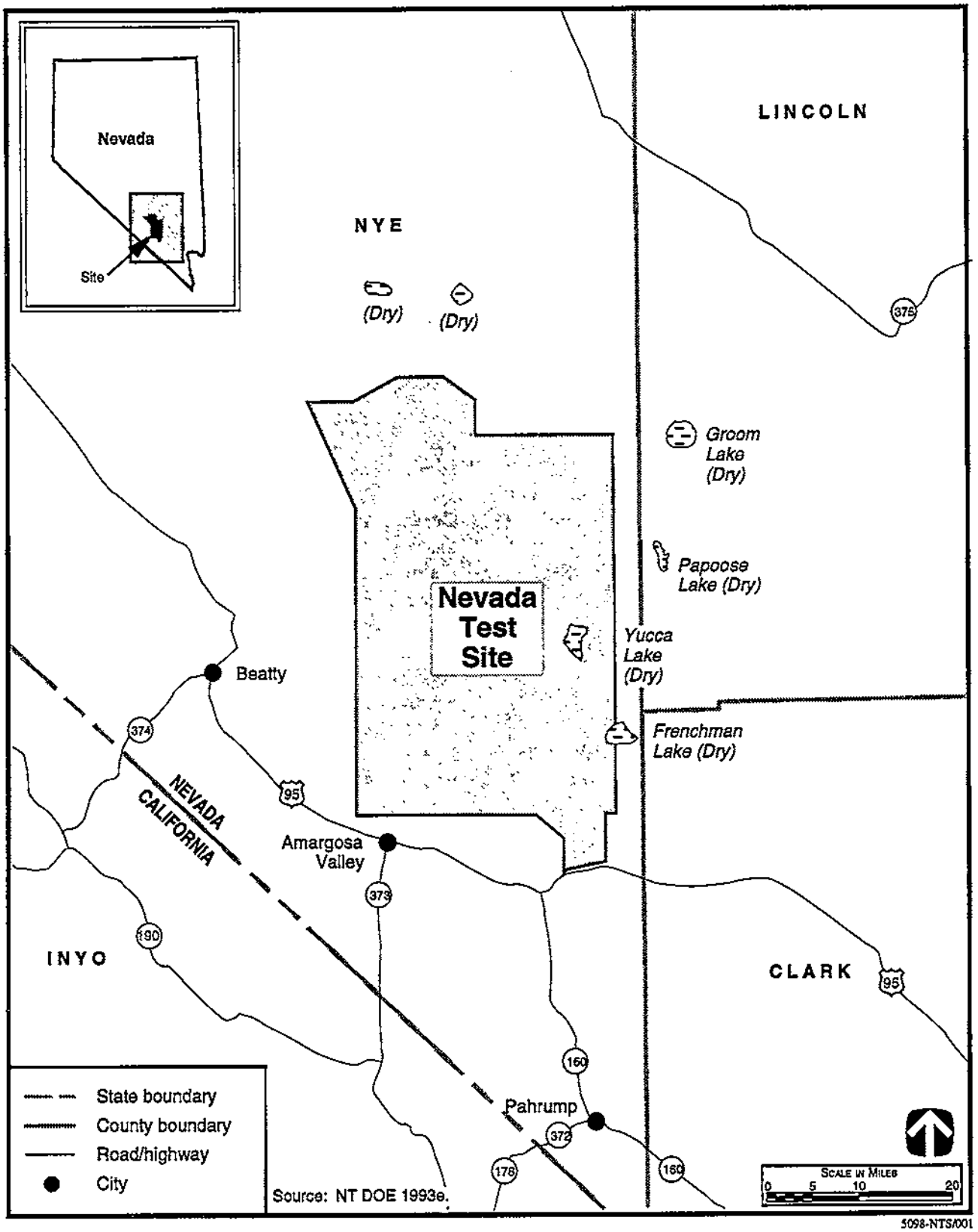


FIGURE 4.3–1.—*Nevada Test Site, Nevada, and Region.*

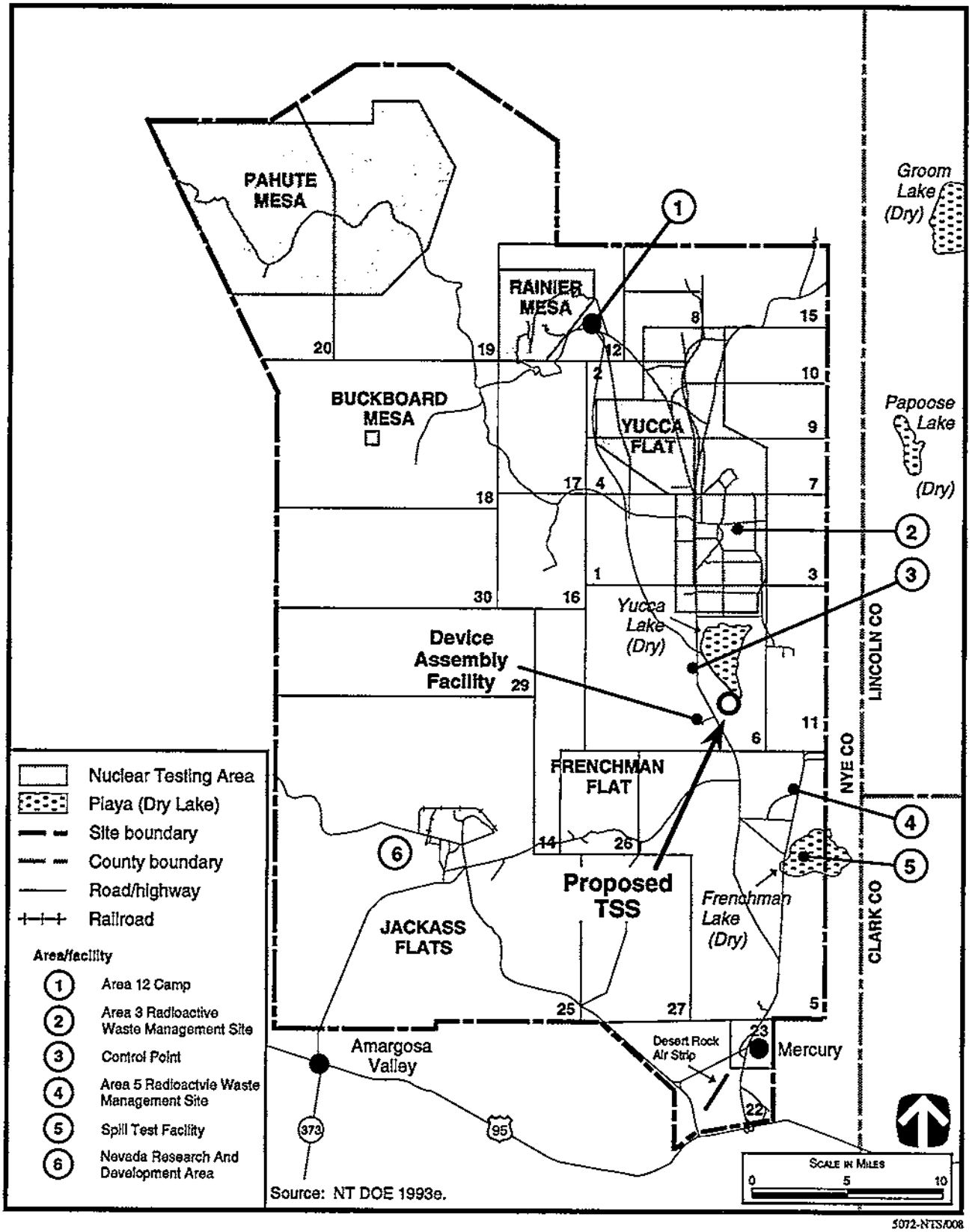


FIGURE 4.3.1–1.—***Primary Facilities, Proposed Tritium Supply Site, and Testing Areas at Nevada Test Site.***

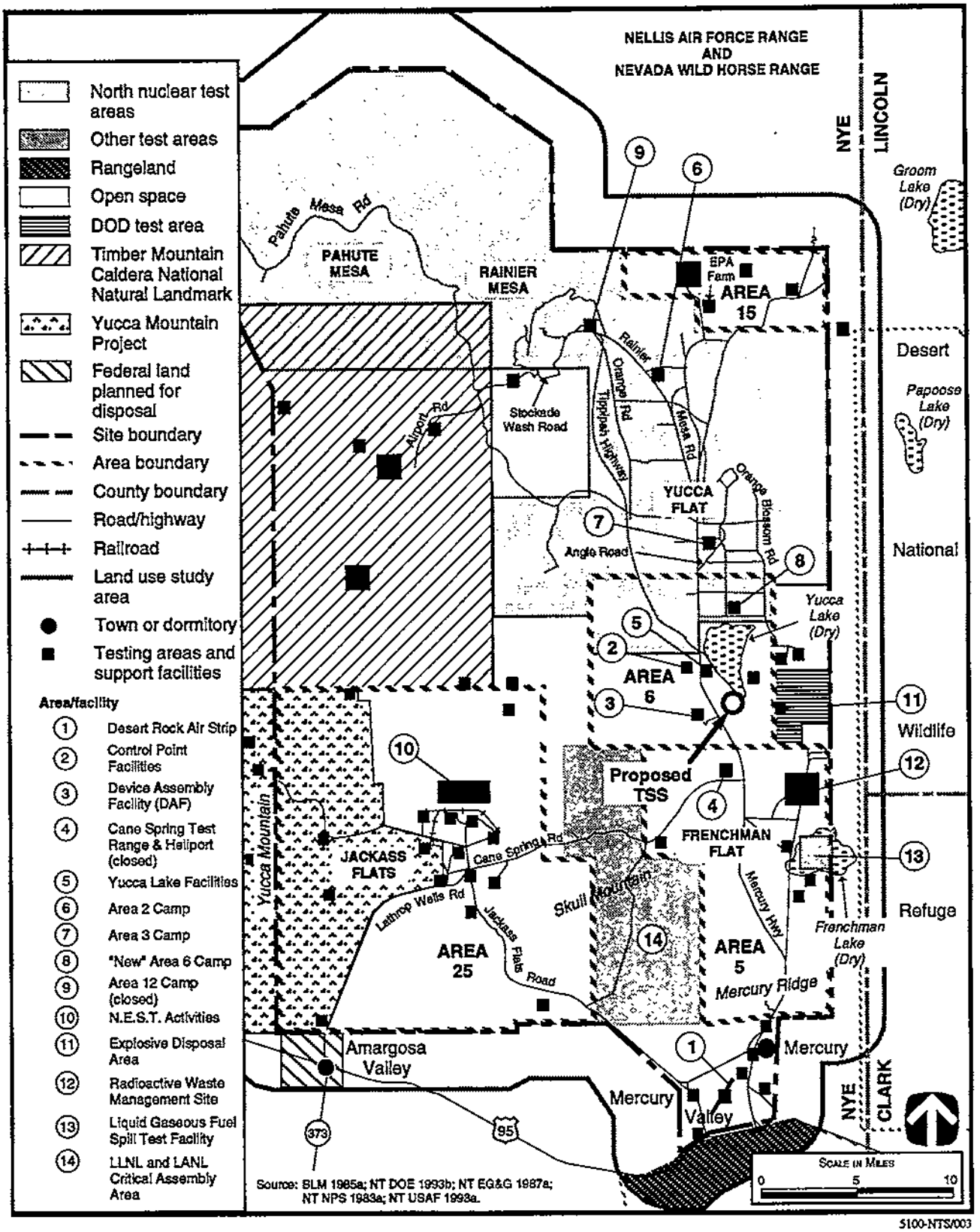


FIGURE 4.3.2.1–1.—*Generalized Land Use at Nevada Test Site and Vicinity.*

facilities are the DOD Test Area, Explosives Disposal Area, Radioactive Waste Management Site, and Liquid Gaseous Fuel Spill Test facility.

In 1992, DOE designated all but approximately 67,800 acres of NTS as a National Environmental Research Park. The National Environmental Research Park is used by the national scientific community as an outdoor laboratory for research on the effects of human activities on the desert ecosystem. There is no prime farmland present on NTS. Past agricultural activities consisted of the EPA Farm in Area 15, an agricultural crop and animal radiological research facility, which closed in 1981. Offsite agricultural activity occurs on the south side of U.S. Route 95, consisting of a cattle allotment granted by the Bureau of Land Management.

The Timber Mountain Caldera National Natural Landmark is located approximately 8 miles north-northwest of the proposed TSS, separated by mountains to the west. A Wilderness Study Area located within the Desert National Wildlife Refuge, which has been recommended for inclusion into the National Wilderness System, is approximately 6 miles east of the proposed TSS. This part of the refuge is also a part of the Nellis Air Force Range; it is jointly managed by the U.S. Air Force and USFWS. Public entry to this portion of the refuge is generally prohibited by the U.S. Air Force.

The closest offsite residence to the NTS boundary is 1.3 miles south, at the unincorporated town of Amargosa Valley.

Visual Resources. The low-lying valleys and flats of NTS are surrounded by mountains typical of the Basin and Range Province. The vegetation is typical of the Great Basin Desert. The visible facilities of NTS are scattered in this desert setting.

Public viewpoints of NTS are located in the Amargosa Valley and Mercury Valley along U.S. Route 95, the principal highway between Tonopah and Las Vegas. The principal viewpoint in the Mercury Valley is a roadside turnoff containing Nevada Historical Marker No. 165 of the Nevada State Park System, entitled "Nevada Test Site." NTS facilities within 5 miles are visible from this viewpoint. The testing areas of NTS, including the proposed TSS, are not visible from the road because of mountainous terrain and distance. The main base camp at Mercury (approximately 4 miles away) is well defined at night by facility lighting, surrounded by the dark desert and night sky. The mix of industrial use and open desert is consistent with the Bureau of Land Management's VRM Class 4 designation.

There are viewpoints of the proposed TSS from Buried Hills, Frenchman Flat, Spotted Range, Ranger Mountains, and Mercury Ridge in the Wilderness Study Area of Desert National Wildlife Refuge. Access to this area of the Desert National Wildlife Refuge is controlled by the U.S. Air Force. The views from this Wilderness Study Area are typical of the Basin and Range Province. Land disturbances from human activity can be seen but are not evident and do not attract attention consistent with a VRM Class 2 designation.

4.3.2.2 *Site Infrastructure*

As shown in figure 4.3.2.1–1, activities at NTS are concentrated in facilities in several general areas. Section 3.3.3 describes the current missions. To support these missions an infrastructure exists as shown in table 4.3.2.2–1. Of critical importance to the proposed action is the electrical power infrastructure at the proposed TSS. NTS is located in the Western Systems Coordinating Council region and draws its power from the California-Southern Nevada Power Area subregion. Characteristics of this subregion are listed in table 4.3.2.2–2.

TABLE 4.3.2.2–1.— *Baseline Characteristics for Nevada Test Site*

Current Characteristics	Value
Land	
Area (acres)	864,000
Roads (miles)	400
Railroads (miles)	0
Electrical	
Energy consumption (MWh/yr)	168,500
Peak load (MWe)	28
Fuel	
Natural gas (ft^3/yr)	0
Oil (GPY)	1,510,000
Coal (ton/yr)	0
Steam (lb/hr)	0

Source: NTS 1993a:4.

TABLE 4.3.2.2–2.—*Subregional Power Pool Electrical Summary for Nevada Test Site*

Type Fuel	Production (percent)
Coal	14
Nuclear	15
Hydro/geothermal	19
Oil/gas	22
Other[a]	30
Total Annual Production: 246,012,000 MWh	
Total Annual Load: 293,262,000 MWh	
Energy Imported Annually[b]: 45,400,000 MWh	
Generating Capacity: 61,681 MWe	
Peak Demand: 57,028 MWe	
Capacity Margin[c]: 11,809 MWe	

[a] Includes power from both utility and nonutility sources.
[b] Energy imported is not the difference of production and load due to positive net pumped storage.
[c] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.
Source: NERC 1993a.

4.3.2.3 *Air Quality and Acoustics*

The following describes the existing air quality and acoustics at NTS, and includes a review of meteorology and climatology and atmospheric dispersion characteristics in the vicinity of NTS. More detailed discussions of air quality and acoustics methodologies and input data are presented in appendix section B.1.3.3.

Meteorology and Climatology. The climate at NTS and in the surrounding region is characterized by limited precipitation, low humidity, and large diurnal temperature ranges. The lower elevations are characterized by hot summers and mild winters which are typical of other Great Basin desert areas. As elevation increases, precipitation amounts increase and temperatures decrease (NT DOE 1986b:3-46).

The average daily temperatures, based upon the mean of the daily minimum and maximum temperature, range from 44.5 °F in January to 89.8 °F in July. The annual average temperature calculated from these average daily temperatures is 66 °F. The average annual precipitation ranges from 6 to 9 inches (NT DOC 1968a). Prevailing winds vary by location. Additional information related to meteorology and climatology is presented in appendix section B.1.3.3.

Ambient Air Quality. NTS is located within the Nevada AQCR 147. The region is in attainment with respect to the NAAQS for criteria pollutants (40 CFR 50). Applicable NAAQS and Nevada State ambient air quality standards are presented in appendix table B.1.3.1–1.

Two Prevention of Significant Deterioration Class I areas in the vicinity of NTS are Grand Canyon National Park, approximately 120 miles to the southeast, and Sequoia National Park, California, approximately 105 miles to the west-southwest.

The primary emission sources of criteria air pollutants include particulates from construction and other surface disturbances, fugitive dust from unpaved roads, various pollutants from fuel burning equipment, incineration, open burning, and volatile organics from fuel storage facilities. A summary of emission estimates for sources at NTS is presented in appendix table B.1.3.3–2.

Table 4.3.2.3–1 shows the site baseline ambient air concentrations for criteria pollutants and other pollutants of concern. With the exception of the 24-hour PM_{10} standard, baseline concentrations are in compliance with applicable guidelines and regulations. The 24-hour PM_{10} standard is exceeded due to moderate background concentrations and contributions from operations at the site. The nearest ambient air quality monitor operated by the State of Nevada is in Nye County (appendix table B.1.3.3–1). Elevated levels of ozone (O_3) or particulates (PM_{10} and TSP) may occur occasionally because of pollutants transported into the area by wind or because of local sources of fugitive particulates (NT DOE 1983a:30). Concentrations of other criteria pollutants (SO_2, NO_2, CO, and lead (Pb)) are low because there are no large emission sources nearby. The nearest significant emission source for criteria pollutants is the Las Vegas area, which is about 65 miles southeast of NTS.

Acoustic Conditions. Major noise emission sources within NTS include various industrial facilities, equipment and machines, and aircraft operations. Noise survey data are unavailable. At the site boundary, away from most of the industrial facilities,

TABLE 4.3.2.3–1.—*Comparison of Baseline Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines at Nevada Test Site, 1990-1992*

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutant			
Carbon monoxide (CO)	8-hour	10,000[a]	2,290
	1-hour	40,000[a]	2,748
Lead (Pb)	Calendar Quarter	1.5[a]	[b]
Nitrogen dioxide (NO_2)	Annual	100[a]	[b]
Ozone (O_3)	1-hour	235	[b]
Particulate matter[c] (PM_{10})	Annual	50[a]	8.4
	24-hour	150[a]	172.6
Sulfur dioxide (SO_2)	Annual	80[a]	6.9
	24-hour	365[a]	117
	3-hour	1,300[a]	660.6
Mandated by Nevada			
Hydrogen sulfide	1-hour	112[d]	[e]
Hazardous and Other Toxic Compounds			
No sources	[e]	[e]	[e]

[a] Federal standard (40 CFR 50).
[b] Not measured.
[c] It is assumed that PM_{10} data are TSP data.
[d] State standard (NT NAC 1991a).
[e] No sources indicated.
Source: NT DCNR 1992a; NT REECO 1990a.

noise emitted from the site is barely distinguishable from background noise levels.

The acoustic environment around NTS can be classified as either uninhabited desert or small rural communities. Wind is the predominant source of noise. Except for the prohibition of nuisance noise, neither the State of Nevada nor its local governments have established specific numerical environmental noise standards applicable to NTS.

4.3.2.4 *Water Resources*

This section describes the surface water and groundwater resources at NTS.

Surface Water. There are no continuously flowing streams on NTS. The most noticeable natural hydrologic features are the playas (lake beds) which collect stormwater runoff. Runoff in the eastern half of the site ultimately collects in the playas of Frenchman and Yucca Flats. In the northeastern portion the runoff drains outside the test site and onto the Nellis Air Force Range Complex. In the western half and southernmost part, runoff is carried offsite towards the Armagosa Desert. Figure 4.3.1–1 shows the location of the playas and flats. A few natural springs can be found at NTS. Surface water is not used at NTS (NT DOE 1992d).

Because there are no continuously flowing surface waters there are no studies to assess 500-year floodplain boundaries, although a 100-year flood analysis has been conducted. This analysis showed that the runoff from a 100-year storm could potentially flow through Jackass Flats, which is well south and west of the proposed TSS (NT SAIC 1991a). However, the proposed TSS is in a region where flooding occurs due to locally isolated intense convection storms. These storms create flash floods which normally last less than 6 hours.

Surface Water Quality. There are no NPDES permits for the site as there are no wastewater discharges to onsite or offsite surface waters. However, the state has issued sewage discharge permits for sewage lagoons and ponds for NTS facilities. Because there are no surface waters at or near the

proposed TSS, and because there will be no withdrawal or discharge to natural surface waters, the assessment of surface water quality is not applicable.

Surface Water Rights and Permits. Surface water rights are not an issue because NTS facilities do not withdraw surface water for use, nor do they discharge effluents directly to natural surface waters.

Groundwater. NTS is located within three groundwater subbasins of the Death Valley Groundwater Basin (NT USGS 1975a). Groundwater beneath the eastern portion of NTS is located in the Ash Meadows Subbasin; the western portion is located in the Alkali Flat Furnace Creek Ranch Subbasin; and a small part of the northwestern corner is located in the Oasis Valley Subbasin (figure 4.3.2.4–1). The proposed TSS is situated above the Ash Meadows Subbasin. Three primary aquifers are present within the Ash Meadows Subbasin: the Lower Carbonate (the deepest), the Volcanic, and the Valley-Fill (the shallowest) (NT DOE 1992d). Other aquifers are present to a limited extent under the area, but their water-bearing potential has not been thoroughly investigated. Limited aquifers may occur in other volcanic units, including lava flows and bedded tuffs.

The Lower Carbonate is the regional aquifer and is comprised of carbonate rocks of Middle Cambrian through Devonian age. The saturated thickness ranges from a few hundred to several thousand feet. This aquifer drains in a south-southwest direction, under Frenchman and Yucca Flats, toward Ash Meadows (NT USGS 1975a). The Volcanic and Valley-Fill aquifers range in thickness from 0 to about 2,000 feet and are confined to their respective drainage basin (i.e., Frenchman and Yucca Flats) (NT DOE 1992d).

Depth to groundwater at NTS ranges from 500 to 2,400 feet. It is approximately 1,600 feet at Yucca Flat, 820 feet at Frenchman Flat, and over 2,000 feet at Pahute Mesa. There are, however, areas of perched water that lie at considerably shallower depths. A study by the U.S. Geological Survey (Harrill and others, 1988) balanced the amount of recharge and discharge throughout the Great Basin and estimated a total of 32 BGY recharge for the entire Death Valley system. Of this total, about 11 BGY flowed through or near Frenchman Flat into the Ash Meadows discharge area to the south. A study by the Desert Research Institute (Sadler and others, 1992) modeled groundwater flow through discrete areas of the Death Valley system and concluded that of 16 BGY total system recharge, about 7 BGY flowed through Frenchman Flat. These differences in estimates of flow exemplify common variations among authors of a factor of 2 or 3 but rarely of as much as a factor of 10. All authors rely on similar methodologies and assumptions, so the uncertainty in recharge and discharge estimates is based upon a lack of complete data and different initial assumptions.

Devil's Hole is a water-filled cavern near Ash Meadows approximately 30 miles southwest of the NTS. Groundwater pumping at Ash Meadows was curtailed by order of the U.S. Supreme Court in order to protect the endangered pupfish by maintaining water levels at Devil's Hole. Studies show that historical pumping on NTS at rates that exceed current rates was probably unrelated to observed declines at Devil's Hole (Avon and Durbin, 1994). Springs at Ash Meadows nearby contain a large concentration of rare, endangered, and threatened indigenous species which depend upon adequate spring flow for their survival. Substantially increased pumping at NTS is unlikely to lower spring levels but might reduce spring discharge rates.

Groundwater Quality. Currently, aquifers beneath NTS have not been classified by EPA. However, during an independent study (NT DOE 1989a) the aquifers beneath NTS were classified as Class IIa and Class IIb (groundwater currently used for drinking water). In 1972, the Nevada Operations Office instituted a Long Term Hydrological Monitoring Program to be operated by the EPA under an Interagency Agreement. Groundwater is monitored on and around NTS, at seven sites in other states, and at two off-NTS sites in Nevada. Only wells drilled previously for water supply or exploratory purposes are being used in the existing monitoring program. In compliance with the SDWA and a State of Nevada drinking water supply system permit, drinking water wells and industrial use distribution systems are sampled and analyzed on a monthly basis. Groundwater samples collected are analyzed for a standard suite of parameters and constituents, including radioactive materials, nonradioactive materials, and other field parameters (pH and total dissolved solids).

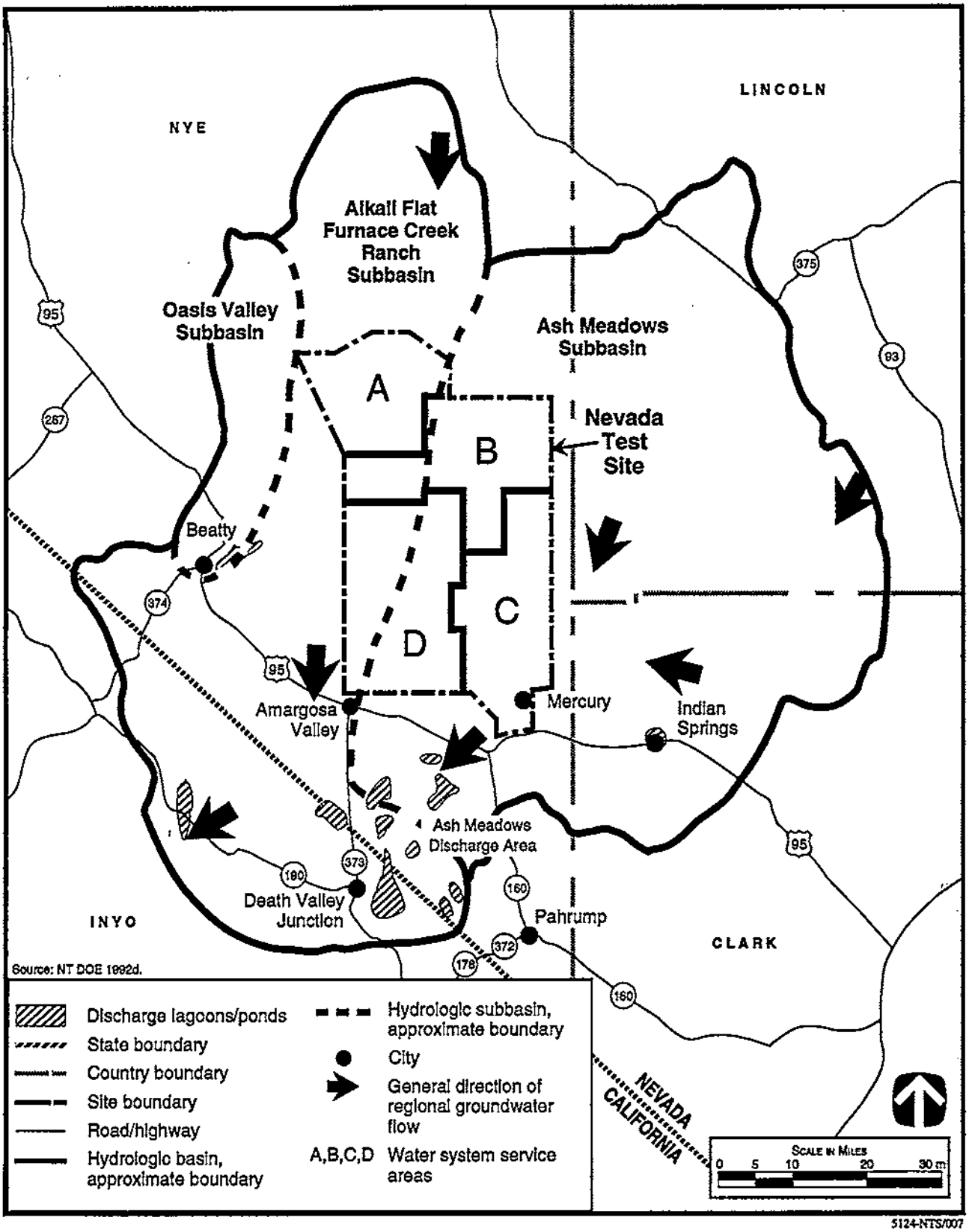


FIGURE 4.3.2.4–1.—*Groundwater Hydrologic Units at Nevada Test Site and Vicinity.*

Groundwater under portions of NTS has been affected as a result of nuclear testing activities conducted during the last 43 years. Additionally, several tests, comprising approximately 20 percent of the total, have been conducted below the water table or have been close enough that effects have extended below it. Table 4.3.2.4–1 shows the groundwater quality in the vicinity of the proposed TSS.

Due to the past nuclear testing activities, radionuclide monitoring has been an important component of the groundwater monitoring program at the site. Because the water table lies at considerable depth, most radionuclides are absorbed before they can reach the groundwater. In general, tritium is the only radionuclide that appears in sampled water. Recent samples show tritium concentrations in the vicinity of the proposed TSS to be 32 picocuries per liter (pCi/l) and decreasing. Subsurface migration of tritium to offsite areas is possible, but the probability of tritium reaching offsite wells or springs is minimal. It is also thought that the Lower and Upper Carbonate aquifers would most likely be the aquifers in which tritium might migrate to offsite areas (LLNL 1976a).

Groundwater Availability, Use, and Rights. Groundwater is the only local source of industrial and drinking water supply in the NTS area. Numerous production wells are located on NTS and distributed among various areas of the site. Figure 4.3.2.4–1 shows how the water system has been divided into four water service areas (A, B, C, and D) based on the location of the water supply system and support facilities. Water usage on NTS is largely for potable, construction, and dust control purposes. Water supply wells at NTS draw water from the Lower and Upper Carbonate, the Volcanic, and the Valley-Fill aquifers. The total water usage in 1990 was 633 MGY, of which 335 MGY were withdrawn

TABLE 4.3.2.4–1.—*Groundwater Quality Monitoring Data at Nevada Test Site, 1991-1992*

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Well No.4[b,c]	Well No.4a[b,d]	Well No.C-1[b,e]
Alkalinity	mg/l	NA	126	138	478
Alpha (gross)	pCi/l	15[f]	4	[g]	6
Arsenic	mg/l	0.05[f]	0.007	0.004	0.006
Barium	mg/l	2.0[f]	0.00	0.01	0.11
Beta (gross)	pCi/l	50[h]	6	[g]	11
Chromium	mg/l	0.1[f]	< 0.005	< 0.005	< 0.005
Copper	mg/l	1.3	0.00	0.00	0.00
Lead	mg/l	0.015[f]	< 0.005	< 0.005	< 0.005
Nitrate	mg/l	10[f]	18.2	14.3	0.3
pH	pH units	6.5 to 8.5[i]	8.13	8.22	7.63
Sodium	mg/l	NA	50	55	125
Total dissolved solids	mg/l	500[j]	283	283	640
Tritium	pCi/l	20,000[f]	[g]	[g]	32

[a] For comparison only.
[b] All data come from wells located downgradient of the proposed TSS.
[c] Data collected by Reeco on 07/22/91.
[d] Data collected by NVHD on 04/30/92.
[e] Data collected by Reeco on 08/01/91.
[f] National Primary Drinking Water Regulations (40 CFR 141).
[g] Does not analyze for paramater.
[h] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).
[i] Nevada State Water Quality Criteria.
[j] National Secondary Drinking Water Regulations (40 CFR 143).
Note: NA - not applicable.
Source: NT DOE 1992e.

from the Ash Meadows Subbasin and 298 MGY were withdrawn from the Alkali Flat Furnace Creek Ranch Subbasin (figure 4.3.2.4–1). The pumping capacity for all the water supply wells at NTS is estimated at 3.9 BGY (NTS 1993a:6).

The State of Nevada strictly controls all groundwater and surface water withdrawals. The Appropriation Doctrine governs the acquisition and use of water rights. However, it is an established principle that when land is withdrawn from public use and reserved for a Federal purpose, the Government's right to appurtenant water may be implied. NTS has been withdrawn from public use and thus possesses an unquantified water right sufficient to meet the purposes of NTS land withdrawal, subject to water rights that existed at the time land for NTS was withdrawn.

Since the Federal Government has not waived its sovereign immunity with respect to Nevada's well drilling laws, it is not subject to these requirements. While DOE is not legally required to follow Nevada water appropriation and well drilling requirements, there is no objection to responding to requests for information and cooperating in other respects with the Nevada Division of Water Resources as a matter of comity.

4.3.2.5 *Geology and Soils*

Geology. NTS is located in the southern part of the Great Basin section of the Basin and Range Province in an intermediate position between the high, topographically closed basins in central Nevada and the low, connected basins of the Amargosa Desert-Death Valley region to the southwest. NTS consists of three flats (Yucca, Jackass, and Frenchman) surrounded by mountains (NT DOE 1988a).

The general region has been tectonically active in the near past and has numerous faults. NTS lies in an area of moderate historic seismicity on the southern margin of the Southern Nevada East-West Seismic Belt in Seismic Zones 2 and 3 (figure 4.3.2.5–1). Since about 1848, more than 4,000 earthquakes have been recorded within a 150-mile radius of NTS. Most of these were minor events with Richter magnitudes of less than 5.5. The largest event on record, which took place 100 miles west in Owens Valley, CA, had an estimated magnitude of 8.3. In 1992, an earthquake of magnitude 5.6 occurred in the southwest corner of the site under Little Skull Mountain. The maximum acceleration from this earthquake was approximately 0.21g at Amargosa Valley.

The Yucca and Carpetbag faults were active during the Late Quarternary and both are considered to be capable faults within the definition of 10 CFR 100, Appendix A. The Yucca fault has undergone surface rupture within the past few thousand to tens of thousands of years. Some earthquakes can be directly associated with the fault trace and also beyond the south end of the mapped section in the Yucca Pass, suggesting that the fault may continue in that direction. No significant vertical surface displacement has occurred on the Carpetbag fault system during the past 150,000 years, but there is evidence of episodes of fracturing and possible minor faulting from 30,000 to 240,000 years ago with average recurrence interval at about 25,000 years, for the last 125,000 years. The Carpetbag fault has been mapped in the subsurface beyond the southern end of Yucca Basin and may project to the northeast of the proposed TSS. Possible magnitude, intensity, and acceleration of earthquakes along the Yucca and Carpetbag faults have not been estimated.

The Cane Spring fault, which lies approximately 5 miles southeast of the proposed TSS, does not show Holocene displacement but is thought to have been the source of a magnitude 4.3 earthquake in 1971. The maximum credible earthquake associated with the Cane Spring fault is expected to produce a peak acceleration of 0.67g with a 6.7 magnitude (NT LANL 1983a:1-202, 1-205). The recurrence interval is estimated at 10,000 to 30,000 years.

The most recent volcanic activity in the immediate area was 3.7 million years ago, and the likelihood for renewed activity in the next 10,000 years is slight (NT LANL 1983a). NTS lies approximately 150 miles southeast of the Long Valley area of California, an area of potential volcanic eruption of the Mount St. Helens type.

Soils. Soil studies have been performed at NTS. Studies in adjacent areas have divided soils into three major types: shallow soils developed in the uplands and mountains; soils on valley fill and nearly level to moderately sloping outwash plains, alluvial fans, and fan aprons; and playas and soils on nearly level flats

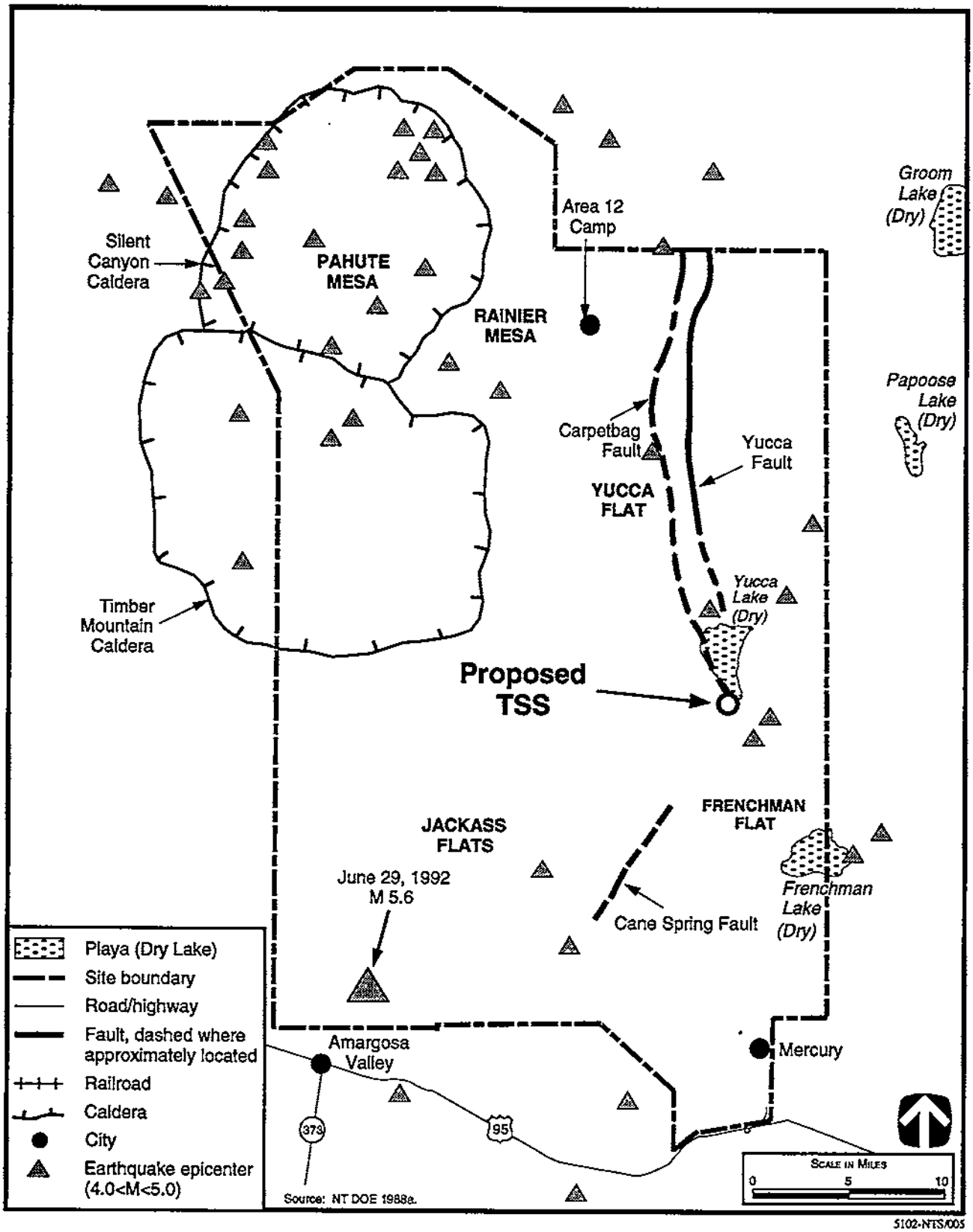


FIGURE 4.3.2.5–1.—*Major Fault Systems, and Historic Earthquakes in Nevada Test Site Region.*

and basins. Possible erosion hazards range from slight-to-severe while the shrink-swell potential ranges from low-to-high for these soils. The potential for wind erosion and shrink-swell increases into the playas and basins. The potential for water erosion increases with increasing slope. The soils at NTS are considered acceptable for standard construction techniques.

4.3.2.6 *Biotic Resources*

The following describes biotic resources at NTS including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. Within each biotic resource area the discussion focuses first on NTS as a whole and then on the proposed TSS. Scientific names of species identified in the text are presented in appendix C. Also presented in appendix C is a list of threatened and endangered species that may be found on the site or in the vicinity of NTS.

Terrestrial Resources. NTS lies in a transition area between the Mojave and Great Basin deserts. As a result, flora and fauna characteristic of both deserts are found within the site boundaries (NT ERDA 1976a:34). Approximately 13 square miles of NTS have been developed, which represents less than 1 percent of the site; thus, natural plant communities are found across most of NTS (NT DOE 1988d:3,4, 6,7). The site has been divided into nine major communities as shown in figure 4.3.2.6–1.

Of the communities present onsite, the mountains, hills and mesas, sagebrush, creosote bush, and hopsage-desert thorn communities are the most extensive. Saltbush and desert thorn communities occupy more limited areas adjacent to the playas in Frenchman and Yucca Flats. Introduced plants such as red brome, cheatgrass, and Russian thistle have become important species in some areas. These plants rapidly invade disturbed areas and delay revegetation of areas by native species. A total of 711 taxa of vascular plants have been identified on or near NTS.

Terrestrial wildlife found on NTS includes 33 species of reptiles, 220 species of birds, and 49 species of mammals. Species common to NTS include the side-blotched lizard, western shovel-nosed snake, black-throated sparrow, red-tailed hawk, Merriam's kangaroo rat, and Great Basin pocket mouse. Water holes, both natural and man-made, are important to many species of wildlife, including game animals such as pronghorn and mule deer (NT Greger nda). Hunting is not permitted anywhere on NTS. Raptors and carnivores are two ecologically important groups and are represented by species such as the turkey vulture and rough-legged hawk, and long-tailed weasel and bobcat, respectively (NT ERDA 1976a:53,58). A variety of migratory birds has been found onsite. Migratory birds, their nests and eggs are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Vegetative communities within the proposed TSS include: creosote bush, hopsage-desert thorn, and mountains, hills, and mesas (figure 4.3.2.6–1). Fauna found in the proposed TSS is expected to be closely associated with Mojave desert fauna and species could include the banded gecko, desert iguana, Gambel's quail, roadrunner, round-tailed ground squirrel, and coyote (NT ERDA 1976a:47,48,56).

Wetlands. National Wetland Inventory maps have not been prepared, nor have wetlands been delineated on the site. However, small wetland areas (less than 1 acre) may be associated with site springs (NTS 1992a:5). There are no known wetlands in the proposed TSS.

Aquatic Resources. Potential aquatic habitat includes surface drainages, playas, springs, and man-made reservoirs. There are no continuously flowing streams on the site and permanent surface water sources are limited to a few small springs. These surface drainages, playas, and springs are unable to support permanent fish populations (NT ERDA 1976a:47). Man-made construction water reservoirs located throughout the site support three introduced species of fish: bluegill, goldfish, and golden shiners (NTS 1992a:6). There are no known aquatic resources in the proposed TSS.

Threatened and Endangered Species. Twenty-four Federal- and state-listed threatened, endangered, and other special status species have been identified in the vicinity of NTS (appendix table C–3). Seventeen have been observed on NTS (table 4.3.2.6–1). The remaining species, listed in appendix C, are transient

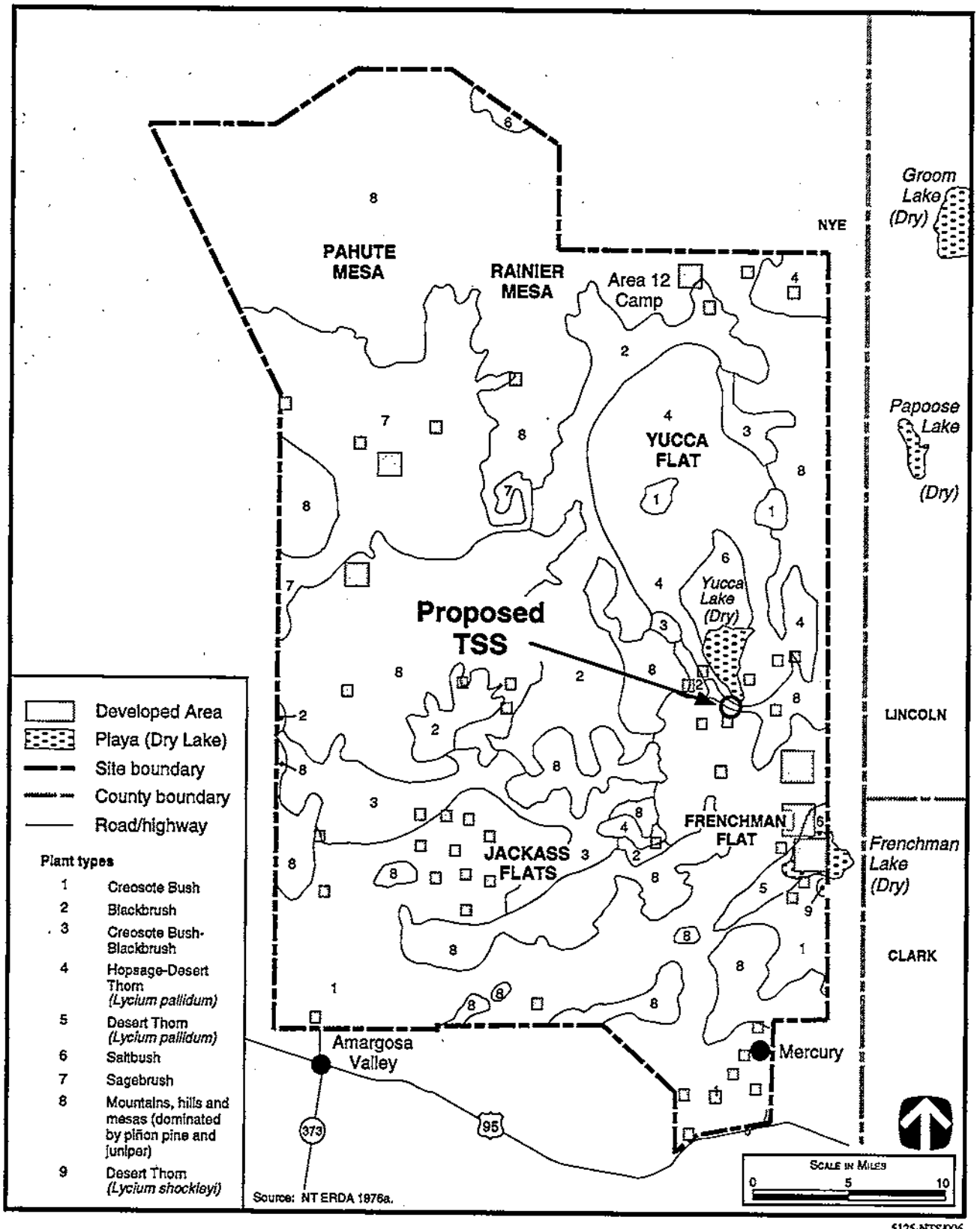


FIGURE 4.3.2.6–1.—*Distribution of Plant Communities at Nevada Test Site.*

species which may occur during migration. No critical habitat for threatened or endangered species, as defined in the *Endangered Species Act* (50 CFR 17.11; 50 CFR 17.12), exists on NTS.

The peregrine falcon has been recorded, but the threatened desert tortoise is the only resident species known to inhabit NTS that is protected under the *Endangered Species Act.* The range of the desert tortoise lies in the southern third of NTS. These tortoises are most commonly found in the areas shown on figure 4.3.2.6–1. Further surveys may reveal other areas of concentration. The abundance of tortoises is considered low to very low relative to other areas within this species' geographic range. The proposed TSS is located near one of the areas having the highest relative number of desert tortoise on NTS. Both tortoise remains and scat have been observed in the proposed site area (NT EG&G 1991a:14,15,31). Densities of tortoises range from 0 to 45 individuals per square mile, with most habitats probably having densities of 0 to 20 individuals per square mile (NT DOE 1991b:3-23).

The only known population of the Devil's Hole pupfish lives in a single, spring-fed sinkhole pool in Ash Meadows, approximately 34 miles southwest of the proposed TSS. There is concern over the

TABLE 4.3.2.6–1.—*Federal- and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found On the Site or In the Vicinity of the Proposed Tritium Supply Site at Nevada Test Site*

Species	Status[a]		Known or Potential Habitat/Location
	Federal	State	
Birds			
Ferruginous hawk	C2	NL	Woodland/grassland
Loggerhead shrike	C2	NL	Most habitats
Mountain plover	C2	NL	Semi-arid plains, grasslands, plateaus
Peregrine falcon[b]	E	E	Open country, cliffs
Western snowy plover	C2	NL	Sand flats
White-faced ibis	C2	NL	Migrant visitor to ponds
Reptiles			
Desert tortoise[c]	T	T	Mojave desert biome
Fish			
Devils Hole pupfish[b, d]	E	E	Deep limestone pool, Devil's Hole
Plants			
Beardtongue	C2	NL	Open area, loose soil
Beatley milkvetch	C1	CE	Shallow gravelly soil in open flat volcanic bedrock
Beatley phacelia	C2	NL	Gravel/volcanic tuff, canyon washes, steep barren slopes
Black wooly-pod	C2	NL	Unstable, steep gravelly slopes of volcanic tuff
Camissonia megalantha	C2	NL	Shad scale, disturbed soil
Green-gentian	C2	NL	Gravelly slopes and valley bottoms
Kingston bedstraw	C2	NL	Ravines, gulleys
Mojave fishhook cactus	NL	CY	Yucca Mountain area
White bear desert-poppy	C2	NL	Shallow gravelly soil, limestone outcrop

[a] Status code: C1 - candidate, Category 1 (appropriate for protection); C2 - candidate, Category (possibly appropriate for protection); CE - critically endangered by authority of NRS 527.270 (State Division of Forestry); CY - protected by authority of NRS 522.60-.120 (Nevada Cacti and Yucca Law); E - endangered; NL - not listed; T - threatened.

[b] USFWS Recovery Plan exists for this species.

[c] Species known to occur in proposed TSS.

[d] Only known location of this species is outside NTS 24 miles southwest of Mercury.

Source: 50 CFR 17.11; 50 CFR 17.12; 55 FR 6184; 56 FR 58804; NT DOE 1991b; NT DOE 1991c; NT FWS 1989a; NT FWS 1991a; NT Greger 1992a; NT SAIC 1991a; NTS 1990a:1: NTS 1990a:2.

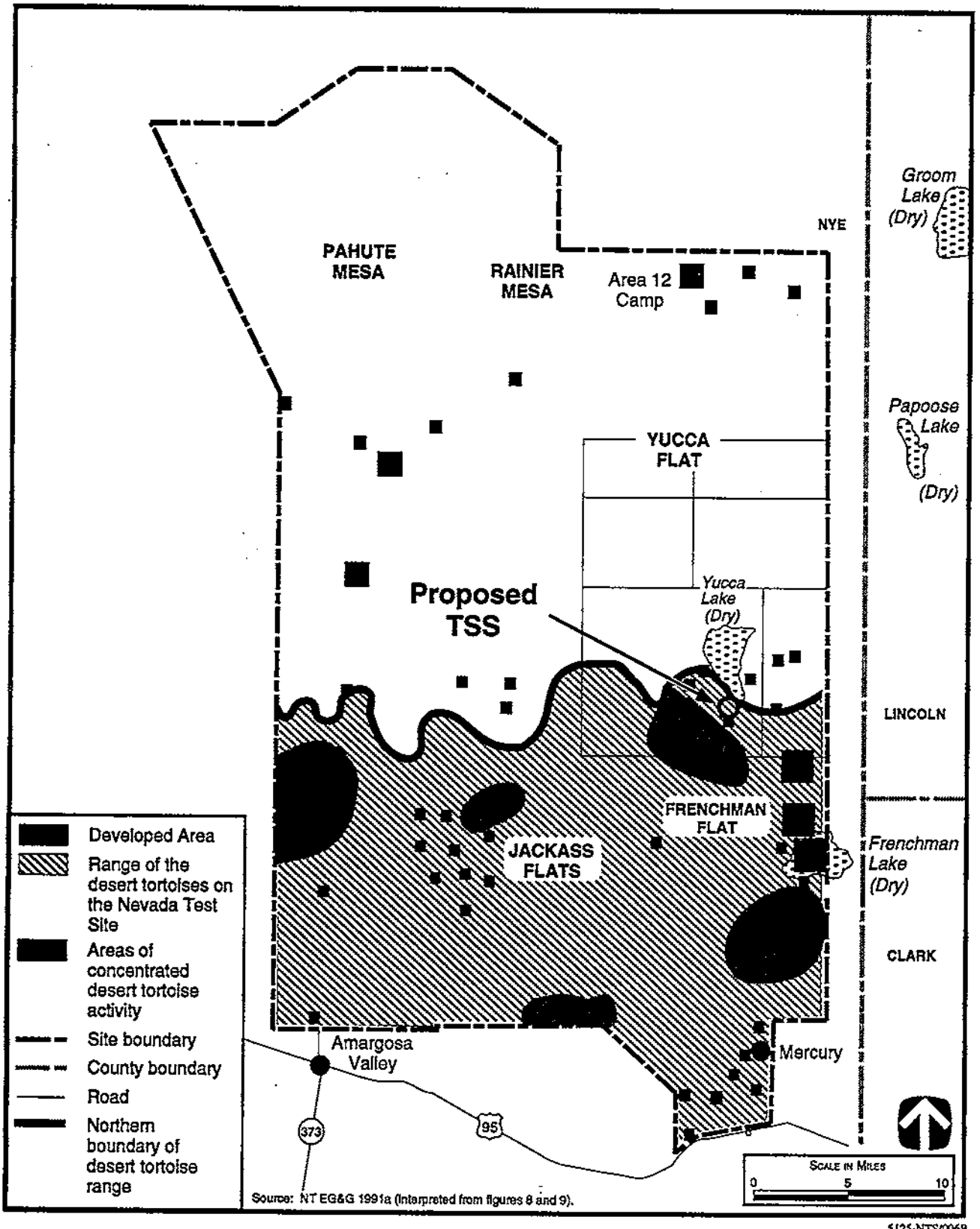


FIGURE 4.3.2.6–2.—***Distribution of Desert Tortoise at Nevada Test Site.***

survival of the pupfish and other sensitive species found in the Ash Meadows area due to the threat of declining water levels (NT DOI 1991a; NT ERDA 1977a:2-134,2-135,4-28,4-29). Twenty-nine sensitive plant species also have been identified. Eight of these species are Federal candidates for listing (table 4.3.2.6–1). Five Federal candidate animal species have been recorded on NTS. The loggerhead shrike is a permanent resident that breeds on NTS. The ferruginous hawk is a winter resident species observed onsite in recent years. The white-faced ibis, mountain plover, and western snowy plover have also been observed onsite. Occurrence of these species in the proposed TSS is unknown.

4.3.2.7 *Cultural and Paleontological Resources*

Prehistoric Resources. Prehistoric site types identified on NTS include habitation sites with wood and brush structures, windbreaks, rock rings, or cleared areas; rockshelters; petroglyphs (rock art); hunting blinds; rock alignments; quarries; temporary camps; milling stations; roasting ovens or pits; water caches; and limited activity locations. Approximately 4 percent of NTS has been inventoried for cultural resources. This includes all lands managed through a Memorandum of Agreement with Nellis Air Force Base. Excluding sites in the Yucca Mountain project area, 916 prehistoric sites and 34 prehistoric/historic sites have been recorded and recommended as eligible for inclusion in the NRHP. The Nevada SHPO has concurred that 82 prehistoric sites and 1 prehistoric/historic site are eligible.

Cultural resources surveys and site evaluations have been conducted in the vicinity of the proposed TSS. Numerous prehistoric sites have been recorded including lithic scatters, temporary camps, and milling stations. Milling stations are especially prevalent in proximity to the Yucca Lake playa margins. Several prehistoric rockshelters have been identified on Hogback Ridge. Additional prehistoric sites may occur in unsurveyed portions of the proposed TSS. These sites have not been evaluated for NRHP eligibility.

Historic Resources. Historic site types include mines and prospects, trash dumps, settlements, campsites, ranches, homesteads, spring developments, trails, and roads. Nuclear test site structures and associated debris, including instrumentation stands and temporary storage bunkers, are also located within NTS. The test site area at Frenchman Flat, which includes the remains of many of these structures, has been recommended to the SHPO as a historic district. Excluding the Yucca Mountain project area, 32 historic sites have been recorded and recommended as eligible for the NRHP. The Nevada SHPO concurred that two historic sites are eligible. The only site currently listed on the NRHP is the Sedan Crater. The crater, located in Yucca Flat, was created in 1962 as part of the Plowshare Program, whose aim was to identify peaceful uses for nuclear explosions.

In the vicinity of the proposed TSS, some historic sites have been recorded including refuse scatters. Additional historic sites may occur in unsurveyed portions. These sites have not been evaluated for NRHP eligibility.

Native American Resources. At the time of Euro-American contact, southern Nevada was inhabited by the Western Shoshone and Southern Paiute. Families foraged in small groups from the spring through the fall. During winter, relatively stable villages of several families were established in relatively warm places, close to caches of pine nuts, seeds, and dried meats.

Native American resources include burials, ceremonial sites, musical stones, medicine rocks, petroglyphs, and traditional use areas. Local plants important in ritual and ceremonial activities include jimsonweed, juniper, greasewood, creosote, Indian tobacco, piñon pine, buckbush, and scrub oak. Concern has been expressed about the availability and accessibility of such resources. It is worth noting that many natural resources at NTS are viewed as cultural resources by Native Americans. As one example, sagebrush is used as a tool, and for clothing and medicinal purposes.

Consultation with Native American cultural and religious leaders has been conducted for other projects at or near NTS to identify traditional cultural resources that may be affected by Federal actions, and to obtain Native American recommendations for mitigating potential adverse impacts on traditional cultural resources. DOE has established ongoing consultation with 13 Native American tribes and one pan-tribal organization (the Owens Valley Board of Trustees) with cultural ties to NTS.

Paleontological Resources. The surface geology of NTS is characterized by alluvium-filled valleys surrounded by ranges composed of Paleozoic sedimentary rocks and Tertiary volcanic tuffs and lavas. The Pre-Cambrian and Paleozoic rocks at NTS represent relict deposits made in shallow water at the submerged edge of a continental platform which ran from Mexico to Alaska and existed throughout most of the Paleozoic. Although the Pre-Cambrian sedimentary deposits contain no fossils or only a few poorly-preserved fossils, the Paleozoic marine limestones are moderately to abundantly fossiliferous. Marine fossils found in the same Paleozoic formations on Nellis Air Force Range, adjacent to NTS to the north, include trilobites, conodonts, ostracods, solitary and colonial corals, brachiopods, algae, gastropods, and archaic fish. These fossils, however, are relatively common and have low research potential.

Tertiary volcanic deposits are not expected to contain fossils; however, the Late Pleistocene terrestrial vertebrate fossils of the Rancholabrean Land Mammal Age could be expected in the Quaternary deposits. The possibility of finding mammoth, horse, camel, and bison remains might be expected because such fossils have been found at Tule Springs, 35 miles from the southern edge of NTS and in Nye Canyon. Fossils found at Tule Springs include bison, deer, a small donkey-like horse, camel, Columbia mammoth, ground sloth, giant jaguar, bobcat, coyote, muskrat, and a variety of rabbits, rodents, and birds. This paleontological assemblage has high research potential. Although Quaternary deposits with paleontological materials may occur on NTS, no known fossil localities have been recorded to date.

Other Pleistocene resources include pack rat middens, which are studied by scientists at the University of Nevada, Reno, the Desert Research Institute, and New Mexico Tech, to investigate paleoclimatic regimes. Pack rat middens would not be expected to be found at the proposed TSS, which is located on an alluvial fan.

4.3.2.8 *Socioeconomics*

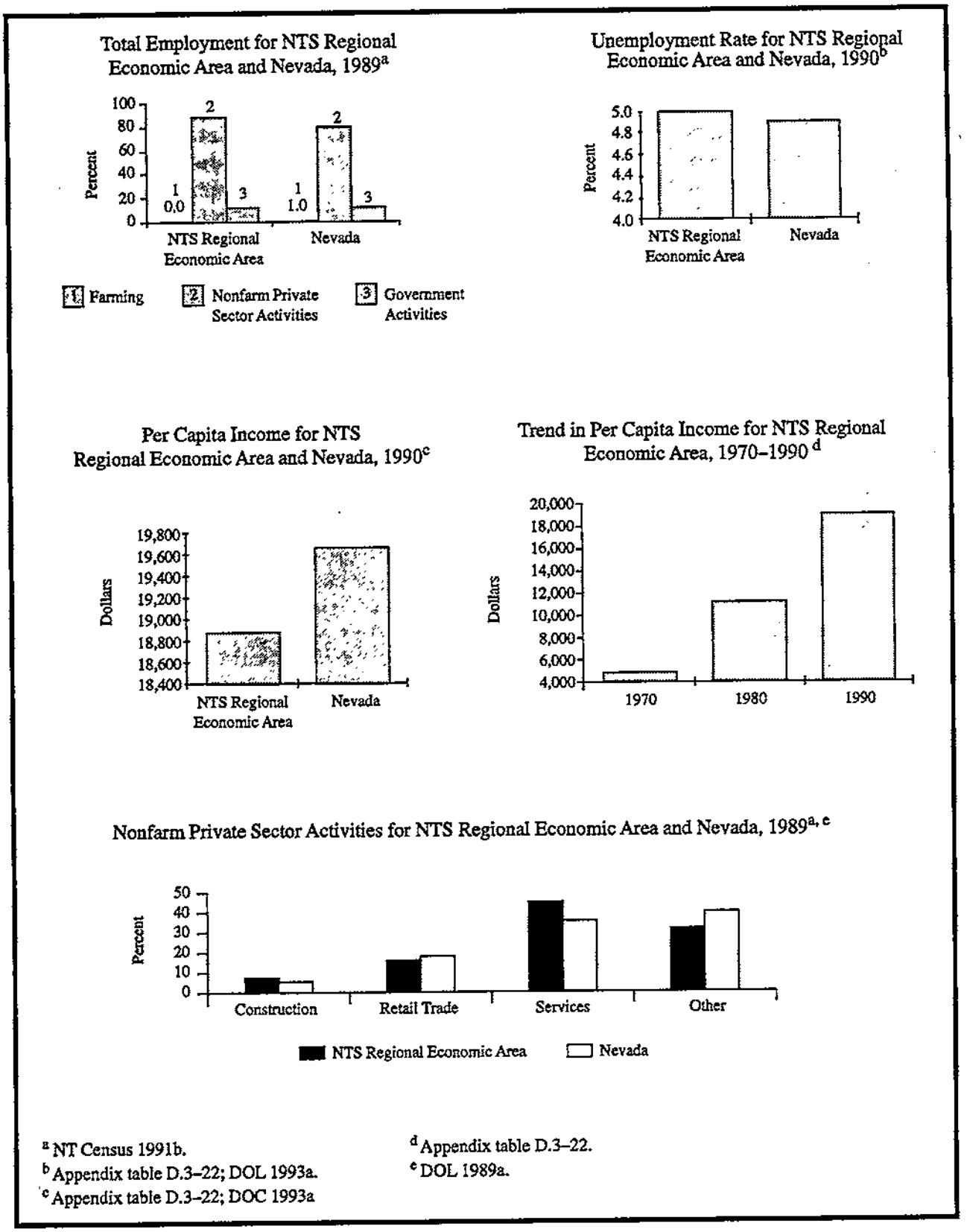
Socioeconomic characteristics addressed at NTS include employment and local economy, population, housing, public finance, and local transportation. Statistics for economy characteristics are presented for the regional economic area that encompasses 4 counties around NTS (appendix table D.2.1–2). The regional economic area is a broad labor and product market-based region linked by trade among economic sectors within the region. Statistics for population and housing, public finance, and local transportation are presented for the ROI, a 2-county area in which 97 percent of all NTS employees reside: Clark County (82 percent) and Nye County (15 percent). (See figure 4.3–1 for a map of counties and cities.) Fiscal characteristics of the jurisdictions in the ROI are presented in the public finance section in appendix tables D.3–31 and D.3–32. The school districts most likely to be affected by the proposed action include those in Clark County and Nye County. Assumptions, assessment methodologies, and supporting data are presented in appendix D.

Regional Economy Characteristics. Employment and local economy statistics for the NTS regional economic area are presented in appendix table D.3–22, and summarized in figure 4.3.2.8–1. Between 1970 and 1990, the civilian labor force in the regional economic area increased 220 percent. The unemployment rate in the regional economic area in 1990 was approximately the same as the state rate. The 1990 per capita income in the regional economic area was also approximately the same as the State of Nevada.

As shown in figure 4.3.2.8–1, the percentage of total employment involving farming, governmental activities, and nonfarm private sector activities of manufacturing, retail trade, and services was similar in the regional economic area and the state.

In 1990, NTS employed 8,019 persons (2.1 percent of the total regional economic area employment), increasing from 6,840 persons in 1970. Historical and future employment at NTS and the distribution of NTS employees by place of residence in the ROI are presented in appendix tables D.2.1–1 and D.3–21, respectively.

Population and Housing. Population and housing distribution in the ROI is presented in appendix tables D.3–25 and D.3–28, and summarized in figure 4.3.2.8–2. The percent increase in population in the ROI from 1970 to 1990 was 26 percent greater than that of the state except for the city of Henderson which experienced a 300-percent increase. The percent increase in housing units between 1970 and 1990 was approximately 50 percent greater than the



[a] NT Census 1991b.
[b] Appendix table D.3–22; DOL 1993a.
[c] Appendix table D.3–22; DOC 1993a
[d] Appendix table D.3–22.
[e] DOL 1989a.

FIGURE 4.3.2.8–1.—***Economy for Nevada Test Site Regional Economic Area.***

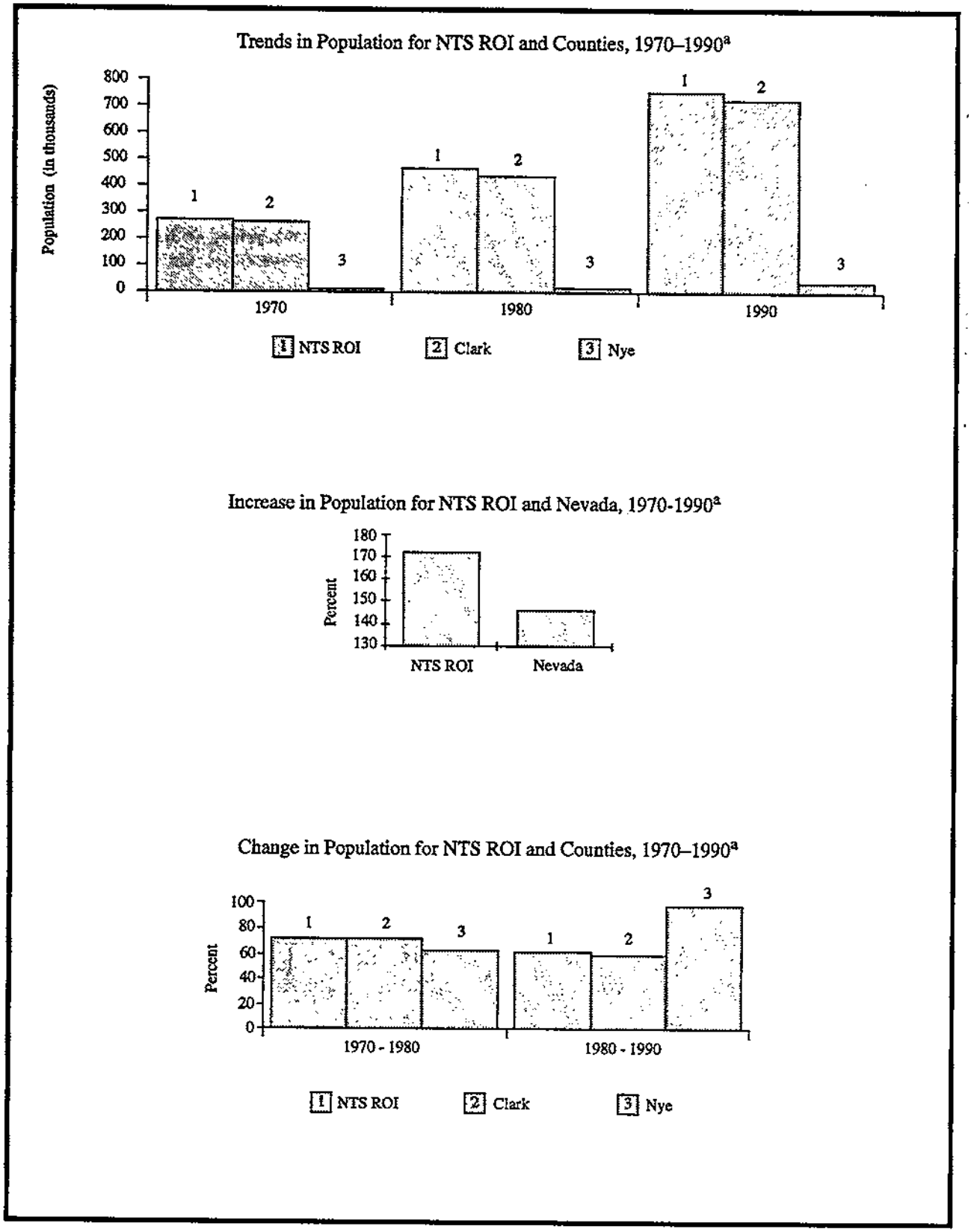
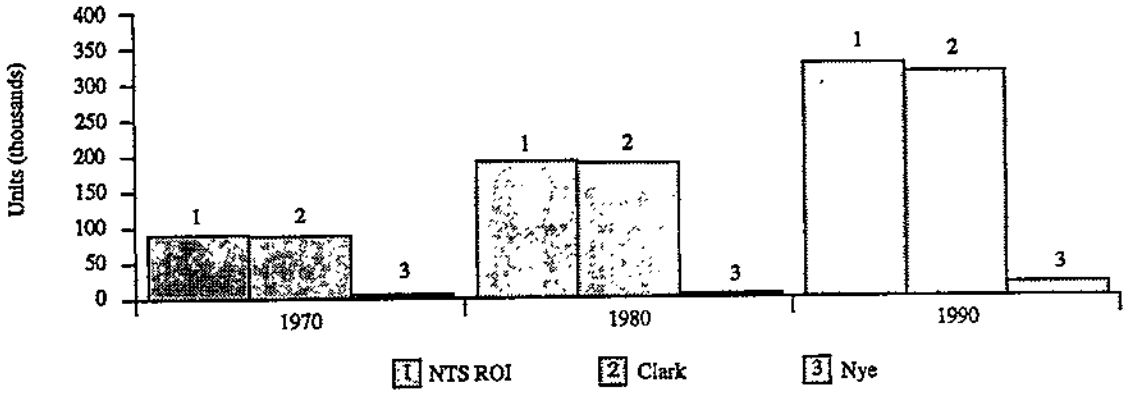
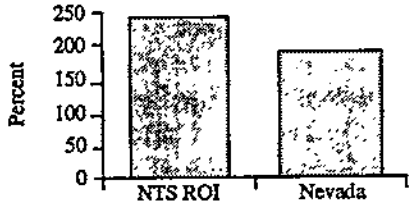


FIGURE 4.3.2.8–2.—*Population and Housing for Nevada Test Site Region of Influence* [Page 1 of 2].

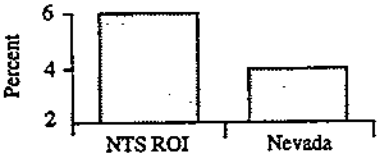
Trends in Housing for NTS ROI and Counties, 1970–1990[a]



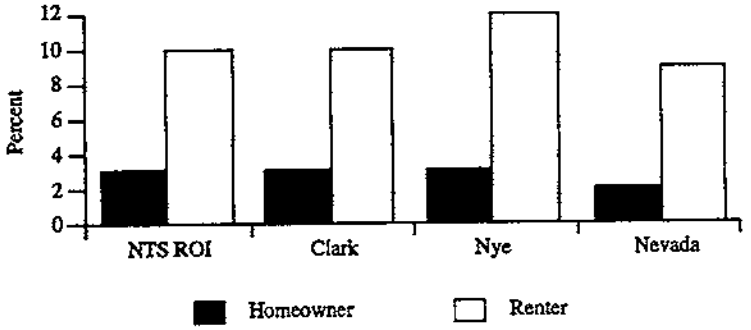
Increase in Housing for NTS ROI and Nevada, 1970-1990[b,c]



Annual Average Increase in Housing for NTS ROI and Nevada, 1970-1990[b,c]



Homeowner and Renter Vacancy Rate for NTS ROI, Counties, and Nevada, 1990[c]



[a] Appendix table D.3–25.
[b] Appendix table D.3–28.
[c] Census 1972a; Census 1982a; NT Census 1991a.

FIGURE 4.3.2.8–2.—*Population and Housing for Nevada Test Site Region of Influence* **[Page 2 of 2].**

percent increase for the state, with the exception of the city of Henderson (400-percent increase). Homeowner and rental vacancy rates in the ROI in 1990 were similar to those experienced by the state.

Public Finance. Financial characteristics of the local jurisdictions in the ROI that are most likely to be affected by the proposed action are presented in this section. The data reflect total revenues and expenditures of each jurisdiction's general fund, special revenue funds, and, as applicable, debt service, capital project, and expendable trust funds. School district boundaries may or may not coincide with county or city boundaries, but the districts are presented under the county where they primarily provide services. Major revenue and expenditure fund categories for counties, cities, and school districts are presented in appendix tables D.3–31 and D.3–32, and figure 4.3.2.8–3 summarizes local government's revenues less its expenditures.

Local Transportation. Vehicular access to NTS is provided by U.S. Route 95 (divided highway) to the south with off-road access to the northeast provided via State Route 373 (figure 4.3–1). Road segments providing access to NTS traffic experience little traffic congestion outside of the Las Vegas metropolitan area. Traffic on U.S. Route 95 generally experiences greater congestion than traffic on State Route 373. Minor congestion may occur due to accidents and maintenance activities. No major improvements are scheduled for those segments providing immediate access to NTS (figure 4.3.1–1) (NT DOT 1992a).

Although there is no public transportation system serving NTS, a contract bus service is available for all workers at a nominal cost. The major railroad in the ROI is the Union Pacific Railroad located approximately 50 miles east of NTS near the city of Las Vegas. A 9-mile, standard gauge railroad serves Area 25 of NTS but does not connect with the Union Pacific Railroad (NT ERDA 1977a). There are no navigable waterways within the ROI.

McCarran International Airport located in the city of Las Vegas provides jet air passenger and cargo service from both national and local carriers. Numerous smaller private airports are located throughout the ROI (DOT 1991a).

4.3.2.9 *Radiation and Hazardous Chemical Environment*

The following provides a description of the radiation and hazardous chemical environment at NTS. Also included are discussions of health effects studies, emergency preparedness considerations, and an accident history.

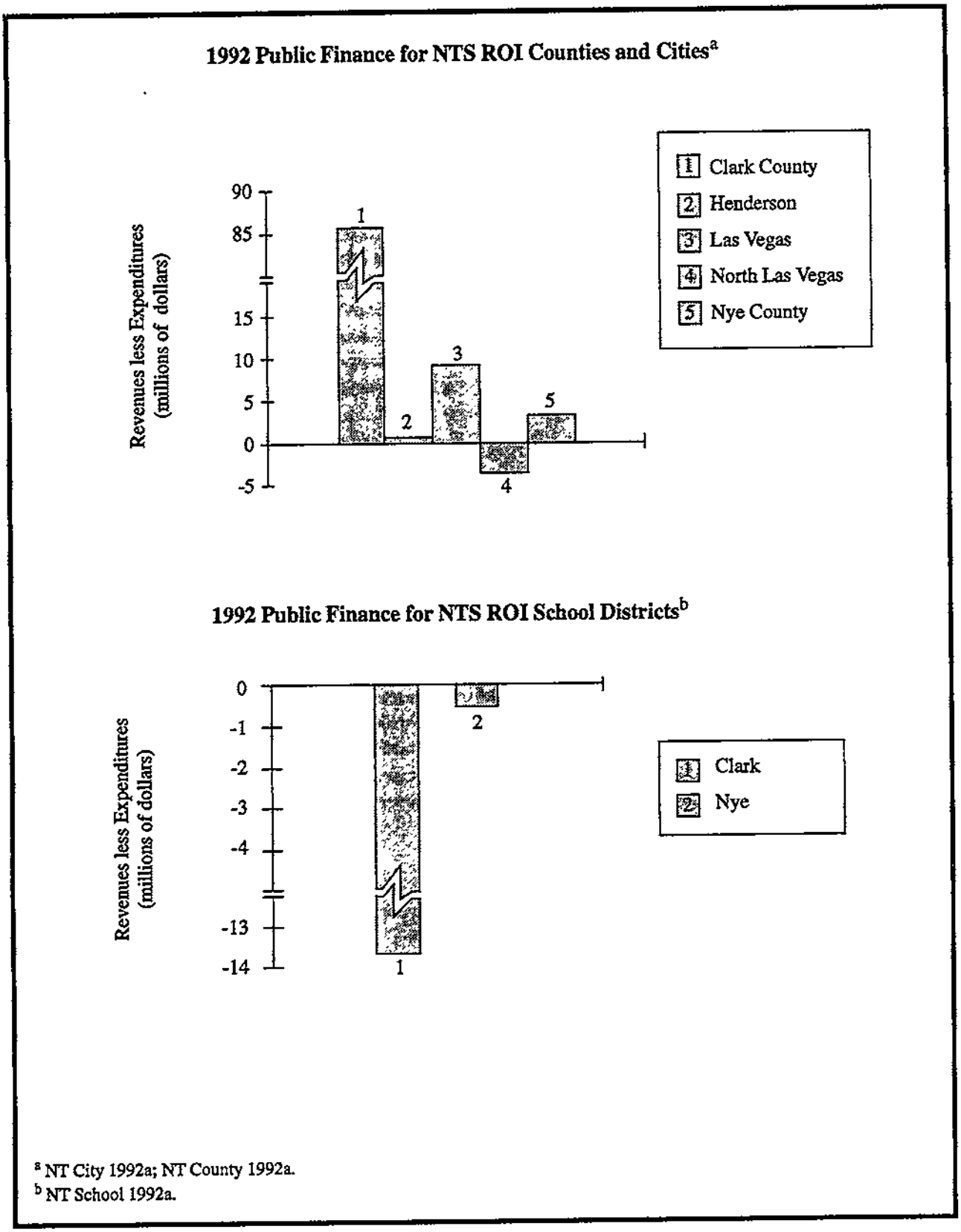
Radiation Environment. Major sources of background radiation exposure to individuals in the vicinity of NTS are shown in table 4.3.2.9–1. All annual doses to individuals from background radiation are expected to remain constant over time. Accordingly, the incremental total dose to the population would result only from changes in the size of the population. Background radiation doses are unrelated to NTS operations.

Releases of radionuclides to the environment from NTS operations provide another source of radiation exposure to individuals in the vicinity of NTS. The radionuclides and quantities released from NTS operations in 1992 are listed in the *U.S. Department of Energy Nevada Operations Office Annual Site Environment Report-1992* (DOE/NV/10630-66). The doses to the public resulting from these releases

TABLE 4.3.2.9–1.—*Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Nevada Test Site Operations*

Source	Committed Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic and external terrestrial radiation	78
Internal terrestrial radiation[b]	39
Radon in homes (inhaled)[b]	200
Other Background Radiation[b]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	382

[a] NT DOE 1993e. Value for radon is an average for the United States.
[b] NCRP 1987a.



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FIGURE 4.3.2.8–3.—*1992 Local Government Public Finance for Nevada Test Site Region of Influence.*

are presented in tables 4.3.2.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1992 report were used in the development of the reference environment (No Action) radiological releases at NTS in 2010 (section 4.3.3.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (appendix section E.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from NTS operations in 1992 is estimated to be approximately 1.3×10^{-8}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of NTS operations is about 13 chances in 1 billion. (Note that it takes several to many years from the time of exposure to radiation for a cancer to manifest itself.)

Approximately 1.5×10^{-5} excess fatal cancers were estimated from normal operations in 1992 to the population living within 50 miles of NTS. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a). Based on this national rate, the number of fatal cancers from all causes expected during 1992 in the population living within 50 miles of NTS was 43.5. This number of expected fatal cancers is much higher than the estimated 1.5×10^{-5} fatal cancers that could result from NTS operations in 1992.

Workers at NTS receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 4.3.2.9–2 includes the average, maximum, and total occupational doses to NTS workers from operations in 1992. These doses fall within radiological limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (appendix section E.2), the number of excess fatal cancers to NTS workers from operations in 1992 is estimated to be 0.0008.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *U.S. Department of Energy Nevada Operations Office Annual Site Environment Report-1992* (DOE/NV/10630-66). The concentrations of radioactivity in various environmental media (e.g., air and water) and in animal tissue in the site region (onsite and offsite) are also presented in the same reference. NTS operations contribute negligible radioactivity to these media.

Chemical Environment. The background chemical environment important to human health consists of: the atmosphere, which may contain toxic chemicals that can be inhaled; drinking water, which may contain toxic chemicals that can be ingested; and other environmental media with which people may

TABLE 4.3.2.9–2.—*Doses to the General Public from Normal Operation at Nevada Test Site, 1992 (committed effective dose equivalent)*

Affected Environment	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual[b]	Standard[a]	Actual[b]	Standard[a]	Actual
Maximally exposed individual (mrem)	10	0.026	4	0.0	100	0.026
Population within 50 miles[c] (person-rem)	None	0.029	None	0.0	100	0.029
Average individual within 50 miles[d] (mrem)	None	0.0013	None	0.0	None	0.0013

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem per year limit from airborne emissions is required by the *Clean Air Act*, the 4 mrem per year limit is required by the *Safe Drinking Water Act*, and the total dose of 100 mrem per year is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 58 FR 16268 (10 CFR 834). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] NT DOE 1993e.

[c] In 1992, this population was approximately 21,750.

[d] Obtained by dividing the population dose by the number of people living within 50 miles of the site.

TABLE 4.3.2.9–3.—*Doses to the Worker Onsite from Normal Operation at Nevada Test Site, 1992 (committed effective dose equivalent)*

Affected Environment	Onsite Releases and Direct Radiation	
	Standard[a]	Actual[b]
Average worker (mrem)	None	2.6
Maximally exposed worker (mrem)	5,000	750
Total workers (person-rem)	None	2

[a] 10 CFR 835. DOE's goal is to maintain radiological exposure as low as reasonably achievable.

[b] DOE 1993n:7. The number of badged workers in 1992 was approximately 780.

come in contact (e.g., soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in sections 4.3.2.3 and 4.3.2.4.

Health impacts to the public can be minimized through effective administrative and design controls for decreasing pollutant releases to the environment and achieving compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations via inhalation of air containing pollutants released to the atmosphere by NTS operations. Risks to public health from other possible pathways such as ingestion of contaminated drinking water or direct exposure are low relative to the inhalation pathway.

Baseline air emission concentrations for hazardous/toxic air pollutants and their applicable standards are presented in section 4.3.2.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous/toxic chemicals is presented in appendix section E.3, with risk assessment specific for NTS presented in appendix tables E.3.4–9, E.3.4–11, E.3.4–12, and summary table E.3.4–14.

Health impacts to workers during normal operation may include those from: inhalation of the workplace atmosphere, drinking NTS potable water, and possible other contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. NTS workers are also protected by adherence to occupational standards that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Monitoring ensures that these standards are not exceeded. Additionally, DOE requirements (DOE Order 3790.1B) ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at NTS are expected to be substantially better than required by standards.

Health Effects Studies. The epidemiologic studies surrounding NTS have concentrated on health effects in soldiers and children associated with nuclear testing rather than operation emissions. Results are contradictory regarding the observed leukemia incidence and deaths in exposed children, with some studies reporting excess whereas others report no excess. There were questions raised about the analytical methods used in some of these studies. For soldiers, the results regarding leukemia and polycythemia vera were different between two studies relating to nuclear test explosions, but reanalyses showed leukemia, respiratory, and other cancers to be associated only with exposure to higher doses (e.g., more than 300 mrem for leukemia cases). For a more detailed description of the study findings reviewed, refer to appendix section E.4.3.

Accident History. Nuclear testing began at NTS in 1951. There were some 100 atmospheric nuclear explosions before the Limited Test Ban Treaty was implemented in 1963. Since then, all nuclear tests have been conducted underground (appendix section A.1.2).

Since 1970, there were 126 nuclear tests which resulted in a release to the atmosphere of approximately 54,000 Ci of radioactivity. Of this amount,

11,500 Ci were accidental due to containment failure (massive releases or seeps) and late-time seeps (seeps are small releases after a test when gases diffuse through pore spaces of the overlying rock). The remaining 42,500 Ci were operational releases. From the perspective of human health risk, if the same person had been standing at the boundary of NTS in the area of maximum concentration of radioactivity for every test since 1970, that person's total exposure would be equivalent to 32 extra minutes of normal background exposure or the equivalent of one-thousandth of a single chest x-ray (OTA 1989a).

Emergency Preparedness. In the event of an accident, each DOE site has established an emergency management program. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response. Section 4.1.9 provides a description of DOE's emergency preparedness program.

The NTS Emergency Preparedness Plan is designed to minimize or mitigate the impact of any emergency upon the health and safety of employees and the public. The plan integrates all emergency planning into a single entity to minimize overlap and duplication, and to ensure proper responses to emergencies not covered by a plan or directive. The manager of the Nevada Operations Office has the responsibility to manage, counter, and recover from an emergency occurring at NTS.

The plan provides for identification and notification of personnel for any emergency that may develop during operational and nonoperational hours. The Nevada Operations Office receives warnings, weather advisories, and any other communications that provide advance warning of a possible emergency. The plan is based upon current Nevada Operations Office vulnerability assessments, resources, and capabilities regarding emergency preparedness.

4.3.2.10 *Waste Management*

This section outlines the major environmental regulatory structure and ongoing waste management activities for NTS. A more detailed discussion of the ongoing waste management operations is provided in appendix section H.2.2. Table 4.3.2.10–1 presents a summary of waste management at NTS for 1991.

The Department is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at NTS. The Department is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed upon milestones.

DOE has decided that underground testing areas should be governed pursuant to the provisions of CERCLA. Preliminary Assessment/Site Investigation reports and a Hazardous Ranking System package were provided to EPA for their use in determining whether NTS should be included on the NPL. In May 1993, the State of Nevada issued a letter to DOE indicating it did not appear that EPA would make a decision on the NPL status of NTS in the near future. EPA is also drafting a two-party agreement between the State of Nevada and DOE. The State of Nevada and DOE are negotiating a Federal Facility Compliance Agreement addressing environmental restoration and waste management on NTS. An Agreement in Principle has been signed with the State of Nevada to provide oversight of environmental, safety, and health activities, including environmental restoration. However, the Agreement in Principle is not a legally binding document and does not provide mandates or drivers to accomplish environmental restoration.

For 1991, the Nevada Operations Office completed a Waste Minimization Plan for NTS and created an organization with the mission to promote waste minimization and pollution prevention and to ensure compliance with DOE requirements. NTS currently generates waste from ongoing operations and remediation associated with past activities, and receives waste from other DOE facilities. NTS manages the following waste categories: TRU, LLW, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

Spent Nuclear Fuel. NTS does not generate or manage spent nuclear fuel.

TABLE 4.3.2.10–1.—*Waste Management at Nevada Test Site*

Category	1991 Generation (yd^3)	Treatment Method	Treatment Capacity	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity (yd^3)
Transuranic[a]	None	None	None	Containers on asphalt pads	10,850[b]	None–WIPP in the future	NA
Mixed Transuranic[a]	None	None	None	Included in TRU	Included in TRU	None–WIPP in the future	NA
Low-level							
Liquid	Included in solid	Evaporation/ solidification[c]	29,700[d] (6,000,000 GPY)	Double-lined holding tanks	5,500[d] (1,100,000 gal)	NA	None[e]
Solid	12,914[f]	None	None	None	None	Shallow burial	643,300
Mixed Low-level							
Liquid	None	Evaporation/ solidification[g] and offsite incineration	29,700[d] (6,000,000 GPY)	Double-lined holding tanks	5,500[d] (1,100,000 gal)	NA	None
Solid	None	None	None	None	None	Pit	155,530
Hazardous							
Liquid	Included in solid	None	Planned	NA	None	NA	NA
Solid	124[h]	None	None	90-day pad	388	Contracted offsite	NA
Nonhazardous (Sanitary)	10,200[i]	None	None	None	None	Landfill (onsite)	Expandable as required as of November 1994, 600,000 yd^3 available
Nonhazardous (Other)	108,253	None	None	None	None	Landfill (onsite)	Expandable as required

[a] All TRU waste at NTS is considered to be mixed until further characterization is completed.
[b] 800 yd^3 (LLNL waste) stored pending WIPP availability.
[c] Evaporation ponds planned for treatment and storage.
[d] Capacity for either LLW or mixed LLW.
[e] 534 yd^3 was previously disposed.
[f] Includes 12,592 yd^3 from offsite.
[g] Lined lagoons or tanks planned for Liquid Waste Treatment System.
[h] Includes 9 yd^3 TSCA waste.
[i] Assumes 1,755 lb/yd^3.

Source: DOE 1992f; DOE 1993c; DOE 1993f; NT DOE 1993d; NT DOE 1993f; NT MMES 1993a; NT REECO 1994a; NTS 1993a:4.

High Level Waste. NTS does not generate or manage HLW.

Transuranic Waste. From 1974 to 1990, 800 yd^3 of mixed TRU waste was received from LLNL and is stored at Area 5 of NTS (NT DOE 1993f:37). DOE and the State of Nevada signed a Settlement Agreement on July 23, 1992, allowing the Nevada Operations Office to retain this inventory of mixed TRU waste subject to an appropriate permitting process. Since that time, TRU waste has been characterized and repackaged and the mixed TRU waste has been placed in a RCRA-permitted storage area. However, these wastes were repackaged before RCRA characterization requirements were imposed on NTS. None of these waste packages are WIPP certified. They would be recertified prior to shipment to WIPP. These wastes will continue to be stored at this area until WIPP is determined to be a suitable disposal facility pursuant to the requirements of 40 CFR 191 and 40 CFR 268, or another suitable repository is found. If WIPP is suitable, no further treatment is required prior to disposal. NTS has areas of plutonium-contaminated soil, for which treatment technology is being developed. This activity probably would produce additional volumes of TRU or mixed TRU waste.

Low-Level Waste. LLW has been generated and disposed of in eight areas at NTS, but currently only Areas 3 and 5 are active for treatment, storage, and disposal. Bulk waste is disposed of in Area 3, and packaged classified and unclassified waste is disposed of in Area 5. Disposal of onsite waste began in 1971 and in 1978 operations expanded to receive wastes generated offsite. The offsite generators are currently revising their procedures to meet NTS waste acceptance criteria. As of December 1993, approximately 276,000 yd^3 of LLW have been disposed of in Area 3 (NT DOE 1993f:C-3) and approximately 219,900 yd^3 in Area 5 (NT REECO 1994a:12). Standard shallow land burial techniques have been employed.

Mixed Low-Level Waste. Disposal of mixed LLW received from Rocky Flats Environmental Technology Site (formerly known as the Rocky Flats Plant) has taken place at NTS. This mixed waste disposal at NTS ceased pending issuance by the State of Nevada of a RCRA Part B permit for NTS. Environmental restoration could generate additional volumes of mixed wastes which will require some form of treatment. The Nevada Division of Environmental Protection provides RCRA oversight for NTS. The 1992 revised RCRA Part B permit application to include a separate mixed waste storage and disposal unit at NTS, in accordance with the provisions of the *Federal Facility Compliance Act* of 1992, has been submitted to the State of Nevada.

Hazardous Waste. Hazardous wastes result from ongoing operations that utilize solvents, lubricants, fuel, lead, metals, motor oil, and acids. Hazardous wastes are accumulated at satellite areas and shipped offsite to a commercial RCRA-permitted facility. Additional accumulation areas are planned, and new equipment is planned to prevent the possibility of cross contamination with radioactive wastes (creating mixed wastes) in handling these materials. Hazardous wastes generation is decreasing as the result of an aggressive waste minimization program and will substantially decrease in the future due to the present moratorium on nuclear testing.

Nonhazardous Waste. Nonhazardous sanitary wastes are expected to be generated at the current rate for several years into the future, then decline assuming the present moratorium on underground weapons testing continues. Liquid nonhazardous wastes are disposed of in septic tanks, sumps, or in ponds, and solid wastes are disposed of in landfills at various locations onsite. Recycling of paper, metals, glass, plastics, and cardboard has already resulted in some decreases in waste quantities.

4.3.3 Environmental Impacts

This section describes the environmental impacts of constructing and operating various tritium supply technologies and recycling facilities at NTS which are described in sections 3.4.1 and 3.4.2.1. It begins by describing potential impacts to existing and planned facilities at NTS, followed by descriptions of potential impacts and the environmental impacts of the proposed action on potentially affected environmental resources. The section concludes by describing the potential impacts of tritium supply and recycling on human health during normal operation and radiation and hazardous chemical accidents, and waste management impacts. Each description addresses the effects of No Action and the potential impacts and environmental impacts of constructing and operating a tritium supply and collocated recycling facility or a tritium supply facility alone at NTS.

4.3.3.1 *Land Resources*

Construction and operation of a tritium supply technology and recycling facilities at NTS would affect land resources, including land use and visual resources. Potential impacts to the land resources are summarized below.

NTS has sufficient land area to accommodate any of the proposed tritium supply technologies and recycling facilities. The nearest offsite boundary to the proposed 600-acre TSS is 3.5 miles east and exceeds the requirement of a 1-mile buffer zone between plant operations and site boundary. The construction and operation of any of the tritium supply technologies would not change the existing landscape character at NTS. The following sections present the impacts of the proposed action on land resources.

Land Use

No Action. Under No Action, no additional land use impacts are anticipated at NTS beyond the effects of existing and future activities which are independent of the proposed action.

Tritium Supply and Recycling. Any one of the tritium supply technologies and collocated tritium recycling facilities (section 3.4) or tritium supply alone could be sited within the proposed TSS (figure 4.3.2.1–1). Land requirements for the tritium facilities are presented in table 4.3.3.1–1. The land area affected ranges from 360 acres for the MHTGR to 173 acres for the APT. An additional 196 acres would be required if the tritium supply facility is collocated with a new recycling facility. Construction and operation of the tritium supply and collocated recycling facilities or the tritium supply alone would be consistent with the NTS Site Development Plan, and would not affect prime farmland, grazing allotments, other agricultural activities, or other land uses on the site. Land requirements during construction and operation would be largest for the MHTGR and the least for APT.

No tritium facilities would be constructed offsite, so offsite land use would not be directly affected. Land is available within the region and could be converted to residential developments to house workers. Such developments would be subject to local land use controls and zoning ordinances, which vary by jurisdiction.

TABLE 4.3.3.1–1.—*Potential Changes to Land Use Resulting from Tritium Supply Technologies and Recycling at Nevada Test Site*

	Tritium Supply Technologies and Recycling				
Indicator	HWR	MHTGR	ALWR[a]	APT[b]	Tritium Recycling
Land requirements[c] (acres)	260	360	350	173	196
Available land[d,e] (percent)	0.3	0.4	0.4	0.2	0.2

[a] Land requirements for both Large and Small ALWR are the same.
[b] Land requirements for both Full and Phased APT are the same.
[c] Land area requirements are estimated to be the same for construction and operation.
[d] Undeveloped land reserved for development is approximately 100,000 acres.
[e] Any land requirement less than 100 percent means sufficient land.
Source: DOE 1992s; DOE 1994a; FDI 1993d; FDI 1994a; FDI 1994b; SNL 1993a.

Less Than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced capacity to meet a tritium supply requirement less than baseline, or the construction and operation of a Phased APT would not change potential baseline tritium requirement land use impacts. Land requirements would be the same in both operation scenarios.

Multipurpose Reactor. The land requirements for the multipurpose MHTGR and ALWR (sections 4.8.3.2 and 4.8.3.3) with recycling would be 925 and 675 acres, respectively. The site requirements for both the multiurpose MHTGR and ALWR exceed the 600-acre TSS study area; however, the proposed TSS is in an area where the additional land requirements would not result in potential conflicts with site land use or development plans. The 925 and 675 acres represent less than 1 percent of the undeveloped available land reserved for development at NTS. Construction and operation of the mulitpurpose MHTGR or ALWR would not affect prime farmland, grazing allotments, other agricultural activities, or other land uses on the site.

Potential Mitigation Measures. Because proposed facilities would be sited within a designated development area consistent with the NTS Site Development Plan, no mitigation measures are proposed.

Visual Resources

No Action. Under No Action, the existing landscape character would remain unchanged, with the Bureau of Land Management VRM Class 2 for the undisturbed desert areas and Class 4 (mixed use of industrial and open desert) for the main base.

Tritium Supply and Recycling. Construction and operation of any of the proposed tritium supply technologies collocated with tritium recycling or tritium supply alone would change the visual baseline of the proposed TSS from VRM Class 2 to Class 5. Of the tritium supply technologies, the APT would be less visually obstructive because of the low-profile buildings and cooling system (figure 3.4.2.4–1). Depending on final siting, the facilities could be visible from the Wilderness Study Area portion of the Desert National Wildlife Range (refuge), approximately 10 to 13 miles away. This is a sensitive viewpoint. Because nonevaporative cooling systems are proposed for all reactor technologies at NTS, there would be little visual impact from plumes.

Less Than Baseline Operations. Baseline visual impacts would not change due to operation of the HWR, MHTGR, or ALWR at reduced tritium capacity or the construction and operation of a Phased APT.

Potential Mitigation Measures. Mitigation measures could include siting the facilities so that views from the Desert National Wildlife Range are blocked by terrain (Massachusetts Mountain); and the use of architectural and landscape design and materials for the proposed facilities that would blend with, or complement, the existing landscape. Siting would be addressed in site-specific tiered NEPA documents.

4.3.3.2 *Site Infrastructure*

This section discusses site infrastructure for No Action and the modifications needed for actions due to construction and operation of new tritium supply and recycling facilities. A primary impact upon NTS due to the additional tritium facilities is the increase electrical power usage. A comparison of site infrastructure and facilities resource needs for No Action and the proposed tritium supply alternatives is presented in table 4.3.3.2–1.

No Action. The missions discussed in section 3.3.3 would continue under No Action. As shown in table 4.3.3.2–1, the site infrastructure would continue to adequately maintain the capability to resume underground nuclear testing in the event it is again required for national security. Facility improvements around the site would continue in a staged manner through 2014; however, overall operations would not increase. A 100 MW solar facility will be constructed as part of the Nevada Solar Enterprise Zone.

Tritium Supply and Recycling. For those potential tritium supply technologies and recycling facilities that could be sited in the proposed TSS, the electrical power loads range from 62 MWe to 566 MWe (table 4.3.3.2–2). The power requirements of the HWR, MHTGR, ALWR, and APT each would require additional high-voltage transmission lines to be run from Las Vegas, NV, and electrical distribution and transmission equipment onsite. The alternatives would utilize between 0.53 and 4.79 percent of

TABLE 4.3.3.2–1.—*Modifications to Site Infrastructure for Tritium Supply Technologies and Recycling at Nevada Test Site*

Alternative	Transportation		Electrical		Fuel[a]		
	Roads (miles)	Railroads (miles)	Energy (MWh/yr)	Peak Load (MWe)	Oil[b] (GPY)	Natural Gas (million ft^3/yr)	Coal (tons/yr)
Current Resources	400	0	168,500	35	1,510,000	0	0
No Action							
Total site requirement	400	0	168,500	28	1,510,000	0	0
Change from current resources	0	0	0	-7	0	0	0
Heavy Water Reactor							
Total site requirement	402	60	796,500	113	3,267,000	0	0
Change from current resources	2	60	628,000	78	1,757,000	0	0
Modular High Temperature Gas-Cooled Reactor							
Total site requirement	402	60	616,500	90	1,726,500	0	0
Change from current resources	2	60	448,000	55	216,500	0	0
Large Advanced Light Water Reactor							
Total site requirement	402	60	1,356,500	184	1,806,000	0	0
Change from current resources	2	60	1,188,000	149	296,600	0	0
Small Advanced Light Water Reactor							
Total site requirement	402	60	836,500	119	1,716,000	0	0
Change from current resources	2	60	668,000	84	206,000	0	0
Full Accelerator Production of Tritium							
Total site requirement	404	0	3,996,500	594	1,619,200	0	0
Change from current resources	4	0	3,828,000	559	109,200	0	0
Phased Accelerator Production of Tritium							
Total site requirement	404	0	2,656,500	399	1,619,200	0	0
Change from current resources	4	0	2,488,000	364	109,200	0	0

[a] Oil is the primary utility fuel at NTS and all of the tritium supply and recycling fuel requirements have been converted to oil equivalents; coal is assumed to be 14,000 British thermal units per pound, natural gas is assumed to be 1,000 British thermal units per ft^3, and fuel oil (8 lb/gal) is assumed to be 19,000 British thermal units per pound.

[b] Includes all petrochemicals.

Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; SNL 1995a; NTS 1993a:4.

the California-Southern Nevada Power Area subregional power pool capacity margin and between 0.21 and 1.95 percent of the Western Systems Coordinating Council Region power pool capacity margin. The additional power for the MHTGR could be supplied by the local Nevada Power Company. The HWR and ALWR would require the Nevada Power Company to obtain additional power from the California-Southern Nevada Power Area Subregion. The APT might require the California-Southern Nevada Power Area Subregion to import more power from the Region. In all cases, approximately 25 miles of new connecting transmission lines from the Mercury area would be needed to provide power to the TSS. The tritium recycling facility conceptual design uses natural gas as a fuel source with an annual requirement of 7 million ft^3. This natural gas requirement is equivalent to approximately 46,000 gallons of fuel oil. Currently, NTS does not use natural gas; therefore, the equivalent amount of fuel oil is used for determining fuel impacts.

To connect the NTS road network with the TSS, approximately 2 miles of additional secondary access roads would be required for the HWR, MHTGR, and ALWR. The APT would need approximately 4 additional miles of secondary access roads. Interconnection requirements for the tritium facilities within the TSS are not expected to change appreciably when specific site adaptations are completed.

TABLE 4.3.3.2–2.— *Impacts on Subregional Electrical Power Pool from Tritium Supply Technologies and Recycling at Nevada Test Site*

Tritium Supply Technology and Recycling	Peak Power Required (MWe)	Margin Capacity (percent)	Annual Energy Required (MWh)	Total Electricity Production (percent)
Heavy Water Reactor	85	0.72	628,000	0.26
Modular High Temperature Gas-Cooled Reactor	62	0.53	448,000	0.18
Large Advanced Light Water Reactor	156	1.32	1,188,000	0.48
Small Advanced Light Water Reactor	91	0.77	668,000	0.27
Full Accelerator Production of Tritium	566	4.79	3,828,000	1.56
Phased Accelerator Production of Tritium	371	3.14	2,488,000	1.01

Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; NERC 1993a; SNL 1995a; NTS 1993a:4.

Should a rail connection be needed, the required minimum length of new rail and railbed would be approximately 120 miles. This would connect the TSS with a Union Pacific rail line.

Tritium Supply Alone. If any of the tritium supply technologies are sited at the TSS without collocating tritium recycling, the electrical power loads associated with the technologies would decrease by 16 MWe or 88,000 MWh. Even with these smaller electrical loads, the HWR and ALWR would still require that the Nevada Power Company obtain additional power from the California-Southern Nevada Power Area. Similarly, the APT would still require the California-Southern Nevada Power Area to import more power via the Western Systems Coordinating Council. The fuel oil requirement (including the equivalent fuel oil requirement attributed to natural gas usage) would decrease by approximately 96,000 gallons.

Less Than Baseline Operations. In the event that only the steady state component of the baseline tritium requirement is required, the impacts for some tritium supply technologies on the site infrastructure would change. There would be no appreciable change for the HWR, MHTGR, and ALWR technologies. The Phased APT would reduce electrical consumption by approximately 35 percent but the fuel, onsite transportation infrastructure, and power line requirements would not change.

Multipurpose Reactor. The MHTGR or the ALWR multipurpose reactor option described in section 4.8.3 could be sited at NTS. The site infrastructure impacts would vary depending on the technology.

The MHTGR multipurpose reactor option would require construction of the Pit Disassembly/Conversion Facility described in section 4.8.3.1 along with three additional MHTGR reactor modules. Fabrication of the plutonium oxide fuel could be accomplished in the fuel fabrication facility already included in the tritium supply MHTGR design. Operation of this facility along with the six module MHTGR multipurpose reactor would increase the total site electrical requirement by about 373,000 MW per year (55 percent) and the total site fuel requirement by about 651,000 GPY (16 percent) over that for operation of the three module tritium supply MHTGR.

The ALWR multipurpose reactor option would require construction of the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility described in section 4.8.3.1. Operation of this facility along with the ALWR multipurpose reactor would increase the total site electrical requirement by about 20,000 MWh per year (less than 2 percent) and the total site fuel requirement by about 830,000 GPY (20 percent) over that for operation of the tritium supply ALWR.

Accelerator Production of Tritium Power Plant. A dedicated gas-fired power plant at NTS to provide the necessary power for the APT could be constructed (see section 4.8.2.2). This would decrease the annual amount of electricity required to be purchased from commercial sources by up to 3,740,000 MWh per year for the Full APT and 2,400,000 MWh for the Phased APT. The planned 100 MWe solar power source at NTS could be expanded to 500 MWe, or a combination of solar and natural gas plants totalling 500 MWe could be constructed. For environmental impacts analysis the 500 MWe gas-fired plant

requirements are discussed here. Although NTS now has no natural gas supply, a pipeline could be installed within existing rights-of-way. This gas-fired plant would require 54,200 million ft^3 per year of natural gas to provide the Full APT requirement of 3,740,000 MWh per year and 34,800 million ft^3 per year of natural gas to provide the Phased APT requirement of 2,400,000 MWh per year. If the 100 MWe solar power source was expanded to 500 MWe, additional powerlines would have to be constructed onsite.

Potential Mitigation Measures. Redesign of the tritium recycling facilities to use oil as a fuel alternative to designs which rely on natural gas and coal would preclude building new natural gas lines from offsite sources and both onsite and offsite infrastructure for coal.

Siting of new roads, railroad spurs, and utility infrastructure could follow existing rights-of-way to minimize impacts to natural resources. Where new rights-of-way would need to be constructed, alignments should consider existing sensitive habitat (e.g., wetlands, streams, and vegetation) to minimize the potential for impacting these resources.

4.3.3.3 *Air Quality and Acoustics*

Construction and operation of a tritium supply and recycling facility at NTS would generate criteria and toxic/hazardous pollutants that have the potential to exceed Federal and state ambient air quality standards and guidelines. To determine the air quality impacts, criteria and toxic/hazardous concentrations from each technology have been compared with Federal and state standards and guidelines. Impacts for radiological airborne emissions are discussed in section 4.3.3.9.

In general, all of the proposed technologies would emit the same types of air pollutants during construction. Emissions would typically not exceed Federal, state, or local air quality regulations or guidelines, except that PM_{10} concentration may be close to or exceed the 24-hour PM_{10} standard during peak construction periods, which is not uncommon for large construction projects.

During operation, impacts from each of the tritium supply technologies and recycling facilities with respect to the concentrations of toxic/hazardous air pollutants are predicted to be in compliance with Federal, state, and local air quality regulations or guidelines. The estimated pollutant concentrations presented in table 4.3.3.3–1 for each of the tritium supply technologies and recycling facilities indicate little difference between technologies with respect to impacts to air quality.

The Prevention of Significant Deterioration regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modifications to existing sources. Based on the emission rates presented in appendix table B.1.4–2, Prevention of Significant Deterioration permits may be required for each of the proposed alternatives at NTS. This may require "offsets," reductions of existing emissions, to permit any additional or new emission source.

Noise emissions during either construction or operation are expected to be low. Air quality and acoustic impacts for each technology are described separately. Supporting data for the air quality and acoustics analysis, including modeling inputs, are presented in appendix B.

Air Quality

An analysis was conducted of the potential air quality impacts of emissions from each of the tritium supply technologies and recycling facilities. The air quality modeling analysis used the Industrial Source Complex Short-Term model recommended by EPA. The resulting air quality conditions were evaluated against local and state air quality regulations, and NAAQS (40 CFR 50). The potential exceedance of Prevention of Significant Deterioration (40 CFR 52.21) increments for PM_{10}, SO_2, or NO_2 was also determined.

No Action. No Action utilizes estimated air emissions data from operations in the year 2010 assuming continuation of site missions as described in section 3.3.2. These data reflect conservative estimates of criteria and toxic/hazardous emissions at NTS. The emission rates for the criteria and toxic/hazardous pollutants for No Action are presented in appendix table B.1.4–2. Table 4.3.3.3–1 presents the No Action concentrations. Pollutant concentrations are in compliance with all air quality

TABLE 4.3.3.3–1.—*Estimated Cumulative Concentrations of Pollutants Resulting from Tritium Supply Technologies and Recycling Including No Action at Nevada Test Site*

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	2010 No Action ($\mu g/m^3$)	Tritium Supply Technologies and Recycling				
				HWR ($\mu g/m^3$)	MHTGR ($\mu g/m^3$)	ALWR ($\mu g/m^3$)	APT ($\mu g/m^3$)	Tritium Recycling ($\mu g/m^3$)
Criteria Pollutant								
Carbon monoxide (CO)	8-hour	10,000	2,306	2,343	2,432	2,353	2,321	15
	1-hour	40,000	2,816	2,972	3,344	3,012	2,876	61
Lead (Pb)	Calendar Quarter	1.5	[a]	[a]	[a]	[a]	[a]	[a]
Nitrogen dioxide (NO_2)	Annual	100	4	5	8	8	4	0.5
Ozone (O_3)	1-hour	235	a	a	a	a	a	a
Particulate matter (PM_{10})[b]	Annual	50	2	3	2	2	2	0.1
	24-hour	150	104	107	106	106	105	1.4
Sulfur dioxide (SO_2)	Annual	80	2	2	2	2	2	0.01
	24-hour	365	59	59	59	60	59	0.1
	3-hour	1,300	216	219	218	221	217	0.8
Mandated by Nevada								
Hydrogen sulfide	1-hour	112	[a]	[a]	[a]	[a]	[a]	[a]
Hazardous and Other Toxic Compounds								
Acetone	8-hour	42,381	[a]	[a]	[a]	6.5	[a]	[a]
Acetylene	8-hour	[c]	[a]	2.1	2.1	2.1	2.1	2.1
Ammonia	8-hour	429	[a]	[a]	[a]	3.4	[a]	[a]
Ethyl alcohol	8-hour	45,238	[a]	0.8	0.8	0.8	0.8	0.8
Methane	8-hour	[c]	[a]	2.1	2.1	2.1	2.1	2.1
Methyl alcohol	8-hour	6,190	[a]	0.8	0.8	0.8	0.8	0.8
Nitric acid	8-hour	119	[a]	3.9	[a]	45.2	[a]	a
1,1,1-Trichloroethane	8-hour	45,238	[a]	0.7	0.2	14.9	[a]	a
Trichlorotrifluoroethane	8-hour	18,095	[a]	27.4	[a]	[a]	[a]	a

[a] No sources indicated.

[b] It is conservatively assumed that all PM_{10} concentrations are TSP concentrations.

[c] There is no standard.

Concentrations for tritium supply and recycling include 2010 No Action concentrations. To determine the concentrations of pollutants from each tritium supply technology, subtract the pollutant concentration for tritium recycling from each of the tritium supply and recycling concentrations.

Note: DOE is committed to the phaseout of ozone-depleting substances and will discontinue use of those substances according to EPA phaseout schedules.

Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; SNL 1995a; NT NAC 1991a; NTS 1993a:4.

regulations and guidelines. It is conservatively assumed that PM_{10} concentrations are equal to TSP concentrations. The air quality at NTS in 2010 is expected to improve in comparison to the baseline air quality presented in section 4.3.2.3.

Tritium Supply and Recycling. Alternatives for NTS consist of four candidate technologies: HWR, MHTGR, ALWR, and APT alone or collocated with tritium recycling facilities. Air pollutants would be emitted during construction of the tritium supply technologies and recycling facilities. The principal sources of such emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and operation of a concrete batch plant.

- Exhaust from, and road dust raised by, construction equipment, vehicles delivering construction material, and vehicles carrying construction workers.

PM_{10} concentration is expected to be close to or exceed the 24-hour ambient standard during the peak construction period. Exceedances would be expected to occur during dry and windy conditions. Appropriate control measures would be followed, such as watering to reduce emissions. With the exception of PM_{10}, it is expected that concentrations of all other pollutants at the NTS boundary would remain within applicable Federal and state ambient air quality standards.

Air pollutant emission sources associated with the operation of each of the technologies include all or part of the following:

- Increased operation of existing boilers to generate additional steam for space heating.

- Operation of diesel generators and periodic testing of emergency diesel generators.

- Recycling operations.

- Exhaust from, and road dust raised by, vehicles delivering supplies and bringing employees to work.

Appendix table B.1.4–2 presents emissions from each of the proposed tritium supply technologies and recycling facilities. There are no gaseous releases associated with the APT, although emissions are associated with operation of the tritium supply facility included with the APT and with recycling facilities (SNL 1995a). Emissions from the Large ALWR were used to determine pollutant concentrations since these represent the maximum emission rates from either the Large or Small ALWR. Consequences from operation of each of the tritium supply technologies and recycling facilities at NTS are presented in table 4.3.3.3–1. Pollutant concentrations, combined with No Action concentrations, are in compliance with Federal and state standards.

Pollutant emissions resulting from the operation of tritium supply technologies alone (HWR, MHTGR, ALWR, and APT) consist of criteria pollutants from the operation of boilers and diesel generators and toxic/hazardous pollutant emissions from facility processes. Criteria pollutant emissions from the MHTGR are the highest among the other tritium supply technologies and would increase existing total site criteria pollutant emissions by greater than 50 percent above No Action emissions. Concentrations of criteria and toxic/hazardous pollutants, added to No Action concentrations, are in compliance with Federal and State standards.

Less Than Baseline Operations. Air emissions from the HWR would be reduced slightly when operated at reduced capacity. However, the reduction would be negligible since most emissions are attributed to support equipment and facilities that are not related to the reactor operating level. The MHTGR or ALWR would have no change in air emissions because it would continue to operate at the same level as the baseline requirement to maintain power levels for steam or electrical production. The Phased APT construction and operation emissions and impacts would be the same as the Full APT.

Accelerator Production of Tritium Power Plant. Operation of a 500 to 600 MWe natural gas electric generating facility (section 4.8.2.2) would generate a substantial amount of emissions consisting of sulfur dioxide, particulate matter, nitrogen oxides, carbon monoxide, and volatile organic compounds.

These emissions would be controlled using the best available control technology to minimize impacts and comply with the NAAQS and state mandated emission standards. Estimated emissions are based upon emission factors for a large controlled gas turbine (EPA 1995a; SPS 1995a). Table B.1.3.1-3 presents the emission factors and resulting annual emission rates for a 600 MWe natural gas-fired turbine power plant.

For a natural gas-fired power plant located at NTS, the increase in carbon monoxide emissions with respect to the 2010 No Action emissions at NTS would be approximately 1,507 percent (75 tons per year); for nitrogen oxides the increase would be approximately 766 percent (314 tons per year); for particulate matter the increase would be approximately 690 percent (179 tons per year); for sulfur dioxide the increase would be approximately 27 percent (5 tons per year). In addition, the gas turbine generating facility would generate 215 tons per year of volatile organic compounds, 126 tons per year of methane, 58 tons per year of ammonia, 29 tons per year of nonmethane hydrocarbons, and 24 tons per year of formaldehyde.

Any power plant facility constructed to meet the power needs of the APT would be required to meet the Federal NAAQS and state mandated regulations for toxic/hazardous pollutants. Appropriate pollution control equipment would be incorporated into the design of that facility to meet these standards.

Potential Mitigation Measures. Potential mitigation measures during construction include: watering to reduce dust emissions; applying non-toxic soil stabilizers to all inactive construction areas; cover, water, or apply non-toxic soil binders to exposed piles (i.e., gravel, sand, and dirt); suspend all excavation and grading operations when wind speeds warrant; pave construction roads that have a traffic volume of more than 50 daily trips by construction equipment; and using electricity from power poles rather than temporary gasoline and diesel power generators. Potential mitigation measures during operation include incorporating additional HEPA filters to reduce particulate emissions from processing facilities; substituting cleaning solvents for those which present health hazards or exceed the applicable standards; and switching from coal or fuel oil, to produce electricity or steam, to natural gas to reduce criteria pollutants.

Acoustics

The location of the tritium supply technologies and recycling facilities relative to the site boundary and sensitive receptors was examined to determine the contribution to noise levels at these locations and the potential for onsite and offsite impacts.

No Action. The continuation of operations at NTS would result in no appreciable change in traffic noise and onsite operational noise sources from current levels (section 4.3.2.3). Sources of nontraffic noise associated with current operations are located at sufficient distances from offsite noise sensitive receptors that the contribution to offsite noise levels would continue to be small.

Tritium Supply and Recycling. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along major offsite transportation routes used to bring construction material and workers to the site.

Most nontraffic noise sources associated with operation of any of the tritium supply technologies and recycling facilities would be located at sufficient distance from offsite areas and the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from construction and operation activities would not be expected to cause annoyance to the public.

Noise impacts associated with increased traffic on access routes would be considered in tiered NEPA documents. Some nontraffic noise sources associated with construction and operation of the tritium supply technologies and recycling facilities may be located close enough to offsite noise receptors to cause some increase in noise levels.

Less Than Baseline Operations. Baseline noise impacts would not change due to reactors operating at reduced capacity or the construction and operation of a Phased APT.

Potential Mitigation Measures. Potential measures to minimize impacts on workers include the use of

standard silencing packages on construction equipment and providing workers in noisy environments with appropriate hearing protection devices meeting OSHA standards. As required, noise levels would be measured in worker areas, and a hearing protection program would be conducted.

4.3.3.4 *Water Resources*

Environmental impacts associated with the construction and operation of tritium supply technologies and recycling facilities at NTS would affect surface water and groundwater resources. All water required for construction or operation would be supplied from groundwater. The proposed site for tritium supply and recycling facilities does not lie within areas historically prone to flooding. There are no continuous-flowing streams and no designated floodplains. During construction, treated sanitary wastewater would be discharged to containment and sewage ponds that would be built in accordance with applicable regulations to avoid impact on groundwater. While the potential impacts to surface waters during the construction phase would be erosion and sedimentation, the relatively dry climate and application of appropriate controls should preclude adverse impacts. All excess wastewater would potentially be disposed of in ponds that would be designed to minimize infiltration to groundwater. No wastewater would be discharged to surface waters during the operation of tritium facilities; therefore, no impacts to surface water quality are expected. Stormwater runoff would be collected and treated, if necessary, before discharge to natural drainage channels.

Table 4.3.3.4–1 presents existing surface water and groundwater resources and the potential changes to water resources resulting from the proposed tritium supply technologies and recycling facilities. Resource requirements for each tritium supply technology shown in this table represent the total requirements at the site, including No Action. Resource requirements for tritium recycling are added to these values to obtain the water resource requirements for assessing impacts associated with combined tritium supply and recycling.

Surface Water

No Action. Under No Action, no impacts to surface water resources are anticipated since there are no surface water withdrawals, liquid discharges to navigable waters, offsite surface drainage systems, or publicly owned treatment works. A description of the activities that would continue at NTS is provided in section 3.3.3.

Tritium Supply and Recycling. No surface water would be withdrawn for any construction or operation activities associated with either the collocated tritium supply technologies and recycling facilities or the tritium supply facilities alone. Consequently, impacts to surface water availability or surface water quality are not expected. Nonhazardous wastewater generated during construction and operation would either be recycled or treated and released to sewage or containment ponds that would be designed to minimize seepage. The potential impacts to surface waters during construction would be erosion of distributed land and sedimentation in drainage channels. To minimize soil erosion impacts, stormwater management and standard erosion control measures would be employed.

In most cases, impacts from runoff would be temporary and manageable. Nonhazardous wastewater, including sanitary wastewater, generated during the construction of either the collocated tritium supply and recycling facilities (which ranges from 28.4 MGY for the Large ALWR to 1.2 MGY for the APT), or the tritium supply facilities alone (which ranges from 27.5 MGY for the Large ALWR to 0.3 MGY for the APT) would be treated, as needed, and discharged to ponds that would be constructed in accordance with applicable regulations to prevent infiltration into groundwater.

During operation, no effluents would be discharged to natural surface waters. Utility, process, and sanitary wastewater from the HWR, MHTGR, and ALWR would be treated prior to discharge into lined evaporation ponds. However, cooling system blowdown and sanitary wastewater from the APT would be treated and recycled for reuse as cooling system makeup. The treated effluent from the process treatment would be discharged to evaporation ponds. Treated effluent would be monitored to comply with the NPDES permit and other discharge requirements. The extent to which treated effluent or stormwater would be recycled for reuse within the plant would be determined during site-specific studies.

TABLE 4.3.3.4–1.—*Potential Changes to Water Resources Resulting from Tritium Supply Technologies and Recycling at Nevada Test Site*

Affected Resource Indicator	No Action	Tritium Supply Technologies and Recycling						
		HWR	MHTGR[a]	Large ALWR[a]	Small ALWR[a]	Full APT	Phased APT	Tritium Recycling[b]
Construction (2005)								
Water Availability and Use								
Water source	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground
Total water requirement[c] (MGY)	669	690	687	702	689	677	677	1.5
Percent increase in projected water use[d]	0	3	3	5	3	1	1	NA
Water Quality								
Wastewater discharge to surface waters (MGY) or groundwater	0	0	0	0	0	0	0	0
Percent change in stream flow from wastewater[d]	NA	NA	NA	NA	NA	NA	NA	NA
NPDES permit required	NA	No	No	No	No	No	No	NA
Operation (2010)								
Water Availability and Use								
Water source	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground
Total water requirement[e] (MGY)	669	717	699	759	719	1,869	1,439	14
Percent Increase in projected water use[d]	0	9	7	16	10	181	117	NA
Water Quality								
Wastewater discharge to surface waters (MGY) or groundwater	0	0	0	0	0	0	0	0
Percent change in stream flow from wastewater	NA	NA	NA	NA	NA	NA	NA	NA
NPDES permit required	No	No	No	No	No	No	No	NA
Floodplain								
Actions in 100-year floodplain	NA	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	NA
Critical actions in 500-year floodplain	NA	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	NA
Floodplain assessment required	NA	Yes	Yes	Yes	Yes	Yes	Yes	NA

[a] Operation water requirements for MHTGR and ALWR technologies include utilization of steam turbine generators.

[b] Resource requirements for tritium recycling do not include No Action. The values presented in this column are added to the requirements of each tritium supply technology to assess the impacts associated with combined tritium supply and recycling.

[c] Total water requirements at NTS are calculated by adding No Action requirements (669 MGY) with that for each tritium supply alternative: HWR (21.3 MGY), MHTGR (17.8 MGY), ALWR (33.3 MGY for Large and 20 MGY for Small), and APT (8.3 MGY for Full and 8.3 MGY for Phased).

[d] Percent increase in projected water use at NTS includes tritium recycling water requirements.

[e] Total water requirements at NTS are calculated by adding No Action requirements (669 MGY) with that for each tritium supply and recycling alternative: HWR (48 MGY), MHTGR (30 MGY), ALWR (90 MGY for Large and 50 MGY for Small), and APT (1,200 MGY for Full and 770 MGY for Phased).

Note: NA - not applicable.

Note: Construction impacts are considered to be temporary, lasting only throughout the construction period.

Source: FDI 1994h; DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; SNL 1995a; NTS 1993a:4; SR DOE 1995a.

Stormwater runoff from either the collocated tritium supply and recycling facilities or the tritium supply facilities alone would be collected in retention ponds. Runoff from site support facilities outside the main plant, except those that require onsite management measures by regulation such as sanitary wastewater plants and landfill areas, would be discharged directly to natural drainage channels. Uncontaminated runoff would be released to natural drainage channels. Contaminated stormwater runoff would be retained, treated in the radioactive waste treatment system, and released.

There are no designated floodplains and the proposed site for the tritium facilities does not lie within areas historically prone to flooding. Before construction, because these operations may constitute a critical action, an assessment of the 500-year floodplain would be made in conjunction with the preparation of site-specific tiered NEPA documents.

Less Than Baseline Operations. Baseline surface water impacts described above for the construction and operation phases would not change because of changes in reactor tritium operating capacity or construction and operation of a Phased APT.

Multipurpose Reactors. The MHTGR or an ALWR multipurpose reactor option at NTS would require a Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility or a Pit Disassembly/Conversion Facility to be constructed in conjunction with the reactors. Water used for both of the reactors and support facilities would be obtained from groundwater resources during operation.

Nonhazardous wastewater generated during construction and operation of a multipurpose MHTGR and ALWR and their support facilities would either be recycled or treated and released to lined sewage or containment ponds that would be designed to minimize seepage. No effluents would be discharged to natural surface waters.

Accelerator Production of Tritium Power Plant. If the APT is selected, a dedicated power plant as discussed in section 4.8.2.2 could be used to support the technology at NTS. An estimated 80 MGY of water for operations would be taken from groundwater resources. During operations, demineralized backwash would be generated. The backwash would contain dilute concentrations of trace metals, and low-to-moderate amounts of sodium and sulfate. With appropriate wastewater treatment, no impacts to surface water resources would be anticipated.

Potential Mitigation Measures. No mitigation measures have been identified in addition to those that could be implemented during construction for erosion and sediment control. Stormwater measures include stabilization practices that cover soils with materials such as vegetation, riprap, or mulch, in order to prevent direct exposure of soils to runoff. Structural controls to divert flow away from disturbed areas include silt fences, dikes, and sediment traps. The dry climate and application of appropriate management measures should preclude potential adverse impacts during operation from stormwater runoff.

Groundwater

No Action. Under No Action, an additional 36 MGY of groundwater will be required for the solar thermal electric facilities that will be completed by the year 2005. Potential total site withdrawal of groundwater (669 MGY) is within the average recharge rate for the aquifer. No additional impacts to groundwater quality are anticipated beyond the effects of existing and future activities that are independent of and unaffected by the proposed action.

Groundwater Availability And Use

Tritium Supply and Recycling. Groundwater required for construction of either a collocated tritium supply and recycling facility or a tritium supply facilities alone would represent approximately a 5-percent maximum increase over the projected 2005 groundwater withdrawal, would be within NTS's allotment, and would not be expected to cause depletion of the aquifer. Groundwater required for both construction and operation and the percent increase in projected water use are shown in table 4.3.3.4–1.

As discussed in section 4.3.2.4, some proportion of the estimated flow through Frenchman Flat (between 7,000 MGY and 11,000 MGY) is available for use. The exact amount available would have to be determined through site-specific studies to determine any potential impacts if any on Ash Meadows, Devil's Hole, and on surrounding users. Based on the lower

recharge rate of 7,000 MGY estimated by Sadler and others, total groundwater withdrawals required for the operation of the HWR, MHTGR, and ALWR, would remain below the lower recharge estimate. Operation of a Full APT (with tritium recycling) at 3/8 capacity, would require a total site groundwater withdrawal of 1,883 MGY that would also not exceed the lower recharge estimate. This represents approximately 27 percent of the estimated recharge (7,000 MGY). However, the more likely scenario for the Full APT (with tritium recycling) would be to operate at 3/8 level for 5 years (requiring groundwater withdrawals of 1,883 MGY), to operate at 3/16 capacity for 30 years (requiring 1,453 MGY), and then to not operate for 5 years. Over the 40-year operating period, the average total site groundwater withdrawal would be 1,409 MGY that would be less than the lower estimated recharge rate of 7,000 MGY.

In addition, Harril and others estimated that there is approximately 4 times the required water in storage as there is in annual recharge. Thus, there is the capacity to minimize the effects of annual or multi-year droughts through the use and replenishment of stored water. Substantially more water could be made available by using resources in the Alkali Flat-Furnace Creek Ranch Subbasin to the west (service area D of figure 4.3.2.4-1). As discussed in section 4.3.2.4, hydrogeologic evidence suggests that part of the regional aquifer, located approximately 34 miles downgradient from the site, discharges into Devil's Hole Cavern. Considering aquifer recharge and the distance between Devil's Hole and the proposed area, the wells servicing the proposed TSS would likely not impact the water levels at Devil's Hole (NT DOE 1993b:4-27).

Less Than Baseline Operations. Operation of the HWR at reduced capacity to meet a tritium supply requirement less than baseline would not change the operating water requirements or the quantity of water discharges. The MHTGR or ALWR water requirements and discharges would not change from the baseline; therefore, the potential impacts would remain the same.

Operation of the Phased APT (with tritium recycling) would require 784 MGY (table 4.3.3.4–1), a 117-percent increase over projected No Action water use. This is approximately two-thirds of the 1,214 MGY required by the Full APT (with tritium recycling). The water requirement for the Phased APT is less than estimated recharge rates for the aquifer used by NTS and should have no impact on water levels at Devil's Hole. All other requirements of the Phased APT are identical to those of the Full APT.

Multipurpose Reactor. For the multipurpose MHTGR, a Pit Disassembly/Conversion Facility would be constructed and operated to support the six reactors. The construction of the multipurpose MHTGR and the Pit Disassembly/Conversion Facility would use approximately 24.33 MGY, which would be a 35 percent increase over the groundwater use for the MHTGR tritium supply facility, and would not exceed the lower recharge rate of 7,000 MGY. Water use during operation of the MHTGR multipurpose reactor (54 MGY) and the Pit Disassembly/Conversion Facility (10 MGY), would total 64 MGY and would be a 113 percent increase over the groundwater use for the MHTGR tritium supply facility. Total site water use would not exceed the lower recharge rate of the aquifer.

Nonhazardous waste water generated during construction and operation of a multipurpose MHTGR and a Pit Disassembly/Conversion Facility would either be recycled or treated and released to lined sewage or containment ponds that would be designed to minimize seepage.

Water use during construction and operation of an ALWR multipurpose reactor would be the same as previously discussed for an ALWR tritium supply facility. However, as discussed in section 4.8.3, a Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would have to be constructed and operated in conjunction with an ALWR multipurpose reactor. A Pit Disassembly/Conversion/Fuel Fabrication Facility would use an additional 0.5 MGY of groundwater during construction, which would be a 1.5 percent increase over the groundwater use for the ALWR tritium supply facility. Total site groundwater withdrawals would not exceed the lower recharge rate of 7,000 MGY. During operation, approximately 10 MGY of water would be used, which would be an 11 percent increase over the groundwater use for the ALWR tritium supply facility. Total site groundwater withdrawals would not exceed the lower recharge rate of 7,000 MGY.

Nonhazardous wastewater generated during construction and operation of a Pit Disassembly/Conversion/Fuel Fabrication Facility would either be recycled or treated and released to sewage or containment ponds that would be designed to minimize seepage.

Accelerated Production of Tritium Power Plant. If the APT technology is selected, a dedicated power plant as discussed in section 4.8.2.2 could be used to support the technology at NTS. Water requirements for a natural gas-fired power plant would be approximately 80 MGY in addition to those groundwater requirements previously discussed. Operation of the Full APT, tritium recycling, and the dedicated power plant would require a total site groundwater withdrawal including No Action of 1,963 MGY that would be a 4-percent increase over the groundwater requirements for the Full APT and tritium recycling without the dedicated power plant. Total site groundwater withdrawal of 1,963 MGY would not exceed the lower recharge rate of 7,000 MGY and would represent approximately 28 percent of the estimated lower recharge rate.

The demineralized backwash generated, during operation, would contain dilute concentrations of calcium, sodium, and sulfate. However, with appropriate wastewater treatment, no impacts to groundwater would be anticipated.

Groundwater Quality

Tritium Supply and Recycling. Under normal construction and operating conditions, sanitary wastewater disposed into the leach field would be the only discharge that would have a potential to reach the Valley-Fill aquifer. The wastewater would not have a measurable effect on groundwater quality because of the combined effects of a deep water table, low discharge volumes, high evaporation rates, and a composition and concentration consistent with treated and monitored sanitary wastewater.

Because nonevaporative cooling towers will be used for reactors, salt would not be released from the cooling tower. There would be some concentration of salt in the blowdown water; however, this would be treated as part of the blowdown water. The nonevaporative cooling tower with blowdown recycle would couple reverse osmosis with an evaporator and crystallizer system that would remove the dissolved solids from blowdown so the water could be recycled to the cooling tower, and discharge would not require disposal.

Less Than Baseline Operations. Potential groundwater quality impacts described previously would not change due to changes in reactor tritium operating capacities or the construction and operations of a Phased APT.

Potential Mitigation Measures. Possible mitigation to minimize potential local groundwater withdrawal impacts could include deepening existing water wells and drilling new wells in other areas.

4.3.3.5 *Geology and Soils*

Construction of tritium supply and recycling facilities at NTS would have no impact on geological resources described in section 4.3.2.5. Although a moderate seismic risk exists for these facilities, this would be considered in the design of the structures. The existing seismic risk does not preclude safe construction and operation of the tritium facilities. The only other geological hazard present is volcanic activity, which is improbable and is not anticipated to impact the proposed facilities. Construction would disturb up to a few hundred surface acres of soil, the amount depending on the tritium supply technology and recycling facilities. Control measures would be used to minimize soil erosion. Impacts would depend on the specific soil units in the disturbed area, the extent of land disturbing activities, and the amount of soil disturbed. Potential changes to geology and soils associated with the construction and operation of tritium supply and recycling facilities are discussed below.

No Action. Under No Action, DOE would continue current and planned activities at NTS. Any impacts to geology and soils from these actions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Construction activities would not affect geologic conditions. Design of the facilities would ensure that they would not be adversely affected by geologic conditions.

There are no known capable faults that cross the proposed TSS. The Cane Spring fault, located approximately 5 miles south of the Device Assembly

Facility, is regarded as the most probable source for seismic activity in the vicinity of the proposed TSS, although a number of smaller faults are inferred in the alluvial areas of the site and in the Massachusetts Mountain area. The Yucca fault, which is located north of the proposed TSS, is regarded as capable and is also a potential source of seismic activity. The location of tritium supply and collocated recycling facilities or tritium supply alone would be evaluated at NTS during site-specific studies so that these capable faults and the associated potential ground rupture would be considered in facilities design. Ground shaking is more likely. Intensities of approximately VII on the modified Mercalli scale are possible at NTS. A peak ground acceleration of 0.67g with a Richter magnitude of 6.7 has been estimated for the Cane Spring fault, with a recurrence interval of 10,000 to 30,000 years. This would affect the integrity of poorly designed or nonreinforced structures but should not affect newly designed facilities. Based on the seismic history of the area, a moderate seismic risk exists at NTS but should not preclude safe construction and operation of tritium supply and collocated recycling facilities or tritium supply alone. In addition, all facilities would be designed for earthquake-generated ground acceleration in accordance with DOE Order 5480.28 and accompanying safety guides.

Although there is a history of past volcanism in the NTS area, volcanic eruptions are improbable (section 4.3.2.5). The most likely danger is from possible ash fall eruptions from the Long Valley area, 150 miles to the west-northwest. Lava extrusion from sources at NTS could recur but is highly unlikely. Precursors, such as shallow earthquakes, fumarole activity, and higher groundwater temperatures, provide advance warning of most eruptions; no such activity is currently indicated at NTS or the immediate vicinity.

It is highly unlikely that landslides, sinkhole development, or other nontectonic events would affect project activities. Slopes and underlying foundation materials are stable.

Properties and conditions of the soils underlying the proposed site have no limitations on construction. Soils would be impacted by construction and operation of the facilities. The amount of acreage that would be potentially disturbed by the tritium supply technologies is shown in table 4.3.3.1–1 and tritium recycling facilities is 202 acres. Therefore, soils would not adversely effect the safe operation of project activities.

The soil disturbance from construction of new facilities could be as much as 562 acres for a MHTGR collocated with recycling facilities. Disturbance would occur at building, parking, and construction laydown areas, destroying the soil profile, and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil losses would depend on frequency of storms; wind velocities; size and location of the facilities with respect to drainage and wind patterns; slopes, shape, and area of the tracts of ground disturbed; and, particularly during the construction period, when soil is bare. Construction of both the MHTGR and the APT would also necessitate deep excavations to accommodate reactor modules and an accelerator tunnel, respectively (see sections 3.4.2.2 and 3.4.2.4). A considerable volume of soil would be removed as a result of excavations. Most of the material removed would be alluvial fan sediment and could be stockpiled for use as fill. Some of this material could be used to cover the accelerator tunnel of the APT. Detailed site-specific NEPA studies will evaluate impacts to geology and soils resulting from deep excavations required for the MHTGR and APT and would identify appropriate mitigation measures.

Net soil disturbance during operation would be less than for construction, because areas temporarily used for laydown would be restored. Although erosion from stormwater runoff and wind action could occur occasionally during operation, it is anticipated to be minimal.

Appropriate erosion and sediment control measures would be used to minimize soil loss. Wind erosion is likely to occur on an intermittent basis, depending on wind velocities, the amount of soil exposed, and the effectiveness of control measures.

Less Than Baseline Operations. Under the less than baseline operations, geology and soil impacts would not change for the HWR, MHTGR, or ALWR technologies. Disturbed acreage for the Phased APT would be the same as the baseline tritium requirement for the Full APT, therefore impacts would be the same.

Multipurpose Reactor. The multipurpose MHTGR would disturb an additional 270 acres of land to accommodate the construction of three additional reactor modules and a Pit Disassembly/Conversion Facility. The additional land area disturbances would result in the destruction of the soil profile and potential temporary increase in erosion as a result of stormwater runoff and wind action. The three additional reactor modules would also double the excavation requirements over that for the tritium supply MHTGR. The excavated soil would substantially increase the volume of soil needing storage and/or disposal. Impacts on ground water resources from the excavation are not expected.

Construction impacts for the multipurpose ALWR would be the same as those described for the tritium supply ALWR. Additional soil impacts would be expected, however, from the construction of the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility needed to support the multipurpose ALWR. Approximately 129 acres would be disturbed for the new facility, destroying the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil losses would depend on frequency of storms; wind velocity; location of the facility with respect to drainage and wind pattern; slope, shape, and area of the tracts of ground disturbed; and the duration of time the soil is bare.

Soil impacts during operation are expected to be minimal. Appropriate erosion and sediment control measures would be used to minimize any long-term soil losses.

Potential Mitigation Measures. Mitigation measures would be required to control erosion from exposed areas of soil during construction. Potential mitigation measures include standard practices for erosion, sediment, and dust control from construction sites such as silt fences, sediment traps, runoff diversion dikes, drainageways, sedimentation ponds, establishment of ground cover and windbreaks, grading of slopes, and construction of berms, or other controls appropriate to the sites. Standard control for wind erosion, such as wetting the surface, would be done on a day-to-day basis. Exposing only small areas for limited periods of time would also reduce erosional effects. After the construction period, long-term control measures could include grading, revegetation, or landscaping.

4.3.3.6 *Biotic Resources*

Construction and operation of tritium supply technology and recycling facilities at NTS would affect biotic resources. Impacts resulting from the construction of the HWR, MHTGR, ALWR, or Full APT to meet the baseline tritium requirement would occur only at the beginning of the project lifecycle. The less than baseline tritium requirement for the Phased APT could incur some additional construction-related impact if expansion is needed to meet baseline tritium requirements. The potential impacts would be minor since the expansion would occur in the already developed main plant site. Impacts to terrestrial resources would result from the loss of habitat during construction and operation. Impacts to wetlands and aquatic resources would not occur since these resources are not located on the proposed TSS. The desert tortoise is the only Federal-listed species on the proposed TSS. Construction and operation could pose a threat to both individual tortoises and their habitat. Where potential conflicts could occur, mitigation measures would be developed in consultation with USFWS. Consultation would be conducted at the site-specific level in tiered NEPA reviews. Table 4.3.3.6–1 summarizes the potential changes to biotic resources at NTS resulting from the proposed action. As noted in the table, no major differences in impacts to biotic resources exist among the four tritium supply technologies and recycling facilities.

The following discussion of impacts from a multipurpose reactor and a dedicated power plant for the APT applies to the biotic resources at NTS as a whole. Where potential impacts to a specific biotic resource are notable for the tritium supply technologies, the discussion on multipurpose reactors identifies the potential impacts to the same resource.

Multipurpose Reactor. The selection of the multipurpose reactor option could result in additional impacts to biotic resources at NTS. The MHTGR Pit Disassembly/Conversion Facility and the ALWR Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would require an additional 129 acres of land. However, it is expected that during the design phase, land requirements for this facility would be substantially reduced when integrated into

TABLE 4.3.3.6–1.—*Potential Impacts to Biotic Resources Resulting During Construction and Operation from Tritium Supply Technologies and Recycling at Nevada Test Site*

		Tritium Supply Technologies and Recycling				
Affected Resource Indicator	**No Action**	**HWR**	**MHTGR**	**ALWR**	**APT**	**Tritium Recycling**
Acres of habitat disturbed	0	462[a]	562[a]	552[a]	375[a]	202
Wetlands potentially impacted	None	None	None	None	None	None
Aquatic resources potentially impacted	None	None	None	None	None	None
Number of threatened and endangered species potentially affected[b]	0/0	1/12	1/12	1/12	1/12	1/12

[a] Acreage disturbed by each tritium supply technology may be obtained by the subtracting the acreage for the tritium recycling facility from the tritium supply technologies and recycling acreage.

[b] The number of threatened and endangered species are represented by two data inputs (a/b) where: a - the number of Federal-listed threatened and endangered species, and b - the number of all other special status species (i.e., Federal candidate and/or state-listed species) that are potentially impacted.

Source: FDI 1993a.

the reactor and recycling facility design. In addition, an MHTGR would require three additional modules which would displace about 240 acres. Thus, total land requirements for the MHTGR and ALWR multipurpose reactors would be 931 and 691 acres, respectively. In general, impacts to terrestrial resources and threatened and endangered species would be similar to, but greater than, those described for the tritium supply and recycling facility. Impacts to wetlands and aquatic resources would not be expected on the proposed TSS since these resources do not occur on the site.

Accelerator Production of Tritium Power Plant. A dedicated natural gas-fired power plant, similar to that described in section 4.8.2.2, could be an option to support an APT at NTS. This facility, which would be constructed on the proposed TSS, would occupy 25 acres of land. Construction of the gas-fired power plant would increase the land disturbance associated with the APT from 375 to 400 acres. This would result in a slight increase in impacts to biotic resources over those described for the tritium supply and recycling facility. Infrastructure requirements, such as parking and laydown areas, would be incorporated into and take advantage of similar requirements associated with the APT. Rights-of-way would be sited to take advantage of existing corridors to the maximum extent practical.

Terrestrial Resources

No Action. Under No Action, the missions described in section 3.3.2 would continue at NTS. This would result in no change to current terrestrial resource conditions at NTS described in section 4.3.2.6.

Tritium Supply and Recycling. Construction and operation of the HWR, MHTGR, ALWR, or APT and recycling facilities at the proposed TSS would result in the disturbance of approximately 462, 562, 552, or 375 acres, respectively, of terrestrial resources or less than 0.07 percent of NTS (table 4.3.3.1–1). These acreages include areas on which facilities would be constructed, as well as areas revegetated following construction. Although vegetation within the proposed TSS would be destroyed during land clearing operations, all of the communities present are well represented on NTS.

Constructing any of the tritium supply technologies and recycling facilities would have some adverse effects on animal populations. Less mobile animals, such as reptiles and small mammals, within the project area would be destroyed during land clearing activities. Larger mammals and birds in construction and adjacent areas would be disturbed and would move to similar habitat nearby. The long-term survival of these animals would depend on whether the area to which they moved was at or below its carrying capacity. Nests and young animals living within the proposed TSS could be lost during con-

struction. Areas disturbed by construction but not occupied by facility structures would be of minimal value to wildlife because of the difficulty in establishing vegetative cover in a desert environment.

Activities associated with operation, such as noise and human presence, could affect wildlife living immediately adjacent to the tritium supply and recycling facilities. These disturbances may cause some species to move from the area.

A dry cooling design is proposed for all tritium supply technologies at NTS except for the APT. While there would be no impacts to vegetation from salt drift from an HWR, MHTGR, or ALWR, this may not be the case for the APT. A total of 10 separate cooling towers would be located along the length of the facility (section 3.4.2.4). Since design parameters for these towers are not known at this time, it is not possible to estimate impacts. This would be determined in future tiered NEPA documentation.

Construction and operation of a stand alone tritium supply facility would result in impacts to terrestrial resources that would be similar to, but less than, those described for a collocated tritium supply and recycling facility. Impacts would be less since 202 fewer acres of habitat would be disturbed.

Less Than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced tritium production capacity would have the same impacts described above for production at baseline tritium requirements.

Construction-related impacts of the less than baseline tritium requirement and Phased APT would be similar to those described above. Some additional construction-related impacts could occur if expansion is needed to meet baseline tritium requirements. The potential impacts would be minor since the expansion activities would occur in the already developed main plant site.

Potential Mitigation Measures. Habitat disturbance would be held to a minimum because of the difficulty in establishing plant cover in a desert environment. Disturbance to wildlife living in areas adjacent to any of the facilities may be lessened by preventing workers from entering undisturbed areas. It may be necessary to survey the proposed TSS for the nests of migratory birds or eagles prior to construction and/or avoid clearing operations during breeding seasons.

Wetlands

No Action. Under No Action, the missions described in section 3.3.2 would continue at NTS with no changes to wetlands at NTS.

Tritium Supply and Recycling. Construction and operation of any of the tritium supply technologies and recycling facilities would not affect wetlands because there are no wetlands in the proposed TSS. Construction and operation of a stand alone tritium supply facility would not affect wetlands because there are no wetlands in the proposed TSS.

Less Than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced tritium production capacity would have no wetland impact. Construction and operation of a Phased APT would also not affect wetlands because there are no wetlands in the proposed TSS.

Potential Mitigation Measures. Mitigation measures are not anticipated.

Aquatic Resources

No Action. Under No Action, the missions described in section 3.3.2 would continue at NTS. Impacts to aquatic resources would not occur because of the lack of permanent surface water at NTS.

Tritium Supply and Recycling. Construction and operation of any of the tritium supply technologies and recycling facilities would not affect aquatic resources because there are no permanent surface water bodies in the proposed TSS. Temporary aquatic habitat may develop in evaporation and retention ponds, as well as in natural channels in the immediate vicinity of NPDES permitted outfalls. Construction and operation of a stand alone tritium supply facility would not affect aquatic resources because there are no permanent surface water bodies.

Less Than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced tritium production capacity would not impact aquatic resources a NTS. Construction and operation of a Phased APT would also not impact aquatic resource because there

are no permanent surface water bodies in the proposed TSS.

Potential Mitigation Measures. Mitigation measures are not anticipated.

Threatened and Endangered Species

No Action. Under No Action, the alternatives described in section 3.3.2 would continue at NTS. Since underground nuclear testing has been suspended, impacts to threatened and endangered species are not expected.

Tritium Supply and Recycling. The threatened desert tortoise is the only Federal-listed species that could be affected by construction of tritium supply and recycling facilities at NTS. During construction, clearing operations, trenches, and excavation could pose a threat to any tortoises residing within the disturbed area. An increase in vehicle traffic is an additional hazard to the tortoise. Measures designed to avoid impacts to the desert tortoise from previous projects at NTS have been implemented as a result of a Biological Opinion issued by USFWS (NT FWS 1992a). Similar measures (see potential mitigation measures) would be followed if tritium supply and recycling facilities are constructed at NTS.

Several Federal candidate Category 2 species may also be affected by construction. The ferruginous hawk could lose foraging habitat and the loggerhead shrike could lose foraging and breeding habitat. Neither species would, however, be adversely impacted due to the abundance of nearby suitable habitat. Any plant species included in table 4.3.2.6–1 that are located within the construction area would be destroyed during land clearing activities. Preactivity surveys would be required prior to construction to determine the occurrence of these species in the area to be disturbed.

During facility operation, vehicle traffic would pose a hazard to the desert tortoise similar to that of current traffic. Extensive measures are presently being taken to ensure that drivers on the NTS avoid the tortoise. The ferruginous hawk would be discouraged from utilizing areas in close proximity to the operating facility but the loggerhead shrike could take advantage of the bordering fences as perching and hunting sites. Groundwater levels in Devil's Hole Cavern are not expected to change due to operation of the tritium supply and recycling facility (section 4.3.3.4); therefore, impacts to the Devil's Hole pupfish are not expected. Similarly, other rare endemic aquatic species found in the Ash Meadows area would not be affected.

Construction and operation of a tritium supply facility alone would result in similar impacts to threatened and endangered species, but less than those described for a collocated tritium supply and recycling facility. Impacts would be less since fewer acres of habitat would be disturbed.

Less Than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced tritium production capacity would have similar impacts on the Federal listed desert tortoise and candidate species as discussed above for the baseline tritium production requirement. Construction and operation of a Phased APT would also have similar impacts as discussed above.

Potential Mitigation Measures. Disturbance of threatened, endangered, and special status species would be avoided where possible and mitigation plans developed as required. A Biological Opinion concerning the desert tortoise has been issued by the USFWS covering current projects (NT FWS 1992a). Recommended mitigation measures included surveys for the desert tortoise and their removal from affected areas, as well as periodic inspections and eventual backfilling, covering, or installation of tortoise-proof fencing around open construction trenches and excavations and reducing speed limits on site roadways. Similar USFWS recommendations would be considered if NTS is selected as the location for the tritium supply and recycling facilities.

Land clearing activities could be scheduled to avoid the nesting season of the loggerhead shrike or avoided in areas where sensitive plant species occur. Where appropriate, habitat restoration or propagation programs would be attempted for plants when their disturbance is unavoidable. Consultation with USFWS would be required if any threatened or endangered species would be disturbed. No critical habitat has been designated for the tortoise or other threatened and endangered species at NTS.

4.3.3.7 *Cultural and Paleontological Resources*

Cultural and paleontological resources may be affected directly through ground disturbance during construction, building modifications, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism. Intensive cultural resources surveys and site evaluations have not been conducted for the majority of the proposed TSS. Site-specific surveys and evaluations would be conducted in conjunction with tiered NEPA documentation. Although the location and acreage for the proposed tritium supply plant or the combined tritium supply and recycling facilities will vary, their potential effects on cultural and paleontological resources are based primarily on the amount of ground disturbance; therefore, the facilities with the greatest ground disturbance will have the greatest potential effect on cultural and paleontological resources. Some NRHP-eligible prehistoric and historic sites, important Native American resources and scientifically important paleontological resources may be affected by the proposed action.

Multipurpose Reactor. Total land requirements for the MHTGR and ALWR multipurpose reactors would be 931 and 691 acres, respectively. NRHP-eligible prehistoric and historic sites, Native American resources, and Late Pleistocene paleontological resources may occur within these acreages and may be affected by the construction of a multipurpose reactor. In general, impacts to prehistoric and historic resources, Native American resources, and paleontological resources would be similar to, but potentially greater than, those described for the tritium supply and recycling facility.

Prehistoric and Historic Resources

No Action. Under No Action existing and planned missions at NTS would continue. Any impacts to prehistoric and historic resources from these missions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Land disturbance for the proposed tritium facilities (section 3.4) would range from 360 acres for the MHTGR to 173 acres for the APT (section 4.3.3.1). Acreages for the HWR and ALWR would be 260 and 350, respectively. Acreage required by the recycling facilities would be an additional 196 acres. Some NRHP-eligible prehistoric and historic sites may occur within the acreages that would be disturbed during construction. The prehistoric sites may include temporary camps, milling stations, habitation sites, quarries, and limited activity locations. The historic sites may include mines, campsites, trails, and trash dumps. NRHP-eligible resources will be identified through project specific inventories and evaluations, and any project related effects would be addressed in site-specific tiered NEPA documents. Operation of new facilities would not involve additional ground disturbance or increased activity; therefore, prehistoric or historic sites would not be affected.

Less Than Baseline Operations. No change in impacts to prehistoric and historic resources would be expected from operating the HWR at reduced capacity. Impacts for the MHTGR or ALWR would also not change from those described for the baseline requirement because the MHTGR or ALWR would not be a reduced size or operate at reduced capacity.

Construction and operation of the Phased APT would not change the expected impacts from the baseline tritium requirement technologies since the disturbed area would be the same.

Potential Mitigation Measures. If NRHP-eligible resources cannot be avoided through project design or siting, and would result in an adverse effect, then a Memorandum of Agreement would need to be negotiated between DOE, the Nevada SHPO, and the Advisory Council on Historic Preservation describing and implementing intensive inventory and evaluation studies, data recovery plans, site treatments, and monitoring programs. The appropriate level of data recovery for mitigation would be determined through the Nevada SHPO and the Advisory Council on Historic Preservation, in accordance with Section 106 of the *National Historic Preservation Act.*

Native American Resources

No Action. Under No Action existing and planned missions at NTS would continue. Any impacts to Native American resources from these missions

would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Some Native American resources may occur within the acreages that would be disturbed during construction of the tritium facilities. Native American resources may include burials, ceremonial sites, petroglyphs (rock art), and traditional plant gathering areas. Operation of facilities may create audio or visual intrusions on Native American sacred sites in the vicinity or reduce access to traditional use areas. Specific concerns about the presence, type, and locations of Native American resources would be identified through consultation with the potentially affected Native American tribes, and any project-related effects would be addressed in tiered NEPA documents.

Less Than Baseline Operations. Impacts to Native American resources would not change due to less than baseline operation of the HWR, MHTGR, or ALWR. Construction and operation of a Phased APT would have similar impacts on Native American resources as those described for the baseline requirement Full APT.

Potential Mitigation Measures. If Native American resources cannot be avoided through project design or siting, then acceptable mitigation measures to lessen the effect on these resources would be determined in consultation with all potentially affected Native American groups. In accordance with the *Native American Graves Protection and Repatriation Act* and the *American Indian Religious Freedom Act* such mitigations may include, but not be limited to, appropriate relocation of human remains, planting vegetation screens to reduce visual and noise intrusions, increased access to traditional use areas during operation, or transplanting or harvesting Native American plant resources. However, impacts to some Native American resources such as rock art sites may be mitigated, as appropriate.

Paleontological Resources

No Action. Under No Action, DOE would continue existing and planned missions at NTS. Any impacts to paleontological resources from these missions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Some Late Pleistocene paleontological resources may occur within the acreages that would be disturbed during construction of the tritium facilities. In such a case, paleontological monitoring of construction activities may be an appropriate mitigation, since scientifically important paleontological materials may be affected.

Less Than Baseline Operations. No change in impacts to paleontological resources would be expected due to reduced operation of the HWR, MHTGR, ALWR, or construction of a Phased APT.

Potential Mitigation Measures. Because scientifically important buried paleontological materials could be affected, paleontological monitoring of construction activities and data recovery of fossil remains would be appropriate mitigation measures.

4.3.3.8 *Socioeconomics*

Locating any of the tritium supply technologies alone or with recycling facilities at NTS would affect socioeconomics in the region. Section 3.2 provides descriptions for No Action, the tritium supply technologies, and tritium recycling. Siting a tritium supply technology with or without a recycling facility at NTS would result in changes in some of the communities in both the ROI and the regional economic area. The in-migrating population could increase the demand for housing units. Additionally, there would be an associated increased burden on community infrastructure and subsequent effects on the public finances of local governments in the ROI. The increase of population could also burden transportation routes in the ROI.

During the construction period, the greater changes in socioeconomic characteristics would result from the ALWR and APT. During operation, the HWR, MHTGR, and ALWR would exhibit similar characteristics. The APT would result in the smallest changes during operation. None of these tritium supply technologies with a recycling facility would increase population, the need for additional housing, or local government spending in the ROI spending beyond 3 percent over No Action during peak construction or operation. Although the greatest percent increases in employment, population and housing, and public finance during construction and operation occur in the peak years of 2005 and 2010, respectively, the annual average increases over the construction period (2001 to 2005) are between 1 and 5 percent average growth annually. Between peak construction and full operation (2005 to 2010), annual average increases vary from decreases of less than 1 percent to increases between 1 and 2 percent. During operation (2010 to 2050), annual average growth is between 1 and 2 percent.

The effects of locating any of the tritium supply technologies alone or with recycling facilities at NTS are summarized in section 4.3.3. The following sections describe the effects that locating one of these technologies would have on the local region's economy and employment, population, housing, public finances, and local transportation.

Employment and Local Economy

Changes in employment and levels of economic activity in the 4-county regional economic area from the proposed action at NTS are described in this section. Although specialized personnel, materials, and services required for construction and operation would be imported from outside the area, a significant portion of these requirements would be available in this regional economic arearegional economic area. Figures 4.3.3.8–1 and 4.3.3.8–2 present the potential changes in employment and local economy that would occur with each of the technologies.

No Action. Under No Action, employment at NTS decreased to 6,850 persons in 1994. This is a decrease of approximately 1,170 persons from the 1990 employment. NTS employment is projected to remain at 6,850 through 2020. Historical and future employment projections at NTS are found in appendix table D.2.1–1. The total NTS payroll was approximately $276 million in 1994 and is expected to continue at this level through 2010.

Total employment in the regional economic area is projected to grow 1 percent annually between 2001 and 2009, reaching 509,500 persons, and less than 1 percent annually between 2010 and 2020, reaching 525,900 persons. The unemployment rate in the regional economic area is expected to remain at 5 percent between 2001 and 2020. Per capita income is projected to increase from $23,600 to $25,100 during this 20-year period. No Action estimates are presented in appendix table D.3–22.

Tritium Supply and Recycling. Construction activities would begin between 2001 and 2003 and would be completed between 2007 and 2009. Phasing in of employment for the operation of the new facilities would begin in 2007, peak at full employment by 2010, and continue at this level into the future.

Locating any of the tritium supply technologies and recycling facilities at NTS would create new jobs (direct) at the site. Indirect job opportunities, such as community support services, would also be created in the regional economic area as a result of these new jobs. The total new jobs (direct and indirect) created would reduce unemployment and increase income in the economic region surrounding NTS during both

the construction and operation periods of the proposed action.

Construction. Siting tritium supply technologies and recycling facilities at NTS would require a total of approximately 7,400 to 13,600 worker-years of activity over a 5- to 9-year construction period. This construction-related employment would indirectly create other jobs in the regional economic area and total employment would grow at an annual average rate of 1 to 2 percent until the peak year of 2005. Between 2005 and 2010, annual growth would increase between 1 and 2 percent. Figure 4.3.3.8–1 gives the estimates of total jobs (direct and indirect) that would be created during peak construction (2005) for each of the tritium supply technologies with recycling, and the recycling facility's contribution to employment growth.

As employment opportunities grow in the regional economic area due to the proposed action, the unemployment rate would be reduced from the No Action estimate of 5 percent. Figure 4.3.3.8–2 presents a comparison of unemployment rates for the different tritium supply technologies and recycling facilities during peak construction in 2005. During the project's peak construction phase, the unemployment rate would range from 3.9 to 4 percent depending on the tritium supply technologies with recycling selected.

Income in the regional economic area would also increase slightly over No Action, particularly during peak construction as shown in figure 4.3.3.8–2. Per capita income is expected to increase at an annual average of 1 percent until the peak construction year (2005). Between 2005 and 2010, per capita income would also increase by 1 percent. The No Action annual average increase for per capita income is 1 percent until 2005 and less than 1 percent between 2005 and 2010.

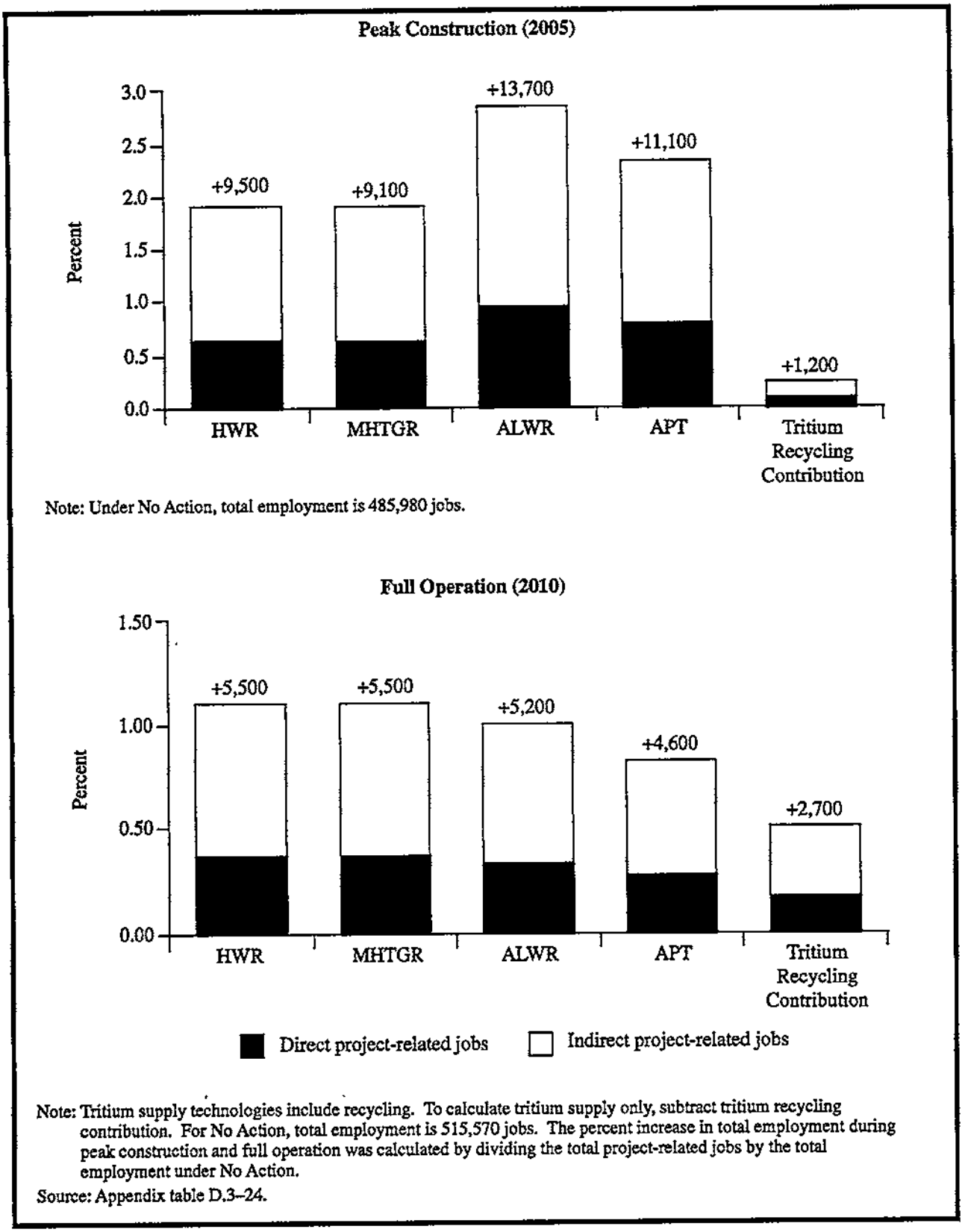
Operation. Employment for operation would begin phasing in as construction nears completion and the construction-related employment begins phasing out. It is expected that full operation employment would peak in 2010 and continue at this level for the life of the operation. Figure 4.3.3.8–2 gives the total project-related jobs projections (direct and indirect) for each of the tritium supply technologies and recycling facilities for 2010. Total employment growth from 2010 to 2020 would be flat.

Creation of additional job opportunities would reduce the unemployment rate below that projected for No Action. Figure 4.3.3.8–2 presents the differences in unemployment rates during the first year of full operation employment (2010) for each of the tritium supply technologies and recycling facilities. From 2010 to 2020, unemployment would be reduced from the No Action projection of 5 percent to between 4.3 and 4.4 percent, depending upon the technology selected for the proposed action.

Income would also increase slightly over No Action in the regional economic area as a result of the proposed action. Per capita income differences for tritium supply technologies and recycling facilities for 2010 are given in figure 4.3.3.8–2. Per capita income annual average increases would be about 1 percent between 2010 and 2020 for all of the tritium supply technologies and recycling facilities considered for location at NTS. The No Action projected annual average increase during the same period would also be approximately 1 percent.

Tritium Supply Alone. Construction of the tritium supply technologies without recycling facilities would begin between 2001 and 2003 and would be completed between 2007 and 2009. Employment for the operation of the facility would begin in 2007 and reach full employment by 2010. Locating any of the tritium supply technologies at NTS would create new jobs at the site and indirectly create other jobs in the region. However, this job creation and the additional economic effects would be less than the effects that would occur with the collocation of the tritium supply technologies with the recycling facilities.

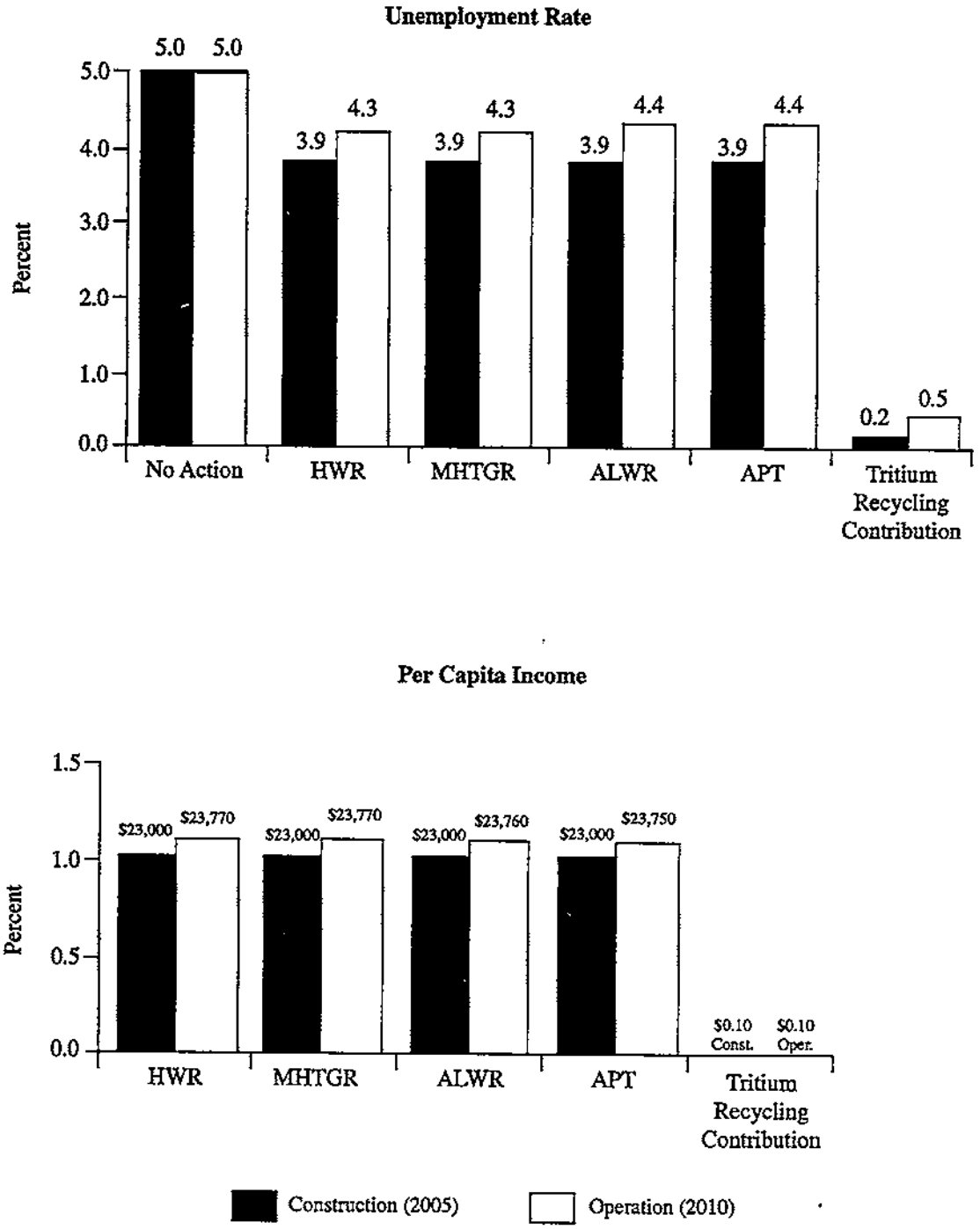
Construction. Construction of the tritium supply technologies only would require between 6,380 and 12,600 worker-years of activity over a 5- to 9-year period. New jobs would be created at an annual average rate of 2 percent until the peak year of construction, 2005. Between 2005 and 2010, employment would generally increase by one percent annually for the four technologies. Appendix table D.3–23 presents the estimates of total employment during peak construction in 2005 resulting from the tritium supply technologies. The total jobs (direct and indirect) that would be created can be calculated



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For No Action, total employment is 515,570 jobs. The percent increase in total employment during peak construction and full operation was calculated by dividing the total project-related jobs by the total employment under No Action.

Source: Appendix table D.3–24.

FIGURE 4.3.3.8–1.—*Total Project-Related Employment (Direct and Indirect) and Percentage Increase over No Action from Tritium Supply Technologies and Recycling for Nevada Test Site Regional Economic Area.*



Note: For No Action, per capita income is projected to be $22,780 in 2005 and $23,640 in 2010.
Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution.
Source: Appendix table D.3–24.

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.*

by subtracting the tritium recycling contribution from the tritium supply technologies and recycling in figure 4.3.3.8–1.

Although the construction of the facility would create new jobs, the effects would not be enough to greatly affect the unemployment rate projected for No Action. Additionally, per capita income in the region would rise only slightly above that estimated for No Action. Estimates of unemployment rate and per capita income for the tritium supply technologies are presented in appendix table D.3–23 or can be derived by subtracting tritium recycling contributions from the values for the tritium supply technologies and recycling figure 4.3.3.8–2.

Operation. Operation employment for the tritium supply technologies only would begin phasing in at the end of the construction period, and be at full employment in 2010. Full employment is expected to be maintained for the life of the facility. Estimates for full employment in 2010 are presented in appendix table D.3–23. Total project-related jobs created by the tritium supply technologies alone can be calculated by subtracting the tritium recycling contribution in figure 4.3.3.8–1.

The addition of new jobs during operation would reduce the unemployment rate below the projection for No Action. The unemployment rate for 2010, the first year of full operation employment, is presented in appendix table D.3–23 or can be derived by subtracting tritium recycling contribution in figure 4.3.3.8–2. Unemployment would be reduced from the No Action projection of 5 percent to a range of 4.6 to 4.7 percent from 2010 through 2020 depending on the technology selected.

The creation of new jobs as a result of the tritium supply operation would also increase income slightly over the No Action estimates. Appendix table D.3–23 presents the per capita income for the tritium extraction and recycling facility for 2010. Per capita income growth can also be calculated by subtracting tritium recycling contribution in figure 4.3.3.8–2. From 2010 through 2020, per capita income annual increases would be 1 percent, the same annual increase projected under No Action.

Less Than Baseline Operations. Tritium supply technologies that provide less than the baseline tritium capacities are described in section 3.1. These options may or may not be collocated with the tritium recycling facilities. The options include lowering the power in the HWR, using fewer target rods in the MHTGR and ALWR, and the phased approach for the APT.

Construction. The less than baseline operation case for the HWR, MHTGR, and ALWR would have the same construction workforce requirements as discussed in the tritium supply and recycling and tritium supply only sections. Therefore, employment and economic effects in the region would be the same.

The Phased APT would require the same total number of construction workers as the Full APT, but the construction period would span from 1999 through 2008 instead of from 2003 through 2007. Additionally, peak construction would occur in 2003 instead of 2005. The effects on the regional economic area's employment, unemployment rate, and per capita income as a result of constructing the Phased APT are presented in appendix table D.3–23. Appendix table D.3–24 presents the effects on employment, unemployment rate, and per capita income for constructing the Phased APT with tritium recycling facilities. Generally, average annual increases in employment and income are similar to those for the Full APT, but these increases are over a longer period of time. These increases are between 1 percent and 2 percent.

Operation. Operation workforce requirements for the less than baseline tritium requirement case for the HWR, MHTGR, ALWR, and the Phased APT would be the same as those described in the tritium supply and recycling and tritium supply only sections. Thus, regional employment and economic effects would be the same.

Multipurpose Reactor. Construction activities for the multipurpose reactor would begin in 2001 and would be completed by 2009. Phasing in of employment for the operation of the multipurpose reactor would begin in 2007, peak at full employment by 2010, and continue at that level into the future. Because this option would perform three processes, it would result in greater changes in employment and local economy characteristics than any of the four tritium supply technologies.

Construction. Siting the multipurpose reactor and a recycling facility at NTS would require 19,140 worker-years of activity over a 9-year period. The multipurpose reactor alone would require 18,150 worker-years of activity over a 9-year period. Employment characteristics, unemployment rates, and per capita income characteristics during construction of the multipurpose reactor alone and with a tritium recycling facility are presented in appendix tables D.3–23A and D.3–24A, respectively. From the first year of construction to the peak year (2005), annual average increases in employment and per capita income would range from 1 to 3 percent. Between 2005 and 2010, employment and per capita income would increase on an annual average of 1 percent. The unemployment rate during peak construction for this option with or without a recycling facility would be 3.9 percent.

Operation. Operation employment for the multipurpose reactor would begin phasing in toward the end of the construction period and reach full employment in 2010. Full employment is expected to be maintained for the life of the facility. Employment characteristics, unemployment rates, and per capita income characteristics during operation of the multipurpose reactor alone and with a tritium recycling facility are presented in appendix tables D.3–23A and D.3–24A, respectively. During operation, annual employment growth would be flat and annual average growth in per capita income would be less than 1 percent. The unemployment rate for the multipurpose reactor alone and with a recycling facility would be 4.3 percent and 4.5 percent, respectively.

Accelerator Production of Tritium Power Plant. Construction activities for the APT power plant would begin in 2003 and would be completed by 2007. Phasing in of employment for the operation of the production of tritium power plant would begin in 2007, peak at full employment by 2010, and continue at that level into the future. This option is similar to the APT with an addition of a gas power plant. The changes in employment and local economy would be similar, but greater than those resulting from the APT.

Construction. Siting this option with a recycling facility at NTS would require 7,600 worker-years of activity over a 5-year period. The APT power plant alone would require 6,600 worker-years of activity of a 5-year period. Employment characteristics, unemployment rates, and per capita income characteristics during construction of this option alone and with a tritium recycling facility are presented in appendix tables D.3–23A and D.3–24A, respectively. From the first year of construction to the peak year (2005), annual average increases in employment and per capita income would range from 1 to 2 percent. Between 2005 and 2010, employment and per capita income would increase on an annual average of 1 percent. The unemployment rate during peak construction for this option with or without a recycling facility would be 3.8 percent.

Operation. Operation employment for the multipurpose power plant would begin phasing in toward the end of the construction period and reach full employment in 2010. Full employment is expected to be maintained for the life of the facility. Employment characteristics, unemployment rates, and per capita income characteristics during operation of the APT power plant alone and with a tritium recycling facility are presented in appendix tables D.3–23A and D.3–24A, respectively. During operation annual employment growth would be flat and annual average growth in per capita income would be less than 1 percent. The unemployment rate for the APT power plant alone and with a recycling facility would be 4.4 percent and 4.7 percent, respectively.

Population and Housing

Changes to ROI population and housing expected from the proposed action at NTS are described in this section. Additional population could be expected to in-migrate to the NTS region and these people would be expected to reside in cities and counties within the ROI in the same relative proportion as the existing population. Increases to the population could lead to a demand for additional housing units beyond existing vacant housing available during construction or operation phases of the proposed action. Figures 4.3.3.8–3 and 4.3.3.8–4 present the changes in population and housing over No Action with the tritium supply technologies and recycling facilities.

No Action. Under No Action, population and housing increases between 2001 and 2009 are projected to be 1 percent. Future annual average increases are also projected to be 1 percent between 2010 and 2020. Population in the ROI is estimated to reach 1,020,900

in 2010 and 1,103,500 in 2020. Total housing units in the ROI are estimated to reach 437,400 in 2010 and 472,800 in 2020. No Action estimates are presented in appendix tables D.3–25 and D.3–28.

Tritium Supply and Recycling. It is expected that the proposed action at NTS would increase population and housing demands in the ROI slightly (2 percent) over No Action projections during peak construction. The effects are expected to be fewer (much less than 1 percent) during the operation phase of the proposed action.

Construction. Construction activities would be phased over a 5- to 9-year period. Figure 4.3.3.8–3 illustrates that during peak construction (year 2005), the ALWR and APT would create the largest population and housing demand increases over No Action, and the HWR and MHTGR would have the fewest effects. The increase in population could require some additional housing units beyond what is currently available in the existing housing mix. However, any requirements for additional housing units would be at annual average increases of 2 percent in the first 3 years of construction of the ALWR and APT, followed by an approximately 1-percent increase until peak operation. The other tritium supply technologies would have annual average population and housing demand growth of less than 2 percent. Therefore, there would not be any major effects on any of the ROI communities.

Operation. Operation of any of the tritium supply technologies and recycling facilities is expected to reach full employment by 2010. In-migrating population is expected to require housing units similar to the existing housing mix in the ROI. Figure 4.3.3.8–4 shows that population increases and potential demand for additional housing units over No Action projections are almost negligible (less than 1 percent) in this peak year. Given that the operation of the proposed action would be phased in over a 4-year period, it is expected that existing vacancies would absorb much of this new demand and that No Action requirements would be exceeded by very few units.

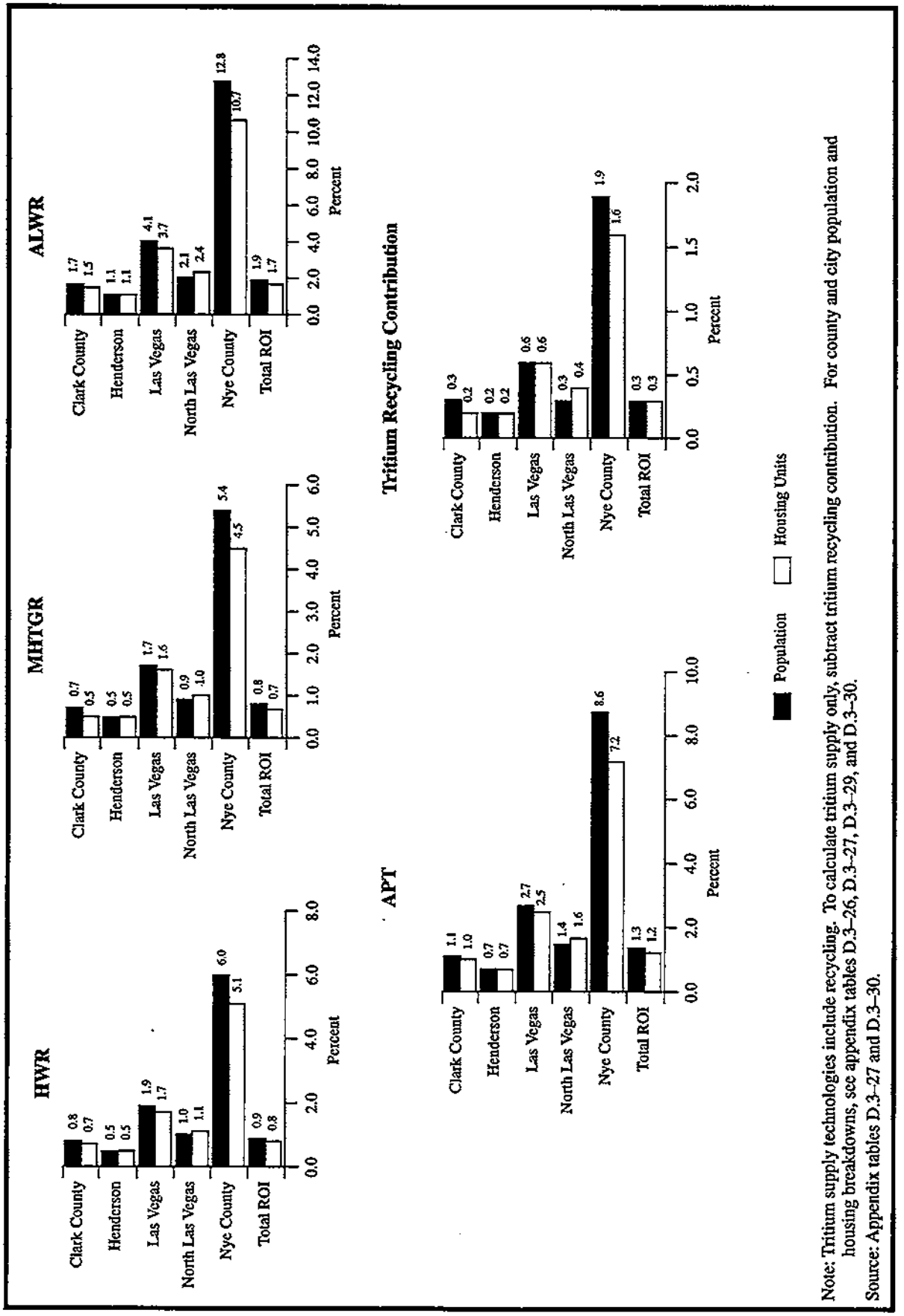
Tritium Supply Alone. Locating only a tritium supply technology at NTS would not increase population or housing demands in the ROI more than 2 percent over No Action projections during the construction period or 1 percent during operation.

Construction. Construction activities for the tritium supply technologies alone would be lower than if collocated with the tritium recycling facilities. The greatest increase in population and housing demand would occur during peak construction in 2005. Appendix tables D.3–26 and D.3–29 show that available vacancies in the existing housing mix would probably accommodate the expected population growth. Estimated growth in the ROI is less than 1 percent over the No Action projection.

Operation. Full employment levels for any of the tritium supply technologies alone would be reached by 2010. In-migrating population would be expected to require housing units similar to the existing mix in the ROI. These requirements would be lower than those any of the tritium supply technologies with the recycling facilities. Potential demand for housing units would be less than 1 percent in the first year of full employment as illustrated in appendix tables D.3–26 and D.3–29. It is expected that existing vacancies would absorb most of this new demand as employment would be phased in from 2007 through 2010.

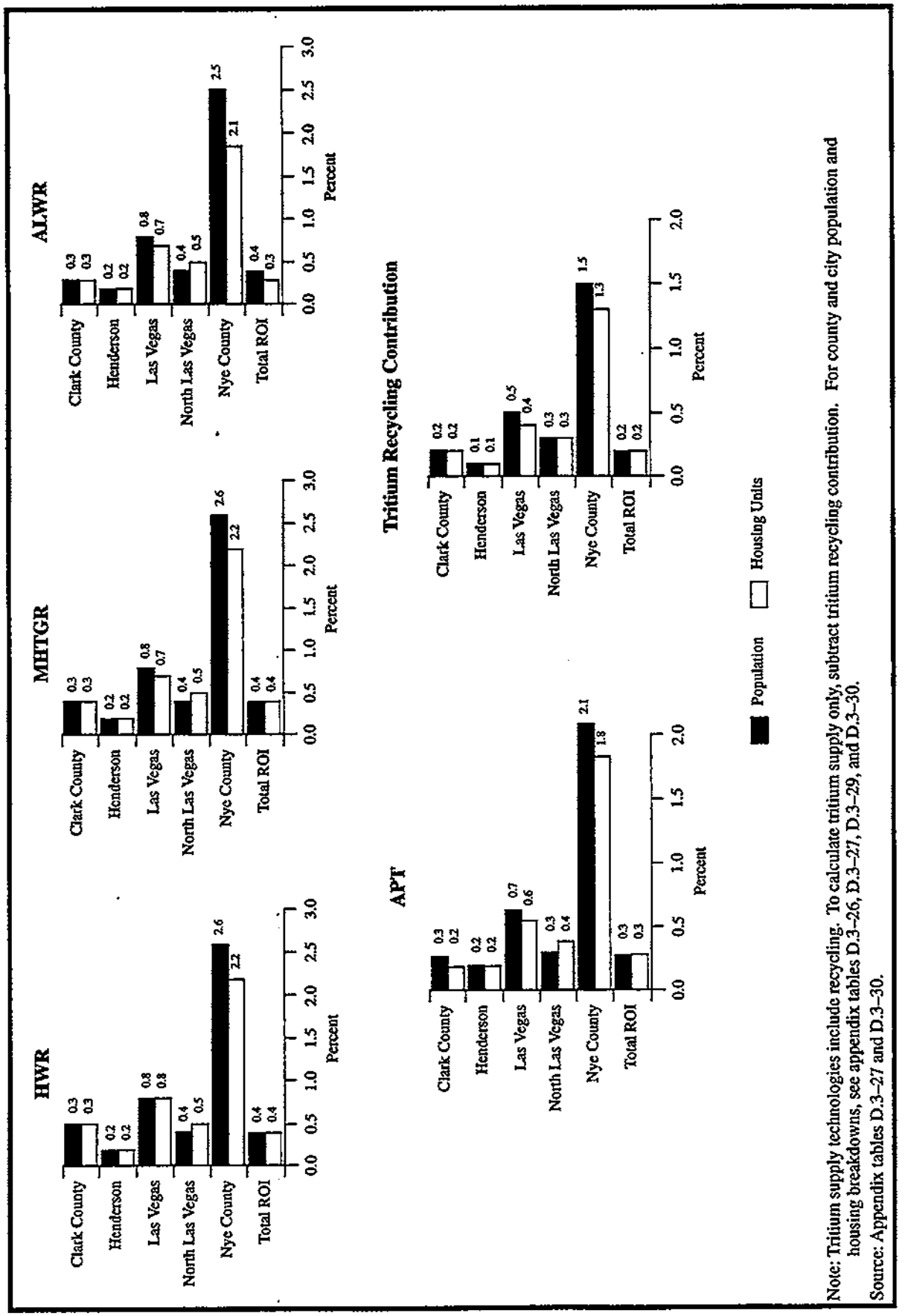
Less Than Baseline Operations. Population increases and housing demands would be the same or lower during construction and operation of tritium supply technologies operated at less than baseline tritium requirements than the alternatives discussed in the tritium supply and recycling and tritium supply only sections.

Construction. Population increases and housing demands would be the same as those given in figure 4.3.3.8–3 for the HWR, MHTGR, and ALWR. The Phased APT would increase population and housing demand during construction to the same level as the Full APT, but this would occur over a longer construction period with lower average annual increases (1 percent). Also, the peak construction year would be 2003 instead of 2005. The effects of the Phased APT on population and housing are presented in appendix tables D.3–26 and D.3–29, respectively. Appendix tables D.3–27 and D.3–30 present the results of constructing the Phased APT with the tritium recycling facilities.



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For county and city population and housing breakdowns, see appendix tables D.3–26, D.3–27, D.3–29, and D.3–30.
Source: Appendix tables D.3–27 and D.3–30.

FIGURE 4.3.8–3.—*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.*



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For county and city population and housing breakdowns, see appendix tables D.3–26, D.3–27, D.3–29, and D.3–30.
Source: Appendix tables D.3–27 and D.3–30.

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.*

Operation. The effects on population and housing of operating the HWR, MHTGR, ALWR, and the Phased APT at less than baseline tritium requirements would be the same as those presented in figure 4.3.3.8–4.

Multipurpose Reactor. Locating the multipurpose reactor with or without a recycling facility at NTS would not increase population and housing demands more than 3 percent over No Action projections during the construction period and 1 percent during operation.

Construction. Because this option would perform three processes, it would result in greater changes in population and housing characteristics than any of the four tritium supply technologies. Changes to population and housing characteristics resulting from multipurpose reactor with and without recycling facilities are presented in appendix tables D.3–26A, D.3–27A, D.3–29A, and D.3–30A. Population and housing growth in the ROI would be at an annual average rate of 2 percent until 2005 and 1 percent between 2005 and 2010.

Operation. Full employment levels for the multipurpose reactor would be reached by 2010. As illustrated in appendix tables D.3–26A, D.3–27A, D.3–29A, and D.3–30A, potential demand for housing units would be less than 1 percent in the first year of full employment. It is expected that existing vacancies would absorb most of this new demand as employment would be phased in from 2007 through 2010.

Accelerator Production of Tritium Power Plant. Locating the APT power plant with or without a recycling facility at NTS would not increase population and housing demands more than 1 percent over No Action projections during the construction and operation periods.

Construction. This option is similar to the APT with an addition of a gas power plant. The changes in population and housing demands would be similar, but greater than those resulting from the APT. Changes to population and housing characteristics resulting from the APT power plant with and without recycling facilities are presented in appendix tables D.3–26A, D.3–27A, D.3–29A, and D.3–30A. Population and housing growth in the ROI would be at an annual average rate of 2 percent until 2005 and 1 percent between 2005 and 2010.

Operation. Full employment levels for the APT power plant would be reached by 2010. As illustrated in appendix tables D.3–6A, D.3–7A, D.3–9A, and D.3–10A, potential demand for housing units would be less than 1 percent in the first year of full employment. It is expected that existing vacancies would absorb most of this new demand as employment would be phased in from 2007 through 2010.

Public Finance

Fiscal changes could occur in some ROI local jurisdictions from the proposed action. Factors influencing these changes include residence of project-related employees and their dependents, cost and duration of construction, and economic conditions in the ROI once the new facilities are operational.

Adding the tritium supply technologies and recycling facilities to NTS would increase population, resulting in more revenues for ROI local jurisdictions. Additional population would also increase public service expenditures. Figures 4.3.3.8–5 and 4.3.3.8–6 present the potential fiscal changes that would occur with the different tritium supply technologies and recycling facilities.

No Action. Appendix tables D.3–31 and D.3–32 present the 1992 public finance characteristics for local ROI jurisdictions. Appendix tables D.3–33 through D.3–36 present the impacts from tritium supply technologies alone or collocated with recycling facilities compared to No Action during construction and operation for the local ROI counties, cities, and school districts. Between 2001 and 2005, all ROI counties, cities, and school districts are projected to increase total revenues on an annual average of less than 1 to 5 percent. Total expenditures are also projected to increase on an annual average of 1 to 5 percent for all ROI counties, cities, and school districts between 2001 and 2005. Between 2005 and 2010, total revenues and expenditures are expected to increase from 1 to 2 percent for all counties, cities, and school districts in the ROI.

Between 2010 and 2020, projected annual average increases in total revenues are less than 1 percent for all counties, cities, and school districts in the ROI.

Total expenditures are also projected to increase on an average by 1 percent or less for ROI jurisdictions between 2010 and 2020.

Tritium Supply and Recycling. The proposed action at NTS would create some fiscal benefits to local jurisdictions within the ROI. Some local government finances would be affected during the construction and operation phases of the proposed action. Construction-related effects on revenues and expenditures could span a 5- to 9-year period with the peak occurring in 2005. The effects of the operation phase would peak in 2010 and remain at this level throughout the life of the facilities.

Construction. The public finances of counties, cities, and school districts within the ROI would be affected by the construction-related activities associated with the proposed action. Initially, there would be slight increases to some local government jurisdictions' revenues and expenditures, which would peak in 2005 and then decline as construction neared completion. Figure 4.3.3.8–5 presents the revenue and expenditure changes of ROI local government jurisdictions over No Action during peak construction for the four tritium supply technologies and recycling facilities. Over the construction phase of the proposed action, revenues and expenditures would increase slightly over No Action at an annual average of less than 1 to 4 percent. Under the tritium supply with recycling, revenues and expenditures would increase between 1 percent and 4 percent in the first three years of construction. After the peak construction year, there would be increases of 1 to 2 percent annually until 2010 for most local jurisdictions.

Operation. The effects of phasing in operation together with the phasing out of construction on ROI local government finances would be fewer than the effects at peak or full operation (2010). The effects that the four tritium supply technologies and recycling facilities would have on county, city, and school district revenues and expenditures are presented in figure 4.3.3.8–6. Between 2010 and 2020, revenues are expected to increase at an average annual rate of 1 percent or less for most jurisdictions. Expenditures are expected to increase to 2020 at an annual average of 1 percent. No Action local government revenues and expenditures would also increase at an average annual rate of 1 percent.

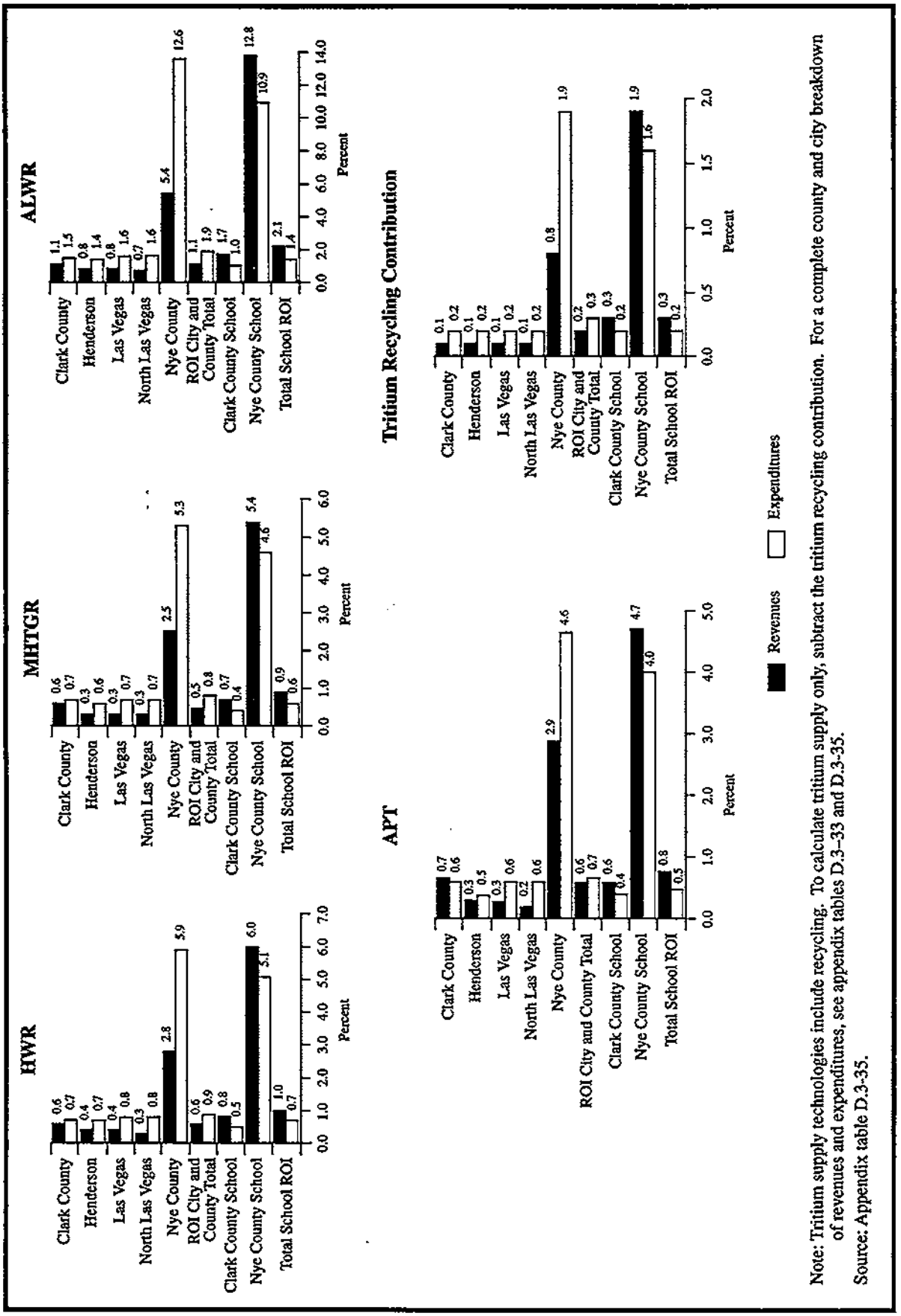
Tritium Supply Alone. Locating the tritium supply without the recycling facilities at NTS would create some fiscal benefits to local jurisdictions within the ROI, but these effects would be less than the effect of collocation with tritium recycling.

Construction. Construction-related effects from the tritium technologies alone on the revenues and expenditures of counties, cities, and school districts would be similar but less than the effects from the tritium supply technologies with recycling facilities. Appendix table D.3–33 presents the revenue and expenditure changes of ROI local governments over No Action during peak construction of the tritium supply technologies alone.

Operation. The operation phase of the tritium supply technologies alone would affect the public finances of counties, cities, and school districts in the ROI but these effects would be less than the tritium supply technologies with the recycling facilities. Appendix table D.3–34 presents the effects that operation would have on these local jurisdictions in 2010. From 2010 through 2020, revenues and expenditures are expected to increase less than 1 percent. In comparison, No Action local government revenues and expenditures would increase at an average annual rate of 1 percent.

Less Than Baseline Operations. The fiscal benefits that local jurisdictions would accrue from the location of a tritium supply technology alone or collocated with recycling would be the same or less if the tritium supply technologies is operated at less than baseline tritium requirements.

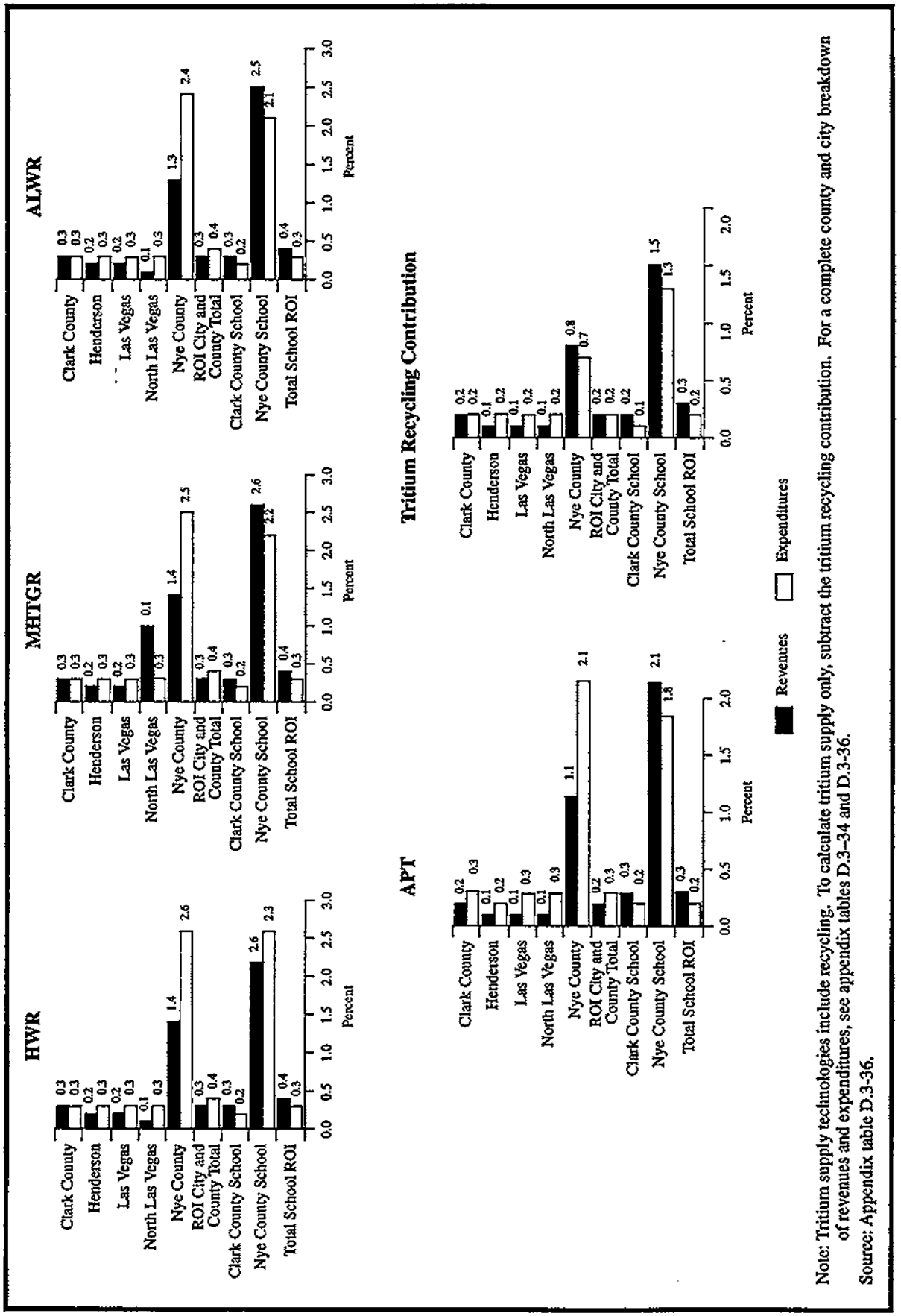
Construction. Increases in local jurisdictions' revenues and expenditures would be the same as those given in figure 4.3.3.8–5 if the HWR, MHTGR, or ALWR are built. If the Phased APT is constructed, the effects would peak in 2003 instead of 2005, and the annual average increases would be lower (2 percent or less). Appendix tables D.3–33 and D.3–34 present the revenue and expenditure changes as a result of constructing the Phased APT for all ROI jurisdictions. Revenue and expenditure changes resulting from the construction of the Phased APT with tritium recycling are presented in appendix tables D.3–35 and D.3–36.



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract the tritium recycling contribution. For a complete county and city breakdown of revenues and expenditures, see appendix tables D.3–33 and D.3-35.

Source: Appendix table D.3-35.

FIGURE 4.3.8–5.—*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, 2005.*



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract the tritium recycling contribution. For a complete county and city breakdown of revenues and expenditures, see appendix tables D.3–34 and D.3-36.

Source: Appendix table D.3-36.

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.*

Operation. Operation of the HWR, MHTGR, ALWR, and Phased APT at less than baseline would have the same effects on local jurisdictions' finances as those presented in figure 4.3.3.8–6.

Multipurpose Reactor. Locating the multipurpose reactor with or without a tritium recycling facility at NTS would create greater changes in public finance characteristics than the four tritium supply technologies because this option would perform three processes. Public finance characteristics for the multipurpose reactor with and without a recycling facility are presented in appendix tables D.3–33A through D.3–36A.

Construction. Between the first year of construction and the peak year, 2005, revenues and expenditures in the local jurisdictions would increase annually between 1 and 4 percent. Between 2005 and 2010, revenues and expenditures would generally increase annually by 1 percent for most jurisdictions.

Operation. From the first year of full operation, 2010, to 2020, growth in revenues and expenditures is generally expected to increase by 1 percent annually for most cities, counties, and school districts.

Accelerator Production of Tritium Power Plant. Locating the APT power plant with or without a tritium recycling facility at NTS would create similar, but greater changes in public finance characteristics than the APT tritium supply technology. Public finance characteristics for the APT power plant with and without a recycling facility are presented in appendix tables D.3–33A through D.3–36A.

Construction. Between the first year of construction and the peak year, 2005, revenues and expenditures in the local jurisdictions would increase annually between 1 and 2 percent. Between 2005 and 2010, revenues and expenditures would increase annually by 1 percent for most jurisdictions.

Operation. From the first year of full operation, 2010, to 2020, growth in revenues and expenditures is generally expected to increase at an annual average rate of less than 1 percent for most cities, counties, and school districts.

Potential Mitigation Measures

Adding new missions to NTS would create new jobs and generally benefit the local economy through increased earnings in the ROI. Some mitigation measures may be required, such as Federal aid to local school districts where additional school age children would attend as a result of siting the tritium facilities at NTS. These new missions at NTS would increase population and the demand for additional housing units. Temporary housing units and mobile homes would help to alleviate the demand for new housing during the construction phase of the proposed action. Generally, construction would be phased over a 5- to 9-year period with peak construction occurring in 2005. Phasing the start of operation employment and training between 2005 and 2010 would reduce the annual level of housing demand and smooth the peak and valley effect that would occur between peak construction and full operation.

Local Transportation

The following is a description of the effects on local transportation resulting from constructing and operating tritium supply and recycling facilities at NTS. Construction and operation of a tritium supply technology with the recycling facilities are expected to increase traffic flow rates on site access routes.

No Action. Under No Action, the worker population at NTS would not increase. Therefore, any increases in traffic would not be the result of DOE-related activities at NTS. Segments providing access to NTS include U.S. Route 95, State Routes 160 and 373. Traffic conditions on site access roads would remain as described in section 4.3.2.8.

Tritium Supply and Recycling. The proposed action at NTS would result in increases, depending on the tritium supply technology, of worker population at the site. Traffic volume on site access roads leading to and from NTS would increase due to the additional workforce. The primary access route to NTS is U.S. Route 95. This route would carry the greatest increase in traffic volume from site development. Locating the MHTGR or ALWR at NTS would have the greatest effect on traffic volume and flow.

Tritium Supply Alone. Locating a tritium supply technology without the recycling facility at NTS

would result in increased worker population, thereby increasing traffic on site access roads. However, the effects on traffic would be fewer than siting the tritium recycling facility with any one of the tritium supply technologies.

Less Than Baseline Operations. The effects on traffic volume and flow will be the same whether or not the HWR, MHTGR, or ALWR operated at baseline or less than baseline tritium requirements. Construction of the Phased APT would increase traffic volume flow during the construction phase but less than the Full APT.

Potential Mitigation Measures. Mitigation of traffic conditions may be necessary due to the proposed action at NTS. Potential mitigation of impacts to the local transportation network could include widening and extending U.S. Route 95, as well as possible realignment of roadways and construction of interchanges at roadway intersections overburdened by increased vehicle traffic and congestion.

4.3.3.9 *Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents*

This section describes the impacts of radiological and hazardous chemical releases resulting from either normal operation or accidents associated with tritium supply technologies and recycling facilities at NTS. The section first describes the impacts from normal operation, followed by a description of impacts from facility accidents.

During normal operation at NTS, all tritium supply technologies and recycling facilities would result in impacts that are within regulatory limits. The risk of adverse health effects to the public and to workers would be small.

For facility accident impacts, the results indicate that for all technologies, the risk of fatal cancers (taking into account both the probability of the accident and its consequences) from an accidental release of radioactive or hazardous chemical substances at NTS is low when compared to fatal cancers from all causes, including severe accidents.

The impact assessment methodology is described in section 4.1.9. Summaries of the radiological and chemical impacts associated with normal operation are presented in tables 4.3.3.9–1 and 4.3.3.9–2, respectively. Summaries of impacts associated with postulated accidents are given in tables 4.3.3.9–3 and 4.3.3.9–3. Detailed results are presented in appendix E for normal operation and in appendix F for accidents.

Normal Operation

No Action. The current missions at NTS are described in section 3.3.2. The site has identified those facilities that will continue to operate and others which will become operational by 2010. Based on that information, the radiological releases for 2010 and beyond were developed and used in the impact assessments.

Radiological Impacts. As shown in table 4.3.3.9–1, No Action would result in a calculated annual dose of 0.04 mrem to the maximally exposed member of the public, which projects to an estimated fatal cancer risk of 8.1×10^{-7} from 40 years of total site operation. This annual dose is within radiological limits and is 0.013 percent of the natural background radiation received by the average person near NTS.

The population dose from total site operation in 2030 was calculated to be 8.2×10^{-3} person-rem, which projects to an estimated 1.6×10^{-4} fatal cancers from 40 years of total site operation. The population dose in 2030 would be approximately 1.4×10^{-4} percent of the dose received by the surrounding population from natural background radiation.

The annual average dose to a site worker resulting from No Action would be 5 mrem, which projects to an estimated fatal cancer risk of 7.8×10^{-5} from 40 years of site operation. The annual dose to the total site workforce would be 3 person-rem, which projects to an estimated 0.048 fatal cancers from 40 years of total site operation. These estimates are based on the annual average worker doses at NTS from 1989 to 1992, and projected employment levels in 2010.

Hazardous Chemical Impacts. There are no hazardous chemical emissions resulting from No Action at NTS; therefore, acceptable regulatory health limits are met.

TABLE 4.3.3.9–1.—*Potential Radiological Impacts to the Public and Workers Resulting from Normal Operation of Tritium Supply Technologies and Recycling at Nevada Test Site*

Affected Environment	Tritium Supply Technologies and Recycling[a]								
	No Action	HWR	MHTGR	Large ALWR	Small ALWR	Full APT		Phased APT	Tritium Recycling
						Helium-3 Target System	SILC Target System	Helium-3 Target System	
Maximally Exposed Individual[b] (Public)									
Dose[c] (mrem per year)	0.04	0.31	0.21	0.4	0.4	0.13	0.18	0.13	0.12
Percent of natural background[d]	0.013	0.098	0.065	0.13	0.13	0.04	0.057	0.04	0.038
40-year fatal cancer risk	8.1×10^{-7}	6.2×10^{-6}	4.1×10^{-6}	8.0×10^{-6}	8.0×10^{-6}	2.6×10^{-6}	3.6×10^{-6}	2.6×10^{-6}	2.4×10^{-6}
Population Within 50 Miles									
Year 2030									
Dose (person-rem)	8.2×10^{-3}	0.2	0.13	0.24	0.25	0.08	0.11	0.08	0.07
Percent of natural background[d]	1.4×10^{-4}	3.4×10^{-3}	2.2×10^{-3}	4.2×10^{-3}	4.3×10^{-3}	1.4×10^{-3}	1.9×10^{-3}	1.4×10^{-3}	1.2×10^{-3}
40-year fatal cancers	1.6×10^{-4}	4.0×10^{-3}	2.6×10^{-3}	4.9×10^{-3}	5.1×10^{-3}	1.6×10^{-3}	2.3×10^{-3}	1.6×10^{-3}	1.4×10^{-3}
Worker Onsite									
Average site worker dose[c] (mrem per year)	5	34	26	140	92	34	36	34	4
40-year fatal cancer risk	7.8×10^{-5}	5.4×10^{-4}	4.2×10^{-4}	2.3×10^{-3}	1.5×10^{-3}	5.5×10^{-4}	5.7×10^{-4}	5.5×10^{-4}	6.4×10^{-5}
Total site workforce dose (person-rem per year)	3	44	33	180	100	43	45	43	1.6
40-year fatal cancers	0.048	0.7	0.53	2.8	1.7	0.69	0.72	0.69	0.026

[a] Includes impacts from No Action facilities.

[b] The location of the maximally exposed individual varies depending on the tritium supply technology.

[c] The applicable radiological limits to an individual member of the public from site operations are 10 mrem per year resulting from the air pathways and 100 mrem per year from all pathways combined (DOE Order 5400.5). The radiological limit for an individual worker is 5,000 mrem per year (10 CFR 835).

[d] Natural background level to the average individuals is 317 mrem; to the population in 2030 is 5,860 person-rem.

Note: SILC - spallation-induced lithium conversion.

Note: Model results. See appendix sections E.2.2 and E.2.5.

Tritium Supply and Recycling

There will be no radiological releases during the construction of new tritium recycling facilities that are associated with all tritium supply technologies under consideration. However, limited hazardous chemical releases are anticipated as a result of construction activities. The concentration of releases will be well within the regulated exposure limits and would not result in any adverse health effects. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The impacts from radiological and hazardous chemicals from each tritium supply technology considered are the summations of the impacts from the various facilities in operation for that technology. The resulting doses and potential health effects to the public and workers from each tritium supply technology are described below.

Radiological Impacts. Radiological impacts to the public resulting from normal operation from the tritium supply technology and recycling facilities considered for NTS are listed in table 4.3.3.9–1. The supporting analysis is provided in appendix section E.2.5.2.

The doses to the maximally exposed member of the public from annual operation at NTS range from 0.13 mrem for both the APT with the helium-3 target option and the Phased APT to 0.4 mrem for both the Large and Small ALWR. From 40 years of operation, the corresponding risks of fatal cancer to this individual would range from 2.6×10^{-6} to 8.0×10^{-6}. As a result of total site operation in 2030, the population doses would range from 0.08 person-rem for the same two APT technologies, to 0.25 person-rem for the Small ALWR. The corresponding numbers of fatal cancers in this population from 40 years of operation would range from 1.6×10^{-3} to 5.1×10^{-3}.

The annual dose to the total site workforce would range from 33 person-rem for the MHTGR to 180 person-rem for the Large ALWR. The annual average dose to a site worker would range from 26 to 140 mrem for the same two technologies, respectively. The risks and numbers of fatal cancers among workers from 40 years of operation are included in table 4.3.3.9–1.

Based on the radiological impacts associated with normal operation as described above, all of the tritium supply technologies and recycling facilities are acceptable for siting at NTS. All resulting doses are within radiological limits and are well below levels of natural background radiation.

Hazardous Chemical Impacts. As shown in table 4.3.3.9–2, the HIs to the maximally exposed individual of the public resulting from hazardous chemical emissions at NTS range from 1.8×10^{-7} for the APT to 7.7×10^{-5} for the ALWR, whereas a cancer risk of 0 was calculated for all tritium supply technologies. The worker HIs ranged from 0.038 for the ALWR to 3.4×10^{-5} for the APT. There was no cancer risk was for any of the tritium supply technologies. All values are within the acceptable regulatory health limits. For details on the derivation of these HIs and cancer risks, see appendix tables E.3.4-9 through E.3.4-12 and summary table E.3.4-14.

Tritium Supply Alone

Radiological Impacts. If the tritium recycling processes are not collocated with the tritium supply, the annual dose to the maximally exposed individual would be 0.12 mrem lower than from operation of both supply and recycling. This is 0.038 percent of the dose from natural background radiation received by the average person near NTS. The estimated risk of fatal cancer to this individual would decrease by 2.4×10^{-6} over 40 years of total site operation.

Not collocating the tritium recycling processes at NTS would result in a decrease of 0.07 person-rem to the population within 50 miles in year 2030, and 1.4×10^{-3} fewer fatal cancers over 40 years of operation.

If the tritium recycling processes are not collocated with the tritium supply, the total annual workforce dose would decrease by 1.6 person-rem, resulting in 0.026 fewer fatal cancers over the 40 years.

Hazardous Chemical Impacts. If the tritium recycling processes are eliminated from all of the supply technologies at NTS, the cancer risks would not change since there is no cancer risk resulting from any options. The effect on HIs for the public however, could be reduced as much as 41 to 51 percent (MHTGR and APT) or as little as 1.4 to

TABLE 4.3.3.9–2.—*Potential Hazardous Chemical Impacts to the Public and Workers Resulting from Normal Operation at Nevada Test Site*

Health Impact	No Action	Tritium Supply Technologies and Recycling[a, b] HWR	MHTGR	ALWR	APT	Tritium Recycling
Maximally Exposed Individual (Public)						
Hazard Index	0	$6.3x10^{-6}$	$2.2x10^{-7}$	$7.7x10^{-5}$	$1.8x10^{-7}$	$9.1x10^{-8}$
Cancer risk	0	0	0	0	0	0
Worker Onsite						
Hazard Index[c]	0	$3.2x10^{-3}$	$3.4x10^{-5}$	0.038	$3.4x10^{-5}$	$1.7x10^{-5}$
Cancer risk	0	0	0	0	0	0

[a] Includes impacts from No Action.

[b] To determine the contribution from any of the tritium supply technologies, subtract the tritium recycling values from the Hazard Index or from the cancer risk, respectively.

[c] The Hazard Index for the onsite worker is computed by using the permissible exposure level as the denominator rather than the reference concentration which is used for the maximally exposed member of the public (appendix E).

Model results. See appendix table E.3.4–14.

0.12 percent (HWR and ALWR); the corresponding effect on HIs for workers would be a reduction of 50 percent for MHTGR or APT and 0.5 percent and 0.04 percent for HWR and ALWR, respectively. Based on the hazardous chemical impacts associated with normal operations at NTS, all values are within regulatory health limits.

Less Than Baseline Operations. The normal operation radiological impacts for the HWR operating at the reduced tritium production capacity to meet a less than baseline tritium operation requirement would be proportional to the level of operation (approximately 50 percent of baseline). The MHTGR or ALWR normal operation radiological impacts would not change because the reactor would maintain power requirements to produce steam or electricity.

The Phased APT is already less than the baseline tritium requirement and thus the impacts are presently given in this PEIS.

Potential Mitigation Measures. Radioactive and hazardous chemical airborne emissions to the general population and onsite exposures to workers could be reduced by implementing the latest technology for process and design improvements. For example, to reduce public exposure from emissions, improved methods could be used to remove radioactivity from the releases to the environment. Similarly, the use of remote, automated and robotic production methods are examples of techniques that are being developed which could reduce worker exposure. Substitution of less toxic/noncancer-causing solvents would result in reductions of the HI and possible complete elimination of the cancer risk.

Facility Accidents

No Action. Under No Action, the risk of accidents at NTS would be unchanged from that reported in plant safety documentation for existing facilities since no additional activities would be undertaken.

Tritium Supply and Recycling. The proposed action at NTS has the potential for accidents that may impact the health and safety of workers and the public. This potential for and associated consequences of reasonably foreseeable accidents have been assessed for each tritium supply technology and recycling facilities at NTS and are summarized in this section and described in more detail in appendix F. The methodology used in the assessment is described in section 4.1.9.

The potential impacts from accidents, ranging from high consequence/low probability to low consequence/high probability events, have been evaluated in terms of the number of cancer fatalities that may

result. The risk of cancer fatalities has also been evaluated to provide an overall measure of an accident's impacts and is calculated by multiplying the accident annual frequency (or probability) of occurrence by the consequences (number of cancer fatalities).

Analyses of postulated accidents for the tritium supply technology and recycling facilities at NTS indicate that, for the high consequence accident, the estimated risk of cancer fatalities to the public within 50 miles of the site is 1.4×10^{-6} cancer fatalities per year (table 4.3.3.9–3). This accident risk, which corresponds with the HWR, is low when compared to the risk of cancer fatalities each year to the same population from all causes.

Details on the range of accidents for the tritium supply technologies and recycling facilities at NTS are presented in appendix F. Each of the technologies has been analyzed from the standpoint of identifying the consequences of design basis/operational accidents (using the GENII Code) and beyond design basis, or severe accidents (using the MACCS computer code). The severe accident consequences are shown in table 4.3.3.9–3 for each technology. The table also shows the consequences of each accident for the population within 50 miles of the site and for an individual who may be located at the site boundary. The results of the analysis indicate that the HWR has the highest severe accident risk. The technology with the lowest accident risk is the APT with the helium-3 target system. The results take into account accidents that may occur in the tritium supply system as well as the tritium recycling and other support facilities. The tritium recycling facility is common to all tritium supply technologies but, except for the APT, the consequences and risks are dominated by reactor accidents. The APT accident consequences are lower than the tritium extraction facility's accident consequences.

Figure 4.3.3.9–1 shows the number of latent cancer fatalities that may result for each technology, including tritium extraction and recycling, if a high consequence accident were to occur. Specifically, each curve in the figure shows the annual probability (vertical axis) that the number of cancer fatalities (horizontal axis) will be exceeded if the accident occurred. The curves reflect the probability of the accident.

The secondary impacts of accidents affect elements of the environment other than humans. For example, a radiological release may contaminate farmland, surface and underground water, recreational areas, industrial parks, historical sites, or the habitat of an endangered species. As a result, farm products may be destroyed; the supply of drinking water may be reduced; recreational areas may be closed; industrial parks may suffer economic losses; historical sites may have to be closed to visitors; and endangered species may move closer to extinction. In the region of the NTS, the natural background level of radiation (excluding radon) is 78 mrem per year. For a hypothetical design basis accidental release, the radiation levels exceeding 78 mrem per year are well within the site boundary. The size of the area in which exposure levels would exceed exposures from natural background radiation is 9.1×10^{5} square meters (225 acres).

Tritium Supply Alone. The analyses of reasonably foreseeable high consequence accidents for the tritium supply facilities at NTS are presented below.

Heavy Water Reactor. A set of four high consequence accident sequences were postulated for the HWR. These are described in appendix section F.2.1.1. In the event any of these accidents were to occur, there would be an estimated 0.15 cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 2.0×10^{-3} to an individual located at the site boundary and 0.031 to a collocated worker located 1,000 meters from the accident. The risk to the population, taking the probability of the accident into account, is 1.4×10^{-6} cancer fatalities per year (table 4.3.3.9–3).

Modular High Temperature Gas-Cooled Reactor. A set of four high consequence accident sequences were postulated for the MHTGR. These are described in appendix section F.2.1.2. In the event that any of these accidents were to occur, there would be an estimated 0.017 cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 1.7×10^{-4} to an individual located at the site boundary and 5.0×10^{-3} to a collocated worker at 1000 meters from the accident. The risk to the population, taking the probability of the accident into account, is 2.8×10^{-7} cancer fatalities per year (table 4.3.3.9–3).

TABLE 4.3.3.9–3.—*Tritium Supply Technologies and Recycling High Consequence/Low Probability Radioactive Release Accidents and Consequences at Nevada Test Site*

Parameter	Tritium Supply Technologies						Tritium Target Extraction Facility[b]	Tritium Recycling Facility[e]
	HWR[a,b]	MHTGR[b,c]	Large ALWR[b,d]	Small ALWR[b,d]	Full/Phased APT	Full APT		
					Helium-3 Target System[f,g]	SILC Target System[b,h,i]		
Consequence								
Maximally Exposed Individual								
Cancer fatalities[j]	2.0×10^{-3}	1.7×10^{-4}	5.5×10^{-3}	6.3×10^{-3}	1.7×10^{-8}	3.3×10^{-7}	1.9×10^{-5}	6.6×10^{-5}
Risk (cancer fatalities per year)	1.8×10^{-8}	2.7×10^{-9}	8.3×10^{-10}	9.8×10^{-10}	1.2×10^{-14}	2.3×10^{-13}	1.9×10^{-11}	6.6×10^{-11}
Population Within 50 Miles								
Cancer fatalities[j]	0.15	0.017	0.035	0.39	9.9×10^{-7}	9.0×10^{-6}	1.1×10^{-3}	3.9×10^{-3}
Risk (cancer fatalities per year)	1.4×10^{-6}	2.8×10^{-7}	5.3×10^{-9}	6.1×10^{-8}	7.0×10^{-13}	6.4×10^{-12}	1.1×10^{-9}	3.9×10^{-9}
Worker at 1,000 meters								
Cancer fatalities[j]	0.031	5.0×10^{-3}	0.03	0.087	4.5×10^{-7}	6.7×10^{-6}	5.0×10^{-4}	1.7×10^{-3}
Risk (cancer fatalities per year)	2.8×10^{-7}	8.1×10^{-8}	4.5×10^{-9}	1.4×10^{-8}	3.2×10^{-13}	4.8×10^{-12}	5.0×10^{-10}	1.7×10^{-9}
Worker at 2,000 meters								
Cancer fatalities[j]	0.015	1.8×10^{-3}	0.018	0.042	1.7×10^{-7}	2.8×10^{-6}	1.9×10^{-4}	6.7×10^{-4}
Risk (cancer fatalities per year)	1.4×10^{-7}	3.0×10^{-8}	2.7×10^{-9}	6.6×10^{-9}	1.6×10^{-13}	2.0×10^{-12}	1.9×10^{-10}	6.7×10^{-10}

[a] For detailed HWR accident discussion see appendix section F.2.1.1.

[b] The tritium target extraction facility is required for the HWR, MHTGR, ALWR, and the APT with spallation-induced lithium conversion (SILC) target system tritium supply configurations and not required for the APT with helium-3 target system tritium supply configuration. For detailed tritium target extraction facility discussion, see appendix section F.2.1.6.

[c] For detailed MHTGR accident discussion see appendix section F.2.1.2.

[d] For detailed ALWR accident discussion see appendix section F.2.1.3

[e] For detailed tritium recycling facility discussion, see appendix section F.2.3.

[f] For detailed APT with helium-3 target system discussion, see appendix section F.2.1.4.2.

[g] Analysis postulated the total failure of the active emergency cooling system and the loss of the heat sink.

[h] For detailed APT with spallation-induced lithium conversion (SILC) target system discussion, see appendix section F.2.1.4.3.

[i] Analysis postulated successful beam trip with the total failure of the active emergency cooling system.

[j] Increased likelihood of cancer fatality.

Source: Appendix F.

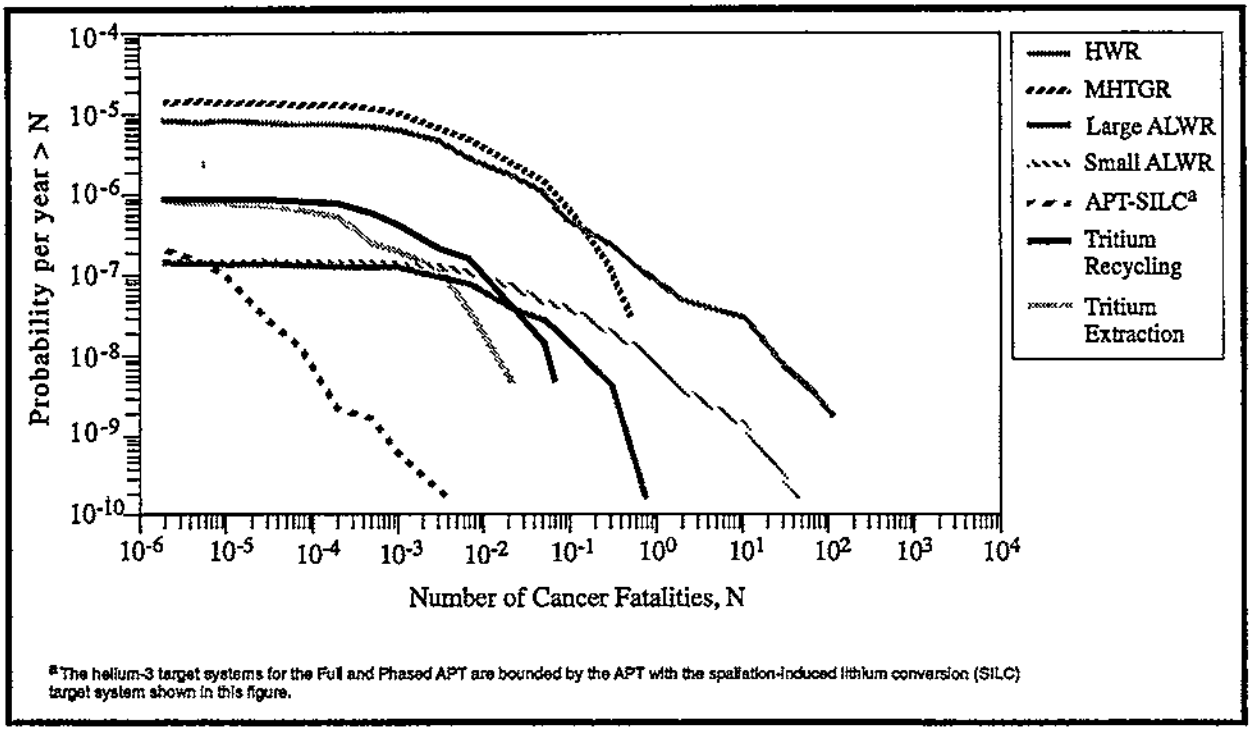


FIGURE 4.3.3.9–1.—*High Consequence Accident–Cancer Fatalities Complementary Cumulative Distribution Functions for Tritium Supply and Recycling Severe Accidents at Nevada Test Site.*

Advanced Light Water Reactor. A range of accident sequences with various release categories was analyzed for the ALWR. One release category for a Large ALWR and one for a Small ALWR were selected to represent the accident consequences for an ALWR (appendix section F.2.1.3). In the event that such an accident were to occur, there would be an estimated 0.034 for a Large ALWR and 0.39 cancer fatalities for a Small ALWR, in the population within 50 miles and an increased likelihood of cancer fatality of 5.5×10^{-3}, for a Large ALWR and 6.3×10^{-3} for a Small ALWR, to an individual located at the site boundary and 0.030 for a Large ALWR and 0.087 for a Small ALWR to a collocated worker at 1,000 meters from the accident. The risk to the population, taking the probability of the accident into account, is 5.3×10^{-9}, cancer fatalities per year for a Large ALWR, and 6.1×10^{-8}, cancer fatalities per year for a Small ALWR (table 4.3.3.9–3).

Accelerator Production of Tritium with Helium-3 Target System. The large break loss of coolant accident with the total loss of the active emergency cooling system and the heat sink with and without confinement were postulated as the high consequence accidents for this APT and target option. In the event that these accidents were to occur, there would be an estimated 9.9×10^{-7} cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 1.7×10^{-8} to an individual located at the site boundary and 4.5×10^{-7} to a collocated worker at 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is on the order of 7.0×10^{-13} cancer fatalities per year (table 4.3.3.9–3).

Accelerator Production of Tritium with Spallation Induced Lithium Conversion Target System. The large break loss of coolant accident with a successful beam trip and the total loss of the active emergency cooling system with and without confinement were postulated as the high consequence accidents for this APT and target option. In the event that this accident were to occur, there would be an estimated 9.0×10^{-6} cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 3.3×10^{-7} to an individual located at the site boundary and 6.7×10^{-6} to a collocated worker located 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is

on the order of 6.4×10^{-12} cancer fatalities per year (table 4.3.3.9–3).

Tritium Extraction and Recycling. The tritium extraction facility is required to support all tritium supply technologies except the APT technology with the helium-3 target system. The tritium recycling facility is required to support all tritium supply technologies. The analyses of postulated high consequence accidents for the tritium extraction and recycling facilities at NTS are presented below.

Tritium Target Extraction Facility. An earthquake and release of process vessel tritium inventory postulated as the high consequence accident. In the event that this accident were to occur, there would be an estimated 1.1×10^{-3} cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatalities of 1.9×10^{-5} to an individual who may be located at the site boundary. The risk to the population, taking the probability of an accident into account, is less than 1.1×10^{-9} cancer fatalities per year (table 4.3.3.9–3).

Tritium Recycling Facility. An earthquake-induced leak/ignition and fire in the unloading station carousel reservoir was postulated as the high consequence accident for the tritium recycling facility. In the event that this accident were to occur, there would be an estimated 3.9×10^{-3} cancer fatalities in the population with 50 miles and an increased likelihood of cancer fatality of 6.6×10^{-5} to an individual located at the site boundary during the accident. The risk to the population, that takes the probability of the accident into account, is on the order of 3.9×10^{-9} cancer fatalities per year (table 4.3.3.9–3).

For comparison purposes with high consequence tritium supply facility accidents, including extraction and recycling, for the same total population of 18,000 in 2050 within 50 miles of the site, there is a risk of 36 cancer fatalities per year from all other natural causes.

The analysis of facility accidents for tritium supply at NTS shows that, for high consequence accidents analyzed using the MACCS computer code, the HWR has the highest risk and the APT has the lowest risk. The risk of accidents for any of the tritium supply technologies, tritium extraction, and tritium recycling facilities common to all technologies, is low when compared to the human risk of cancer fatalities from all other causes.

Design-Basis Accidents. The consequences of operational basis or design basis accidents for the tritium extraction and recycling facilities at NTS are shown in table 4.3.3.9–3. The results in table 4.3.3.9–3 should not be compared with the severe accident analysis results in table 4.3.3.9–3 because different computer codes using different calculation approaches were used. More detailed descriptions of design-basis accidents are included in appendix F.2.2.

Less Than Baseline Operations. Less than baseline tritium operation would have no significant change to the current accident analyses consequences for the HWR unless the baseline HWR core design was downsized. The baseline HWR configuration would adjust to the reduced target through-put requirements by reducing the time that the reactor is required to operate at 100 percent power. It is not anticipated that the overall risk from operating the reactor in this mode would decrease significantly. Accident analyses have not been performed to address accident sequences and initiating events when the reactor is in the cold shut down mode. In addition, operator error has a significant effect on facility risk and if the reactor is shutdown a high percentage of the time, operator error may actually increase when the reactor is at power.

Less than baseline tritium operation would have no significant change to the current accident analyses consequences for the MHTGR or ALWR. The reactor surplus capacity would be used to generate steam for electric power production.

Less than baseline tritium operation would have no significant change to the MHTGR accident analyses because the analyses assumed that only one of the modules would be involved in the accident.

Less than baseline tritium operation would have no significant change to the APT accident analyses consequences. The accident consequences Full and Phased APT accidents with low to moderate consequences were negligible. For the beyond design basis accident, there was no difference in the Full and Phased accident sequences. Review of the source terms for the Full and Phased APT indicated that the

TABLE 4.3.3.9–4.—*Tritium Supply Technologies and Recycling Low-to-Moderate Consequence/High Probability Radioactive Release Accidents and Consequences at Nevada Test Site*

Parameter	Tritium Supply Technologies						
	HWR[a,b]	MHTGR[b,c]	Large ALWR[b,d]	Small ALWR	APT SILC Target System[b,f]	Tritium Target Extraction Facility[b]	Tritium Recycling Facility[e]
Accident							
Description	Fuel Assembly failure during charge and discharge operations	Moderate break in primary system piping	Fuel Handling	Fuel Handling	Large break loss of coolant accident[g]	Deflagration[h]	Hybrid Bed Rupture
Frequency (per year)	1.0×10^{-3}	2.5×10^{-2}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-3}	2.0×10^{-5}	2.0×10^{-4}
Consequence							
Maximally Exposed Individual							
Cancer fatalities[i]	4.2×10^{-6}	2.2×10^{-9}	2.2×10^{-6}	3.0×10^{-6}	negligible	2.2×10^{-5}	9.5×10^{-8}
Risk (cancer fatalities per year)	4.2×10^{-9}	5.5×10^{-11}	2.2×10^{-11}	3.0×10^{-11}	negligible	4.4×10^{-10}	1.9×10^{-11}
Population Within 50 Miles							
Cancer fatalities[j]	1.2×10^{-3}	6.8×10^{-7}	7.3×10^{-4}	1.0×10^{-3}	negligible	7.5×10^{-3}	3.2×10^{-5}
Risk (cancer fatalities per year)	1.2×10^{-6}	1.7×10^{-8}	7.3×10^{-9}	1.0×10^{-8}	negligible	1.5×10^{-7}	6.4×10^{-9}
Worker at 1,000 meters							
Cancer fatalities[j]	2.8×10^{-5}	3.3×10^{-8}	3.1×10^{-5}	3.9×10^{-5}	negligible	5.2×10^{-8}	2.2×10^{-6}
Risk (cancer fatalities per year)	2.8×10^{-8}	8.3×10^{-10}	3.1×10^{-10}	3.9×10^{-10}	negligible	1.0×10^{-12}	4.4×10^{-10}
Worker at 2,000 meters							
Cancer fatalities[j]	9.8×10^{-6}	1.2×10^{-8}	1.0×10^{-5}	1.3×10^{-5}	negligible	1.7×10^{-8}	7.2×10^{-7}
Risk (cancer fatalities per year)	9.8×10^{-9}	3.0×10^{-10}	1.0×10^{-10}	1.3×10^{-10}	negligible	3.4×10^{-13}	1.4×10^{-10}

[a] For detailed HWR accident discussion see appendix section F.2.2.1.

[b] The tritium target extraction facility is required for the HWR, MHTGR, ALWR, and the APT with spallation-induced lithium conversion target system tritium supply configurations and not required for the APT with helium-3 target system tritium supply configuration. For detailed tritium target extraction facility discussion, see appendix section F.2.2.6.

[c] For detailed MHTGR accident discussion see appendix section F.2.2.2.

[d] For detailed ALWR accident discussion see appendix section F.2.2.3

[e] For detailed tritium recycling facility discussion, see appendix section F.2.4.

[f] The APT with helium-3 target system bounding low-to-moderate consequence accident consequences are bounded by the APT with spallation-induced lithium conversion target system. For detailed APT discussion, see appendix section F.2.2.4.

[g] Analysis postulated all plant protection systems functioned as designed.

[h] Deflagration - intense rapid burning.

[i] Increased likelihood of cancer fatality.

Note: SILC - spallation-induced lithium conversion.

Source: Appendix F.

tritium component of the source term is identical for both accidents. Review of the MACCS computer code output data for each accident analysis indicated that the tritium component of the source term dominated the dose calculation results. The impact of the other source term isotopes on the dose calculation results is negligible.

Potential Mitigation Measures. The accidents postulated for tritium supply technologies and recycling facilities are based on operation and safety analyses that have been performed at similar facilities. One of the major design goals for tritium supply and recycling facilities is to achieve a reduced risk to facility personnel and to public health and safety to as low as reasonably achievable.

Current estimates are that there would be no collocated workers within 2,000 meters from an accident's location. There would be approximately 3,042 collocated workers beyond 2,000 meters from the accident. Involved workers that are associated with the proposed action would be located in and around the facility.

Worker exposure that may result from the accidental release of radioactive material will be minimized through design features and administrative procedures that will be defined in conjunction with the facility design process. The radiological impacts to involved workers from accidents could not be quantitatively estimated for this PEIS because the facility design information needed to support the estimate has not yet been developed. The impacts on workers from accidents will be analyzed as part of subsequent project-specific NEPA documentation and in detailed safety analysis documentation that are prepared in conjunction with the facility design process.

The tritium supply and recycling facilities would be designed to comply with current Federal, state, and local laws, DOE orders, and industrial codes and standards. This would provide facilities that are highly resistant to the effects of severe natural phenomena, including earthquake, flood, tornado, high wind, as well as credible events as appropriate to the site, such as fire and explosions, and man-made threats to its continuing structural integrity for containing materials.

The tritium supply and recycling facilities would be designed to resist the effects of severe natural phenomena as well as the effects of man-made threats to its continuing structural integrity. It also would be designed to provide containment of the tritium inventory at all times through the use of multiple, high quality confinement barriers to prevent the accidental release of tritium to the environment. It also would be designed to produce a lower quantity of waste materials when compared with the tritium facilities of the existing weapons complex.

In addition, DOE orders specify the requirements for emergency preparedness at DOE facilities. NTS has comprehensive emergency plans to protect life and property within the facility and the health and welfare of surrounding areas. The emergency plans would be revised to incorporate future DOE requirements and expanded to incorporate the addition of tritium supply and recycling facilities to NTS. See section 4.3.2.9 for emergency preparedness and emergency plan details at NTS.

4.3.3.10 *Waste Management*

Construction and operation of tritium supply and recycling facilities would impact existing waste management operations, increasing the generation of low-level, mixed low-level, hazardous, and nonhazardous wastes, and initiating the generation of spent nuclear fuel. There are no high-level or TRU wastes associated with the proposed action. As part of their design, all reactor technologies would provide stabilization and storage of spent nuclear fuel for the life of the facility. The impacts range from 0.6 acres per year LLW disposal for the HWR; increasing the quantity of hazardous waste generated by a factor of 6 for the MHTGR; to producing solid sanitary wastes at a rate that could require additional landfill capacity. The reactor technologies produce liquid LLW in quantities requiring new treatment facilities, and all technologies require treatment facilities for their liquid sanitary wastes. The volumes of mixed LLW for all technologies is small enough to be handled with the addition of an organic mixed waste treatment capability by existing and planned facilities as part of the compliance with the *Federal Facility Compliance Act* of 1992. This section provides a description of the waste generation, treatment, storage, and disposal requirements of the tritium

supply technologies and recycling facilities and the potential impacts on waste management at NTS.

No Action. Under No Action, mixed TRU, low-level, mixed low-level, hazardous, and nonhazardous wastes would continue to be managed from the missions described in section 3.3.2. Receipt of wastes from other DOE sites would also continue. Table 4.3.3.10–1 lists the projected waste generation rates; and treatment, storage, and disposal capacities under No Action. Projections for No Action were derived from 1991 environmental data with appropriate adjustments made for those changing operational requirements where the volume of wastes generated are identifiable. The projection does not include wastes from future yet uncharacterized, environmental restoration activities. The disposal of wastes received from offsite would not involve treatment at NTS, since these wastes must be treated, packaged, and certified to NTS waste acceptance criteria before they can be shipped to NTS for disposal. NTS has retrievable storage of TRU wastes awaiting shipment to a Federal repository. Although there is no generation of TRU waste onsite, mixed TRU waste from LLNL are presently stored at NTS. A liquid LLW treatment facility is planned for the treatment of wastewater from soil decontamination. Mixed solid waste is stored awaiting treatment in a RCRA-permitted commercial offsite facility. Hazardous waste is accumulated, then shipped offsite for disposal in a commercial RCRA-permitted facility. Nonhazardous and sanitary wastes are treated and disposed of locally in facilities located within the separate activity areas onsite.

Tritium Supply and Recycling. Tritium supply and recycling facilities that will support the nuclear weapons stockpile requirements (both new and existing facilities) would treat and package all waste generated from this activity into forms which would enable long-term storage and/or disposal in accordance with the *Atomic Energy Act*, RCRA, and other relevant statutes as outlined in chapter 5 and in appendix H, section H.1.2. The resultant waste effluents are shown in section 3.4. Waste generated during construction would consist of wastewater, nonhazardous solids, and hazardous waste. The nonhazardous wastes would be disposed as part of the construction project by the contractor, and the hazardous wastes would be shipped to a commercial RCRA-permitted treatment and disposal facility. Operation of the three reactor-based tritium supply technologies and recycling facilities would generate spent nuclear fuel, and all four technologies would generate low-level, mixed low-level, hazardous, and nonhazardous wastes. The volume of the waste streams from tritium supply would vary according to the technology chosen. Table 4.3.3.10–2 lists the total estimated waste volumes projected to be generated as a result of various tritium supply technologies and recycling facilities. The incremental waste volumes from the tritium supply and recycling facilities that were added to the No Action projection can be found in appendix section A.2. Table 4.3.3.10–3 lists potential waste management impacts at the time of initial operation of the tritium facilities. Spent nuclear fuel storage for the life of the reactor is provided for in the reactor designs (appendix section A.2.1). The DOE estimated inventory of spent nuclear fuel in 2035 is 2,742 metric tons. For comparison purposes, the commercial spent nuclear fuel inventory in 2030, assuming no reprocessing or new orders, is projected to be 85,700 metric tons of heavy metal (DOE 1994d:16). Because spent nuclear fuel reprocessing is not planned, no HLW would be generated. Without plutonium production, no TRU waste would be generated. The treatment, storage, and disposal of mixed LLW would be in accordance with the NTS Site Treatment Plan which is currently being developed pursuant to the *Federal Facility Compliance Act* of 1992.

Heavy Water Reactor. Spent nuclear fuel would be generated at the rate of 7 yd^3 per year. This would add 0.3 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The HWR would be designed to provide the necessary stabilization and storage of the spent nuclear fuel while awaiting final disposition. The liquid LLW generated by the HWR would require new treatment facilities to reduce its volume and stabilize the remaining concentrated radionuclides and prepare the solidified waste for disposal onsite. The solid onsite LLW generated would be increased to a rate that is 13 percent greater than the No Action volume. Assuming a 3,200 yd^3 per acre LLW disposal usage factor, this would require approximately 0.6 acres per year for onsite LLW disposal. A small amount of liquid mixed LLW is generated. This small volume could be handled by adding an organic mixed waste treatment capability within facilities being planned to comply with the *Federal Facility Compliance Act.*

TABLE 4.3.3.10–1.—*Projected Waste Management Under No Action at Nevada Test Site*

Category	Annual Generation Rate (yd^3)	Treatment Method	Treatment Capacity	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity (yd^3)
Mixed Transuranic	None	None	None	Containers on asphalt pads	1,485	To repository	NA
Low-Level							
Liquid	Dependent on restoration activities	Not determined	None	Ponds	Sized to inventory	NA	NA
Solid	42,400[a]	None	None	None	NA	Shallow burial	156,741 plus 801,300 reserved for expansion
Mixed Low-Level							
Liquid	Included in solid	Evaporation, filtration, solidification	Being designed	Ponds	Being designed	NA	NA
Solid	5,460	None	NA	To be designed	To be designed	Minimum technology[b]	222,220
Hazardous							
Liquid	38 (7,680 gal)	Contracted offsite	None	90-day pad	146[c] (29,500 gal)	Contracted offsite	NA
Solid	20	Contracted offsite	None	90-day pad	146[c]	Contracted offsite	NA
Nonhazardous (Sanitary)							
Liquid	Included in solid	Septic fields	As required	None	NA	Septic fields	As required
Solid	7,000	None	None	NA	NA	Landfill onsite	As required
Nonhazardous (Other)							
Liquid	Included in sanitary	Septic fields	As required	None	NA	Septic fields	As required
Solid	100,000	None	None	NA	NA	NA	As required

[a] Total onsite and offsite receipts.

[b] As required to meet RCRA requirements.

[c] Total capacity for solid and liquid hazardous wastes.

Note: NA - not applicable.

Source: DOE 1993a; DOE 1993c; NT DOE 1993d; NT MMES 1993a; NTS 1993a:4.

TABLE 4.3.3.10–2.—*Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes for Tritium Supply Technologies and Recycling at Nevada Test Site*

Category	No Action[a] (yd^3)	Tritium Supply Technologies and Recycling				
		HWR (yd^3)	MHTGR (yd^3)	Large ALWR (yd^3)	Small ALWR (yd^3)	APT[b] (yd^3)
Spent Nuclear Fuel	None	7[c]	80[d]	55[e]	36[f]	None
Low-Level						
Liquid	None[g]	10,400[g] (2,100,000 gal)	2,600[g] (525,000 gal)	24,800[g] (5,000,000 gal)	3,910[g] (790,000 gal)	None[g]
Solid	42,400	48,000	44,100	43,500	43,400	43,300
Mixed Low-Level						
Liquid	Included in solid	0.03 (6 gal)	0.03 (6 gal)	0.03 (6 gal)	0.03 (6 gal)	0.03 (6 gal)
Solid	5,460	5,580	5,460	5,470	5,470	5,470
Hazardous						
Liquid	38 (7,680 gal)	38 (7,680 gal)	38 (7,680 gal)	38 (7,680 gal)	38 (7,680 gal)	38 (7,680 gal)
Solid	20	61	121	56	56	24
Nonhazardous (Sanitary)						
Liquid	Included in solid	309,000 (62,300,000 gal)	219,000 (44,300,000 gal)	516,000 (104,000,000 gal)	318,000 (64,300,000 gal)	1,290,000 (260,000,000 gal)
Solid	7,000	22,000	21,800	21,300	18,600	15,600
Nonhazardous (Other)						
Liquid	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary	Included in sanitary
Solid	100,000	113,000[h]	113,000[h]	112,000[h]	110,000[h]	106,000[h]

[a] The No Action waste volumes are from table 4.3.3.10–1. Waste volumes were derived by adding the waste volumes of the various alternatives found in appendix section A.2 (tables A.2.1.1–4, A.2.1.2–4, A.2.1.3–4, A.2.1.3–5, A.2.1.4–4, and A.2.2.1–4) to the No Action volumes. Waste volumes have been rounded to three significant figures.

[b] The APT and Recycling waste volumes are based on the spallation-induced lithium conversion target. The helium-3 target waste volumes are approximately the same with the exception of solid LLW which is 42,800 yd^3.

[c] Residual heavy metal content is 660 lbs (0.3 metric tons).

[d] Residual heavy metal content is 550 lbs (0.24 metric tons).

[e] Residual heavy metal content is 230,000 lbs (105 metric tons).

[f] Residual heavy metal content is 150,000 lbs (68 metric tons).

[g] Additional liquid LLW may be generated from environmental restoration activities. The amount would depend on the level of effort and the treatment method selected.

[h] Includes recyclable wastes.

TABLE 4.3.3.10–3.—*Potential Spent Nuclear Fuel and Waste Management Impacts from the Tritium Supply Technologies and Recycling at Nevada Test Site* [Page 1 of 2]

	Tritium Supply Technologies and Recycling									
	HWR		MHTGR		Large ALWR		Small ALWR		APT	
Category	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact
Spent Nuclear Fuel	New	New storage facility	New	New storage facility	New	New storage facility	New	New storage facility	None	None
Low-Level										
Liquid	New	New treatment facility required	New	New treatment facility required	New	New treatment facility required	New	New treatment facility required	None	None
Solid	+13	0.6 acres per year of LLW disposal required	+4	0.2 acres per year of LLW disposal required	+3	0.2 acres per year of LLW disposal required	+2	0.1 acres per year of LLW disposal required	+2	0.1 acres per year of LLW disposal required
Mixed Low-Level										
Liquid	New	Additional treatment capability for organic mixed waste may be required	New	Additional treatment capability for organic mixed waste may be required	New	Additional treatment capability for organic mixed waste may be required	New	Additional treatment capability for organic mixed waste may be required	New	Additional treatment capability for organic mixed waste may be required
Solid	+2	Additional treatment capability for organic mixed waste may be required	+<1	Additional treatment capability for organic mixed waste may be required	+<1	Additional treatment capability for organic mixed waste may be required	+<1	Additional treatment capability for organic mixed waste may be required	+<1	Additional treatment capability for organic mixed waste may be required
Hazardous										
Liquid	None	None	None	None	None	None	None	None	None	None
Solid	+205	Additional storage facility	+505	Additional storage facility	+180	Additional storage facility	+180	Additional storage facility	+18	Enlarge storage facility

TABLE 4.3.3.10–3.—*Potential Spent Nuclear Fuel and Waste Management Impacts from the Tritium Supply Technologies and Recycling at Nevada Test Site* [Page 2 of 2]

	Tritium Supply Technologies and Recycling									
	HWR		MHTGR		Large ALWR		Small ALWR		APT	
Category	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact
Nonhazardous (Sanitary)										
Liquid	New	New treatment facility required	New	New treatment facility required	New	New treatment facility required	New	New treatment facility required	New	New treatment facility required
Solid	+214	Landfill life reduced or, expansion required	+211	Landfill life reduced or, expansion required	+204	Landfill life reduced or, expansion required	+166	Landfill life reduced or, expansion required	+123	Landfill life reduced or, expansion required
Nonhazardous (Other)										
Liquid	None	None	None	None	None	None	None	None	None	None
Solid	+13	None - Project wastes are recyclable	+13	None - Project wastes are recyclable	+12	None - Project wastes are recyclable	+10	None - Project wastes are recyclable	+6	None - Project wastes are recyclable

[a] This column reflects the percentage change in generation rate for No Action. Percentage change was calculated using waste volumes prior to rounding. Do not use rounded numbers in table 4.3.3.10–2 to calculate percentage change.

Source: Tables 4.3.3.10–1 and 4.3.3.10–2.

Mixed solid LLW volume is small enough to be handled by existing and planned facilities pursuant to compliance with the *Federal Facility Compliance Act* of 1992. Hazardous waste generation would increase by a factor of 3. This would require a permitted storage facility where the waste can be packaged for shipment to a commercial RCRA-permitted treatment and disposal facility. Liquid sanitary wastes generated by the HWR would require new treatment facilities since NTS does not have centralized facilities for these wastes. The volume of solid sanitary wastes generated would increase approximately by a factor of three more than No Action. This could reduce the remaining useful life of the landfill or require a proportional expansion.

Siting an HWR without tritium recycling facilities at NTS would not affect the generation of nor change the impacts from spent nuclear fuel or liquid LLW as described above. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.3.3.10–3. The LLW disposal area required for solid LLW would decrease by approximately 0.04 acres per year. The increase in generation rate over No Action for solid sanitary wastes would decrease from a factor of 3 to a factor of 2; thus, proportionately decreasing the impact to the planned lifetime of the landfill.

Modular High Temperature Gas-Cooled Reactor. Spent nuclear fuel would be generated at the rate of 80 yd^3 per year. This would add 0.24 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The MHTGR would be designed to provide the necessary stabilization and storage of the spent nuclear fuel while awaiting final disposition. The liquid LLW generation would require a new treatment facility, to concentrate and stabilize this waste. Solid LLW generation at NTS would increase to a rate 4 percent greater than No Action. It would be treated and disposed of onsite, and would require 0.2 acres per year of LLW disposal. The small volume of liquid mixed LLW could be handled by adding an organic mixed waste treatment capability within facilities being planned to comply with the *Federal Facility Compliance Act*. Mixed solid LLW volumes are small enough to be handled by adding an organic mixed waste treatment capability to existing and planned facilities pursuant to compliance with the *Federal Facility Compliance Act* of 1992. The generation of hazardous waste would increase to a level six times greater than No Action. This would require a RCRA-permitted facility where the waste can be staged for shipment to a commercial RCRA-permitted treatment and disposal facility. Liquid sanitary nonhazardous wastes generated by the MHTGR would require new treatment facilities since NTS does not have centralized facilities for these wastes. The volume of sanitary nonhazardous solid wastes generated would increase by a factor of three greater than No Action. This could reduce the remaining useful life of the landfill or require a proportional expansion.

Siting an MHTGR without tritium recycling facilities at NTS would not affect the generation of nor change the impacts from spent nuclear fuel or liquid LLW as described above. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.3.3.10–3. The LLW disposal area required for solid LLW would decrease by approximately 0.04 acres per year. The increase in generation rate over No Action for solid sanitary wastes would decrease from a factor of 3 to a factor of 2; thus, proportionately decreasing the impact to the planned lifetime of the landfill.

Advanced Light Water Reactor (Large). Spent nuclear fuel would be generated at the rate of 55 yd^3 per year. This would add 105 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The Large ALWR would be designed to provide the necessary stabilization and storage of the spent nuclear fuel while awaiting final disposition. The liquid LLW generated by the ALWR would require new treatment facilities to reduce its volume and stabilize the remaining concentrated radionuclides to prepare the waste for disposal onsite. The solid LLW generation rate would increase by 3 percent more than the No Action rate. This would require 0.2 acres per year of LLW disposal. The small volume of liquid mixed LLW could be handled by adding an organic mixed waste treatment capability within facilities being planned to comply with the *Federal*

Facility Compliance Act. Mixed solid LLW volume is small enough to be handled by adding an organic mixed waste treatment capability to existing and planned facilities pursuant to compliance with the *Federal Facility Compliance Act* of 1992. Hazardous wastes would be generated at a rate almost three times the No Action rate. This would require a RCRA-permitted facility to prepare the waste for shipment to a commercial RCRA-permitted treatment and disposal facility. Liquid sanitary nonhazardous wastes generated by the ALWR would require separate treatment and disposal facilities since NTS does not have centralized facilities for these wastes. The solid sanitary nonhazardous wastes generated by the ALWR increases the disposal at NTS to a rate that is three times the No Action generation. This could reduce the remaining useful life of the landfill or require a proportional expansion.

Siting a Large ALWR without tritium recycling facilities would not affect the generation of nor change the impacts from spent nuclear fuel as described above. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.3.3.10–3. The LLW disposal area required for solid LLW would decrease by approximately 0.04 acres per year. The increase in generation rate over No Action for solid sanitary wastes would decrease from a factor of 3 to a factor of almost 2; thus, proportionately decreasing the impact to the planned lifetime of the landfill.

Advanced Light Water Reactor (Small). Spent nuclear fuel would be generated at the rate of 36 yd^3 per year. This would add 68 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The Small ALWR would be designed to provide the necessary stabilization and storage of the spent nuclear fuel while awaiting final disposition. The liquid LLW generated by the ALWR would require new treatment facilities to reduce its volume and stabilize the remaining concentrated radionuclides to prepare the waste for disposal onsite. The solid LLW volume would increase the generation rate at NTS by 2 percent more than the No Action volume and would require 0.1 acres per year of LLW disposal. The small volume of mixed liquid LLW generated by the ALWR could be handled by adding an organic mixed waste treatment capability within facilities being planned to comply with the *Federal Facility Compliance Act*, since there are no facilities planned for this purpose at NTS. The ALWR solid mixed LLW generation would cause the rate to increase by less than 1 percent above No Action. With an added organic mixed waste treatment capability, existing/planned facilities would be adequate. Hazardous waste would be generated at a rate of almost three times the No Action rate. This would require a RCRA-permitted facility where the waste can be staged for shipment to a commercial RCRA-permitted treatment and disposal facility. Liquid sanitary nonhazardous wastes generated by the Small ALWR would require new treatment and disposal facilities because NTS does not have centralized facilities for these wastes. The solid sanitary nonhazardous wastes generated by the Small ALWR would increase by a factor of two and one-half more than No Action generation. This could reduce the remaining useful life of the landfill or require a proportional expansion.

Siting a Small ALWR without tritium recycling facilities would not affect the generation of nor change the impacts from spent nuclear fuel or liquid LLW as described above. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.3.3.10–3. The LLW disposal area required for solid LLW would decrease by approximately 0.04 acres per year. The increase in generation rate over No Action for solid sanitary wastes would decrease from a factor of 2.5 to 60 percent; thus, proportionately decreasing the impact to the planned lifetime of the landfill.

Accelerator Production of Tritium. The APT would not generate spent nuclear fuel. Any liquid LLW can be solidified at the point of generation. The APT generated solid LLW would increase the volume disposed at NTS by 2 percent more than No Action. This would require 0.1 acres per year of LLW disposal. A small amount of liquid LLW generated could be treated at the point of generation. The solid mixed LLW volume is small enough to be handled by adding an organic mixed waste treatment capability to existing and planned facilities pursuant to compli-

ance with the *Federal Facility Compliance Act* of 1992. There would be no liquid hazardous waste generation. Solid hazardous waste generation would be increased by 18 percent over No Action. An expansion of existing or planned RCRA-permitted facilities could be required where the hazardous wastes are staged for shipment to a commercial RCRA-permitted treatment and disposal facility. Liquid sanitary nonhazardous wastes generated by the APT would require new treatment and disposal facilities because NTS does not have centralized facilities for these wastes. When the volume of solid sanitary nonhazardous wastes is added to No Action, the generation increases by a factor of two. This would require additional or expansion of existing landfill facilities.

Siting an APT without tritium recycling facilities would not affect the generation of nor change the impacts from liquid LLW as described above and in table 4.3.3.10–3. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.3.3.10–3. The LLW disposal area required for solid LLW would decrease by approximately 0.04 acres per year. The increase in generation rate over No Action for solid sanitary wastes would decrease from a factor of 2 to 18 percent; thus, proportionately decreasing the impact to the planned lifetime of the landfill.

Less Than Baseline Operations. In the event of a reduced baseline tritium requirement the waste volumes shown in table 4.3.3.10–2 would not appreciably change as a result of the HWR operating at less power, and the MHTGR and ALWR irradiating fewer target rods. In the case of a Phased APT using the helium-3 target, the waste volumes with the exception of cooling tower blowdown, which decreases by 36 percent (86 MGY), are approximately the same as the Full APT using the helium-3 target.

Multipurpose Reactor.

Multipurpose Modular High Temperature Gas-Cooled Reactor. The volume of spent nuclear fuel generated by the six-reactor module multipurpose MHTGR would be approximately double the spent nuclear fuel from the three-reactor module tritium supply MHTGR. Similar to the mixed-oxide fuel assemblies, the plutonium-oxide fuel assemblies would have greater decay heat. Because the increased decay heat reduces storage density in the pool area and increases the fuel pool dwell time before dry storage, the spent nuclear fuel storage requirement would more than double that required for the three-reactor module tritium supply MHTGR. No increases in waste generation rates or characteristics are expected due to the change from uranium-oxide reactor fuel to plutonium-oxide reactor fuel. However, there would be increases in waste generation for all waste categories due to operation of the Pit Disassembly/Conversion Facility to include the introduction of mixed TRU and TRU wastes from both the Pit Disassembly/Conversion Facility and the fabrication of plutonium-oxide fuel. These increases are in addition to those listed in table 4.3.3.10-2 for the tritium supply MHTGR. Table 4.8.3.1-8 provides the quantity of waste effluents from the Pit Disassembly/Conversion Facility. In addition approximately 385 yd^3 of mixed TRU and TRU wastes would result from the fabrication of plutonium-oxide fuel. The 399 yd^3 of mixed TRU and TRU wastes would require transport to a geologic repository (assuming one is available) after they have been processed to meet the WIPP waste acceptance criteria.

Since NTS has a very limited capability to manage TRU and mixed TRU wastes, additional facilities to handle TRU waste would be needed. The transport of the mixed TRU and TRU wastes to WIPP would require 35 truck shipments per year, 18 regular train shipments per year, or six dedicated train shipments per year. One hundred gallons of liquid and 0.2 yd^3 of solid mixed LLW would require treatment in accordance with the NTS Site Treatment Plan. Approximately 0.003 acres per year of LLW disposal area would be required to dispose of the 10 yd^3 of solid LLW. Sufficient staging capacity exists to accumulate the 1,000 gallons of liquid and 1 yd^3 of solid hazardous wastes while awaiting shipment to a RCRA-permitted treatment and disposal facility. An additional 87 yd^3 of solid nonhazardous wastes would require disposal in the sanitary landfill. Additional liquid sanitary and industrial wastewater treatment facilities may be required if the Pit Disas-

sembly/Conversion Facility is not collocated with the multipurpose reactor.

Multipurpose Advanced Light Water Reactor. Spent fuel would be generated at the same rate with approximately the same amount of residual heavy metal content as the tritium supply ALWR. The decay heat in the mixed-oxide fuel assemblies could be 10 to 20 percent greater than the heat in spent uranium-oxide fuel assemblies. The increased decay heat load could reduce the fuel assembly storage density in the fuel pool and dry storage casks or increase fuel pool dwell time before dry storage. No increases in waste generation rates or characteristics are expected due to the change from uranium-oxide reactor fuel to mixed-oxide reactor fuel. However, there would be increases in waste generation for all waste categories due to operation of the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility to include the introduction of mixed TRU and TRU wastes. These increases are in addition to those listed in table 4.3.3.10-2 for the Large and Small tritium supply ALWR. As shown in table 4.8.3.1-4, approximately 399 yd^3 of mixed TRU and TRU wastes would require transport to a geologic repository (assuming one is available) after they have been processed to meet the WIPP waste acceptance criteria.

Since NTS has a very limited capability to manage TRU and mixed TRU wastes, additional facilities to handle TRU waste would be needed. The transport of the mixed TRU and TRU wastes to WIPP would require 35 truck shipments per year, 18 regular train shipments per year, or six dedicated train shipments per year. Two hundred gallons of liquid and 13 yd^3 of solid mixed LLW would require treatment in accordance with the NTS Site Treatment Plan. Approximately 0.16 acres per year of LLW disposal area would be required to dispose of the 524 yd^3 of solid LLW. Sufficient staging capacity exists to accumulate the 200 gallons of liquid and 13 yd^3 of solid hazardous wastes while awaiting shipment to a RCRA-permitted treatment and disposal facility. An additional 3,920 yd^3 of solid nonhazardous wastes would require disposal in the sanitary landfill. Additional liquid sanitary and industrial wastewater treatment facilities may be required if the Pit Disassembly/Conversion/Mixed Oxide Fuel Fabrication Facility is not collocated with the multipurpose reactor.

Potential Mitigation Measures. Each tritium supply technology and recycling facility would be designed to process its own waste into forms suitable for long-term storage or disposal and would use proven waste minimization and pollution prevention technologies to the extent possible. Some facility designs would produce waste quantities or waste forms that could undergo additional reductions by utilizing emerging technologies, thereby further reducing or mitigating impacts. Pollution prevention and waste minimization would be major factors in determining the final design of any facility constructed as part of the proposed action at NTS. Pollution prevention and waste minimization would also be analyzed as part of the site-specific analyses and tiered NEPA documents.

NTS has a very limited onsite treatment capability. The plans for remediation of inactive waste disposal areas will be formulated over the next 3.5 years, and these plans will likely result in changes (from current practices) in waste generation, treatment, storage, and disposal at NTS by the time tritium facilities begin operation. A mixed waste treatment facility is planned, and accommodation of the small amount of mixed LLW from the tritium facility would have a minor impact. The use of existing facilities for the staging of hazardous wastes could be considered, although the volume generated by the tritium facilities is sufficient that new facilities may be more feasible. Utilization of any of these facilities would require site-specific engineering studies and would be analyzed in site-specific tiered NEPA documents.

4.4 Oak Ridge Reservation

ORR was established in 1942 and is located on approximately 35,000 acres within the city boundaries of Oak Ridge, TN. Of the three major facilities on ORR, the Y-12 Plant is the primary location of the 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. Section 3.3.4 describes the other missions at ORR. DOE's property boundaries for ORR are illustrated in figure 4.4–1.

4.4.1 Description of Alternatives

Under the proposed action, any one of the four tritium supply technologies (HWR, MHTGR, ALWR, or APT) could be sited at ORR alone or collocated with a new tritium recycling facility. Section 3.4.2 provides a description of the tritium supply technologies and section 3.4.3.1 describes the tritium recycling facility. Figure 4.4.1–1 shows the location of existing facilities within ORR and the proposed TSS.

Under No Action, ORR would continue to perform the missions described in section 3.3.4. There are no facilities at ORR that would be phased out as a result of any of the proposed action alternatives discussed in the PEIS.

4.4.2 Affected Environment

The following sections describe the affected environment at ORR for land resources, air quality and acoustics, water resources, geology and soils, biotic resources, cultural and paleontological resources, and socioeconomics. In addition, the infrastructure at ORR, the radiation and hazardous chemical environment, and the waste management conditions are described.

4.4.2.1 *Land Resources*

The discussion of land resources at ORR includes land use and visual resources.

Land Use. ORR is located on approximately 35,000 acres within the corporate limits of the city of Oak Ridge, approximately 12 miles west of Knoxville, TN. All the land within ORR is owned by the Federal government and is administered, managed, and controlled by DOE. Generalized land uses at ORR and in the vicinity are shown in figure 4.4.2.1–1.

Land uses within ORR can be grouped into four major land use classifications: industrial, public/quasi-public, forest/undeveloped, and water. The industrial areas account for approximately 11,700 acres of the total site acreage. An additional 1,200 acres are used for a security buffer zone around various facilities. Approximately 800 acres are classified as public land and consist mainly of the 90-acre Clark Center Recreational Park, numerous small public cemeteries, and an onsite public road (OR DOE 1989b:5-10). The remaining area, about 21,600 acres, consists of forest/undeveloped land, some of which is managed as pine plantations for production of pulpwood and saw timber. The DOE water treatment facility, which provides water to many ORR facilities and the city of Oak Ridge, is located just north of Y-12. There are no prime farmlands on ORR.

In 1980, DOE designated approximately 13,600 acres of ORR undeveloped land as a National Environmental Research Park. The National Environmental Research Park is used by the national scientific community as an outdoor laboratory for environmental science research on the impact of human activities on the eastern deciduous forest ecosystem (DOE 1985a:3,27).

The proposed 600-acre TSS would be located within the west-central portion of ORR, between K-25 and Oak Ridge National Laboratory (figure 4.4.2.1–1) on forest/undeveloped land. The current primary land uses are environmental research and cultivation of pine plantations. A portion of the siting area, south of the Bear Creek Valley Road and west of State Route 95, is part of the National Environmental Research Park. There are two cemeteries within the area. There are three utility easements and also rights-of-way for State Routes 58, 95, and 327 (Blair Road) (OR DOE 1991f:2-6).

ORR has other facilities planned including proposed short-range projects (1995 through 1999). The short-range projects include the Composite Materials Laboratory, Center for Biological Sciences, Mixed Waste Treatment Facility, Recycle

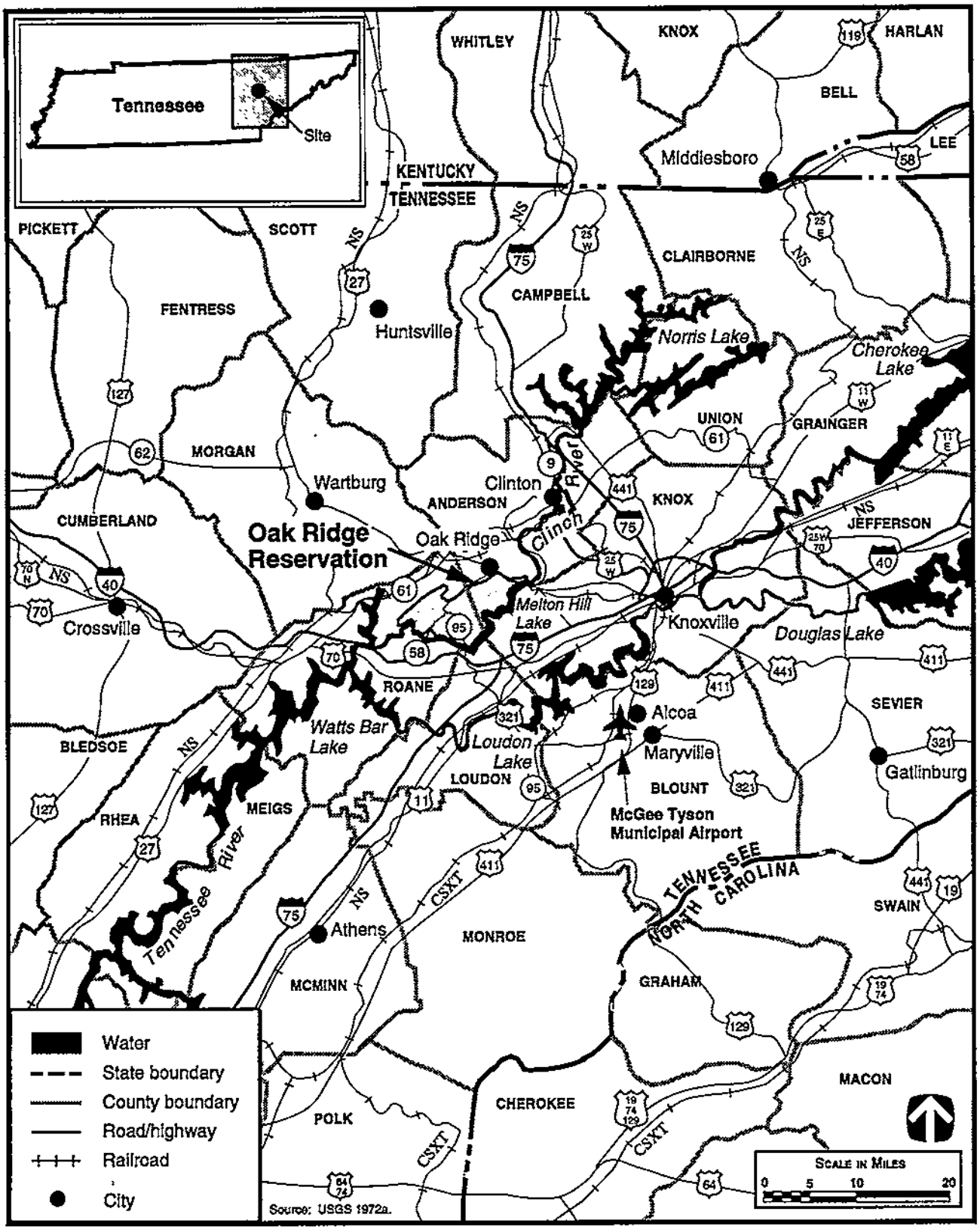


FIGURE 4.4–1.—*Oak Ridge Reservation, Tennessee, and Region.*

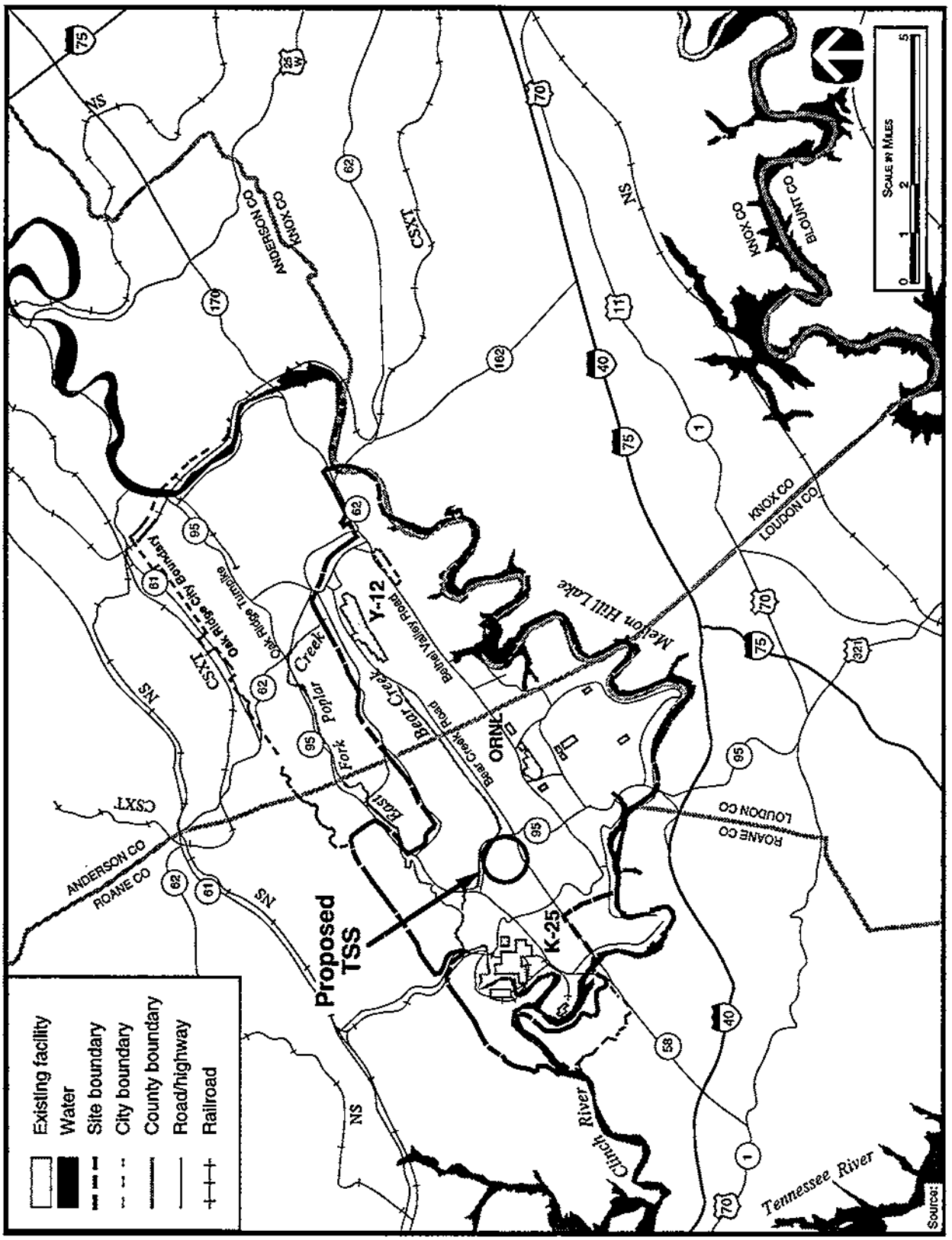


FIGURE 4.4.1–1.—*Primary Facilities and Proposed Tritium Supply Site at Oak Ridge Reservation.*

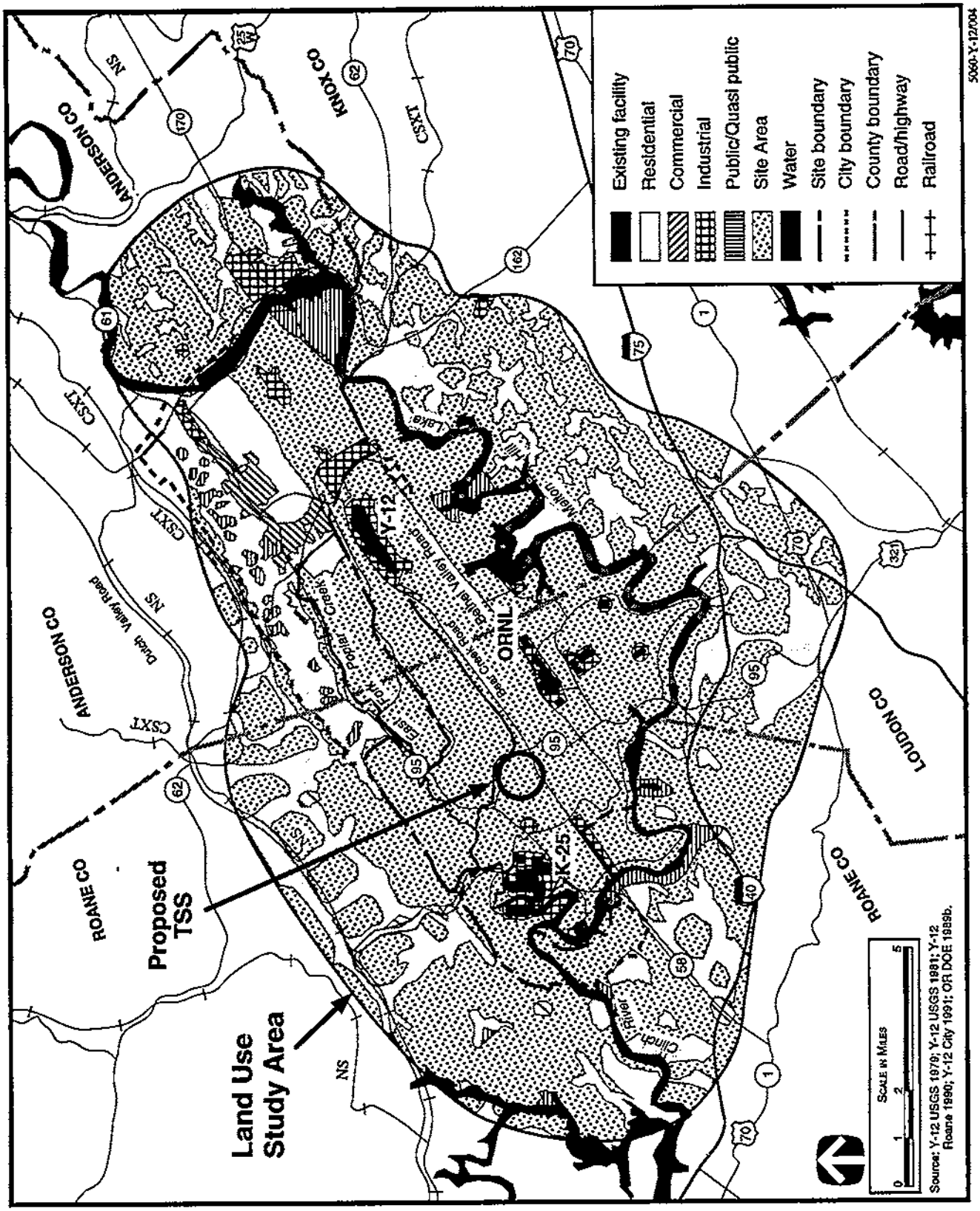


FIGURE 4.4.2.1–1.—*Generalized Land Use at Oak Ridge Reservation and Vicinity.*

and Materials Processing Facility, Process Waste Treatment Facility, Industrial Landfill Expansion and Upgrades, and Steam Plant Waste Water Treatment Facility. Figure 4.4.2.1–2 shows proposed development areas in relation to existing ORR facilities and the proposed TSS.

Land bordering ORR is predominately rural and used largely for residences, small farms, forest land, and pasture land. The city of Oak Ridge, along the northeast portion of the site, has a typical urban mix of residential, public, commercial, and industrial land uses. There are four residential areas along the northern boundary of ORR; each has several houses within 100 feet of the boundary.

Visual Resources. The ORR landscape is characterized by a series of ridges and valleys that trend in a northeast-to-southwest direction. The vegetation is dominated by deciduous forest mixed with some coniferous forest. Much of ORR's open fields (about 5,000 acres) have been planted in shortleaf and loblolly pine; smaller areas have been planted in a variety of deciduous and coniferous trees (OR DOE 1989b:3-14). The DOE facilities are brightly lit at night, making them especially visible. The developed areas are consistent with the Bureau of Land Management's VRM Class 5 designation. The remainder of ORR ranges from VRM Class 3 to Class 4 designation. Portions of the proposed TSS where contrasts caused by development activity are evident, but subordinate to the natural landscapes, are consistent with VRM Class 3. Other portions that have roads and utility lines that attract the attention of the viewer are designated VRM Class 4.

The viewshed consists mainly of rural land. The city of Oak Ridge is the only adjoining urban area. Viewpoints affected by DOE facilities are primarily associated with the public access roadways, the Clinch River/Melton Hill Lake, and the bluffs on the opposite side of the Clinch River. Views are limited by the hilly terrain, heavy vegetation, and generally hazy atmospheric conditions. Some partial views of the DOE water treatment plant facilities can be seen from the urban areas of the city of Oak Ridge.

4.4.2.2 *Site Infrastructure*

Section 3.3.4 describes the current missions at ORR. To support these missions, an extensive infrastructure exists as shown in table 4.4.2.2–1. Of critical importance to the proposed action is the electrical power capacities and reserves at each site. ORR is located in the Southeastern Electric Reliability Council Regional Power Pool and draws its power from the Tennessee Valley Authority Subregion. Characteristics of this subregion are given in table 4.4.2.2–2.

TABLE 4.4.2.2–1.—*Baseline Characteristics for Oak Ridge Reservation*

Current Characteristics	Value
Land	
Area (acres)	34,709
Roads (miles)	43
Railroads (miles)	17
Electrical	
Energy consumption (MWh/yr)	12,368,800
Peak load (MWe)	1,411
Fuel	
Natural gas (ft^3/yr)	3,122,000,000
Oil (GPY)	980,600
Coal[a] (ton/yr)	25,000
Steam (lb/hr)	340,000

[a] Oil and coal availability is unlimited, figures are for current use.

Source: ORR 1993a:8.

4.4.2.3 *Air Quality and Acoustics*

The following describes existing air quality and acoustics including a review of the meteorology and climatology in the vicinity of ORR. More detailed discussions of the air quality and acoustics methodologies, input data, and atmospheric dispersion characteristics are presented in appendix section B.1.3.4.

Meteorology and Climatology. The Cumberland and Great Smoky Mountains have a moderating influence on the climate at ORR. Winters are generally mild and summers warm, with no noticeable extremes in precipitation, temperature, or winds.

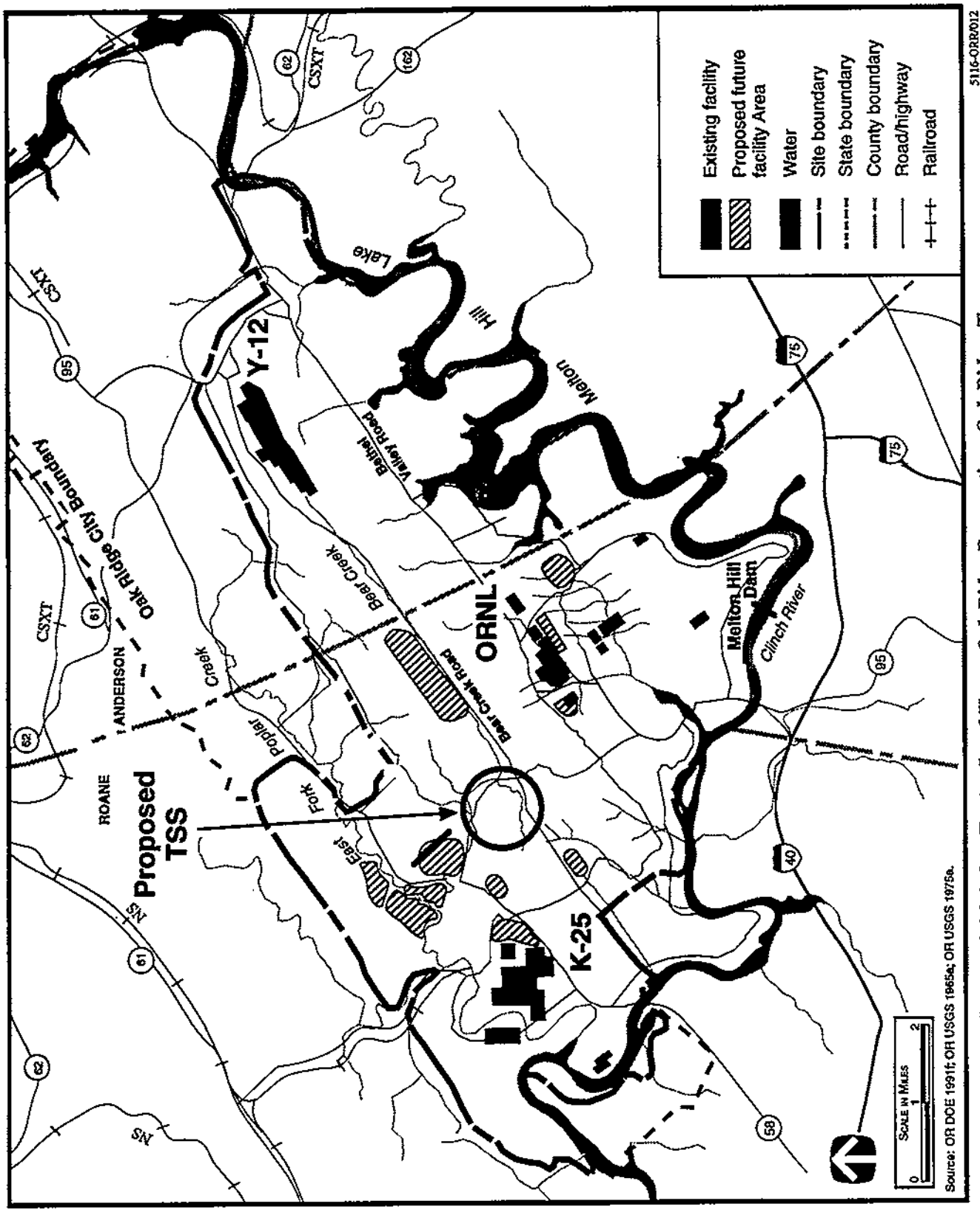


FIGURE 4.4.2.1-2.—*Future Land Use at Oak Ridge Reservation, Oak Ridge, Tennessee.*

TABLE 4.4.2.2–2.—*Subregional Power Pool Electrical Summary for Oak Ridge Reservation*

Type Fuel	Production[a] (percent)
Coal	49
Nuclear	39
Hydro/geothermal	11
Oil/gas	<1
Other[b]	0
Total Annual Production: 159,842,000 MWh	
Total Annual Load: 156,987,000 MWh	
Energy Exported Annually[c]: 2,407,000 MWh	
Generating Capacity: 33,370 MWe	
Peak Demand: 28,127 MWe	
Capacity Margin[d]: 4,550 MWe	

[a] Percentage does not total 100 percent due to round-off error.
[b] Includes power from both utility and nonutility sources.
[c] Energy exported is not the difference of production and load due to system losses and pumped storage.
[d] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.
Source: NERC 1993a.

The annual average temperature at ORR is 57.5 °F; the average daily minimum temperature is 27.7 °F in January and the average daily maximum temperature is 87.2 °F in July. The average annual precipitation is approximately 54.8 inches (NOAA 1991c:3). Prevailing wind directions tend to follow the orientation of the valley; up valley, from west to southwest, or down valley, from east to northeast. The annual average wind speed is approximately 4.6 mph. Additional information related to meteorology and climatology at ORR is presented in appendix section B.1.3.4.

Ambient Air Quality. ORR is located in Anderson and Roane Counties in the eastern Tennessee and southwestern Virginia Interstate AQCR 207. As of 1991, the areas within this AQCR were designated as attainment with respect to all NAAQS for criteria pollutants (40 CFR 81.343). Applicable NAAQS and Tennessee state ambient air quality standards are presented in appendix table B.1.3.1–1.

One Prevention of Significant Deterioration Class I area can be found in the vicinity of ORR. This area, the Great Smoky Mountains National Park, is located approximately 30 miles east of ORR. Since the promulgation of regulations, no Prevention of Significant Deterioration permits have been required for any emissions source at ORR.

Ambient air quality monitoring data collected at ORR during 1989 and 1990 are summarized in appendix table B.1.3.4–1. The primary emission sources of criteria pollutants are the steam plants at K-25, Y-12, and the Oak Ridge National Laboratory. Other emission sources include fugitive particulates from coal piles, the TSCA incinerator, other processes, vehicles, and temporary emissions from various construction activities (OR DOE 1987a:34-49). Appendix table B.1.3.4–2 presents emissions of criteria pollutants from ORR.

Table 4.4.2.3–1 presents the baseline ambient air concentration for criteria pollutants and other pollutants of concern at ORR. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Acoustic Conditions. Major noise emission sources within ORR include various industrial facilities, equipment, and machines. At the site boundary, noise emitted from the site is barely distinguishable from background noise levels of 35 to 50 dBA. Areas near the site that are within the city of Oak Ridge are typical of a suburban area. The primary source of noise at the site boundary and at residences near roads is traffic. During peak hours, the plant traffic is a major contribution to traffic noise levels in the area.

The State of Tennessee has not established specific numerical environmental noise standards applicable to ORR. The city of Oak Ridge has specific acceptable sound levels at property lines.

4.4.2.4 *Water Resources*

This section describes the surface water and groundwater resources at ORR.

Surface Water. The major surface water body in the immediate vicinity of ORR is the Clinch River, which borders the site to the south. There are four major sub-drainage basins on ORR that flow into the Clinch River and are affected by site operations: Poplar Creek, East Fork Poplar Creek, Bear Creek, and White Oak Creek (ORR 1992a:5). Two smaller drainage basins, Ish Creek and Grassy Creek, drain

TABLE 4.4.2.3–1.—*Comparison of Baseline Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines at Oak Ridge Reservation, 1992*

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	Baseline Concentration[a] ($\mu g/m^3$)
Criteria Pollutant			
Carbon monoxide (CO)	8-hour	10,000[b]	5
	1-hour	40,000[b]	11
Lead (Pb)	Calendar quarter	1.5[b]	0.05[c]
Nitrogen dioxide (NO_2)	Annual	100[b]	3
Ozone (O_3)	1-hour	235[b]	[d]
Particulate matter (PM_{10})	Annual	50[b]	9
	24-hour	150[b]	56
Sulfur dioxide (SO_2)	Annual	80[b]	29
	24-hour	365[b]	105
	3-hour	1,300[b]	401
Mandated by Tennessee			
Total suspended particulates (TSP)	24-hour	150[e]	75
Hydrogen fluoride (as fluorides)	30-day	1.2[e]	0.2
	7-day	1.6[e]	0.3
	24-hour	2.9[e]	[e]
	12-hour	3.7[e]	[f]
	8-hour	250[e]	0.60
Hazardous and Other Toxic Compounds			
CFC-11	8-hour	562,000[e]	46.2
CFC-114	8-hour	699,000[e]	24.1
Chlorine	8-hour	150[e]	4.1
Chlorodifluoromethane	8-hour	354,000[e]	16.4
Dichlorodifluoromethane	8-hour	495,000[e]	10.5
Hydrogen chloride	8-hour	750[e]	57
Methyl alcohol	8-hour	26,200[e]	216
Nitric acid	8-hour	520[e]	78
Sulfuric acid	8-hour	100[e]	20
Tetrachloroethylene	8-hour	33,900[e]	100
Trichloroethane	8-hour	191,000[e]	6.1
Trichlorotrifluoroethane	8-hour	767,000[e]	10.1

[a] The baseline concentration represents a conservative assessment of air quality since the contributions from individual sources do not necessarily occur at the same location.

[b] Federal standard (40 CFR 50).

[c] Value is maximum for 24-hour period.

[d] No monitoring data available.

[e] Data unavailable.

Source: OR DOE 1993a.

directly into the Clinch River. Each drainage basin takes the name of the major stream flowing through the area. Within each basin is a number of small tributaries. The natural surface water bodies in the vicinity of ORR are shown on figure 4.4.2.4–1.

The three major facilities at ORR each affect different basins of the Clinch River. Drainage from Y-12 enters both Bear Creek and East Fork Poplar Creek; K-25 drains predominantly into Poplar Creek; and Oak Ridge National Laboratory drains into the White Oak Creek drainage basin.

The proposed TSS lies within the central portion of ORR in an area drained by tributaries of Grassy, Ish, and Bear Creeks. No buildings or structures are currently located within the candidate area (OR DOE 1991c).

The Clinch River and connected waterways supply all raw water for ORR. The Clinch River has an average flow of 4,882 ft^3/s (OR USGS 1986a). The average flows of Grassy, Ish, and Bear Creeks near the proposed TSS are 2.82 ft^3/s, 1.77 ft^3/s, and 3.22 ft^3/s, respectively. The average flow at East Fork Poplar Creek is 51.4 ft^3/s. ORR and the city of Oak Ridge use approximately 18.3 MGD of water; the ORR water supply system, which includes the DOE treatment facility and the K-25 treatment facility, has a capacity of 32.1 MGD.

Wastewater treatment facilities are located throughout ORR. At Y-12, there are six treatment facilities with NPDES-permitted discharge points to East Fork Poplar Creek. Y-12 also has a permit to discharge wastewater to the Oak Ridge Treatment Facility. At Oak Ridge National Laboratory, there are three NPDES-permitted wastewater treatment facilities discharging into White Oak Creek basin. K-25 operates one sanitary sewage system discharging to Poplar Creek (OR DOE 1992c).

Clinch River water levels in the vicinity of ORR are regulated by a system of dams operated by the Tennessee Valley Authority. Melton Hill Dam controls the flow of the Clinch River along the northeast and southeast sides of ORR. Watts Bar Dam, on the Tennessee River near the lower end of the Clinch River, controls the flow of the Clinch River along the southwest side of ORR (ORNL 1986a).

The Tennessee Valley Authority has conducted flood studies along the Clinch River, Bear Creek, and East Fork Poplar Creek (OR TVA 1991a). Portions of Y-12 lie within the 100- and 500-year floodplains of East Fork Poplar Creek *(Oak Ridge Y-12 Technical Site Information*, Y/EN-SFPI). Studies have not been performed to delineate the 100- or 500-year floodplain boundaries of Grassy, Ish, and Bear Creeks near the proposed TSS (OR DOE 1991c). A site-specific assessment would be required before constructing any tritium supply and recycling facility at ORR.

Surface Water Quality. The streams and creeks of Tennessee are classified by the Tennessee Department of Environment and Conservation and defined in the State of Tennessee Water Quality Standards. Classifications are based on water quality, designated uses, and resident aquatic biota. The Clinch River is the only surface water body on ORR classified for domestic water supply. Streams at ORR are classified for fish, aquatic life, and livestock watering; irrigation; recreation; and wildlife. White Oak Creek and Melton Branch are the only streams not classified for irrigation. Portions of Poplar Creek, East Fork Poplar Creek, and Melton Branch are not classified for recreation (OR DOE 1992c).

ORR streams receive effluents from treated sanitary wastewater, industrial discharges, cooling water blowdown, stormwater, surface water runoff, and groundwater (OR DOE 1991f). At Y-12, Bear Creek, McCoy Branch, Rogers Quarry, and East Fork Poplar Creek receive effluents (OR DOE 1993a).

DOE is currently involved with remediation of East Fork Poplar Creek under CERCLA due to contamination from past releases from Y-12 operations. Significant cleanup activities are required onsite and offsite.

There were three primary areas of NPDES noncompliances at Y-12: creek outfalls, discharges from Rogers Quarry, and discharges from wastewater treatment facilities. Observable excursions along East Fork Poplar Creek consisted primarily of discharges of visible foam or oil sheens. The foam noncompliance occurred as a result of numerous sinks being tied to the storm sewer system. Most oil sheen noncompliances were the result of parking lot runoff (OR DOE 1993a). A building drain identification survey has been started to address the foam problem. Noncompliance of the discharge from Rogers Quarry as a result of elevated pH levels is believed to be caused by algae growth. A subsurface

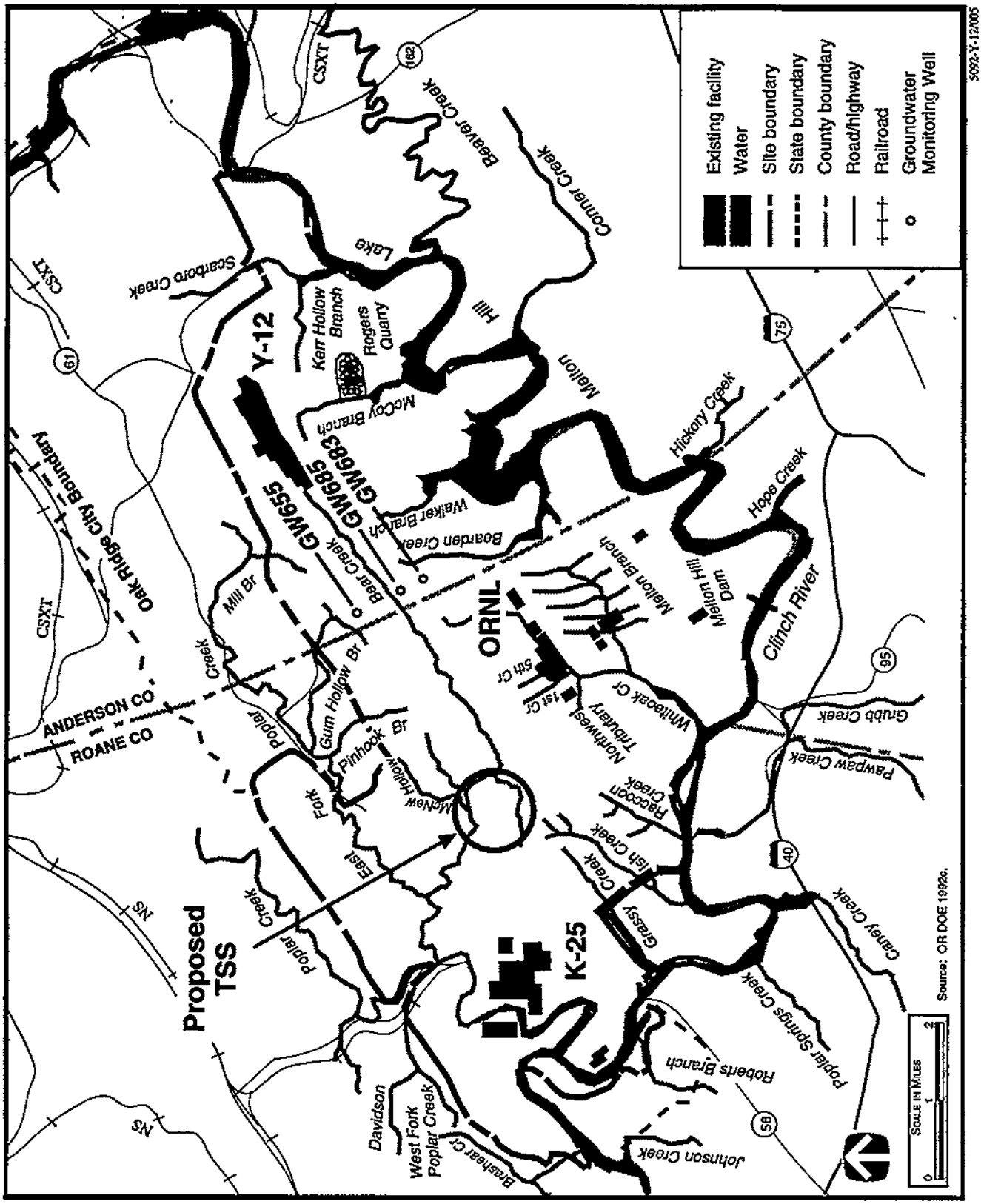


FIGURE 4.4.2.4-1.—*Surface Water Features at Oak Ridge Reservation.*

discharge pipe has been installed to allow deeper, CO_2-rich water to be discharged (OR DOE 1992c). Noncompliances with wastewater treatment facilities discharge limits are being addressed by better operational controls and preventive maintenance programs (OR DOE 1993a).

As shown in table 4.4.2.4–1, concentrations of copper, mercury, zinc, and dissolved solids exceed both chronic and acute (where applicable) state water quality criteria where the Clinch River leaves ORR. Monitoring data from this sampling site were compared with data from the Melton Hill Dam sampling site, located upstream of all ORR discharges. Concentrations at Melton Hill Dam were well below applicable water quality criteria.

TABLE 4.4.2.4–1.—*Summary of Clinch River Surface Water Quality Monitoring at Oak Ridge Reservation, 1991*

Parameter	Unit of Measure	Water Quality Criteria[a]	Average Water Body Concentration
Alpha (gross)	pCi/l	15[b]	0.416
Beta (gross)	pCi/l	50[c]	0.563
Cesium-137	pCi/l	120[d]	7.63
Chemical oxygen demand	mg/l	NA	11,071
Copper[e] (acute/chronic)	mg/l	0.018[f]/0.012[f]	5.5/5.2
Dissolved solids	mg/l	500[f]	140,000
Fluoride	mg/l	4.0[b]	100
Manganese	mg/l	0.05[g]	49.3
Mercury[e] (acute/chronic)	mg/l	0.0024[f]/0.000012[f]	0.24/0.24
Neptunium-237	pCi/l	1.2[d]	-0.0378[h]
Nitrate	mg/l	10.0[b]	0.373
pH	pH units	6.5-8.5[f]	8.04
Plutonium-238	pCi/l	1.6[d]	-1.23[h]
Plutonium-239	pCi/l	1.2[d]	-0.026[h]
Sodium	mg/l	NA	4,393
Sulfate	mg/l	250[g]	21,333
Suspended solids	mg/l	NA	17,917
Technetium-99	pCi/l	4,000[d]	-258.16[h]
Uranium, Total	mg/l	NA	0.001
Zinc[e] (acute/chronic)	mg/l	0.117[f]/0.106[f]	14/8.05

[a] For comparison only, except for parameters which have state water quality criteria.

[b] National Primary Drinking Water Regulations (40 CFR 141).

[c] Proposed National Primary Drinking Water Regulations, Radionuclides (56 FR 33050).

[d] DOE Derived Concentration Guides for water (DOE Order 5400.5). Derived Concentration Guides values are based on a committed effective dose equivalent of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the Derived Concentration Guides.

[e] Concentration of parameter exceeded Tennessee state water quality criteria. The state standards exceeded apply to protection of aquatic biota. For the protection of human health, the maximum contaminant levels for these compounds are as follows: copper, 1mg/L secondary maximum contaminant level; mercury, 0.002 mg/l maximum contaminant level; and zinc, 5 mg/l.

[f] Tennessee state water quality criteria.

[g] National Secondary Drinking Water Regulations (40 CFR 143).

[h] All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored concentration. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the environmental level and there is no significant impact from the facility.

Note: NA - not applicable.

Source: DOE 1993u; OR DEC 1991a; OR DOE 1991a; OR DOE 1992c.

Surface Water Rights and Permits. In Tennessee, the state's water rights laws are codified in the *Water Quality Control Act.* In effect, the water rights are similar to riparian rights in that the designated usages of a water body cannot be impaired. Requirements to withdraw water from available supplies would be dependent on intake location. Construction may require a 26A permit from Tennessee Valley Authority, review by the Watts Bar Inter-Agency Working Group, State Aquatio Resources Alteration Permit, or a Corps of Engineers 404 permit State 401 certification.

Groundwater. ORR is located in an area of sedimentary rocks of widely varying hydrological character. However, because of the topographic relief and a decrease in bedrock fracture density with depth, groundwater flow is restricted primarily to shallow depths and groundwater discharges primarily to nearby surface waters within ORR (ORNL 1992b). Depth to groundwater is generally 20 to 30 feet, but is as little as 5 feet in the area of Bear Creek Valley near Highway 95 (OR DOE 1992c).

Aquifers at ORR include a surficial soil and regolith unit and bedrock aquifers. The surficial aquifer consists of man-made fill, alluvium, and weathered bedrock. Bedrock aquifers occur in carbonates and low-yield sandstones, siltstones, and shales.

There are no Class I sole-source aquifers that lie beneath ORR. All aquifers are considered Class II aquifers (current potential sources of drinking water). Because of the abundance of surface water and its proximity to the points of use, very little groundwater is used at ORR. Only one supply well exists on the Reservation; it provides a supplemental water supply to an aquatics laboratory during extended droughts.

Recharge occurs over most of the area but is most effective where overburdened soils are thin or permeable. In the area near Bear Creek Valley, recharge into the carbonate rocks is mainly along Chestnut Ridge. Groundwater generally flows from the recharge areas to the center of Bear Creek Valley and discharges into Bear Creek and its tributaries (OR DOE 1992c).

Groundwater Quality. Groundwater samples are collected quarterly from over 1,000 monitoring wells throughout ORR. Groundwater samples collected from the monitoring wells are analyzed for a standard suite of parameters and constituents, including trace metals, volatile organic compounds, radioactive materials, and pH (ORNL 1992b). Background groundwater quality at ORR is generally good in the near surface aquifer zones and poor in the bedrock aquifer at depths greater than 1,000 feet due to high total dissolved solids.

Groundwater in Bear Creek Valley near Y-12 has been contaminated by hazardous chemicals and radionuclides (mostly uranium) from weapons production process activities. The contaminated sites include past waste disposal sites, waste storage tanks, spill sites, and contaminated inactive facilities (OR DOE 1992c). The groundwater quality as indicated by groundwater contamination monitoring wells near the proposed TSS at ORR is summarized in table 4.4.2.4–2.

Groundwater Availability, Use, and Rights. Industrial and drinking water supplies in the area are primarily taken from surface water sources. However, single-family wells are common in adjacent rural areas not served by the public water supply system. Most of the residential supply wells in the immediate area of ORR are south of the Clinch River (OR DOE 1992c). The State of Tennessee does not issue permits or allotments and does not regulate groundwater use.

4.4.2.5 *Geology and Soils*

Geology. ORR lies in the Valley and Ridge province of east-central Tennessee. The topography consists of alternating valleys and ridges that have a northeast-southwest trend, with most ORR facilities occupying the valleys; Y-12 and the proposed TSS are in the Bear Creek Valley. Bear Creek Valley and the adjacent Pine and Chestnut Ridges are underlain by rocks composed of siltstone, silty limestone, and shale with some sandstone. The present topography of the valleys is the result of stream erosion of the softer shales and limestones; the ridges are underlain by the more resistant sandstones and dolomites.

ORR is cut by many inactive faults formed during the Late Paleozoic Era. There is no evidence of capable faults in the immediate area of Oak Ridge within the definition of 10 CFR 100, Appendix A; the nearest are 300 miles west in the New Madrid fault zone (OR EG&G 1991a).

TABLE 4.4.2.4–2.—*Groundwater Quality Monitoring Data at Oak Ridge Reservation, 1991*

Parameter	Unit of Measure	Water Quality Criteria and Standard[a]	Well No. GW-655[b]	Well No. GW-683[b]	Well No. GW-685[b]
Alkalinity-CO_3	mg/l	NA	<1	<1	<1
Alkalinity-HCO_3	mg/l	NA	35	141	245
Alpha (gross)	pCi/l	15[c]	1.77	12.60	1.35
Aluminum	mg/l	0.05-0.2[d]	2.4	0.22	0.062
Barium	mg/l	2.0[c]	0.21	0.083	0.091
Beta (gross)	pCi/l	50[e]	1.59	27.40	6.68
Boron	mg/l	NA	0.016	0.063	0.054
Calcium	mg/l	NA	4.5	4.8	71
Chloride	mg/l	250[d]	<1	6.2	31
Chromium	mg/l	0.05[f]	0.034	<0.01	0.01
Copper	mg/l	1.3[c]	0.012	<0.004	<0.004
Fluoride	mg/l	4.0[c]	0.2	0.2	0.2
Iron	mg/l	0.3[d]	4.6	0.26	0.29
Lead	mg/l	0.015[c]	0.0096	<0.004	<0.004
Magnesium	mg/l	NA	6.4	14	20
Manganese	mg/l	0.05[d]	0.075	0.011	0.086
Nickel	mg/l	NA	<0.01	<0.01	<0.01
Nitrate-N	mg/l	10.0[c]	<0.2	4.4	2.74
pH	pH units	6.5-8.5[d]	7.9	7.13	7.38
Potassium	mg/l	NA	2	2	1.9
Sodium	mg/l	NA	6	4.4	18
Strontium	mg/l	NA	0.022	0.079	0.099
Sulfate	mg/l	250[d]	9.2	18.2	20
Total dissolved solids	mg/l	500[d]	94	212	350
Uranium	pCi/l	20[g]	<0.001	0.032	0.002
Vanadium	mg/l	NA	<0.005	<0.005	<0.005
Zinc	mg/l	5.0[d]	0.027	0.0077	0.0091

[a] For comparison only.

[b] Well locations are shown on figure 4.4.2.4-1.

[c] National Primary Drinking Water Regulations (40 CFR 141).

[d] National Secondary Drinking Water Regulations (40 CFR 143).

[e] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

[f] Tennessee water quality standards.

[g] DOE Derived Concentrations for water (DOE Order 5400.5). Derived Concentration Guides values are based on a committed effective does equivalent of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the Derived Concentration Guide.

Note: NA - not applicable.

Source: OR DEC 1991a; OR DOE 1992a.

The Oak Ridge area lies at the boundary between Seismic Zones 1 and 2 (figure 4.2.2.5–2). Since the New Madrid earthquakes of 1811–1812, at least 26 other earthquakes with a modified Mercalli intensity of III to VI have been felt in the Oak Ridge area; most of these have occurred in the Valley and Ridge province. The nearest seismic event occurred in 1930, 5 miles from ORR; it had an intensity of V at the site (OR EG&G 1991a).

There is no volcanic hazard at ORR. The area has not experienced volcanism within the last 230 million years. Therefore, future volcanism is not expected.

Soils. Bear Creek Valley lies on well to moderately well drained soils underlain by shale, siltstone, and sandstone. Developed portions of the valley are designated as urban land. Soil erosion from past land uses has ranged from slight to severe. Erosion potential is very high in those areas with slopes greater than 25 percent and which have been eroded in the past. Erosion potential is lowest in nearly flat-lying permeable soils that have a loamy texture (ORNL 1988b). Additionally, wind erosion is slight, shrink-swell potential is low-to-moderate, and the soils are acceptable for standard construction techniques.

4.4.2.6 *Biotic Resources*

The following describes biotic resources at ORR including terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. Within each biotic resource area, the discussion focuses first on ORR as a whole and then on the proposed TSS. Scientific names of species identified in the text are presented in appendix C. Also, presented in appendix C is a list of threatened and endangered species that may occur on the site or in the vicinity of ORR.

Terrestrial Resources. Plant communities are characteristic of the intermountain regions of central and southern Appalachia. Approximately 10 percent of ORR has been developed since it was withdrawn from public access; the remainder of the site has reverted to or been planted with natural vegetation (OR DOE 1989a:3-5). The vegetation of ORR has been categorized into seven plant communities (figure 4.4.2.6–1) (ORNL 1987a).

Pine and pine-hardwood forest is the most extensive plant community on ORR. Important species of this community type include loblolly pine, shortleaf pine, and Virginia pine (ORNL 1987a). Another abundant plant community is the oak-hickory forest, which is commonly found on ridges throughout ORR. Northern hardwood forest and hemlock-white pine-hardwood forest are the least common forest community types on ORR. Currently, forest resources are not managed for timber production, although in the past both cordwood and saw timber were produced (ORNL 1986b:1). Nine-hundred eighty-three species, subspecies, and varieties of plants have been identified on ORR (OR NERP 1993b:2).

Animal species found on ORR include 26 species of amphibians, 33 species of reptiles, 169 species of birds, and 39 species of mammals (OR NERP nda). Animals commonly found include the American toad, eastern garter snake, Carolina chickadee, northern cardinal, white-footed mouse, and raccoon. Although the whitetail deer is the only species hunted onsite (OR DOE 1991c: 4-6), other game animals are also present. Raptors, such as the northern harrier and great horned owl, and carnivores, such as the gray fox and mink, are ecologically important groups on ORR. A variety of migratory birds has been found at ORR. Migratory birds, their nests and eggs, are protected by the *Migratory Bird Treaty Act.*

Vegetative communities in the area of the proposed TSS are typical of ORR as a whole, with pine and pine hardwood and oak-hickory forest being the predominant community types. Fauna of the proposed TSS would also be similar to that expected throughout ORR.

Wetlands. Wetlands have recently been evaluated based on National Wetland Inventory maps and field surveys of vegetation. Soils and hydrology were not specifically considered in this survey (OR NERP 1991a:4). Wetland surveys conducted since 1992 have used the U.S. Army Corps of Engineers methodology. This survey uses the three criteria of hydrophytic vegetation, hydric soils, and wetland hydrology. Based on this survey, wetlands include emergent, scrub/shrub, and forested wetlands associated with embayments of the Melton Hill and Watts Bar Reservoirs, riparian areas bordering major streams and their tributaries, old farm ponds, and groundwater seeps. Well-developed communities of emergent wetland plants in the shallow embayments of the two reservoirs typically intergrade into forested wetland plant communities, which extend upstream through riparian areas associated with streams and their tributaries. Old farm ponds vary in size and support diverse plant communities and fauna. Although most riparian wetlands are forested, areas within utility rights-of-way, such as those in Bear Creek and Melton Valleys, support emergent wetland vegetation.

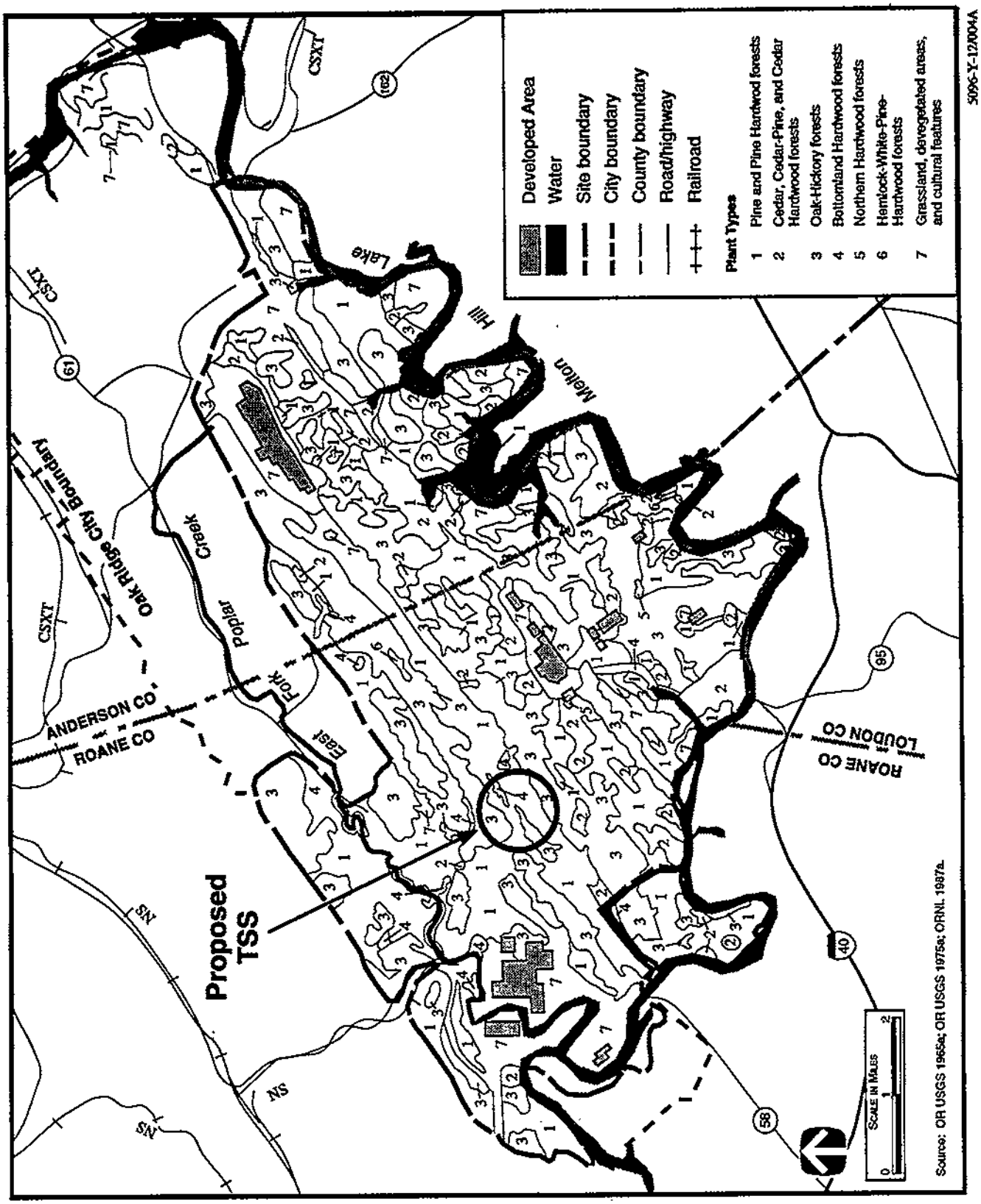


FIGURE 4.4.2.6–1.—*Distribution of Plant Communities at Oak Ridge Reservation.*

Within the vicinity of the proposed TSS, most wetlands are forested, located in riparian areas bordering headwater tributaries to Bear Creek, Grassy Creek, and Ish Creek. Forested wetlands also occupy several acres in the floodplain of Bear Creek as it flows through this vicinity. Emergent wetlands are present where tributaries to Grassy Creek cross a power line paralleling Bear Creek Road.

Portions of the forested wetland in the Bear Creek floodplain located near the northern edge of the proposed TSS are designated as a National Environmental Research Park Reference Area and Natural Area. This wetland area is uncommon because it is not subject to the changing water levels from the Tennessee Valley Authority dams, and it has a deep, organic substrate combined with a diversity of herbaceous plants. The springs, seeps, and old streambeds create a variety of habitats. This wetland supports a state-listed endangered plant species. A portion of the Reference Area and the entire Natural Area have been designated as state Natural Areas (OR NERP 1993a:13).

Aquatic Resources. Aquatic habitat on or adjacent to ORR ranges from small, free-flowing streams in undisturbed watersheds to larger streams with altered flow patterns due to dam construction. These aquatic habitats include tailwaters, impoundments, reservoir embayments, and large and small perennial streams. Aquatic areas in ORR also include seasonal and intermittent streams. The ORR streams evaluated for this project include Bear Creek, Grassy Creek, and Ish Creek, as well as the Clinch River.

Sixty-four fish species have been collected on or adjacent to ORR. The minnow family has the largest number of species and is numerically dominant in most streams (ORNL 1988c:0-43). Fish species representative of the Clinch River in the vicinity of ORR are shad, herring, common carp, catfish, bluegill, crappie, and drum (ORNL 1981b:138-149). The most important fish species taken commercially in the ORR area are common carp and catfish. Commercial fishing is permitted on the Clinch River downstream from Milton Hall Dam (OR WRA 1995a:1-5). Area recreational species consist of crappie, bass, sauger, sunfish, and catfish (OR DEC 1992e; OR WRA 1993a). Sport fishing is not permitted within ORR.

Fish species that have been recorded near the proposed TSS include 18 species in Bear Creek, 15 species in Grassy Creek, and 8 species in Ish Creek. Fish found in these streams include: blacknose dace, creek chub, shiner, Tennessee dace, banded sculpin, central stoneroller, bluntnose minnow, redbreast sunfish, and rock bass (OR DOE 1984a:3-30; ORNL 1988c:4-10; ORNL 1992c:4-5, 4-6, 4-7).

A National Environmental Research Park Aquatic Reference Area is located along Grassy Creek and its tributaries to the southwest of the proposed TSS (OR NERP 1993a:16). Grassy Creek has a diverse assemblage of invertebrates and fish species for a stream its size. ORR uses Grassy Creek as a reference area for studies of other streams affected by site development.

Threatened and Endangered Species. Eighty-eight Federal- and state-listed threatened, endangered, and other special status species have been identified on the site and in the vicinity of ORR (appendix table C–4). Thirty of these species may occur on the site or near the proposed TSS (table 4.4.2.6–1). No critical habitat for threatened or endangered species, as defined in the *Endangered Species Act* (50 CFR 17.11; 50 CFR 17.12), exists on ORR.

There are no Federal-listed threatened and endangered species known to occur in the proposed TSS. East Fork Poplar Creek, north of the proposed TSS, contains suitable habitat for the Indiana bat. ORR lies within the geographic range of the gray bat but suitable caves for this species are not known to occur on or near the proposed TSS. Neither bat species was collected during a limited survey conducted in 1992 (OR TT 1993a). The peregrine falcon may occur in the area as a rare migrant or winter visitor. Hellbenders may occur in streams that drain the proposed TSS. Federal candidate species do not receive legal protection under the *Endangered Species Act*, but the USFWS recommends that impacts to these species be considered in project planning.

A number of state-listed threatened and endangered species are known to occur in the proposed TSS. The Cooper's and sharp-shinned hawks are resident forest-dwelling raptors (ORNL 1987b:11,12). The Cooper's hawk probably nests on ORR, and the sharp-shinned hawk has been observed nesting on ORR (ORR 1992a:3). A large population of pink lady's-slippers have been found within a National Environmental Research Park Reference Area located northeast of the proposed TSS. This

TABLE 4.4.2.6–1.—*Federal- and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found On the Site or In the Vicinity of Proposed Tritium Supply Site at Oak Ridge Reservation*

Species	Status[a]		Known or Potential Habitat/Location
	Federal	State	
Mammals			
Eastern woodrat	C2	D	Rocky cliffs
Gray bat[b]	E	E	Caves, forage over water
Indiana bat[b]	E	E	Floodplain hardwood forest
Southeastern shrew	NL	D	Open fields and wood lots
Birds			
American peregrine falcon[b]	E	E	Rare migrant, winter visitor
Arctic peregrine falcon	T	E	Rare migrant, winter visitor
Bachman's sparrow	C2	E	Open pine woods
Barn owl	NL	D	Woodlands, dense conifers (winter)
Bewick's wren	C2	T	Thickets, underbrush
Black vulture[c]	NL	D	Entire Oak Ridge Reservation
Cooper's hawk[c]	NL	T	Woodland forest, uncommon permanent resident
Grasshopper sparrow	NL	T	Grassy, weedy fields
Northern harrier	NL	T	Rare migrant, winter visitor, forages in fields
Redheaded woodpecker	NL	D	Floodplain forest
Red-shouldered hawk[c]	NL	D	Woodland, floodplain forest
Sharp-shinned hawk[c]	NL	T	Woodland forest, rare permanent resident
Reptiles			
Northern pine snake	NL	T	Sandy pine woods, dry mountain ridges
Six-lined racerunner	NL	D	Open, well-drained areas
Amphibians			
Hellbender[c]	C2	D	Rivers, streams with running water and ample shelter
Tennessee cave salamander	C2	T	Caves with streams and pools in county
Fish			
Tennessee dace[c]	NL	D	Bear Creek and tributaries
Plants			
Canada (wild yellow) lily[c]	NL	T	Moist woods and edges in Natural Area just north and east of TSS
Fen orchid[c]	NL	E	Lower McNew Hollow, in Natural Area north of TSS
Ginseng[c]	NL	T	Rich woods, Bear Creek
Golden seal[c]	NL	T	Limestone, moist woods in Natural Area just northeast of TSS
Gravid sedge[c]	NL	S	Dry open soil
Michigan lily[c]	NL	T	Moist woods
Pink lady's-slipper[c]	NL	E	Pine Ridge area
Purple fringeless orchid[c]	NL	T	Along small powerline near Bear Creek Road
Tuberculed rein-orchid[c]	NL	T	Shaded wetland along Bear Creek, in Natural Area north of NFS

[a] Status code: C2 - candidate, Category 2 (possibly appropriate for protection); D, - deemed in need of management; E - endangered; NL - not listed; S - sensitive; T - threatened.

[b] USFWS Recovery Plan exists for this species.

[c] Species known to occur on or near proposed TSS.

Source: 50 CFR 17.11; 50 CFR 17.12; 55 FR 6184; 56 FR 58804; OR FWS 1990a; OR FWS 1991a; OR FWS 1992a; OR NERP 1993a; ORNL 1981a; ORNL 1984b; ORNL 1991b; ORR 1992a:4.

population is expected to occur throughout the Pine Ridge area, which includes the proposed project site (ORNL 1992a:1,2). The tubercled rein-orchid occurs in two National Environmental Research Park Natural Areas, one located near the northern section of the proposed TSS along Bear Creek and the other extending from the eastern edge of the proposed TSS. The purple fringeless orchid and Canada lily also occur in the latter area. Ginseng is found in the western edge of the TSS. The fen orchid occurs in the Bear Creek/McNew Hollow floodplain within a Natural Area located to the northeast of the proposed TSS (OR NERP 1993a:6).

Several species listed by the state in need of management occur in the proposed TSS. The red-shouldered hawk and black vulture are both resident raptor species that nest on ORR, the latter near the proposed TSS (ORNL 1988c:0-43; ORR 1991a:7). The Tennessee dace is an inhabitant of Bear Creek and its tributaries. This stream system, which flows through the proposed TSS, is designated as a National Environmental Research Park Aquatic Natural Area. The habitat of this fish is protected by the state (OR DOE 1990a:250). Bear Creek is the site of life history studies of the Tennessee dace and may contain the greatest density of this species in the state. The Tennessee dace also occurs in several other streams designated as Aquatic Natural Areas, including Ish Creek and a number of tributaries of East Fork Poplar Creek (OR NERP 1993a:10,11).

4.4.2.7 *Cultural and Paleontological Resources*

Prehistoric Resources. More than 20 cultural resources surveys have been conducted on ORR. About 90 percent of ORR has received at least reconnaissance-level studies, however, less than 5 percent has been intensively surveyed. Most cultural resources studies have occurred along the Clinch River and adjacent tributaries. Prehistoric sites recorded at ORR include villages, burial mounds, camps, quarries, chipping stations, limited activity locations, and shell scatters. Over 45 prehistoric sites have been recorded at ORR. At least 10 prehistoric sites may be considered potentially eligible for the NRHP; however, most of these sites have not yet been evaluated.

Only a reconnaissance-level survey has been conducted on portions of the proposed TSS. The survey found no prehistoric sites, however, additional prehistoric sites, mostly small camps and activity locations, may be identified in the unsurveyed portions of the proposed TSS.

Historic Resources. Several historic resources surveys have been conducted at ORR. Historic resources identified include both archaeological remains and standing structures. Documented log, wood frame, or fieldstone structures include cabins, barns, churches, gravehouses, springhouses, storage sheds, smokehouses, log cribs, privies, henhouses, and garages. Archaeological remains consist primarily of foundations, roads, and trash scatters. Sixty-five pre-1942 cemeteries were located within the original ORR (OR Robinson 1950a:130). Today there are 32 cemeteries within ORR since the size of the reservation has been reduced. More than 240 historic resources have been recorded at ORR, and 20 of those sites may be considered potentially NRHP-eligible. Freels' cabin, two church structures, and two guard houses have been listed on the NRHP. The X-10 Reactor is listed on the NRHP as a National Historic Landmark. Many other buildings and facilities at ORR are associated with the Manhattan Project and may be potentially eligible for the NRHP. Historic building surveys were completed during fiscal year 1994 at K-25 and Oak Ridge National Laboratory. Similar surveys occurred during fiscal year 1995 at Y-12.

A reconnaissance-level survey has been conducted on portions of the proposed TSS. Forty-five historic sites have been previously recorded; however, only four are considered potentially NRHP-eligible. Additional historic sites may be anticipated in the unsurveyed portions of the proposed TSS.

Native American Resources. The Overhill Cherokee occupied portions of the Tennessee, Hiwassee, Clinch, and Little Tennessee River Valleys by the 1700s. Overhill Cherokee villages consisted of a large townhouse, a summer pavilion, and a plaza; residences had both summer and winter structures. Subsistence was based on hunting, gathering, and horticulture. The Cherokee were relocated to the Oklahoma territory in 1838; some Cherokee later returned to the area from Oklahoma. Resources that may be sensitive to Native American groups include prehistoric and historic villages, ceremonial lodges, cemeteries, burials, and traditional plant gathering areas.

Paleontological Resources. The majority of geological units with surface exposures at ORR contain paleontological materials. All paleontological materials consist of invertebrate remains, and these assemblages have relatively low research potential.

4.4.2.8 *Socioeconomics*

Socioeconomic characteristics presented for ORR include employment and local economy, population, housing, public finance, and local transportation. Statistics for regional economy characteristics are presented for the regional economic area that encompasses 29 counties around ORR (appendix table D.2.1–2). The regional economic area is a broad labor and product market-based region linked by trade among economic sectors within the region. Statistics for population and housing, public finance, and local transportation are presented for the ROI, a 4-county area in which 95 percent of all ORR employees reside: Anderson County (35 percent), Knox County (37 percent), Loudon County (6 percent), and Roane County (17 percent). (See figure 4.4–1 for a map of counties and cities). Fiscal characteristics of the jurisdictions in the ROI are presented in the public finance section in appendix table D.3–47. The schools most likely to be affected by the proposed action include those funded by Anderson, Knox, Loudon, and Roane Counties and the cities of Clinton, Oak Ridge, Lenoir City, and Harriman. Assumptions, assessment methodologies, and supporting data are presented in appendix D.

Regional Economy Characteristics. Employment and local economy statistics for the ORR regional economic area are presented in appendix table D.3–38 and summarized in figure 4.4.2.8–1. Between 1970 and 1990, the civilian labor force in the regional economic area increased 50 percent. The unemployment rate in the regional economic area in 1990 was slightly higher than the rate for the State of Tennessee. The 1990 per capita income in the regional economic area was approximately 10 percent below the state.

As shown in figure 4.4.2.8–1, the percentage of total employment involving farming in the regional economic area was slightly higher than the state. The percentage employed in governmental activities was approximately the same. Nonfarm private sector activities of manufacturing, retail trade, and services were similar in the regional economic area and the state.

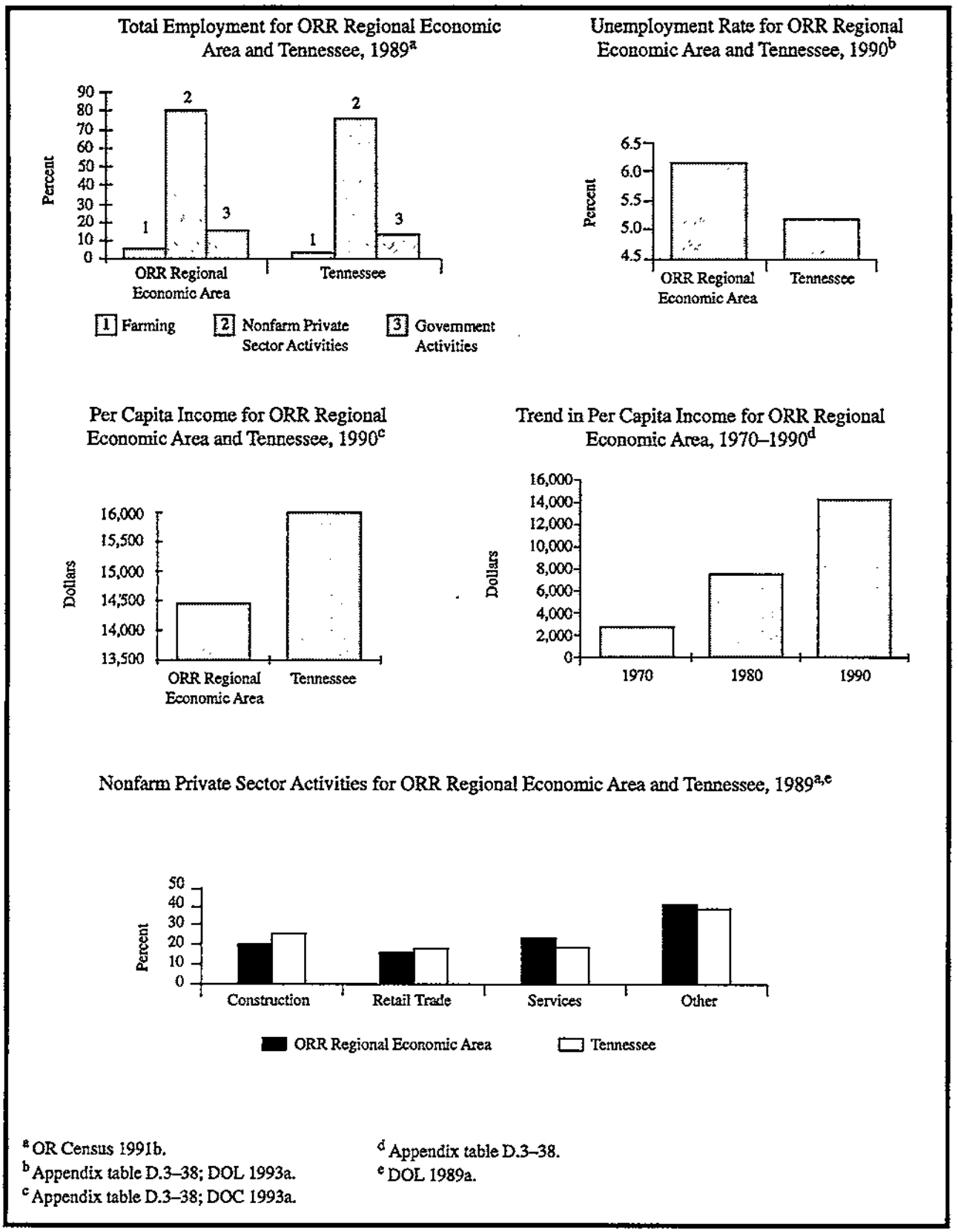
In 1990, ORR employed 15,273 persons (3.1 percent of the total regional economic area employment), increasing from 14,257 persons in 1970. Historical and future employment of ORR and the distribution of ORR employees by place of residence in the ROI are presented in appendix tables D.2.1–1 and D.3–37, respectively.

Population and Housing. Population and housing distribution in the ROI is presented in appendix tables D.3–41, D.3–44, and summarized in figure 4.4.2.8–2. The percent increase in population in the ROI from 1970 to 1990 was similar to that of the state except for the city of Clinton, which experienced an 87-percent increase. The percentage increase in housing units between 1970 and 1990 was similar to the percentage increase for the state with the exception of the city of Clinton (135-percent increase). Homeowner and rental vacancy rates in the ROI in 1990 were similar to those experienced by the state.

Public Finance. Financial characteristics of the local jurisdictions in the ROI that are most likely to be affected by the proposed action are presented in this section. The data reflect total revenues and expenditures of each jurisdiction's general fund, special revenue funds, and, as applicable, debt service, capital project, and expendable trust funds. Funding for schools in the ROI is provided by the county or city in which they are located. Major revenue and expenditure fund categories for counties and cities are presented in appendix table D.3–47. Figure 4.4.2.8–3 summarizes local governments revenues less its expenditures.

Local Transportation. Vehicular access to the Y-12 Plant is via Bear Creek Valley Road. State Routes 58, 62, 95, and 162 pass through ORR and are open to the general public (figure 4.4–1). Road segments providing access to Y-12 experience varying levels of traffic congestion. Traffic on State Route 162 generally experiences less traffic congestion than Bear Creek Valley Road and State Route 58, whereas traffic on State Routes 95 and 62 generally experience more traffic congestion.

Road reconstruction, widening, modification of interchanges, and new interchange construction projects are planned for segments of Bear Creek Valley Road, Scarboro Road, and State Routes 58, 62, and 95 (figure 4.4–1) (OR DOE 1991f; OR DOT 1992a; OR DOT 1992b).



[a] OR Census 1991b.
[b] Appendix table D.3–38; DOL 1993a.
[c] Appendix table D.3–38; DOC 1993a.
[d] Appendix table D.3–38.
[e] DOL 1989a.

FIGURE 4.4.2.8–1.—*Economy for Oak Ridge Reservation Regional Economic Area.*

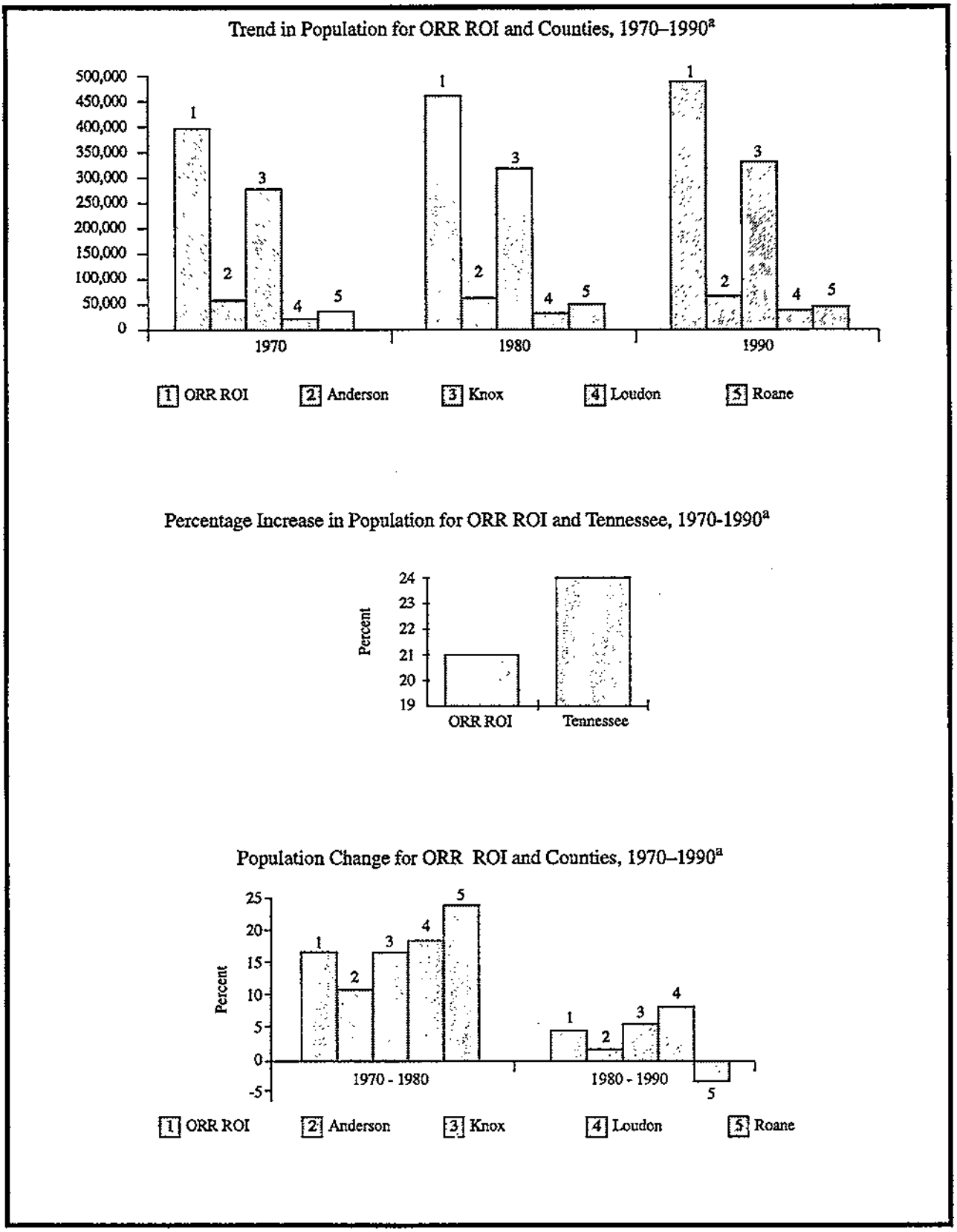
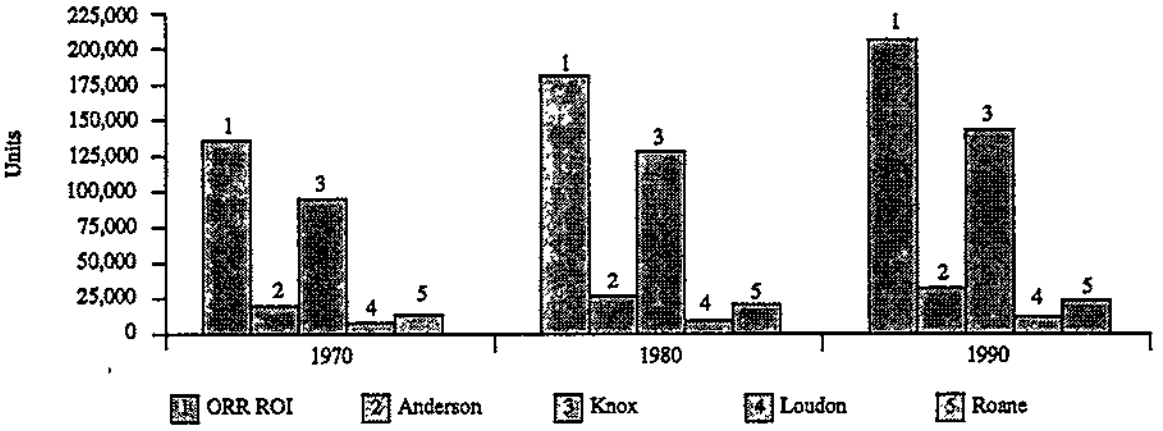
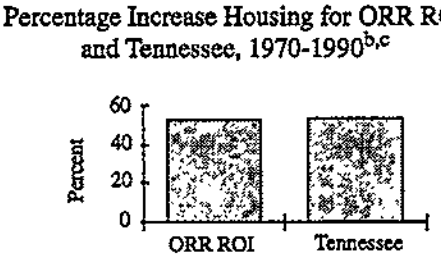
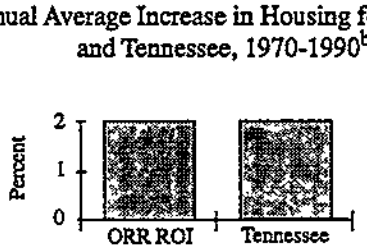
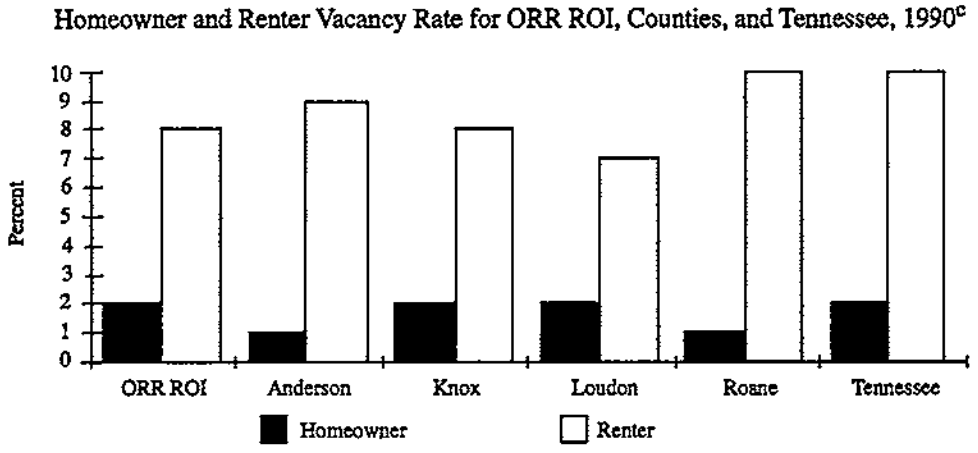


FIGURE 4.4.2.8–2.—*Population and Housing for Oak Ridge Reservation Region of Influence* [Page 1 of 2].



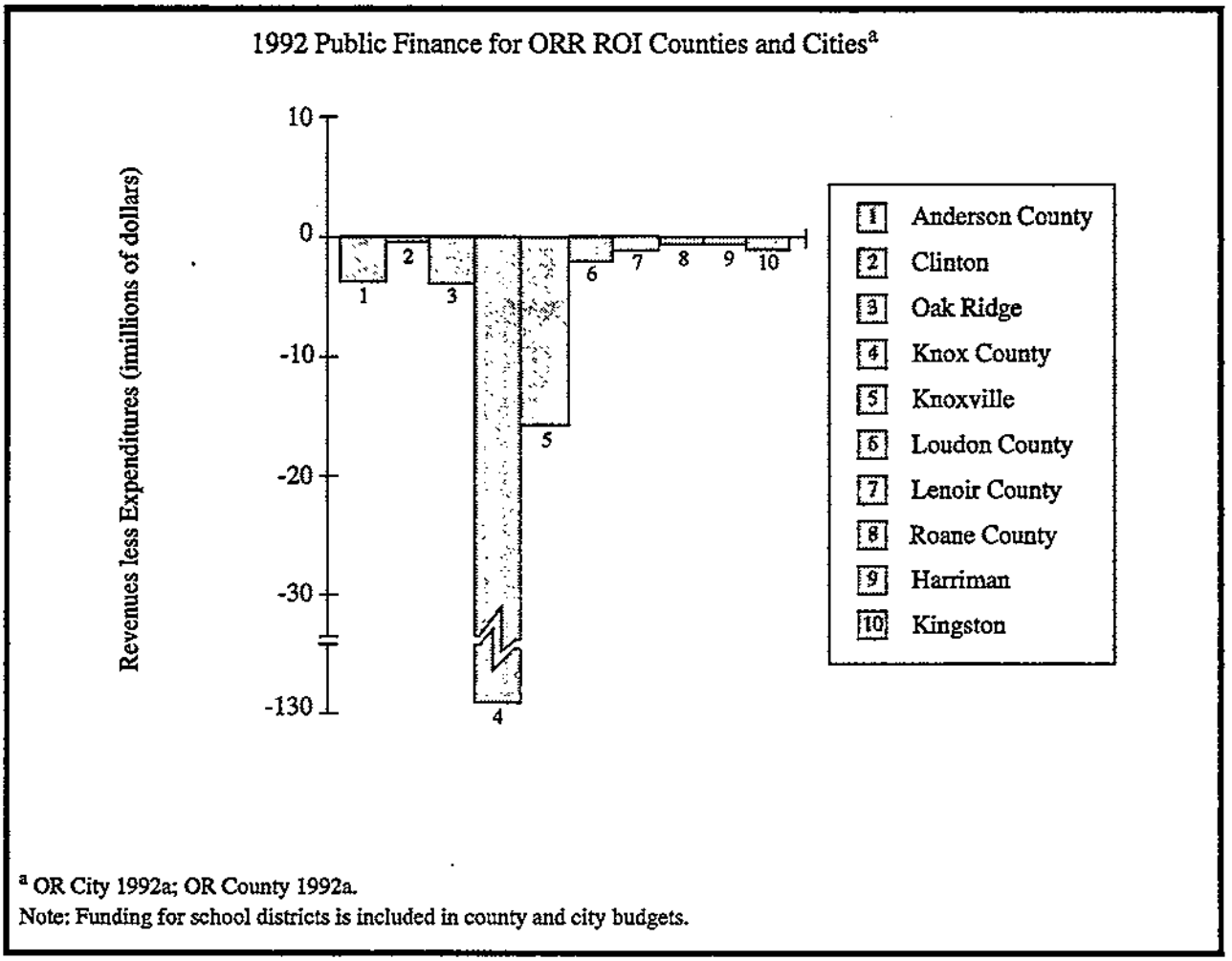






[a] Appendix table D.3–41.
[b] Appendix table D.3–44.
[c] Census 1972a; Census 1982a; OR Census 1991a.

FIGURE 4.4.2.8–2.—*Population and Housing for Oak Ridge Reservation Region of Influence* [Page 2 of 2].



[a] OR City 1992a; OR County 1992a.
Note: Funding for school districts is included in county and city budgets.

FIGURE 4.4.2.8–3.—*1992 Local Government Public Finance for Oak Ridge Reservation Region of Influence.*

The city of Oak Ridge has no public transportation service. Other modes of transportation within the ROI include railways and waterways. Railroad service in the ROI is provided by two main lines. A spur line serves Y-12 as well as the city of Oak Ridge. Waterborne transportation is potentially available via the Clinch River. The Clinch River waterway has rarely been used for DOE business and no designated port facilities exist for such purposes (USCOE 1991a).

The McGhee Tyson Regional Airport in the city of Knoxville, approximately 23 miles from ORR, supports regularly scheduled jet air passenger and cargo aircraft. Numerous private airports are located throughout the ROI (DOT 1991a).

4.4.2.9 *Radiation and Hazardous Chemical Environment*

The following provides a description of the radiation and hazardous chemical environment at ORR. Also included are discussions of health effects studies, emergency preparedness considerations, and an accident history.

Radiation Environment. Major sources of background radiation exposure to individuals in the vicinity of ORR are shown in table 4.4.2.9–1. All annual doses to individuals from background radiation are expected to remain constant over time. Accordingly, the incremental total dose to the population would result only from changes in the size of the population. Background radiation doses are unrelated to ORR operations.

TABLE 4.4.2.9–1.—*Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Oak Ridge Reservation Operations*

Source	Committed Effective Dose Equivalent (mrem/yr)
Natural Background Radiation	
Cosmic and cosmogenic radiation[a]	29
External terrestrial radiation[a]	38
Internal terrestrial radiation[b]	39
Radon in homes (inhaled)[b]	200
Other Background Radiation[b]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	371

[a] EPA 1981b. Value for radon is an average for the United States.
[b] NCRP 1987a.

Releases of radionuclides into the environment from ORR operations provide another source of radiation exposure to individuals in the vicinity of ORR. The radionuclides and quantities released from operations in 1992 are listed in the *Oak Ridge Reservation Environmental Report for 1992* (ES/ESH-31/V1). The doses to the public resulting from these releases and direct radiation are presented in table 4.4.2.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1992 report were used in the development of the reference environment (No Action) radiological releases at ORR in the year 2010 (section 4.4.3.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (appendix section E.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from ORR operations in 1992 is estimated to be approximately 8.5×10^{-6}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of ORR operations is less than 9 chances in 1 million. (Note that it takes several to many years from the time of exposure to radiation for a cancer to manifest itself.)

Approximately 2.2×10^{-2} excess fatal cancers were estimated from normal operations in 1992 to the population living within 50 miles of ORR. To place this number into perspective, it can be compared with the

TABLE 4.4.2.9–2.—*Doses to the General Public from Normal Operation at Oak Ridge Reservations, 1992 (committed effective dose equivalent)*

	Atmospheric Releases		Liquid Releases		Total	
Affected Environment	**Standard[a]**	**Actual[b]**	**Standard[a]**	**Actual[b,c]**	**Standard[a]**	**Actual**
Maximally exposed individual (mrem)	10	1.4	4	0.62	100	17[d]
Population within 50 miles[e] (person-rem)	None	43	None	1	100	44
Average individual within 50 miles[f] (mrem)	None	0.049	None	1.1×10^{-3}	None	0.05

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem per year limit from airborne emissions is required by the *Clean Air Act*, the 4 mrem per year limit is required by the *Safe Drinking Water Act*, and the total dose of 100 mrem per year is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 58 FR 16268 (10 CFR 834). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.
[b] DOE 1993a.
[c] The actual dose value conservatively includes all water pathways.
[d] Includes 15 mrem of direct radiation from a radiation field along Poplar Creek.
[e] In 1992, this population was approximately 880,000.
[f] Obtained by dividing the population dose by the number of people living within 50 miles of the site.

numbers of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a). Based on this national rate, the number of fatal cancers from all causes expected to occur during 1992 was 1,760 for the population living within 50 miles of ORR. This number of expected fatal cancers is much higher than the estimated 2.2×10^{-2} fatal cancers that could result from ORR operations in 1992Workers at ORR receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 4.4.2.9–2 presents the average, maximum, and total occupational doses to ORR workers from operations in 1992. These doses fall within radiological limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (appendix section E.2), the number of excess fatal cancers to ORR workers from operations in 1992 is estimated to be 0.027. A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Oak Ridge Reservation Environmental Report for 1992* (ES/ESH-31/V1). The concentrations of radioactivity in various environmental media (e.g., air, water, soil) in the site region (onsite and offsite) are also presented in the same report. ORR operations contribute small amounts of radioactivity to these media.

Chemical Environment. The background chemical environment important to human health consists of: the atmosphere, which may contain toxic chemicals that can be inhaled; drinking water, which may contain toxic chemicals that can be ingested; and other environmental media with which people may come in contact; e.g., surface waters during swimming, soil through direct contact, or via the food pathway. The baseline data for assessing potential health impacts from the chemical environment are those presented in previous sections of this PEIS, particularly sections 4.4.2.3 and 4.4.2.4.

Health impacts to the public can be minimized through effective administrative and design controls for decreasing pollutant releases to the environment and achieving compliance with permit requirements (e.g., air emissions and NPDES permit requirements). The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations via inhalation of air containing pollutants released to the atmosphere by ORR operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway.

TABLE 4.4.2.9–3.—*Doses to the Worker Onsite from Normal Operation at Oak Ridge Reservation, 1992 (committed effective dose equivalent)*

	Onsite Releases and Direct Radiation	
Affected Environment	**Standard[a]**	**Actual[b]**
Average worker (mrem)	None	4
Maximally exposed worker (mrem)	5,000	2,000
Total workers (person-rem)	None	68

[a] 10 CFR 835. DOE's goal is to maintain radiological exposure as low as reasonably achievable.
[b] DOE 1993x. The number of badged workers in 1992 was approximately 17,100.

Baseline air emission concentrations for hazardous/toxic air pollutants and their applicable standards are presented in section 4.4.2.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous/toxic chemicals is presented in appendix section E.3.

Health impacts to ORR workers during normal operations may include those from: inhalation of the workplace atmosphere, drinking ORR potable water, and possible other contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. ORR workers are also protected by adherence to occupational standards

that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Monitoring ensures that these standards are not exceeded. Additionally, DOE requirements (DOE Order 3790.1B) ensure that conditions in the work place are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at ORR are expected to be substantially better than required by the standards.

Health Effects Studies. Two epidemiologic studies were conducted to determine whether the Oak Ridge National Laboratory facility contributed to any excess cancers in the communities surrounding the facility. One study found no excess cancer mortality in the population living in counties surrounding Oak Ridge National Laboratory when compared to the control populations located in other nearby counties and elsewhere in the United States. The other found slight excess cancer incidences of several types in the counties near Oak Ridge National Laboratory, but none of the excess risks were statistically significant. More epidemiologic studies have been conducted to assess the health effects of the population working at ORR than at any other site reviewed for this PEIS. Excess cancer mortalities have been reported and linked to specific job categories, age, and length of employment as well as to the levels of exposure to radiation. For a more detailed description of the studies reviewed and the findings, refer to appendix section E.4.4.

Accident History. There have been no accidents with a measurable impact on offsite population during nearly 50 years of Y-12 operations at ORR. The most noteworthy accident in Y-12 history was the 1958 criticality accident. The impact from this accident resulted in temporary radiation sickness for a few ORR employees. In 1989, there was a one-time accidental release of xylene into the ORR sewer system with no adverse offsite impacts. Accidental releases of anhydrous hydrogen fluoride occurred in 1986, 1988, and 1992, with little onsite and negligible offsite impacts. The hydrogen fluoride system where these accidents occurred is being modified to reduce the probability of future releases and to minimize the potential consequences if a release does occur (ORR 1992a:6).

Emergency Preparedness. In the event of an accident, each DOE site has established an emergency management program. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response. Section 4.1.9 provides a description of DOE's emergency preparedness program.

DOE has overall responsibility for emergency planning and operations at ORR. However, DOE has delegated primary authority for event response to the operating contractor. Although the contractor's primary response is onsite, it does provide offsite assistance if requested under the terms of existing mutual aid agreements. If a hazardous materials event with offsite impacts occurs at a DOE ORR facility, elected officials and local governments are responsible for the state's response efforts. The Governor's Executive Order No. 4 established the Tennessee Emergency Management Agency as the agency responsible for coordinating state emergency services. When a hazardous materials event occurring at DOE facilities is beyond the capability of local government and assistance is requested, the Tennessee Emergency Management Agency Director may direct state agencies to provide assistance to the local governments. To accomplish this task and ensure prompt initiation of emergency response actions, the Director may cause the State Emergency Operations Center and Field Coordination Center to be activated. City or county officials may activate local emergency operations centers in accordance with existing emergency plans.

4.4.2.10 *Waste Management*

This section outlines the major environmental regulatory structure and ongoing waste management activities for ORR. A more detailed discussion of the ongoing waste management operations is provided in appendix section H.2.3. Tables 4.4.2.10–1 (Y-12), 4.4.2.10–2 (Oak Ridge National Laboratory), and 4.4.2.10–3 (K-25) present a summary of waste management at ORR for 1992.

The Department is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at ORR. The Department is engaged in several activities to bring its operations into full regulatory

TABLE 4.4.2.10–1.—*Spent Nuclear Fuel and Waste Management at Y-12 Plant* [Page 1 of 2]

Category	1992 Generation (yd^3)	Treatment Method	Treatment Capacity (yd^3/yr)	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity (yd^3)
Spent Nuclear Fuel	None	NA	NA	Storage vaults[a]	0.02[b]	None	NA
Low-Level							
Liquid	740 (148,000 gal)	Settlement and filtration	20,800[c] (4,200,000 GPY)	Stored onsite	None	NA	NA
Solid	7,700	Compaction/ incineration	62,000[d]	Stored onsite at Y-12 or K-25	5,710[e]	Onsite (K-25)	NA
Mixed Low-Level							
Liquid	2,120 (428,000 gal)	Settlement and filtration	5,800[f] (1,200,000 GPY)	Tanks	810[g] (163,000 gal)	NA	NA
Solid	740	None	NA	Staged for shipment	2,200[h]	None - offsite to NTS pending	NA
Hazardous							
Liquid	4,850 (978,000 gal)	Settlement and filtration	273,000[i] (55,000,000 GPY)	Tanks	1,320[j] (267,000 gal)	Offsite	NA
Solid	1,100[k]	None	NA	Staged for shipment	7,800	Offsite	NA
Nonhazardous (Sanitary)							
Liquid	3,200 yd^3/day (650,000 GPD)	Offsite[l]	6,940 yd^3/day (1,400,000 GPD)	None	NA	Offsite	NA
Solid	63,600[m]	None	NA	None	NA	Landfill (onsite)	640,000[n]

TABLE 4.4.2.10–1.—*Spent Nuclear Fuel and Waste Management at Y-12 Plant* [Page 2 of 2]

Category	1992 Generation (yd^3)	Treatment Method	Treatment Capacity (yd^3/yr)	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity (yd^3)
Nonhazardous (Other)							
Liquid	191,000[o] (38,500,000 gal)	Evaporation and incineration	208,000[p] (41,900,000 GPY)	None	NA	Offsite - NPDES outfall	NA
Solid	2,370[q]	None	NA	None	NA	Landfill VI and VII (onsite)[r]	1,700,000

[a] Building 9720-5.

[b] Based on conversion factor of 13,700 kg/yd^3. The size of all fuel-elements was assumed to be the same and the Bulk Shielding Reactor pool was assumed to be 80 percent full, while the High Flux Isotope Reactor was 40 percent full. The Tower Shielding Reactor pool is already full.Thus, the available capacity of spent fuel pools was determined to be 214 kg.

[c] West End Treatment Facility and Central Pollution Control Facility.

[d] Waste Fuel Preparation Facility.

[e] Includes the Classified Waste Storage Facility and the Depleted Uranium Oxide Storage Vaults.

[f] Includes Biodentification Facility, Cyanide Treatment Facility, and Groundwater Treatment Facility. The West End Treatment Facility, the Plating Rinsewater Treatment Facility, and the Central Pollution Control Facility can process mixed waste and LLW.

[g] OD9, OD10, and Waste Storage Facility.

[h] RCRA and PCB Container Storage Area (9720-58), Container Storage Facility (Bldg. 9720-12), PCB Drum Storage Facility (9407-7), and the Solid Storage Facility. Does not include Y-12 Salvage Yard.

[i] Plating Rinsewater Treatment Facility and Stream Plant Wastewater Treatment Facility.

[j] Liquid Organic Waste Storage Facility, OD3, Bldg. 9418-9, OD9, and Liquid Storage Facility.

[k] Currently, all RCRA-hazardous wastes are stored at Y-12 or K-25 awaiting further disposal.

[l] Oak Ridge Sewage Treatment Plant.

[m] Includes construction/demolition spoil, fly ash and classified waste.

[n] New sanitary landfill to open 1994. Current landfill is almost full.

[o] Includes wastewater treated at the Steam Plant Wastewater Treatment Facility (37,800,000 gal) and Plating Rinsewater Treatment Facility (375,000 gal).

[p] Approximate Central Pollution Control Facility, West End Treatment Facility, and Steam Plant Wastewater Treatment Facility NPDES permit annual discharge volume limits for East Fork Poplar Creek.

[q] Scrap metal.

[r] Serves all three sites and will be used only for construction debris.

Source: DOE 1993a; DOE 1993j; DOE 1993s; DOE 1993t; DOE 1994c; OR DOE 1992c; OR DOE 1993a; OR MMES 1993f; ORR 1993a:4; ORR 1993a:5.

TABLE 4.4.2.10–2.—*Spent Nuclear Fuel and Waste Management at Oak Ridge National Laboratory* [Page 1 of 2]

Category	1992 Generation (yd^3)	Treatment Method	Treatment Capacity (yd^3/yr)	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity
Spent Nuclear Fuel	0.008[a]	None	NA	Pools	0.04[b]	None	NA
Transuranic (Solid)							
Contact handled	14	None	NA	Staged for shipment	800	None, WIPP in future	NA
Remote handled	5	None	NA	Staged for shipment	290	None, WIPP in future	NA
Low-Level							
Liquid	1,970 (398,000 gal)	Ion exchange, decantation, stabilization, evaporation	340,000[c] (68,500,000 GPY)	Stored onsite	750 (150,000 gal)	NA	NA
Solid	510[d]	Compaction	14,800	Stored onsite	42,900[e]	Onsite	NA
Mixed Low-Level							
Liquid	None	See liquid low-level waste	Included in liquid low-level waste	Tanks	770 (155,000 gal)	NA	NA
Solid	160[f]	Planned	Planned	Staged for shipment	110[g]	None, offsite to NTS pending	NA
Hazardous							
Liquid	9 (1,850 gal)	Neutralization/ sedimentation and evaporation	261,000[h] (53,000,000 GPY)	None	NA	Offsite	NA
Solid	49[i]	None[j]	NA	Staged for shipment	120[k]	Incineration (K-25)/offsite disposal Planned - onsite disposal	Planned

TABLE 4.4.2.10–2.—*Spent Nuclear Fuel and Waste Management at Oak Ridge National Laboratory* [Page 2 of 2]

Category	1992 Generation (yd^3)	Treatment Method	Treatment Capacity (yd^3/yr)	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity
Nonhazardous (Sanitary)							
Liquid	467,000[l] (94,200,000 gal)	Biological degradation	542,000[m] (109,300,000 GPY)	None	NA	NPDES outfall	NA
Solid	9,500[l]	None	NA	None	NA	Y-12 landfill	Included in Y-12 table 4.4.2.10–1
Nonhazardous (Other)							
Liquid	783,000[n] (157,000,000 gal)	Evaporation and Incineration	2,000,000[o] (403,000,000 GPY)	None	NA	Offsite	NA
Solid	40[p]	None	NA	None	NA	Y-12 landfill and SWSA 6 burial	Included in sanitary

[a] The HFIR research reactor generates 12 cores per year (9.4 kg U-235 per core). Based on conversion factor of 13,700 kg/yd^3.

[b] Based on conversion factor of 13,700 kg/yd^3 and the size of all fuel elements is assumed to be the same. Includes 600 kg of available spent fuel capacity at the HFLR pool (40 percent full) and 2 kg available capacity at the Bulk Shielding Reactor Pool (80 percent full).

[c] Process Waste Treatment Plant, Melton Valley Low-Level Waste Immobilization Facilities and Liquid Low-Level Waste Evaporation Facility.

[d] Includes scrap metal and sludge from Sanitary Waste Treatment Plant.

[e] Solid Waste Storage Area 6.

[f] Includes TSCA-regulated mixed LLW and radioactive asbestos. No RCRA- or state-regulated mixed LLW was generated in 1992.

[g] Mixed Waste Drum Storage Pads (Bldg. 7507W Part A permit - 22,000 gal).

[h] Nonradiological Wastewater Treatment Plant (Approximate capacity is 300 gpm).

[i] Includes PCB and asbestos.

[j] The Chemical Detonation Facility treats small amounts of hazardous water that would be dangerous to transport offsite. Explosives such as aged picric acid are detonated in this facility.

[k] Hazardous Waste Storage Facility (Bldg. 7652 Part B permit - 15,125 gal and Bldg. 7507 Part A permit - 8,250 gal).

[l] 1991 generation rates.

[m] Sanitary Waste Treatment Facility design capacity.

[n] Includes 374,000 yd^3 from Process Waste Treatment Facility and steamplant blowdown (1991 generation rate).

[o] NPDES discharge limit for Oak Ridge National Laboratory Waste Water Treatment Facility.

[p] Scrap metal estimate not available (1991 generation rate).

Note: HFIR - High Flux Isotope Reactor.

Source: DOE 1993a; DOE 1993r; DOE 1993s; DOE 1993t; DOE 1994c; OR DOE 1993a; OR DOE 1993b; OR MMES 1993d; ORR 1993a:4; ORR 1993a:6.

TABLE 4.4.2.10–3.—*Waste Management at K-25 Site* [Page 1 of 2]

Category	1992 Generation (yd^3)	Treatment Method	Treatment Capacity (yd^3/yr)	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity
Low-level							
Liquid	Included in hazardous liquid	Settlement and Filtration	1,860[a] (375,000 GPY)	None	NA	NA	NA
Solid	3,100[b]	Compaction/ smelting	Offsite	Stored onsite	Included in solid mixed low-level[c]	Planned onsite-nonmetallic Planned offsite-metallic	Planned
Mixed Low-Level							
Liquid	1,500 *302,000 gal)	Settlement and filtration/ incineration	452,000[d] (91,000,000 GPY)	Stored onsite	127,000[e] (26,000,000 gal)	NA	NA
Solid	11[f]	Planned	Planned[g]	Stored onsite	157,000[h]	None	NA
Hazardous							
Liquid	80,000[i] (16,000,000 gal)	Neutralization/ precipitation	82,000[j] (16,600,000 GPY)	Stored for processing	NA	Planned offsite	NA
Solid	900[k]	Compaction for non-RCRA/TSCA and incineration	2,100[l]	Staged for shipment	Included in solid mixed low-level	Planned offsite	NA
Nonhazardous (Sanitary)							
Liquid	844,000[m] (170,000,000 gal)	Neutralization/ precipitation	1,100,000 - sewage[n] (219,000,000 GPY) 95,200 - industrial[o] (19,200,000 GPY)	None	NA	NPDES outfall	NA
Solid	11,700[m]	None	NA	None	NA	Oak Ridge Landfill (offsite)	NA

TABLE 4.4.2.10–3.—*Waste Management at K-25 Site* [Page 2 of 2]

Category	1992 Generation (yd^3)	Treatment Method	Treatment Capacity (yd^3/yr)	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity
Nonhazardous (Other)							
Liquid	3[m] (600 GPY)	See liquid sanitary	Included in liquid sanitary	None	NA	See liquid sanitary	NA
Solid	5,600[p]	None	NA	Stockpiled at scrap yard	Unspecified capacity	Y-12 landfill and metal sold to public	Included in Y-12 table 4.4.2.10–1

[a] TSCA Incinerator (K-1435). Also treats mixed waste.
[b] May include some PCB-tainted waste.
[c] Does not include 6.9-acre scrap metal storage site.
[d] Central Neutralization Facility normal operating capacity.
[e] Includes current permitted container (solid/sludges/liquid wastes) and tank (liquids) storage capacity.
[f] Includes contaminated asbestos/beryllium oxide (BeO) and may include some PCB-tainted waste.
[g] Sludge Fixation Facility may be used after engineering problems are solved.
[h] Total current permitted waste pile unit storage capacity.
[i] Hydrogen softener blowdown from the steam plant and TSCA Incinerator wastewater.
[j] Amount of hazardous liquid waste treated in 1992. Some may also be included in mixed waste treatment capacity.
[k] Uncontaminated asbestos/BeO and PCB.
[l] Amount of hazardous (RCRA/TSCA) solid waste treated in 1992.
[m] 1991 generation rates.
[n] Sewage treatment plant capacity.
[o] Nonhazardous waste section of the Central Neutralization Facility. May be part of liquid mixed waste treatment capacity.
[p] Includes construction/demolition spoil and scrap metal (1991 generation rates).
Source: DOE 1993a; DOE 1993h; DOE 1994c;OR DOE 1992c; OR DOE 1993a; OR DOE 1993b; ORNL 1993a; ORR 1993a:4.

compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed upon milestones.

EPA placed ORR on the NPL on November 21, 1989. DOE, EPA Region IV, and the Tennessee Department of Environment and Conservation completed a Federal Facility Agreement effective January 1, 1992. This agreement coordinates future assessments and remedial activities at ORR under CERCLA with existing actions being conducted under RCRA and applicable state laws, minimizes duplication, expedites response actions, and achieves a comprehensive remediation of the site.

ORR generates and manages spent nuclear fuel and the following waste categories: TRU, LLW, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

Spent Nuclear Fuel. ORR generates and manages a small quantity of spent nuclear fuel. The only operating reactor is the Oak Ridge National Laboratory High-Flux Isotope Reactor, which is used to produce isotopes for medical and industrial applications, neutron scattering experiments, and various materials irradiation experiments. ORR has also received some offsite shipments of reactor irradiated nuclear material. Most of the fuel and irradiated nuclear material is stored in numerous buildings and hot cells at Oak Ridge National Laboratory and one building at Y-12. Some of the fuel still remains in the core of the inactive research reactors. Irradiated fuel and its associated fission products are stored in dry wells at Oak Ridge National Laboratory in Solid Waste Storage Area-5N. A small amount of irradiated spent nuclear fuel is stored in wells and trenches in Solid Waste Storage Areas-5S and -6. The interim management of the spent nuclear fuel (pending the availability of a geologic repository) will be in accordance with the ROD published in the *Federal Register* (60 FR 28680) on June 1, 1995, for the *DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE/EIS-0203-F).

High-Level Waste. ORR does not generate or manage HLW.

Transuranic Waste. Oak Ridge National Laboratory is the only generator of TRU waste at ORR. Solid TRU waste consisting of filters, paper, metals, and other items was generated at Oak Ridge National Laboratory through laboratory, pilot plant, and reactor operations in 1992. This includes both contact-handled and remote-handled TRU waste contaminated with lead and, in some cases, mercury. Contact-handled waste is TRU waste that contains mainly plutonium, which emits alpha particles and low-energy photons. The packaging is designed to provide sufficient containment and shielding to minimize personnel exposure problems. Remote-handled TRU waste contains activation materials and fission products that decay and emit beta and gamma radiation on the surface of the packaging that exceeds 200 mrem/hr.

As of December 31, 1992, approximately 1,400 yd^3 of TRU wastes were in retrievable drum or concrete cask storage. The amount of remote-handled waste was about 1,500 yd^3 (DOE 1994c:89). Current activities center around certification of contact-handled waste, planning/designing of a repackaging and certification facility for remote-handled wastes, and planning for shipment of wastes to the WIPP or another suitable repository which can provide for the disposal of TRU wastes pursuant to the provisions of 40 CFR 191.

Low-Level Waste. Solid LLW consisting primarily of radioactively-contaminated construction debris, wood, paper, asbestos, trapping media, process equipment, and radionuclides removed from liquid and airborne discharges is generated at ORR. Currently, solid LLW is being stored at K-25 and Y-12 for future disposal. Contaminated scrap metal is stored above ground at the K-770 scrap metal facility and the Y-12 old salvage yard until further disposal methods are evaluated. As of 1992, the amount of LLW buried at ORR was approximately 577,000 yd^3 (DOE 1994c:121).

The primary generator of radioactively-contaminated liquid waste is the K-1435 TSCA Incinerator from the wet scrubber blowdown. This waste is currently being treated at the Central Neutralization Facility,

which provides pH adjustment and chemical precipitation. Treated effluents are discharged through an NPDES outfall. The contaminated sludges are stored above ground at K-25.

The Energy Systems Waste Management Organization has been established and assigned the responsibility to design, construct, and operate all new LLW disposal facilities for ORR. This organization is located at K-25. The new LLW disposal facilities will serve waste generators from all three DOE facilities on ORR. The Low-Level Waste Disposal Facilities project will provide new disposal facilities at a new centralized location of ORR for LLW, and capacity for up to 40 years at current generation rates. The facility will be able to handle tritium wastes. The disposal facility will utilize state-of-the-art disposal technologies for Below Regulatory Concern/Class L-I wastes and for Class L-II wastes. The limits for tritium waste are 5.6×10^5 Ci/yd^3 for Class L-I wastes and 1.2×10^6 Ci/yd^3 for Class L-II wastes. Class L-I waste is LLW that is suitable for disposal using sanitary/industrial landfill disposal technology and will not expose any member of the public to an effective dose equivalent of more than 10 mrem per year at the time of disposal. Class L-II waste is LLW primarily containing fission product radionuclides with half-lives of 30 years or less that is suitable for disposal in engineered facilities designed to isolate the waste from the environment and the public for a period of time sufficient to allow for the decay of radionuclides to such a level that any member of the public will not be exposed to an effective dose equivalent of more than 10 mrem per year (OR DOE 1992b:9-7). As currently scheduled, the Class L-II facility, for wastes contaminated with very low concentrations of long half-life radionuclides, is expected to be operational in 2002. DOE has indefinitely postponed construction of the Class L-I facility for wastes contaminated with low concentrations of predominantly short half-life radionuclides. The Federal Facility Agreement has specific requirements concerning LLW tank systems.

Mixed Low-Level Waste. RCRA mixed, radioactive land disposal restricted waste (including some nonradiological classified land ban waste) has been stored in some areas at K-25. Because storage of these wastes is in violation of RCRA, ORR entered into a Federal Facility Compliance Agreement for RCRA Land Disposal Restriction wastes with EPA on June 12, 1992. This Federal Facility Compliance Agreement recognizes that DOE will continue to generate and store such mixed wastes subject to land disposal restrictions. The terms of this agreement are presently being reviewed and will be renegotiated pursuant to the requirements of the *Federal Facility Compliance Act*. This compliance agreement will form the basis for the site-specific treatment plan required by the *Federal Facility Compliance Act* of 1992.

Sludges contaminated with low-level radioactivity are generated by settling and scrubbing operations and in the past were stored in K-1407-B and 1407-C ponds at K-25. Sludges have been removed from these ponds and a portion have been fixed in concrete at the K-1419 Sludge Treatment Facility and stored above ground at the K-1417 Casting and Storage Yard. These materials are considered mixed waste and a delisting petition has been submitted to EPA. Disposition of this waste is pending a determination of this petition. Mixed waste sludges are also generated at Y-12 in the treatment of nitrate waste from purification/recycling of uranium and in the treatment of plating shop waste.

The K-25 TSCA incinerator has a design capacity to incinerate 2,000 lb/hr of mixed liquid waste and up to 1,000 lb/hr of solids and sludge (200 lb/hr maximum sludge content). DOE guidance currently does not allow incineration of solids/sludges. Because of permit limits (TSCA, RCRA, State of Tennessee), the incinerator is not running at full capacity. It is currently incinerating approximately 3,000,000 lb/yr (ORR 1993a:2).

Uranium-contaminated PCB wastes (i.e., mixed wastes) are being stored in excess of the 1-year limit imposed by TSCA because of the lack of treatment and disposal capacities. DOE and EPA have signed a Federal Facility Compliance Agreement, effective February 20, 1992, to bring the facility into compliance with TSCA regulations for use, storage, and disposal of PCBs. It also addressed the approximately 10,000 pieces of nonradioactive PCB-containing dielectric equipment associated with the shutdown of diffusion plant operations.

Hazardous Waste. RCRA-regulated and PCB wastes are generated by ORR in laboratory research, electroplating operations, painting operations,

descaling, demineralizer regeneration, and photographic processes. Certain other wastes (e.g., spent photographic processing solutions) are processed onsite into a nonhazardous state. Those wastes that are safe to transport and contain no DOE-added radioactivity are shipped offsite to RCRA-permitted commercial treatment/disposal facilities. Small amounts of reactive chemical explosives that would be dangerous to transport offsite, such as aged picric acid are processed onsite in the Chemical Detonation Facility at Oak Ridge National Laboratory.

The majority of the Y-12 hazardous waste treatment, storage, and disposal units are currently operating in accordance with RCRA interim status requirements. Y-12 has submitted a RCRA Part B Permit application to the state for all hazardous waste treatment storage and disposal facilities. These applications are presently under review with the Tennessee Department of Environment and Conservation and the units are awaiting issuance of final RCRA operating permits. These permits will cover more than 200 RCRA waste streams, 48 90-day waste accumulation areas, and 49 underground tanks.

Nonhazardous Waste. Nonhazardous wastes are generated from ORR maintenance and utilities. For example, the steam plant produces nonhazardous sludge. Scrap metals are discarded from maintenance and renovation activities and are recycled when appropriate. Construction and demolition projects also produce nonhazardous industrial wastes. All nonradioactive medical wastes are autoclaved to render them noninfectious and are sent to the Y-12 Sanitary Landfill. A new landfill became operational in March 1994. Remedial action projects also produce wastes requiring proper management. The State of Tennessee permitted landfill receives nonhazardous industrial materials such as fly ash and construction debris. Asbestos and general refuse are managed in the Y-12 Sanitary Landfill.

Groundwater monitoring at five of seven land-based waste disposal sites at Y-12 have detected volatile organic compounds, nitrates, heavy metals, and radioactivity levels that exceed applicable standards. Additional monitoring wells and continued monitoring is required to define precise contaminant plumes.

4.4.3 Environmental Impacts

This section describes the environmental impacts of constructing and operating the various tritium supply technologies and recycling facilities at ORR described in section 4.4.1. It begins by describing potential impacts to existing and planned facilities at ORR, followed by descriptions of potential impacts and the environmental impacts of the proposed action on potentially affected environmental resources. The section concludes by describing the potential impacts of tritium supply and recycling on human health during normal operation, the consequences of facility accidents, and regulatory considerations and waste management. Each description addresses the effects of No Action and the potential impacts and environmental impacts of constructing and operating any of the tritium supply technologies collocated with tritium recycling facilities or tritium supply alone at ORR.

4.4.3.1 *Land Resources*

Construction and operation of a tritium supply technology and recycling facilities at ORR would affect land resources, including land use and visual resources. Potential impacts to these resources are summarized below.

ORR has sufficient land area to accommodate any of the proposed tritium supply technologies and recycling facilities. The 600-acre TSS would be located in an undeveloped area of the reservation (figure 4.4.2.1–1). A portion of this area is designated as a National Environmental Research Park. The proposed facilities would create a visual impact to nearby viewpoints with high levels of sensitivity, and result in negative changes in VRM classification of the site. The following sections present the effects of the proposed action on land resources.

Land Use

No Action. Under No Action, DOE would continue existing and planned land use activities at ORR as presented in figure 4.4.2.1–1. Any impacts to land use from these actions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Any one of the tritium supply technologies and collocated tritium recycling facilities (section 3.4) or tritium supply alone could be sited at ORR in the proposed TSS (figure 4.4.2.1–1). Land requirements for the tritium facilities are presented in table 4.4.3.1–1. The land area affected ranges from 360 acres for the MHTGR to 173 acres for the APT. An additional 196 acres would be required if the tritium supply facility is collocated with a new recycling facility. As shown in the table, adequate undeveloped land exists. The land use designation would change from forest/undeveloped to industrial. Prime farmland or agricultural activities would not be affected.

No tritium facilities would be constructed offsite, thus offsite land use would not be directly affected. Offsite land is available and could be converted to residential developments to house workers. Such development would be subject to local land use and zoning controls, which vary by jurisdiction.

Less Than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced capacity to meet a tritium supply requirement less than baseline, or the construction and operation of a tritium

TABLE 4.4.3.1–1.—*Potential Changes to Land Use Resulting from Tritium Supply Technologies and Recycling at Oak Ridge Reservation*

	Tritium Supply Technologies and Recycling				
Indicator	HWR	MHTGR	ALWR[a]	APT[b]	Tritium Recycling
Land requirements[c]	260	360	350	173	196
Available land[d,e] (percent)	1.2	1.7	1.6	0.8	0.9

[a] Land requirements for both Large and Small ALWR are the same.
[b] Land requirements for both Phased and Full APT are the same.
[c] Land area requirements are estimated to be the same for construction and operation.
[d] Undeveloped land is approximately 21,600 acres.
[e] Any land requirement less than 100 percent means sufficient land.
Source: DOE 1994a; FDI 1993d; FDI 1994a; FDI 1994b; SNL 1993a; OR DOE 1989b.

requirement Phased APT would not change potential baseline land use impacts. Land requirements would be the same in both operation scenarios.

Multipurpose Reactor. The land requirement for the multipurpose MHTGR and ALWR (section 4.8.3.2 and 4.8.3.3) with recycling would be 925 and 675 acres, respectively. The site requirements for both the multipurpose MHTGR and ALWR exceed the 600-acre TSS study area; however, the proposed TSS is in an area where the additional land requirements would not result in potential conflicts with site land use or development plans. The land use designation would change from forest/undeveloped to industrial. The 925 and 675 acres represent approximately 3 and 4 percent, respectively, of the undeveloped available land at ORR. Construction and operation of the multipurpose MHTGR and ALWR would not affect prime farmland, other agricultural activities, or other land uses on the site.

Potential Mitigation Measures. Avoidance of steep slopes and special National Environmental Research Park reference and natural areas present in the vicinity of the TSS, through alternative facility layouts, would minimize or eliminate impacts to these areas.

Visual Resources

No Action. Under No Action, both existing and planned activities, described in section 4.4.2.1 would continue. Thus, no new facilities would be constructed that could impact visual characteristics at the site. It is also not anticipated that these activities would cause a change in the Bureau of Land Management VRM classification. The existing ORR landscape character would still range from VRM Class 3 to Class 5.

Tritium Supply and Recycling. Views of the construction and operation of the proposed tritium supply technologies and recycling facilities would be similar to other existing large industrial facilities at ORR. Of the tritium supply technologies, the APT would be much less visually obtrusive because most of the facility would be low profile (figure 3.4.2.4–1). The existing landscape at the proposed site, presently VRM Class 4, has been moderately disturbed by roads and clear cutting for utility lines. Construction of any of the tritium supply technologies and recycling facilities would impact visual aesthetics. The proposed facilities could result in extensive surface disturbance and would result in a change in the VRM landscape classification of the affected area from Class 4 to Class 5. These facilities would be visible from viewpoints along Bear Creek Road, State Route 58, and/or State Route 95. These viewpoints are highly sensitive because of their relatively high traffic volumes. The use of a wet cooling system for an HWR, MHTGR, or ALWR would potentially result in large cooling towers (up to 50 stories high) and visible plumes during certain atmospheric conditions.

Less Than Baseline Operations. Baseline visual impacts would not change due to operation of the HWR, MHTGR, or ALWR at reduced capacity or the construction and operation of a Phased APT.

Potential Mitigation Measures. Mitigation measures such as rerouting public access roadways (State Routes 58 and 95) away from the TSS, or siting the facilities away from these roadways could reduce visual impacts. These measures could provide existing vegetation and/or terrain to screen views and would allow landscaping, including heavy plantings and earth berms to increase screening. Use of alternate architectural designs and special materials for the proposed facilities would help facilities to blend with, or complement, the existing landscape; and/or efficient site planning could minimize surface disturbance to the existing landscape. The use of alternative cooling systems (such as low profile cooling towers or mechanical draft dry cooling systems) could further reduce the visual impacts caused by cooling tower vapor plumes from a HWR, MHTGR, or ALWR.

4.4.3.2 *Site Infrastructure*

This section discusses the site infrastructure for No Action and the modifications needed for actions due to construction and operation of new tritium supply and recycling facilities. With nominal increases to fuel procurement contracts, the ORR infrastructure would be capable of supporting any of the proposed tritium supply technologies and recycling facilities selected for the site. A comparison of site infrastructure and facilities resource needs for No Action and the proposed tritium supply alternatives is presented in table 4.4.3.2–1.

TABLE 4.4.3.2–1.—*Modifications to Site Infrastructure for Tritium Supply Technologies and Recycling at Oak Ridge Reservation*

Alternative	Transportation		Electrical		Fuel		
	Roads (miles)	Railroads (miles)	Energy (MWh/yr)	Peak Load (MWe)	Oil (GPY)	Natural Gas (million ft^3/yr)	Coal (tons/yr)
Current Resources	43	17	12,368,800	1,411	980,600	3,122	25,000
No Action							
Total site requirement	43	17	727,000	107	900,000	3,000	35,000
Change from current resources	0	0	-11,641,800	-1,304	-80,600	-122	10,000
Heavy Water Reactor							
Total site requirement	43	17	1,185,000	174	1,032,000	3,247	35,000
Change from current resources	0	0	-11,183,800	-1,237	51,400	125	10,000
Modular High-Temperature Gas-Cooled Reactor							
Total site requirement	43	17	1,075,000	159	1,031,000	3,013	35,000
Change from current resources	0	0	-11,293,800	-1,252	50,400	-109	10,000
Large Advanced Light Water Reactor							
Total site requirement	43	17	1,515,000	219	1,150,000	3,007	35,000
Change from current resources	0	0	-10,853,000	-1,192	169,400	-115	10,000
Small Advanced Light Water Reactor							
Total site requirement	43	17	1,195,000	175	1,060,000	3,007	35,000
Change from current resources	0	0	-11,173,800	-1,236	169,400	-115	10,000
Full Accelerator Production of Tritium							
Total site requirement	43	17	4,555,000	673	963,200	3,007	35,000
Change from current resources	0	0	-7,813,800	-738	-17,400	-115	10,000
Phased Accelerator Production of Tritium							
Total site requirement	43	17	3,215,000	478	963,200	3,007	35,000
Change from current resources	0	0	-9,153,800	-933	-17,400	-115	10,000

Note: A negative number (-) indicates that sufficient resources exist to meet the demands.

Source: FDI 1994h; DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; NERC 1993a; SNL 1995a; ORR 1993a:8.

No Action. The missions discussed in section 3.3.4 would continue under No Action. It is anticipated that certain process improvements to be implemented in the near future would eliminate specific effluents and emissions and reduce or eliminate some waste streams. These process improvements, along with the expected reduction in workload for Y-12, would result in reduced utilities infrastructure requirements for the ORR with the exception of coal use. The increase in coal use is planned to take economic advantage of this fuel source. Estimated reductions for other resource requirements are shown in table 4.4.3.2–1. No modifications are necessary under No Action. The existing site infrastructure would adequately support all No Action missions.

Tritium Supply and Recycling. The modifications to the infrastructure at ORR to support the various tritium supply technologies and recycling facilities are summarized in table 4.4.3.2–1. Table 4.4.3.2–2 summarizes the demands the mission would place on the Tennessee Valley Authority subregional electrical power pool. The pool would be able to meet the additional ORR requirements for any tritium supply technology. The alternatives would require between 1.14 and 12.44 percent of the Tennessee Valley Authority subregional power pool capacity margin and between 0.06 and 2.0 percent of the Southeastern Electric Reliability Council regional power pool capacity margin. Additional natural gas, oil, and coal fuel requirements could be satisfied through normal contractual means. No other modifications would be necessary.

Tritium Supply Alone. If new tritium recycling facilities are not collocated with the tritium supply facilities at ORR, and the upgraded recycling facility at SRS is utilized, the overall impact at ORR would be reduced. Onsite transportation network and electrical transmission line requirements would not be affected. The electrical power requirements associated with each of the tritium supply technologies would decrease by 88,000 MWh per year with the peak load decreasing by 16 MWe. This represents a reduction in the total site peak power requirement of between 2 and 10 percent with no appreciable change to the capacity margin of the subregional power pool. Since the overall electrical requirements still represent a reduction from current requirements, no additional impact would be expected. The natural gas requirement would decrease by 7 million ft^3 per year and the fuel oil requirement would decrease by 50,000 gallons per year. This represents a decrease of only about 2 percent in the overall site requirement for natural gas and about 5 percent for fuel oil.

Less Than Baseline Operations. In the event that only the steady state component of the baseline tritium requirement is required, the impacts on the site infrastructure would change for some supply technologies. There would be no appreciable change for the HWR, MHTGR, and the ALWR technologies. The Phased APT would reduce electrical consumption by approximately 30 percent but the fuel, onsite transportation infrastructure, and power line requirements would not change.

Multipurpose Reactor. The MHTGR or the ALWR multipurpose reactor option described in section 4.8.3 could be sited at ORR. The site infrastructure impacts would vary depending on the technology.

The MHTGR multipurpose reactor option would require construction of the Pit Disassembly/Conver-

TABLE 4.4.3.2–2.—*Impacts on Subregional Electrical Power Pool from Tritium Supply Technologies and Recycling at Oak Ridge Reservation*

Tritium Supply Technology and Recycling	Peak Power Required (MWe)	Capacity Margin (percent)	Annual Energy Required (MWh)	Total Electricity Production (percent)
Heavy Water Reactor	67	1.47	458,000	0.29
Modular High Temperature Gas-Cooled Reactor	52	1.14	348,000	0.22
Large Advanced Light Water Reactor	112	2.46	788,000	0.49
Small Advanced Light Water Reactor	68	1.5	468,000	0.29
Full Accelerator Production of Tritium	566	12.44	3,828,000	2.4
Phased Accelerator Production of Tritium	371	8.15	2,488,000	1.56

Source: FDI 1994h; DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; NERC 1993a; SNL 1995a; ORR 1993a:8.

sion Facility described in section 4.8.3.1 along with three additional MHTGR reactor modules. Fabrication of the plutonium-oxide fuel could be accomplished in the fuel fabrication facility already included in the tritium supply MHTGR design. Operation of this facility along with the six module MHTGR multipurpose reactor would increase the total site electrical requirement by about 373,000 MW per year (55 percent) and the total site fuel requirement by about 651,000 GPY (16 percent) over that for operation of the three module tritium supply MHTGR.

The ALWR multipurpose reactor option would require construction of the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility described in section 4.8.3.1. Operation of this facility along with the ALWR multipurpose reactor would increase the total site electrical requirement by about 20,000 MWh per year (less than 2 percent) and the total site fuel requirement by about 830,000 GPY (20 percent) over that for operation of the tritium supply ALWR.

Accelerator Production of Tritium Power Plant. A dedicated gas-fired power plant at ORR to provide the necessary power for the APT could be constructed (section 4.8.2.2). This would decrease the annual amount of electricity required to be purchased from commercial sources by up to 3,740,000 MWh per year for the Full APT and 2,400,000 MWh for the Phased APT. This gas plant would require 54,200 million ft^3 per year of natural gas to provide the Full APT requirement of 3,740,000 MWh per year and 34,800 million ft^3 per year of natural gas to provide the Phased APT requirement of 2,400,000 MWh per year. Since this is a large increase (11 to 17 times) over normal usage, the existing gas line would likely have to be expanded.

Potential Mitigation Measures. The siting of new tritium supply and recycling facilities would require only minor modifications to the existing site infrastructure. Siting of utility infrastructure could follow existing rights-of-way or be upgraded in place to minimize impacts to natural resources. Where new rights-of-way would need to be constructed, alignments would consider existing sensitive habitat (e.g., wetlands, streams, and vegetation) to minimize the potential for impacting these resources.

4.4.3.3 *Air Quality and Acoustics*

Construction and operation of a tritium supply technology and recycling facility at ORR would generate criteria and toxic/hazardous pollutants that could potentially exceed Federal and state ambient air quality standards and guidelines. To determine the air quality impacts, criteria and toxic/hazardous estimated concentrations from each technology have been compared with Federal and state standards and guidelines. Impacts for radiological airborne emissions are discussed in section 4.4.3.9.

In general, all of the proposed technologies would emit the same types of air pollutants during construction. Emissions would typically not exceed Federal, state, or local air quality regulations or guidelines, except that PM_{10} and TSP concentrations may be close to or exceed the 24-hour PM_{10} and TSP standard during peak construction periods. This exceedance is not uncommon for large construction projects.

During operation, impacts from each of the tritium supply technologies and recycling facilities with respect to the concentrations of toxic/hazardous air pollutants are predicted to be within standards set forth in Federal, state, and local air quality regulations or guidelines.

The Prevention of Significant Deterioration regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modifications to existing sources. Based on the emission rates presented in appendix table B.1.4–3, Prevention of Significant Deterioration permits may be required for each of the proposed alternatives at ORR. This may require "offsets," reductions of existing emissions, to permit any additional or new emission source. The proximity of Prevention of Significant Deterioration Class I areas may require significantly more stringent mitigation for air resource impacts.

Noise emissions during either construction or operation are expected to be low. Air quality and acoustic impacts for each technology are described separately. Supporting data for the air quality and acoustics analysis, including modeling results, are presented in appendix B.

Air Quality

An analysis was conducted of the potential air quality impacts of emissions from each tritium supply technology and recycling facility. The air quality modeling analysis used the Industrial Source Complex Short-Term model recommended by EPA. The resulting air quality concentrations were then evaluated against local and state air quality regulations, and NAAQS (40 CFR 50). The potential exceedance of Prevention of Significant Deterioration (40 CFR 52.21) increments for PM_{10}, SO_2, or NO_2 was also determined.

No Action. No Action utilizes estimated air emissions data from current operations at ORR extrapolated to the year 2010 assuming continuation of site missions as described in section 3.3.3. These data reflect conservative estimates of criteria and toxic/hazardous emissions at ORR. The emission rates for the criteria and toxic/hazardous pollutants for No Action are presented in appendix table B.1.4–3. Table 4.4.3.3–1 presents the No Action concentrations. Pollutant concentrations are in compliance with all air quality regulations and guidelines.

Tritium Supply and Recycling. Alternatives for ORR consist of four candidate technologies: HWR, MHTGR, ALWR, and APT, alone or collocated with tritium recycling facilities. Air pollutants would be emitted during construction of the tritium supply and recycling facilities. The principal sources of such emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and operation of a concrete batch plant.
- Exhaust from and road dust raised by construction equipment, vehicles delivering construction material, and vehicles carrying construction workers.

PM_{10} and TSP concentrations are expected to be close to or exceed the 24-hour ambient standard during the peak construction period. Exceedances would be expected to occur during dry and windy conditions. Appropriate control measures would be followed, such as watering to reduce emissions. With the exception of PM_{10} and TSP, it is expected that concentrations of all other pollutants at the ORR boundary or public access highways, would remain within applicable Federal and state ambient air quality standards.

Air pollutant emission sources associated with the operation of each of the technologies include all or part of the following:

- Increased operation of existing boilers to generate additional steam for space heating.
- Operation of diesel generators and periodic testing of emergency diesel generators.
- Recycling operations.
- Exhaust from and road dust raised by vehicles.

Appendix table B.1.4–3 presents emissions from each of the proposed tritium supply technology and recycling facilities. There are no gaseous releases associated with the APT (SNL 1995a), although emissions are associated with operation of the tritium supply facility included with the APT and with recycling facilities. Emissions from the Large ALWR were used to determine pollutant concentrations since these represent the maximum emission rates from either the Large or Small ALWR. Concentrations of pollutants from the operation of each of the tritium supply and recycling facilities at ORR are presented in table 4.4.3.3–1. Pollutant concentrations, combined with No Action concentrations, are in compliance with Federal and state standards.

Pollutant emissions resulting from the operation of tritium supply technologies alone (HWR, MHTGR, ALWR, and APT) consist of criteria pollutants from the operation of boilers and diesel generators and toxic/hazardous pollutant emissions from facility processes. Criteria pollutant emissions from the MHTGR are the highest among the other tritium supply technologies and would increase existing total site criteria pollutant emissions by less than 5 percent above No Action emissions. Concentrations of criteria and toxic/hazardous pollutants, added to No Action concentrations, are in compliance with Federal and state standards.

Less Than Baseline Operations. Air emissions from the HWR would be reduced slightly when operated at

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* [Page 1 of 2]

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	2010 No Action ($\mu g/m^3$)	Tritium Supply Technologies and Recycling				
				HWR ($\mu g/m^3$)	MHTGR ($\mu g/m^3$)	ALWR ($\mu g/m^3$)	APT ($\mu g/m^3$)	Tritium Recycling ($\mu g/m^3$)
Criteria Pollutant								
Carbon monoxide (CO)	8-hour	10,000	5	61	194	75	27	22
	1-hour	40,000	11	267	879	334	111	100
Lead (Pb)	Calendar Quarter	1.5	0.05[a]	0.05[a]	0.05[a]	0.05[a]	0.05[a]	[c]
Nitrogen dioxide (NO_2)	Annual	100	3	6	12	11	4	1
Ozone (O_3)	1-hour	235	[b]	[c]	[c]	[c]	[c]	[c]
Particulate matter (PM_{10})[d]	Annual	50	9	10	9	9	9	0.2
	24-hour	150	56	62	59	61	59	2.9
Sulfur dioxide (SO_2)	Annual	80	29	29	29	29	29	0.02
	24-hour	365	105	106	106	106	105	0.2
	3-hour	1,300	401	405	404	408	402	1.2
Mandated by Tennessee								
Hydrogen fluoride (as fluorides)	30-day	1.2	0.2	0.2	0.2	0.2	0.2	[c]
	7-day	1.6	0.3	0.3	0.3	0.3	0.3	[c]
	24-hour	2.9	[e]	[e]	[e]	[e]	[e]	[e]
	12-hour	3.7	[e]	[e]	[e]	[e]	[e]	[e]
	8-hour	250	0.6	0.6	0.6	0.6	0.6	[c]
Total suspended particulates[d]	24-hour	150	75	81	78	80	78	2.9
Hazardous and Other Toxic Compounds								
Acetone	8-hour	178,000	[c]	[c]	[c]	9.7	[c]	[c]
Acetylene	8-hour	[f]	[c]	3.1	3.1	3.1	3.1	3.1
Ammonia	8-hour	1,700	[c]	[c]	[c]	5.1	[c]	[c]
Chlorine	8-hour	150	8.8	8.8	8.8	8.8	8.8	[e]
Chlorodifluoromethane	8-hour	354,000	18.6	18.6	18.6	18.6	18.6	[c]
Dichlorodifluoromethane	8-hour	495,000	16.3	16.3	16.3	16.3	16.3	[c]
Ethyl alcohol	8-hour	188,000	[c]	1.2	1.2	1.2	1.2	1.2

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* [Page 2 of 2]

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	2010 No Action ($\mu g/m^3$)	Tritium Supply Technologies and Recycling				
				HWR ($\mu g/m^3$)	MHTGR ($\mu g/m^3$)	ALWR ($\mu g/m^3$)	APT ($\mu g/m^3$)	Tritium Recycling ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (Continued)								
Hydrogen chloride	8-hour	750	37.3	37.3	37.3	37.3	37.3	[c]
Methane	8-hour	[f]	[c]	3.1	3.1	3.1	3.1	3.1
Methyl alcohol	8-hour	26,200	140.7	141.9	141.9	141.9	141.9	1.2
Nitric acid	8-hour	520	50.8	56.6	50.8	118.5	50.8	[c]
Sulfuric acid	8-hour	100	13.1	13.1	13.1	13.1	13.1	[c]
Tetrachloroethylene	8-hour	33,900	65.3	65.3	65.3	65.3	65.3	[c]
1,1,1-Trichloroethane	8-hour	191,000	4	4.9	4.3	26.2	4	[c]
Trichlorofluoromethane	8-hour	562,000	42.6	42.6	42.6	42.6	42.6	[c]
Trichlorotrifluoroethane	8-hour	767,000	14.6	55.7	14.6	14.6	14.6	[c]

[a] Value is maximum for a 24-hour period.

[b] No monitoring data available.

[c] No sources indicated.

[d] It is conservatively assumed that all PM_{10} concentrations are TSP concentrations.

[e] Data unavailable.

[f] There is no standard.

Note: Concentrations for tritium supply and recycling include 2010 No Action concentrations. To determine the concentrations of pollutants from each tritium supply technology, subtract the pollutant concentration for tritium recycling from each of the tritium supply and recycling concentrations.

Note: DOE is committed to the phaseout of ozone-depleting substances and will discontinue use of these substances according to EPA phaseout schedules.

Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; SNL 1995a; OR DHE 1991a; ORR 1993a:8.

reduced capacity. However, the reduction would be negligible since most emissions are attributed to support equipment and facilities that are not related to the reactor operating level. The MHTGR or ALWR would have no change in air emissions because it would continue to operate at the same level as the baseline requirement to maintain power levels for steam or electrical production. The Phased APT construction and operation emissions and impacts would be the same as the Full APT.

Accelerator Production of Tritium Power Plant. Operation of a 500 to 600 MWe natural gas electric generating facility (section 4.8.2.2) would generate a substantial amount of emissions consisting of sulfur dioxide, particulate matter, nitrogen oxides, carbon monoxide, and volatile organic compounds.

These emissions would be controlled using the best available control technology to minimize impacts and comply with NAAQS and state mandated emission standards.

Estimated emissions are based upon emissions factors for a large controlled gas turbine (EPA 1995a; SPS 1995a). Table B.1.3.1-3 presents the emission factors and resulting annual emission rates of a 600 MWe natural gas-fired turbine power plant.

For a natural gas-fired power plant located at ORR, the increase in carbon monoxide emissions with respect to the 2010 No Action emissions at ORR would be approximately 72 percent (75 tons per year); for nitrogen oxides the increase would be approximately 33 percent (314 tons per year); for particulate matter the increase would be approximately 897 percent (179 tons per year); for sulfur dioxide the increase would be less than 1 percent (5 tons per year); and for volatile organic compounds the increase would be approximately 5,382 percent (215 tons per year). In addition, the gas turbine generating facility would generate 126 tons per year of methane, 58 tons per year of ammonia, 29 tons per year of nonmethane hydrocarbons, and 24 tons per year of formaldehyde.

Any power plant facility constructed to meet the power needs of the APT would be required to meet the Federal NAAQS and state mandated regulations for toxic/hazardous pollutants. Appropriate pollution control equipment would be incorporated into the design of that facility to meet these standards.

Potential Mitigation Measures. Potential mitigation measures during construction include watering to reduce dust emissions; applying nontoxic soil stabilizers to all inactive construction areas; cover, water, or apply nontoxic soil binders to exposed piles (i.e., gravel, sand, dirt); suspend all excavation and grading operations when wind speeds warrant; pave construction roads that have a traffic volume of more than 50 daily trips by construction equipment; and using electricity from power poles rather than temporary gasoline and diesel power generators. Potential mitigation measures during operation include incorporating additional HEPA filters to reduce particulate emissions from processing facilities; substituting cleaning solvents for those that present health hazards or exceed the applicable standards; and switching from coal or fuel oil to produce electricity or steam to natural gas to reduce criteria pollutants.

Acoustics

The location of the tritium supply technologies and recycling facilities relative to the site boundary and sensitive receptors was examined to determine the contribution to noise levels at these locations and the potential for onsite and offsite impacts.

No Action. The continuation of operations at ORR would result in no appreciable change in traffic noise and onsite operational noise sources from current levels (section 4.4.2.3). The nontraffic noise sources associated with operation are located at sufficient distance from offsite noise sensitive receptors that the contribution to offsite noise levels would continue to be small.

Tritium Supply and Recycling. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along major offsite transportation routes used to bring construction material and workers to the site.

Most nontraffic noise sources associated with operation of any of the tritium supply and recycling facilities would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Based on the size of the site, noise emissions from construction equipment and machinery and from operational facilities, equipment, explosives, and machinery would not be expected to cause annoyance to the public.

Noise impacts associated with increased traffic on access routes would be considered in tiered NEPA documents. Some nontraffic noise sources associated with construction and operation of the tritium supply technologies and recycling facilities may be located close enough to offsite noise receptors that they could experience some increase in noise levels.

Less Than Baseline Operations. Baseline noise impacts would not change due to reactors operating at reduced capacity or the construction and operation of a Phased APT.

Potential Mitigation Measures. Potential measures to minimize noise impacts on workers include the use of standard silencing packages on construction equipment and providing workers in noisy environments with appropriate hearing protection devices meeting OSHA standards. As required, noise levels would be measured in worker areas, and a hearing protection program would be conducted.

4.4.3.4 *Water Resources*

Environmental impacts associated with the construction and operation of the proposed tritium supply technologies and recycling facilities at ORR would affect both surface water and groundwater resources. The proposed site for the tritium supply and recycling facilities would be outside any 100-year floodplain. Complete information on the location of the 500-year floodplain at ORR is currently unavailable. At ORR, surface water resources, primarily the Clinch River, would be used to meet all construction and operation water requirements. The Clinch River has sufficient flow to support any of the tritium supply technologies and recycling facilities. During construction, treated sanitary wastewater would be discharged in compliance with NPDES permit requirements to nearby streams. No construction-related discharge would exceed 0.2 percent of the Clinch River's average flow. Any construction-related impacts would be mitigated by standard erosion control practices with the exception of the large amount of dewatering wastewater generated during the construction of the MHTGR and APT where detention basins may become necessary to control the discharge. During operation of the tritium supply and recycling facilities, treated wastewater and cooling system blowdown would be discharged to nearby streams. Because of the manner in which blowdown is usually released (e.g., high velocity pulsed releases), it has the potential to scour streambeds and erode stream banks of small receiving streams. Impacts from blowdown velocity and elevated temperatures can be mitigated with energy dissipating structures, cooling water canals, or retention basins. During operation, stormwater runoff would be collected, and treated if necessary, before discharge to natural drainage channels in accordance with NPDES permit requirements.

Minimal impacts to groundwater are anticipated because no water will be withdrawn and no direct discharges would occur during construction and operation. Table 4.4.3.4–1 presents existing surface water and groundwater resources and the potential changes to water resources at ORR resulting from the proposed tritium supply technologies and recycling facilities. Resource requirements for each tritium supply technology shown in this table represent the total requirements at the site, including No Action. Resource requirements for tritium recycling are added to these values to obtain water resource requirements for assessing impacts associated with combined tritium supply and recycling.

Surface Water

No Action. Under No Action, no additional impacts to surface water resources are anticipated beyond the effects of existing and future activities which are independent of and not affected by the proposed action. A description of the activities that would continue at ORR is provided in section 3.3.4. Under No Action, because of reduced operating requirements of existing facilities at ORR, surface water withdrawals from the Clinch River are expected to decrease to 0.2 percent of the river's average flow. Wastewater discharges from Y-12 would continue to East Fork Poplar Creek and Bear Creek although the volume would decrease.

Tritium Supply and Recycling. Surface water withdrawals during construction of any tritium supply technology, with or without the tritium recycling facilities, would comprise no more than 0.003 percent of the Clinch River's average flow and would therefore have no adverse effect on flow or downstream users. Treated wastewater effluent released to surface streams would be less than 0.002 percent of the average flow of the Clinch River. Similarly, discharges to East Fork Poplar Creek would not exceed 0.2 percent of the creek's average

TABLE 4.4.3.4–1.—*Potential Changes to Water Resources Resulting from Tritium Supply Technologies and Recycling at Oak Ridge Reservation* [Page 1 of 2]

Affected Resource Indicator	No Action	Tritium Supply Technologies and Recycling						
		HWR	MHTGR[a]	Large ALWR[a]	Small ALWR[a]	Full APT	Phased APT	Tritium Recycling[b]
Construction (2005)								
Water Availability and Use								
Water source	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
Total water requirement[c] (MGY)	1,849	1,870	1,867	1,882	1,869	1,857	1,857	1.5
Percent increase in projected water use[d]	0	1	1	2	1	<1	<1	NA
Percent change in Clinch River flow from withdrawals[e]	0.2	<0.002	<0.002	<0.003	<0.002	<0.002	<0.002	NA
Water Quality								
Wastewater discharge to surface waters (MGY)	NA	16.5	13.6	27.5	15.5	0.3	0.3	0.9
Percent change in stream flow[f]	NA	0.002	0.001	0.002	0.001	0.0001	0.0001	NA
NPDES permit required	NA	Yes	Yes	Yes	Yes	Yes	Yes	NA
Operation (2010)								
Water Availability and Use								
Water source	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
Total water requirement[g]	1,849	7,749	5,849	17,849	9,049	3,049	2,619	14
Percent increase in projected water use[d]	0	320	217	866	390	66	42	NA
Percent change in Clinch River flow from withdrawals[e]	0.2	<1	<1	1	<1	<1	<1	NA
Water Quality								
Wastewater discharge to surface waters[h] (MGY)	negligible	48	30	90	50	0.2	0.2	13
Percent change in stream flow[f]	NA	0.005	0.004	0.009	0.005	0.001	0.001	NA
Blowdown discharge to surface waters[i] (MGD)	NA	9.6	6.7	25.8	11.7	1	0.7	0.04
Percent change in stream flow[f]	NA	0.2	0.1	0.5	0.2	0.02	0.01	NA
NPDES permit required	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA

TABLE 4.4.3.4–1.—*Potential Changes to Water Resources Resulting from Tritium Supply Technologies and Recycling at Oak Ridge Reservation* [Page 2 of 2]

Affected Resource Indicator	No Action	Tritium Supply Technologies and Recycling						
		HWR	MHTGR[a]	Large ALWR[a]	Small ALWR[a]	Full APT	Phased APT	Tritium Recycling[b]
Floodplain								
Actions in 100-year floodplain	NA	No	No	No	No	No	No	No
Critical actions in 500-year floodplain	NA	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain
Floodplain assessment required	NA	Yes 500-year	Yes 500-year	Yes 500-year	Yes 500-year	Yes 500-year	Yes 500-year	NA NA

[a] Operational water requirements for MHTGR and ALWR include utilization of steam turbine generators.

[b] Resource requirements for tritium recycling do not include No Action. The values presented in this column are added to the requirements of each tritium supply technology to assess the impacts associated with combined tritium supply and recycling.

[c] Total water requirements at ORR are calculated by adding No Action requirements (1,849 MGY) with that for each tritium supply technology (with recycling): HWR (21.3 MGY), MHTGR (17.8 MGY), ALWR (33.3 MGY for Large and 20 MGY for Small), and APT (8.3 MGY for Full and 8.3 MGY for Phased).

[d] Percent increase in projected water use at ORR includes tritium recycling water requirement.

[e] Percent change in Clinch River flow from withdrawals at ORR includes tritium recycling water requirements.

[f] Percent change in stream flow from wastewater discharge is calculated by dividing the total discharges from tritium supply and recycling by the average flow of Clinch River (4,882 ft^3/s).

[g] Total water requirements at ORR are calculated by adding No Action requirements (1,849 MGY) with that for each tritium supply technology (with recycling): HWR (5,900 MGY), MHTGR (4,000 MGY), ALWR (16,000 MGY for Large and 7,200 MGY for Small), and APT (1,200 MGY for Full and 770 MGY for Phased).

[h] Existing discharges directly into the Clinch River are negligible compared to the base flow of the river. Existing discharges to East Fork Poplar Creek are downstream of Y-12 and the city of Oak Ridge wastewater plant discharges.

[i] Blowdown is expected to occur once a day over a 1-hour period, rather than continuously over the course of the day. As such, the discharge rate would be much greater for a shorter period of time. Blowdown discharges are assumed to be directed to the same streams as wastewater discharges. Annual blowdown discharge is calculated based on a 240-day year.

Note: NA - not applicable.

Note: Construction impacts are considered to be temporary, lasting only throughout the construction period.

Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; SNL 1995a; ORR 1993a:8.

flow. All discharges would be monitored to comply with NPDES permit and other discharge requirements. The potential impacts during construction would be erosion of disturbed land and siltation in surface waters. To minimize soil erosion impacts, stormwater management and erosion control measures would be implemented.

In addition to wastewater effluent, MHTGR or APT would require dewatering because of construction activities below the water table. The amount of dewatering discharges would depend on hydrologic and engineering conditions of the site. These discharges could either be directed to Clinch River or East Fork Poplar Creek and are expected to exhibit low turbidity and not require settling basins. However, temporary sediment basins to remove soil particles could be built as part of standard soil erosion and sediment control plans for the site. Dewatering discharges to East Fork Poplar Creek could cause stream bank erosion, increased turbidity, stream bed scouring, and potential flooding. As discussed in section 4.4.2.4, DOE is currently involved with remediation of East Fork Poplar Creek under CERCLA. Any discharges including cooling tower blowdown involved with tritium production that may potentially impact East Fork Poplar Creek would require engineering design mitigation measures to avoid interference with the goals of the remediation effort. More detailed analyses would be conducted during site-specific NEPA studies to evaluate the site conditions and the amount of dewatering needed, construction techniques to reduce dewatering, and to identify mitigation measures. Construction of an HWR or ALWR would require much less dewatering, and the impact on East Fork Popular Creek or Clinch River are expected to be minor.

Operation of the Large ALWR would require the most water, approximately 16,000 MGY or approximately 1 percent of the Clinch River's average flow. The other tritium supply technologies, with or without tritium recycling, would require no more than 0.8 percent of this flow. Treated sanitary, process, and utility wastewater discharge of the Large ALWR with recycling (103 MGY) released to East Fork Poplar Creek would not exceed 1 percent of the creek's average flow and therefore should not result in any downstream effects. Release to the Clinch River would represent 0.009 percent of the average flow. All discharges would be monitored to comply with NPDES permit limits. Stormwater runoff from the main plant area would be collected in detention ponds, monitored, and if acceptable, discharged to nearby streams. Stormwater runoff from outside the main plant area, except those facilities that require onsite management controls by regulation such as sanitary wastewater treatment plants and landfills, would be discharged to nearby streams.

Unlike wastewater effluent from treatment facilities, which is released on a continuous basis, cooling system blowdown activities discharge greater quantities over a shorter period of time. The Large ALWR would release approximately 26 million gallons of blowdown water once a day over a 1-hour period. The other tritium supply technologies would release less than half of this amount. Without engineered measures such as those described under "Potential Mitigation Measures," blowdown from the Large ALWR and other tritium supply technologies would temporarily increase the average flow rate of receiving streams by 0.5 percent (for Clinch River) and 78 percent (for East Fork Poplar Creek). These discharges would cause scouring of streambeds, erosion of stream channels, increased turbidity, and potential flooding of areas. In addition to impacts from the discharge velocity of the blowdown, the high temperature of the releases could also affect receiving waters. As discussed in section 4.4.2.4, DOE is currently involved with remediation of East Fork Poplar Creek under CERCLA. Any discharges including cooling tower blowdown involved with tritium production that may potentially impact East Fork Poplar Creek would require engineering design mitigation measures to avoid interference with the goals of the remediation effort. Engineering measures incorporated in technology design adapted to site conditions could significantly reduce these impacts. Various cooling system blowdown disposal options would be evaluated in site-specific tiered NEPA documents. All discharges to surface waters would be subject to and required to comply with NPDES permit requirements.

Blowdown would also contain concentrated chemicals and diffused tritium. Depending on the operation of the system, blowdown chemical and tritium concentrations would range from between 2.5 to 5 times the river water concentrations. Previous studies of tritium concentrations in liquid

discharges from reactors operating at higher production rates than anticipated for the proposed facilities showed that the concentration in the receiving water of a river having a comparable flow to the Clinch River did not exceed the water quality standard of 20,000 pCi/l after dilution. For the purpose of this analysis, it is anticipated that any release of tritium from the proposed facilities would not exceed the water quality standard for tritium and would comply with NPDES discharge requirements. For information on the radiological constituents present in cooling system blowdown, refer to section 4.4.3.9.

The proposed site for the tritium supply and recycling facilities lies outside the 100-year floodplain. However, since 500-year floodplain information does not exist for this portion of ORR, and because operation of the tritium supply and recycling facilities may constitute a critical action, an assessment of the 500-year floodplain would be required before construction activities were initiated. This study would be done for site-specific assessments and appropriate design considerations made on the results.

Less Than Baseline Operations. Operation of the HWR at reduced capacity to meet a tritium supply requirement less than baseline would reduce slightly the operation water requirements and the quantity of water discharges. A reduction in the temperature of cooling water discharges would be expected because of the lower thermal output of the reactor. The MHTGR or ALWR water requirements and discharges would not change from the baseline, therefore the potential impacts would remain the same.

Operation of the Phased APT (with tritium recycling) would require 784 MGY (table 4.4.3.4–1), a 42-percent increase over projected No Action water use. This is approximately two-thirds of the 66-percent increase required by the Full APT, and is 0.07 percent of the Clinch River's average flow. The 0.2 MGY of wastewater discharges from the Phased APT would not exceed 1 percent of Clinch River's average flow and should not have any downstream effects. The Phased APT would discharge 0.7 million gallons of blowdown water during 1 hour every day. This is approximately one-half of the blowdown discharge of the Full APT (1 MGD), and is 0.02 percent of Clinch River's average flow and 1.3 percent of East Fork Poplar Creek's average flow. This discharge is less than the blowdown of the other technologies and its impacts would be less than but similar to those of other technologies. All other requirements of the Phased APT are identical to those of the Full APT.

Multipurpose Reactor. For the multipurpose MHTGR, a Pit Disassembly/Conversion Facility would be constructed and operated to support the reactors. The construction of the multipurpose MHTGR and the Pit Disassembly/Conversion Facility would require an additional 24.3 MGY, which would be a 35 percent increase over the surface water use for the MHTGR tritium supply facility, and less than 1 percent of the Clinch River's average flow. Water use during operation of the MHTGR multipurpose reactor (7,200 MGY) and the Pit Disassembly/Conversion Facility (10 MGY), would total 7,210 MGY and would be a 78.2 percent increase over the surface water use for the MHTGR tritium supply facility and 4.6 percent of the Clinch River's average flow.

During construction and operation of a multipurpose MHTGR and Pit Disassembly/Conversion Facility, all wastewater generated would be treated at either the Y-12 Centralized Pollution Control Facility or at the Y-12 West End Treatment Facility prior to being released to NPDES permitted outfalls. During construction, approximately 269 MGY of wastewater would be generated and during operations approximately 394 MGY of wastewater would be generated. These discharge rates would not exceed 0.3 percent of the average flow.

Potential impacts from stream flow increases, such as streambed scouring and sediment transport, would increase due to the increase in discharge volume. Engineering measures could be implemented to minimize impacts of the discharges. Treatment of all wastewater discharges would minimize potential impacts to water quality. Therefore, impacts from the additional water discharges would not be substantially different than those expected from the tritium supply MHTGR analyzed in this PEIS.

Water use during construction and operation of an ALWR multipurpose reactor would be the same as previously discussed for an ALWR tritium supply facility. However, as discussed in section 4.8.3, a Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would have to be constructed and

operated in conjunction with an ALWR multipurpose reactor. A Pit Disassembly/Conversion/Fuel Fabrication Facility would use an additional 0.5 MGY of surface water during construction, which would be less than a 1-percent increase over the surface water use for the ALWR tritium supply facility, and 1.6 percent of the Clinch River's average flow. During operation, approximately 10 million gallons of water would be used, which would be a 0.05 percent increase over the surface water use for the ALWR tritium supply facility and 1.6 percent of the Clinch River's average flow.

During construction and operation of a Pit Disassembly/Conversion/Fuel Fabrication Facility an additional 3 and 10 MGY of sanitary wastewater, respectively, would be generated and treated at either the Y-12 Central Pollution Control Facility or at the Y-12 West End Treatment Facility before being released to surface waters. These discharge amounts would have similar impacts as those discussed for the ALWR tritium supply facility.

Accelerator Production of Tritium Power Plant. If the APT technology is selected, a dedicated power plant as discussed in section 4.8.2.2 could be used to support the technology at ORR. Water requirements for the natural gas-fired power plant would be approximately 80 MGY in addition to the surface water requirements previously discussed for the APT. Operation of the Full APT (with tritium recycling) and the dedicated power plant would require a total site surface water withdrawal of 3,943 MGY, that would be a 2-percent increase over the surface water requirements for the Full APT without the dedicated power plant (3,863 MGY), and is 0.34 percent of the Clinch River average flow.

The demineralized backwash generated during operations would contain dilute concentrations of trace metals, and low-to-moderate concentrations of calcium, sodium, and sulfate. However, with appropriate wastewater treatment at either the Y-12 Central Pollution Control Facility or at the Y-12 West End Treatment Facility, minimal impacts to surface waters would be expected.

Potential Mitigation Measures. Surface water impacts associated with construction could be mitigated by applying standard erosion control practices. Impacts from operational discharges, such as scouring and erosion in stream channels, could be mitigated through retention basins to accommodate the volume of wastewater flow. Blowdown velocity and temperature impacts could be mitigated with energy dissipating structures such as plunge or stilling basins, cooling water canals, or retention basins. Lined conveyance channels with additional energy dissipation features could also be designed to further reduce the velocity of flow prior to entering the natural stream channel and discharges directed through a series of detention ponds to reduce discharge velocities and allow the water to cool.

Groundwater

No Action. Under No Action, no additional impacts to groundwater resources are anticipated beyond the effects of existing and future activities which are independent of and unaffected by the proposed action. A description of the activities that would continue at ORR is provided in section 3.3.4. Currently, no groundwater is used.

Water quality data obtained from wells located near the Y-12 facility indicate that water quality is above or bordering drinking water standards for a number of parameters (table 4.4.2.4–1). Under No Action, current restoration programs would continue onsite and offsite. Process and wastewater would continue to be treated at either the Y-12 Central Pollution Control Facility or at the Y-12 West End Treatment Facility before being released to surface waters. Minimal impacts on groundwater quality are expected due to wastewater releases.

Tritium Supply and Recycling. All water for construction and operation of tritium supply technologies and recycling facilities would be taken from the Clinch River, with no plans for withdrawal from groundwater resources. All process, utility, and sanitary wastewater will be treated prior to discharge into East Fork Poplar Creek in accordance with NPDES permits. Minimal impact to groundwater quality is expected.

Any salt coming from the cooling tower would have originated from the Clinch River. Because the salt is concentrated in a wet cooling tower, it can potentially damage vegetation in a small area near the facility. At ORR there is adequate rainwater and groundwater flow such that the salt from the cooling

tower would be flushed into the groundwater and diluted. The groundwater and surface water systems are connected such that the salt originating from the Clinch River and reaching the groundwater will return to the river and the total amount of salt in the ecological system would remain the same.

Less Than Baseline Operations. Potential groundwater quality impacts described above would not change due to changes in reactor operating capacities, or the construction and operation of a Phased APT.

Multipurpose Reactor. The MHTGR or a ALWR multipurpose reactor option at ORR would require a Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility or a Pit Disassembly/Conversion Facility to be constructed in conjunction with the reactors. Water used for both of the reactors and support facilities would be obtained from surface water resources with no plans to withdraw groundwater resources during operations.

During operation, wastewater and sanitary water would continue to be treated at either the Y-12 Central Pollution Control Facility or at the Y-12 West End Treatment Facility before being released to surface waters, to minimize potential impacts to groundwater resources.

Accelerator Production of Tritium Power Plant. If the APT technology is selected, a dedicated power plant as discussed in section 4.8.2.2 could be used to support the technology at ORR. Water requirements (approximately 80 MGY) for the natural gas-fired power plant would be obtained from surface water resources with no plans to withdraw groundwater during operation. Therefore there will be no impacts to groundwater levels.

During operations demineralized backwash containing dilute concentrations of trace metals and low-to-moderate concentrations of calcium, sodium, and sulfate would be generated. With the appropriate wastewater treatment at either the Y-12 Central Pollution Control Facility or at the Y-12 West End Treatment Facility, negligible impacts to groundwater quality would be anticipated.

Potential Mitigation Measures. No mitigation measures have been identified because no impacts to groundwater resources are anticipated.

4.4.3.5 *Geology and Soils*

Construction of tritium supply and recycling facilities at ORR would have no impact on geological resources, and hazards posed by geological conditions are expected to be minor. Construction could disturb a few hundred surface acres of soil, the amount depending on the tritium supply technology and the collocation of recycling facilities. Control measures would be used to minimize soil erosion. Impacts would depend on the specific soil units in the disturbed area, the extent of land disturbing activity, and the amount of soil disturbed. Potential changes to geology and soils associated with the construction and operation of tritium supply and recycling facilities are discussed below.

No Action. Under No Action, DOE would continue existing and planned activities at ORR. Any impacts to geology and soils from these actions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Construction activities would not affect geologic conditions. Facility design would ensure that they would not be adversely affected by geologic conditions.

There are no known capable faults within the boundaries of ORR. There is little chance for ground rupture as a result of an earthquake; minor ground shaking is more likely but is not anticipated during the life of the proposed project. Intensities of more than VI on the modified Mercalli scale are not likely at ORR. Ground shaking could affect the integrity of poorly designed or nonreinforced existing structures but would not affect newly designed facilities. Based on the seismic history of the area, low seismic risk exists at ORR, but this should not preclude safe construction and operation of tritium supply and collocated recycling facilities or tritium supply alone. In addition, all facilities would be designed for earthquake-generated ground acceleration in accordance with DOE Order 5480.28 and accompanying safety guides.

Volcanic activity has not occurred in the area for millions of years and is extremely unlikely to impact the project. It is also highly unlikely that landslides or other nontectonic movements would affect project activities. Slopes and underlying foundation materials are generally stable. Sinkholes are

present in the Knox Dolomite, but it is unlikely that they would impact the project, as the Knox Dolomite is not present in Bear Creek Valley (potential site).

Properties and conditions of soils underlying the proposed site have no limitations on construction. Soils would be impacted by construction and operation of the facilities. The amount of acreage that would potentially be disturbed by the tritium supply technologies is shown in table 4.4.3.1–1 and for tritium recycling is 202 acres. Soils, therefore, would not adversely effect the safe operation of project activities.

The soil disturbance from construction of new facilities could be as much as 562 acres for a collocated MHTGR with the new recycling facilities. Disturbance would occur at building, parking, and construction laydown areas, destroying the soil profile, and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil losses would depend on frequency of storms; wind velocities; size and location of the facilities with respect to drainage and wind patterns; slopes, shape, and area of the tracts of ground disturbed; and, particularly during the construction period, the duration of time the soil is bare. Construction of both the MHTGR and the APT would also necessitate deep excavations to accommodate reactor modules and an accelerator tunnel, respectively (sections 3.4.2.2 and 3.4.2.4). A considerable volume of spoil would be removed as a result of the excavations. Most of the material removed would be shale and limestone bedrock and could be stockpiled for use as fill. Some of this material could be used to cover the accelerator tunnel of the APT. Site-specific NEPA studies would evaluate in detail impacts to geology and soils at ORR resulting from deep excavations required for the MHTGR and the APT and would identify appropriate mitigation measures.

Net soil disturbance during operation would be less than for construction because some areas temporarily used for laydown would be restored. Although erosion from stormwater runoff and wind action could occur occasionally during operation, it is anticipated to be minimal.

Appropriate erosion and sediment control measures would be used to minimize soil loss. Wind erosion is likely to occur on an intermittent basis, depending on the wind velocities, the amount of soil exposed, and the effectiveness of control measures.

Less Than Baseline Operations. Under less than baseline operations, geology and soil impacts would not change for the HWR, MHTGR, or ALWR technologies. Disturbed acreage for the Phased APT would be the same as the baseline tritium requirement for the Full APT; therefore, impacts would be the same.

Multipurpose Reactor. The multipurpose MHTGR would disturb an additional 270 acres of land to accommodate the construction of three additional reactor modules and a Pit Disassembly/Conversion Facility. The additional land area disturbances would result in the destruction of the soil profile and potential temporary increase in erosion as a result of stormwater runoff and wind action. The three additional reactor modules would also double the excavation requirements over that for the tritium supply MHTGR. The excavated soil would substantially increase the volume of soil needing storage and/or disposal. Impacts on ground water resources from the excavation are not expected. Groundwater flow direction may be influenced in the immediate construction area from the extent of the excavation. However, appropriate engineering measures are available to minimize potential groundwater infiltration into the excavation and groundwater impacts.

Construction impacts for the multipurpose ALWR would be the same as those described for the tritium supply ALWR. Additional soil impacts would be expected from the construction of the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility needed to support the multipurpose ALWR. Approximately 129 acres would be disturbed for the new facility, destroying the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil losses would depend on frequency of storms; wind velocity; location of the facility with respect to drainage and wind pattern; slope, shape, and area of the tracts of ground disturbed; and the duration of time the soil is bare.

Soil impacts during operation are expected to be minimal. Appropriate erosion and sediment control measures would be used to minimize any long-term soil losses.

Potential Mitigation Measures. Mitigation measures would be required to control erosion of soil, especially during construction. Potential measures include accepted standard practices for erosion, sediment, and dust control such as silt fences, sediment traps, runoff diversion dikes, drainageways, sedimentation ponds, establishment of ground cover and windbreaks, grading of slopes, and construction of berms or other controls appropriate to the sites. Standard control for wind erosion, such as wetting the surface, could be done on a day-to-day basis. Exposing only small areas for limited periods of time, as necessary, could also reduce erosional effects. After the construction period, long-term control measures could include grading, revegetation or landscaping.

4.4.3.6 *Biotic Resources*

Construction and operation of tritium supply and recycling facilities at ORR would affect biotic resources. Impacts resulting from the construction of the HWR, MHTGR, ALWR, or Full APT to meet the baseline tritium requirement would occur only at the beginning of the project life cycle. The less than baseline tritium requirement Phased APT could incur some additional construction-related impacts if expansion is needed to meet baseline tritium requirements. The potential impacts would be minor since the expansion would occur in the already developed main plant site. Impacts to terrestrial resources would result from the loss of habitat during construction and operation. Displacement of wetlands would be avoided or mitigated in cooperation with the U.S. Army Corps of Engineers and state agencies. Without mitigation measures, water discharged during construction and operation could disturb wetlands and aquatic habitat. No Federal-listed threatened or endangered species would be affected by the proposed action. However, several special status plant species could be destroyed and special status animal species could be affected, primarily through the loss of potential foraging, nesting, or spawning habitat during construction. Where potential conflicts could occur, mitigation measures would be developed in consultation with the USFWS. Consultation would be conducted at the site-specific level in tiered NEPA documents. Table 4.4.3.6–1 summarizes the potential changes to biotic resources at ORR resulting from the proposed action. No major differences in impacts to biotic resources exist between the four tritium supply technologies and recycling facilities. However, MHTGR or APT-related construction and operation discharges have the potential to impact wetlands and aquatic resources to a greater degree than the other tritium supply technologies.

The following discussion of impacts from a multipurpose reactor and a dedicated power plant for the APT applies to the biotic resources at ORR as a whole. Where potential impacts to a specific biotic resource are notable for the tritium supply technologies, the discussion on multipurpose reactors identifies the potential impacts to the same resource.

Multipurpose Reactor. The selection of the multipurpose reactor option could result in additional impacts to biotic resources at ORR. The MHTGR Pit Disassembly/Conversion Facility and the ALWR Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would require an additional 129 acres of land. However, it is expected that during the design phase, land requirements for this facility would be substantially reduced when integrated into the reactor and recycling facility design. In addition, an MHTGR would require three additional modules which would displace about 240 acres. Thus, total land requirements for the MHTGR and ALWR multipurpose reactors would be 931 and 691 acres, respectively. In general, impacts to terrestrial resources species would be similar to, but greater than, those described for the tritium supply and recycling facility.

Although the fuel fabrication facility would require some additional water, construction and operation of the MHTGR would greatly increase both water use and discharge. Selection of the ALWR as the multipurpose reactor would not result in an increase in water use or wastewater discharge beyond the increase required for the fuel fabrication facility. If the MHTGR option is selected, impacts to wetlands and aquatic resources would be greater than those described for construction and operation of the three module MHTGR. Mitigation measures would be required to lessen impacts to these resources.

For both the MHTGR and ALWR multipurpose reactor options, impacts to threatened and endangered species would be similar to, but greater than, those described for the tritium supply and recycling

TABLE 4.4.3.6–1.—*Potential Impacts to Biotic Resources During Construction and Operation Resulting from Tritium Supply Technologies and Recycling at Oak Ridge Reservation*

		Tritium Supply Technologies and Recycling				
Affected Resource Indicator	**No Action**	**HWR**	**MHTGR**	**ALWR**	**APT**	**Tritium Recycling**
Acres of habitat disturbed	0	462[a]	562[a]	552[a]	375[a]	202
Wetlands potentially impacted	None	Yes	Yes	Yes	Yes	Yes
Aquatic resources potentially impacted	None	Yes	Yes	Yes	Yes	Yes
Number of threatened and endangered species potentially affected[b]	0/0	0/12	0/12	0/12	0/12	0/12

[a] Acreage distributed by each tritium supply technology only may be obtained by subtracting the acreage for the tritium recycling facility from the tritium supply technologies and recycling acreage.

[b] The number of threatened and endangered species are represented by two data inputs (a/b) where: a = the number of Federal-listed threatened and endangered species and b = the number of all other special status species (i.e., Federal candidate and/or state-listed species) that are potentially impacted.

Source: DOE 1992k; DOE 1992o.

facility. This is primarily the case since more land and water would be required.

Accelerator Production of Tritium Power Plant. A dedicated natural gas-fired power plant, similar to that described in section 4.8.2.2, could be an option to support an APT at ORR. This facility, which would be constructed on the proposed TSS, would occupy 25 acres of land. Construction of the gas-fired power plant would increase the land disturbance associated with the APT from 375 to 400 acres. This would result in a slight increase in impacts to terrestrial resources over those described for the tritium supply and recycling facility. Infrastructure requirements, such as parking and laydown areas, would be incorporated into and take advantage of similar requirements associated with the APT. Rights-of-way would be sited to take advantage of existing corridors to the maximum extent practical. Since wet cooling towers would be used, impacts to vegetation from salt drift are possible.

Direct and indirect impacts to wetlands resulting from construction of a power plant would be similar to those described for the APT. If new intake and discharge structures are required, wetlands bordering the affected waterbody could be impacted. Also, the discharge of cooling and other wastewater could adversely affect any wetlands in the vicinity of the outfall. Any impacts to wetlands would require a permit from the U.S. Army Corps of Engineers and all discharges would be required to meet NPDES permit and state water quality requirements.

Direct and indirect impacts resulting from construction of a natural gas-fired power plant would be similar to those described for the APT. Construction of new intake and discharge structures, if required, could adversely impact aquatic resources by disturbance of the stream bottom. Downstream impacts could result from sedimentation and turbidity. Such impacts would be temporary in nature. Operational impacts could include impingement and entrainment of aquatic organisms. Also, if discharges represented a large proportion of the streamflow of the receiving waterbody, streambed scouring and subsequent increases in turbidity and downstream sedimentation could affect aquatic habitat, including spawning habitat. Thermal impacts from the discharge of cooling tower blowdown are also possible. Many of these potential impacts could be reduced through proper design of intake and discharge structures and by taking water from and discharging it to larger waterbodies. All effluent discharges would be required to meet NPDES permit and *Tennessee Water Quality Control Act* requirements.

Impacts from construction and operation of a power plant on threatened and endangered species would be similar to those described for the APT. Results of preactivity surveys associated with the APT would also apply to the power plant. If new intake and

discharge structures are required, preactivity surveys also would be required for these structures.

Terrestrial Resources

No Action. Under No Action, the missions described in section 3.3.3 would continue at ORR. This would result in no changes to current terrestrial conditions at ORR described in section 4.4.2.6.

Tritium Supply and Recycling. Construction and operation of the HWR, MHTGR, ALWR, or APT in the proposed TSS would result in the disturbance of approximately 462, 562, 552, or 375 acres, respectively, or 1.6 percent or less of ORR (table 4.4.3.6–1). These acreages include areas on which the tritium supply and recycling facility would be constructed, as well as areas that would be revegetated following construction.

Vegetation within the area to be developed would be destroyed during land clearing. Vegetation cover within the proposed TSS is predominantly oak-hickory forest or pine and pine-hardwood forest (figure 4.4.2.6–1). While both types would be affected by construction, it is likely that a greater area of pine and pine-hardwood forests would be removed. This type of forest is more heavily concentrated in valleys where most of the development would occur. Oak-hickory forests are typically found on ridges. Both forest types are common throughout ORR and within the region.

Constructing any of the tritium supply technologies and recycling facilities would have some adverse effects on animal populations. Less mobile animals within the proposed project area, such as amphibians, reptiles, and small mammals, would be destroyed during land-clearing activities. Construction activities would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. The long-term survival of these animals would depend on whether the area where they migrated to was at or below its carrying capacity. Nests and young animals living within the proposed TSS could be lost during construction. Upon completion of construction, revegetated areas would be of minimal value to most wildlife since they would be maintained as landscaped areas.

Salt drift from wet cooling towers may cause salt deposition on surrounding land areas and vegetation. Recent data on deposition rates from a similar sized cooling tower at ORR are not available. However, previous studies for a proposed tritium reactor at SRS, which was designed for the southeastern United States, would be expected to be applicable to ORR. The proposed SRS reactor was predicted to impact 13 acres at a deposition rate of 15.2 pounds per acre per month. This is the level at which salt stress symptoms could become evident on sensitive plants (DOE 1992e: 5-213). While specific data are not available, all the proposed tritium supply technologies and recycling facilities would use less water than the previous SRS design. Assuming similar parameters for the ORR and SRS cooling towers, impacts from salt drift at ORR are expected to be less. Potential impacts would be further reduced since a portion of the salt drift would fall on developed areas in the vicinity of the cooling tower.

Activities associated with facility operation, such as noise and human presence, could affect wildlife living immediately adjacent to the tritium supply and recycling facility. These disturbances may cause some species to move from the area.

Construction and operation of a tritium supply facility alone would result in similar impacts to terrestrial resources but less than those described for a collocated tritium supply and recycling facility. Impacts would be less since 202 fewer acres of habitat would be disturbed.

Less Than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced tritium production capacity would have the same impacts described above for production at baseline tritium requirements.

Construction-related impacts of the less than baseline tritium requirement Phased APT would be similar to those described above. Some additional construction-related impacts could occur if expansion is needed to meet baseline tritium requirements. The potential impacts would be minor since the expansion activities would occur in the already developed main plant site.

Potential Mitigation Measures. The loss of habitat due to construction and operation of tritium supply and recycling facilities may be mitigated by revegetating with native species where possible.

Disturbance to wildlife living in areas adjacent to the facility may be minimized by preventing workers from entering undisturbed areas. It may be necessary to survey the TSS for the nests of migrating birds prior to construction and/or avoid clearing operations during the breeding season.

Wetlands

No Action. Under No Action, the missions described in section 3.3.3 would continue at ORR. This would result in no change to site wetlands. Section 4.4.2.6 describes current wetland resource conditions at ORR.

Tritium Supply and Recycling. Because the majority of the area in which the proposed tritium supply technology and recycling facilities would be located is upland, it is expected that direct impacts to wetlands could be avoided. Implementation of erosion and sediment control measures would control secondary impacts. Any unavoidable displacement of wetlands would be made in accordance with the requirements of the U.S. Army Corps of Engineers permit and the Tennessee *Water Quality Control Act.*

Construction-related discharges would be directed to either East Fork Poplar Creek or the Clinch River. Discharges to the Clinch River would have a minimal impact on the flow of the river and are not expected to affect associated wetlands. Discharges associated with dewatering from the MHTGR or APT to East Fork Poplar Creek could result in increased flow (section 4.4.3.4). This could cause a temporary rise in the local water table adjacent to the stream, especially during periods of low flow in the summer and fall. An increase in water levels in wetlands adjacent to the creek could favor plants better adapted to growing in wet soil conditions. Consequently, the composition of the wetland communities adjacent to the stream could change to plants favoring wet soil conditions. Additionally, the extent of any existing wetlands could also increase.

Scouring of the streambed of East Fork Poplar Creek due to high flow rates could result in the deposition of sediments downstream. If this deposition occurred in wetland areas, it could also change wetland vegetation composition. Construction of detention ponds to control the release of water would reduce impacts to wetlands associated with the creek. All wastewater discharges would be required to meet NPDES permit and Tennessee *Water Quality Control Act* requirements.

During operation of the tritium supply technologies and recycling facilities, blowdown water from the cooling system would also be discharged to either East Fork Poplar Creek or the Clinch River (section 4.4.3.4). If directed to East Fork Poplar Creak, large intermittent discharges of blowdown could result in streambed scouring and subsequent deposition of sediments in downstream areas. If deposition occurs in wetland areas, the vegetation composition of these wetlands could change. Thermal impacts to wetland vegetation could occur with the release of large volumes of cooling system water.

Due to the larger volume of water in the Clinch River, impacts to wetlands bordering the river would not be as great as those to wetlands along East Fork Poplar Creek. However, flows would be large enough (section 4.4.3.4) to cause streambed scouring in the vicinity of the outfall. Therefore, if present, wetlands in the vicinity of the outfall could be altered. All wastewater discharges would be required to meet NPDES permit and Tennessee *Water Quality Control Act* requirements.

Impacts on wetlands are not expected from salt deposition from the tritium supply technologies and recycling facilities. Any impacts that would occur would be limited to a relatively small area. All the tritium supply technologies and recycling facilities could be sited at a sufficient distance from wetlands to avoid any potential impacts from salt deposition.

Construction and operation of a tritium supply facility alone would result in similar impacts to wetlands, but slightly less than those described for a collocated tritium supply and recycling facility. This is the case since both land and water requirements would be less.

Less Than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced tritium production capacity would have the same types of wetland impacts described above for the baseline tritium production requirement. However, operation of the HWR at reduced capacity would potentially reduce the volume of cooling water discharges and may result in less wetland vegetation impacts. The MHTGR or ALWR related wetland impacts would not change from the baseline tritium production

requirement consequences since the reactor would operate at the same level to maintain power levels for steam or electrical production. Construction and operation of a Phased APT would have similar wetlands impacts as described for the Full APT.

Potential Mitigation Measures. Construction impacts to wetlands could be avoided by siting the tritium supply and recycling facilities in areas away from wetland habitat. Construction impacts could also be reduced by implementing soil erosion and sediment control measures. The use of detention ponds could reduce cooling system water discharges to wetlands adjacent to East Fork Poplar Creek. Unavoidable impacts to wetlands would be mitigated according to DOE policy as set forth in 10 CFR 1022 and in accordance with the U.S. Army Corps of Engineers requirements. All effluent discharges to wetlands would be required to meet NPDES permit and Tennessee *Water Quality Control Act* requirements.

Aquatic Resources

No Action. Under No Action, the missions described in section 3.3.3 would continue with no additional impacts to water bodies on the ORR. Currently, the only notable impacts are entrainment and impingement losses of fish species resulting from water withdrawal, and possible reduction in species diversity in some water bodies on the ORR due to reduced water quality. Section 4.4.2.6 describes the current aquatic resource conditions at ORR.

Tritium Supply and Recycling. Construction of the HWR, MHTGR, ALWR, or APT could cause water quality changes (primarily sediment loading and resulting turbidity) to Bear Creek, Grassy Creek, or Ish Creek as a result of soil erosion. These changes would vary according to the acres disturbed by each tritium supply technology (table 4.4.3.6–1). Soil erosion and sediment control measures would be implemented to control erosion. Construction water withdrawal would represent a very small percentage of the Clinch River's average flow and would have little affect on the flow of the river. Impingement and entrainment impacts would, therefore, be minimal and would be unlikely to affect fish populations in the Clinch River. During construction, dewatering discharges would be directed to either East Fork Poplar Creek or the Clinch River. Dewatering discharges from the HWR and ALWR would result in minor impacts to either stream or river (section 4.4.3.4). However, during construction of the MHTGR or APT, dewatering discharges, without design mitigation, could cause streambed scouring and increased turbidity in East Fork Poplar Creek. This could eliminate some fish spawning and feeding habitat. Aquatic life would be displaced during construction but would likely recolonize after construction is complete and water quality returns to normal. If dewatering discharges from the HWR or APT are directed to the Clinch River they would represent a small percentage of the river flow.

During operation, water withdrawals could increase entrainment and impingement of fish in the Clinch River. However, the greatest amount of water required would comprise a small percentage of the Clinch River's average flow and is unlikely to affect fish populations. Treated wastewater would be discharged to either East Fork Poplar Creek or the Clinch River; however, it would only represent a small percentage of the flow of either stream (section 4.4.3.4) and would minimally affect aquatic resources.

Blowdown water from the cooling system of a tritium supply and recycling facility would be released to either East Fork Poplar Creek or the Clinch River during operation. Without mitigation, intermittent discharge of large volumes of blowdown water would greatly increase the flow rate of East Fork Poplar Creek (section 4.4.3.4). This could result in flooding and/or streambed scouring and, as a result, alter aquatic resources by displacing existing plant and animal communities. Discharge of cooling system blowdown water to the Clinch River would represent up to 20 percent of the flow of the river during each discharge period (section 4.4.3.4). This could result in streambed scouring in the vicinity of the outfall and subsequent downstream sedimentation. Although fish would likely return to the disturbed area between periods of discharge, this would not be possible for benthic organisms. Thermal impacts may also occur as the result of the release of large intermittent volumes of cooling water. Mitigation measures would be required to lessen impacts to either East Fork Poplar Creek or the Clinch River. Chemical constituents and temperature of the discharges would be required to meet NPDES permit and Tennessee *Water Quality Control Act* requirements. If temperature limits are not met, a Section 316a demonstration of a balanced biotic community would be required.

Construction and operation of a tritium supply facility alone would result in similar impacts to aquatic resources but slightly less than those described for a tritium collocated supply and recycling facility. This is the case since both land and water requirements would be less.

Less Than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced tritium production capacity would have the same type of impacts to aquatic resources at ORR as described above for the baseline tritium production requirement. However, operation of the HWR at reduced capacity would potentially reduce the volume of cooling water discharges and may result in fewer aquatic resource impacts. The MHTGR- or ALWR-related aquatic resource impacts would not change from the baseline tritium production requirement consequences since the reactor would operate at the same level to maintain power levels for stream or electrical production. Construction and operation of a Phased APT would have similar aquatic resource impacts but potentially slightly less than the Full APT.

Potential Mitigation Measures. Impacts to aquatic resources could be mitigated by implementing a soil erosion and sediment control plan to reduce stream turbidity. Also, the use of discharge detention basins and energy dissipating structures could prevent excessive increases in the rate of stream flows. Intake structures could also be designed and operated to reduce intake flow rates, thereby reducing impingement and entrainment losses. All discharges would be required to meet NPDES and Tennessee *Water Quality Control Act* requirements.

Threatened and Endangered Species

No Action. Under No Action, the missions described in section 3.3.3 would continue, with no change in impacts to threatened and endangered species at ORR.

Tritium Supply and Recycling. Impacts to threatened and endangered species resulting from construction of the HWR, MHTGR, ALWR, or APT would vary by the amount of terrestrial habitat disturbed (table 4.4.3.6–1). Federal-listed threatened and endangered species are not expected to be affected by construction activities. Although the Indiana and gray bats are potential resident species, neither is known to occur on ORR. Land-clearing activities may destroy state-protected plant species found within or adjacent to disturbed portions of the proposed site including pink lady's-slippers and fen orchid (state, endangered), tubercled fen-orchid, ginseng, purple fringeless orchid, and Canada lily (state, threatened). The Tennessee dace is sensitive to siltation and actively seeks clean gravel for spawning. An increase in amount or duration of sediment runoff to Ish Creek or Bear Creek during facility construction could adversely impact this fish species.

Construction could also impact four state-listed bird species. The Cooper's hawk and sharp-shinned hawk (both threatened) would lose potential nesting and foraging habitat as a result of the construction of the facility. The red-shouldered hawk and black vulture, both deemed in need of management by the state, would also lose habitat. Preactivity surveys would be required prior to construction to determine the occurrence of these species in the area to be disturbed. During operation, the high velocity and large volume of cooling system blowdown discharge to surface water could alter the aquatic ecology of East Fork Poplar Creek and disrupt hellbender habitat.

Construction and operation of a tritium supply facility alone would result in similar impacts to threatened and endangered species but slightly less than those described for a collocated tritium supply and recycling facility. This is the case since both land and water requirements would be less.

Less Than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced tritium production capacity would be expected to result in similar impacts to threatened, endangered or sensitive species as described for the baseline tritium production requirement. Construction and operation of a Phased APT would also have similar impacts to these species.

Potential Mitigation Measures. Disturbance of threatened, endangered, and special status species would be avoided where possible. Land clearing could be avoided during the nesting season of protected bird species. Where appropriate, habitat restoration or propagation programs could be attempted for protected plants when their disturbance is unavoidable. Use of the Clinch River for wastewater discharge would avoid impacting hellbender habitat. Detention ponds and other alternative

cooling system blowdown release mechanisms described in section 4.4.3.4 could be used to prevent increasing the rate of stream flow.

Consultation with the USFWS would be pursued as required and, if necessary, a detailed plan to mitigate impacts to Federal-listed threatened and endangered species at ORR would be developed. Currently, no critical habitat has been designated for threatened and endangered species at ORR.

4.4.3.7 *Cultural and Paleontological Resources*

Cultural and paleontological resources may be affected directly through ground disturbance during construction, visual intrusion of the project to the historic setting or environmental context of historic sites, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism. Intensive cultural resources inventories and site evaluations have not been conducted for the proposed TSS. Site-specific surveys and evaluations would be conducted in conjunction with tiered NEPA documentation. Although the location and acreage for the proposed tritium supply plant or combined tritium supply and recycling facilities will vary, the effects on cultural and paleontological resources are based primarily on the amount of ground disturbance; therefore, the facilities with the greatest ground disturbance will have the greatest effect on cultural and paleontological resources. Some NRHP-eligible prehistoric and historic sites and some important Native American sites may be affected by the proposed action. Effects to paleontological resources will be negligible.

Multipurpose Reactor. Total land requirements for the MHTGR and ALWR multipurpose reactors would be 931 and 691 acres, respectively. NRHP-eligible prehistoric and historic sites and Native American resources may occur within these acreages and may be affected by the construction of a multipurpose reactor. Paleontological resources are limited at ORR to common assemblages with relatively low research potential, therefore potential impacts are expected to be limited. In general, impacts to prehistoric and historic resources and Native American resources would be similar to, but potentially greater than, those described for the tritium supply and recycling facility.

Prehistoric and Historic Resources

No Action. Under No Action, DOE would continue existing and planned missions at ORR. Any impacts to prehistoric and historic resources from these missions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Land disturbance for the proposed tritium supply facility (section 3.4) would range from 360 acres for the MHTGR 173 acres for the APT at ORR (section 4.4.3.1). Acreages for the HWR and ALWR would be 260 and 360, respectively. Acreage required by the recycling facilities would be an additional 196 acres. Although an intensive survey has not yet been conducted, some NRHP-eligible prehistoric and historic sites may occur within acreages that would be disturbed during construction. The prehistoric sites may include small camps and limited activity locations; the historic sites may include remains of farmsteads, roads, and trash scatters. NRHP-eligible resources will be identified through project-specific inventories and evaluations, and any project-related effects would be addressed in tiered NEPA documentation. Operation of new tritium facilities does not involve additional ground disturbance or increased activity; therefore, prehistoric or historic sites would not be affected.

Less Than Baseline Operations. No change in impacts to prehistoric and historic resources would be expected from operating the HWR at reduced capacity. Impacts for the MHTGR or ALWR would also not change from those described for the baseline tritium requirement because the MHTGR or ALWR would not be a reduced size or operate at reduced capacity.

Construction and operation of the Phased APT would not change the expected impacts from the baseline tritium requirement sized technologies since the disturbed area would be the same.

Potential Mitigation Measures. If NRHP-eligible resources cannot be avoided through project design or siting, and would result in an adverse effect, then a Memorandum of Agreement would need to be negotiated between DOE, the Tennessee SHPO, and the Advisory Council on Historic Preservation describing and implementing intensive inventory and evaluation studies, data recovery plans, site treatments, and monitoring programs. The appropriate

level of data recovery for mitigation would be determined through the Tennessee SHPO and the Advisory Council on Historic Preservation, in accordance with Section 106 of the *National Historic Preservation Act.*

Native American Resources

No Action. Under No Action, DOE would continue existing and planned missions at ORR. Any impacts to Native American resources from these missions would be independent of an unaffected by the proposed action.

Tritium Supply and Recycling. Native American resources may occur within the acreages that would be disturbed during construction of the tritium supply plant or combined tritium supply and recycling facilities. Native American resources may include villages, cemeteries, burials, and traditional plant gathering areas. Operation of tritium facilities may create audio or visual intrusions on Native American sacred sites in the vicinity or reduce access to traditional use areas. Specific concerns about the presence, type, and locations of Native American resources would be identified through consultation with the potentially affected Native American groups, and any project-related effects would be addressed in tiered NEPA documentation.

Less Than Baseline Operations. Impacts to Native American resources would not change due to less than baseline tritium operation of the HWR, MHTGR or ALWR. Construction and operation of a Phased APT would have similar impacts on Native American resources as those described for the baseline tritium requirement Full APT.

Potential Mitigation Measures. If Native American resources cannot be avoided through project design or siting, acceptable mitigation measures to minimize the effect on these resources would be determined in consultation with the potentially affected Native American groups. Such mitigations may include, but not be limited to, appropriate relocation of human remains according to the *Native American Graves Protection and Repatriation Act*, planting vegetation screens to reduce visual and noise intrusions, increased access to traditional use areas during operations, or transplanting or harvesting sensitive Native American plant resources.

Paleontological Resources

No Action. Under No Action, DOE would continue existing and planned missions at ORR. Any impacts to paleontological resources from these missions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Fossiliferous geological formations with surface exposures occur within the proposed area designated for the tritium supply and recycling facilities. All known paleontological materials consist of relatively common and widespread invertebrate fossils and these assemblages have relatively low research potential. Consequently, while there may be effects on paleontological resources, impacts would be negligible.

Less Than Baseline Operations. No change in impacts to paleontological resources would be expected due to reduced operation of the HWR, MHTGR or ALWR. Construction of a Phased APT may potentially have a slightly smaller impact on paleontological resources due to less excavation for APT tunnel length.

Potential Mitigation Measures. Because no significant or rare paleontological resources would be affected, no mitigation measures are required.

4.4.3.8 *Socioeconomics*

Locating any of the tritium supply technologies alone or with recycling facilities at ORR would affect socioeconomics in the region. Section 3.2 provides descriptions for No Action, the tritium supply technologies, and tritium recycling. Siting a tritium supply technology and recycling facility at ORR would create changes in some of the communities in both the ROI and the regional economic area. The inmigrating population could increase the demand for housing units. Additionally, there would be an associated increased burden on community infrastructure and subsequent effects on the public finances of local governments in the ROI. The increase of population could also burden transportation routes in the ROI.

During the construction period, the greater changes in socioeconomic characteristics would result from the ALWR and APT. During operation, the HWR, MHGTR, and ALWR would exhibit similar characteristics. The APT would result in the smallest changes during operation. None of these tritium supply technologies would increase population, the need for additional housing, or local government spending in the ROI beyond 3 percent over No Action during peak construction or operation. Although the greatest percent increases in employment, population and housing, and public finance during construction and operation occur in the peak years of 2005 and 2010, respectively, the annual average increases over the periods for construction (2001 to 2005) and peak construction to full operation (2005 to 2010) are between less than 1 percent and 2 percent average growth annually, and 1 percent average annual growth during operation (2010 to 2050).

The effects of locating any of the tritium supply technologies alone or with recycling facilities at ORR are summarized in section 4.4.3. The following sections describe the effects that locating one of these technologies would have on the local region's economy and employment, population, housing, public finances, and local transportation.

Employment and Local Economy

Changes in employment and levels of economic activity in the 29-county regional economic area from the proposed action at ORR are described in this section. Although specialized personnel, materials, and services required for construction and operation would be imported from outside the area, a significant portion of these requirements would be available in this regional economic area. Figures 4.4.3.8–1 and 4.4.3.8–2 present the potential changes in employment and local economy that would occur with each of the technologies.

No Action. Under No Action, employment at ORR was approximately 15,000 persons in 1994. This is a decrease of approximately 300 persons from the 1990 employment. ORR employment is projected to remain at 15,000 persons through 2020. Historical and future employment projections at ORR are found in appendix table D.2.1–1. The total ORR payroll was approximately $513 million in 1994 and is expected to remain at this level through 2010.

Total employment in the regional economic area is projected to grow less than 1 percent annually between 2001 and 2009, reaching 570,500 persons, and decrease less than 1 percent annually between 2010 and 2020, reaching 565,200 persons. The unemployment rate in the regional economic area is expected to remain at 6.2 percent between 2001 and 2020. Per capita income is projected to increase from $17,900 to $20,700 during this 20-year period. No Action estimates are presented in appendix table D.3–38.

Tritium Supply and Recycling. Construction activities would begin between 2001 and 2003 and would be completed between 2007 and 2009. Phasing in of employment for the operation of the new facilities would begin in 2007 or 2008, peak at full employment by 2010, and continue at this level into the future.

Locating any of the tritium supply technologies and recycling facilities at ORR would create new jobs (direct) at the site. Indirect job opportunities, such as community support services, would also be created in the regional economic area as a result of these new jobs. The total new jobs (direct and indirect) created would reduce unemployment and increase income in the economic region surrounding ORR during both the construction and operation periods of the proposed action.

Construction. Locating tritium supply and recycling facilities at ORR would require a total of approximately 7,400 to 13,600 worker-years of activity over

a 5- to 9-year construction period. This construction-related employment would indirectly create other jobs in the regional economic area and total employment would grow at an annual average rate of 1 percent until the peak year of 2005. Between 2005 and 2010, annual growth would slow to less than 1 percent. Figure 4.4.3.8–1 gives the estimates of total jobs (direct and indirect) that would be created during peak construction (year 2005) for each of the tritium supply technologies with recycling and the recycling facility's contribution to employment growth.

As employment opportunities grow in the regional economic area due to the proposed action, the unemployment rate would be reduced from the No Action estimate of 6.2 percent. Figure 4.4.3.8–2 presents a comparison of unemployment rates for the different tritium supply technologies and recycling facilities during peak construction in 2005. During the project's peak construction phase, the unemployment rate would range from a high of 5.5 percent to 4.8 percent, depending upon the tritium supply technology with recycling selected.

Income in the regional economic area would also increase slightly, particularly during peak construction as shown in figure 4.4.3.8–2. Per capita income is expected to increase at an annual average of 1 percent until the peak construction year (2005). Between 2005 and 2010, per capita income is also expected to increase annually by 1 percent. This is the same increase that is projected for the No Action per capita income for the same time periods.

Operation. Siting tritium supply and recycling facilities at ORR would help offset the employment and income losses at ORR from the approximately 300 jobs lost between 1990 and 1994. Employment for operation would begin phasing in as construction nears completion and the construction-related employment begins phasing out. It is expected that full operation employment would peak in 2010 and continue at this level into the future. Figure 4.4.3.8–1 gives the total project-related jobs projections (direct and indirect) for each of the tritium supply technologies and recycling facilities for 2010. Total employment would be flat from 2010 to 2020; the same is projected under No Action.

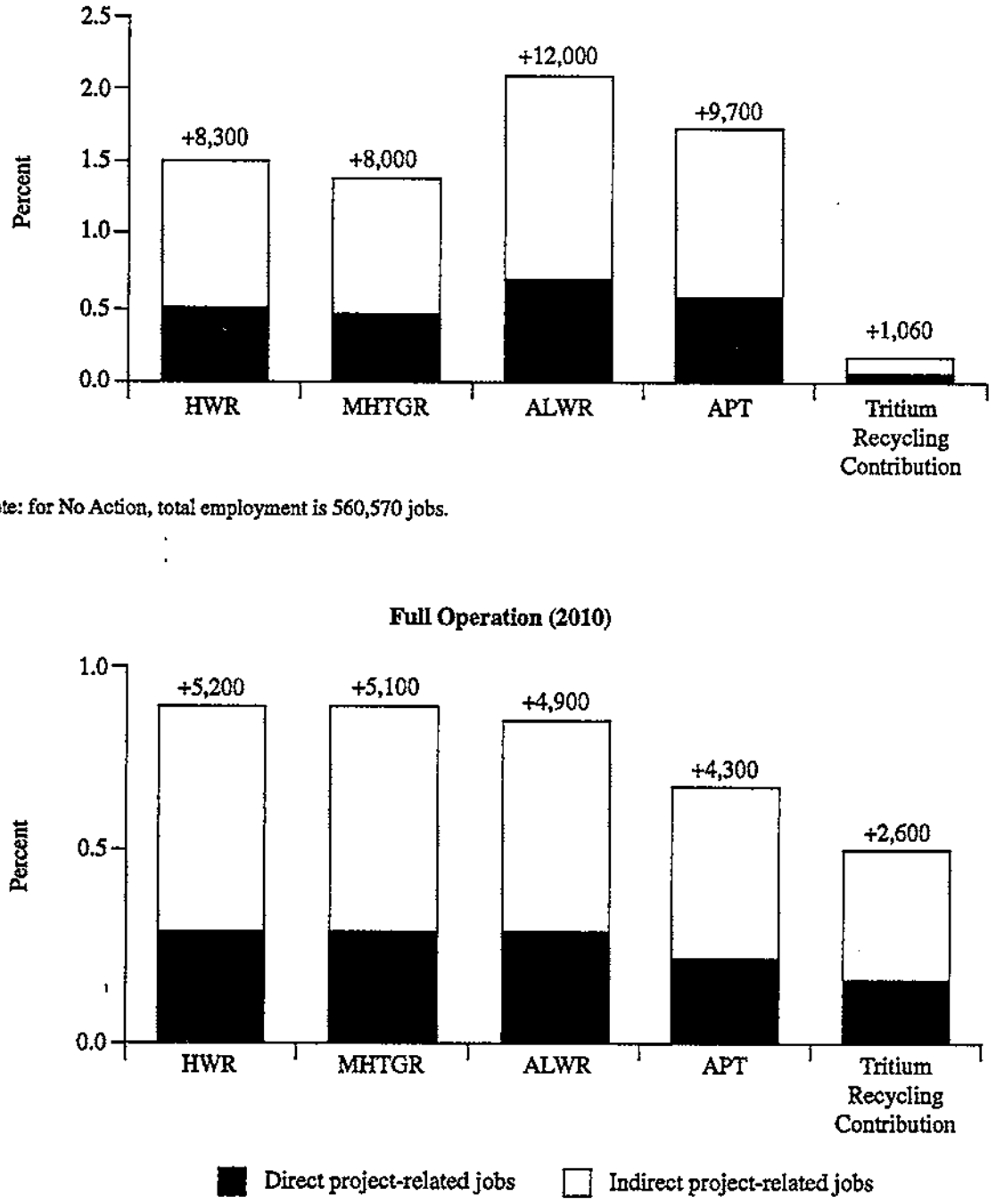
Creation of additional job opportunities would reduce the unemployment rate below that projected for No Action. Figure 4.4.3.8–2 presents the differences in unemployment rates during the first year of full operation employment (2010) for each of the tritium supply technologies and recycling facilities. From 2010 to 2020, unemployment would be reduced from the No Action projection of 6.2 percent to between 5.6 and 5.7 percent, depending upon the technologies selected for the proposed action.

Income would also increase slightly in the regional economic area as a result of the proposed action. Per capita income differences for tritium supply technologies and recycling facilities for 2010 are given in figure 4.4.3.8–2. Per capita income annual average increases would be about 1 percent from 2010 through 2020 for the different tritium supply technologies and recycling facilities considered for location at ORR. The No Action projected annual average increase during the same period would also be approximately 1 percent.

Tritium Supply Alone. Construction of the tritium supply technologies without recycling facilities would begin between 2001 and 2003 and would be completed between 2007 and 2009. Employment for the operation of the facility would begin in 2007 and reach full employment by 2010. Locating any of the tritium supply technologies at ORR would create new jobs at the site and indirectly create other jobs in the region. However, this job creation and the additional economic effects would be less than the effects that would occur with the collocation of tritium supply with the recycling facility.

Construction. Construction of tritium supply technologies would require a total of 6,380 to 12,600 worker-years of activity over a 5- to 9-year period. New jobs would be created at an annual average rate of 1 percent until the peak year of construction, 2005. Between 2005 and 2010, employment would generally increase by less than 1 percent annually for the four technologies. Appendix table D.3–39, presents the estimates of total employment during peak construction in 2005, or these new jobs can be calculated by subtracting the tritium recycling contribution from tritium supply technologies and recycling in figure 4.4.3.8–1.

Although the construction of the facility will create new jobs, the effects would not be enough to greatly affect the unemployment rate projected for No

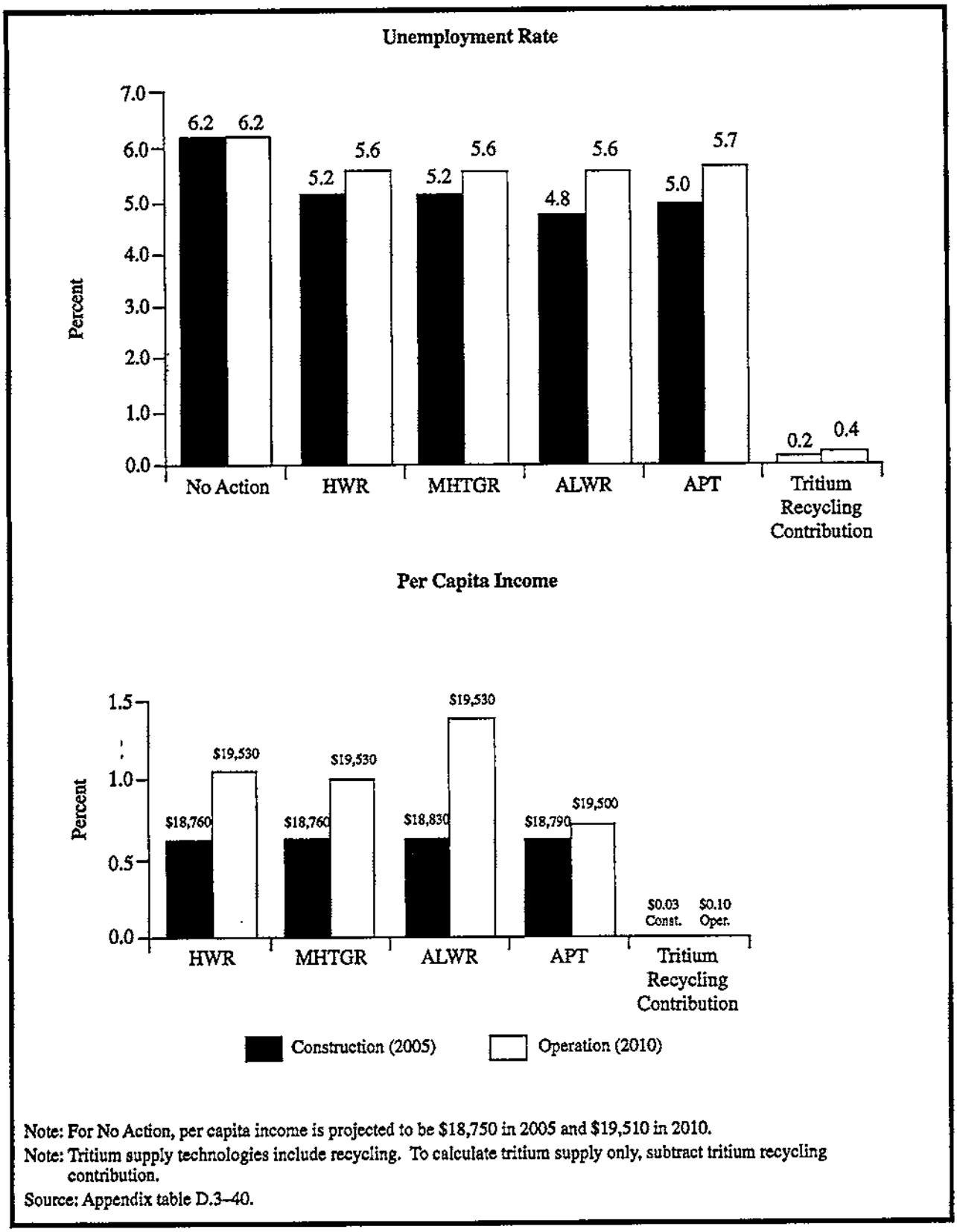


Note: Tritium supply technologies include recycling. To calculate supply only, subtract tritium recycling contribution. For No Action, total employment is 573,000 jobs. The percent increase in total employment during peak construction and operation was calculated by dividing the total project-related jobs by the total employment for No Action.

Source: Appendix table D.3–40.

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



Note: For No Action, per capita income is projected to be $18,750 in 2005 and $19,510 in 2010.
Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution.
Source: Appendix table D.3–40.

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.*

Action. Additionally, per capita income in the region would rise only slightly above that estimated for No Action. Estimates of unemployment rate and per capita income are presented in appendix table D.3–39, or can be derived for tritium supply technologies by subtracting the tritium recycling contribution in figure 4.4.3.8–2.

Operation. Operation employment for the tritium supply technologies alone would begin phasing in at the end of the construction period and be at full employment in 2010. Full employment is expected to be maintained for the life of the facility. Estimates for full employment in 2010 are presented in appendix table D.3–39. Total project related jobs created by the tritium supply technologies alone can be calculated by subtracting tritium recycling contribution in figure 4.4.3.8–1.

The addition of new jobs during operation would reduce the unemployment rate below the projection for No Action. The unemployment rate for 2010, the first year of full operation employment, is presented in appendix table D.3–39, or can be calculated by subtracting the tritium recycling contribution in figure 4.4.3.8–2. Unemployment would be reduced from the No Action projection of 6.2 percent to between 6 and 5.9 percent from 2010 through 2020, depending on the technology selected.

The creation of new jobs as a result of tritium supply operation would also increase income slightly over the No Action estimates. Appendix table D.3–39 gives the per capita income for the facility for 2010. Per capita income growth can also be calculated by subtracting the tritium recycling contribution in figure 4.4.3.8–2. From 2010 to 2020, per capita income annual increases would be 1 percent, the same annual increase projected under No Action.

Less Than Baseline Operations. Tritium supply technologies that provide less than the baseline tritium operation capacities are described in section 3.1. These options may or may not be collocated with the tritium recycling facilities. The options include lowering the power in the HWR, using fewer target rods in the MHTGR or ALWR, and the phased approach for the APT.

Construction. The less than baseline operations case for the HWR, MHTGR, and ALWR would have the same construction workforce requirements as discussed in the tritium supply and recycling and tritium supply only sections. Therefore, employment and economic effects in the region would be the same.

The Phased APT would require the same total number of construction workers as the Full APT, but the construction period would span from 1999 to 2008 instead of from 2003 to 2007. Additionally, peak construction would occur in 2003 instead of 2005. The effects on the regional economic area's employment, unemployment rate, and per capita income as a result of constructing the Phased APT are presented in appendix table D.3–39. Appendix table D.3–40 presents the effects on employment, unemployment rate, and per capita income for constructing the Phased APT with tritium recycling facilities. Generally, average annual increases in employment and income are similar to those for the Full APT, but these increases are over a longer period of time. These increases are less than or equal to 1 percent, the same as the No Action estimates.

Operation. Operation workforce requirements for the less than baseline tritium requirement case for the HWR, MHTGR, ALWR, and the Phased APT would be the same as those described in the tritium supply and recycling and tritium supply only sections. Thus, regional employment and economic effects would be the same.

Multipurpose Reactor. Construction activities for the multipurpose reactor would begin in 2001 and would be completed by 2009. Phasing in of employment for the operation of the multipurpose reactor would begin in 2007, peak at full employment by 2010, and continue at that level into the future. Because this option would perform three processes, it would result in greater changes in employment and local economy characteristics than any of the four tritium supply technologies.

Construction. Siting the multipurpose reactor and a recycling facility at ORR would require 19,140 worker-years of activity over a 9-year period. The multipurpose reactor alone would require 18,150 worker-years of activity over a 9-year period. Employment characteristics, unemployment rates, and per capita income characteristics during construction of the multipurpose reactor alone and with a tritium recycling facility are presented in appendix tables

D.3–39A and D.3–40A, respectively. From the first year of construction to the peak year (2005), annual average increases in employment and per capita income would range 1 to 2 percent. Between 2005 and 2010, employment growth would be flat and per capita income would increase on an annual average of 1 percent. The unemployment rate during peak construction for this option with or without a recycling facility would be 4.5 and 4.6 percent, respectively.

Operation. Operation employment for the multipurpose reactor would begin phasing in toward the end of the construction period and reach full employment in 2010. Full employment is expected to be maintained for the life of the facility. Employment characteristics, unemployment rates, and per capita income characteristics during operation of the multipurpose reactor alone and with a tritium recycling facility are presented in appendix tables D.3–39A and D.3–40A, respectively. During operation annual employment growth would be flat and annual average growth in per capita income would be less than 1 percent. The unemployment rate for the multipurpose reactor alone and with a recycling facility would be 5.2 and 5.5 percent, respectively.

Accelerator Production of Tritium Power Plant. Construction activities for the APT power plant would begin in 2003 and would be completed by 2007. Phasing in of employment for the operation of the APT power plant would begin in 2007, peak at full employment by 2010, and continue at that level into the future. This option is similar to the APT with an addition of a gas power plant. The changes in employment and local economy would be similar, but greater than those resulting from the APT.

Construction. Siting this option with a recycling facility at ORR would require 7,600 worker-years of activity over a 5-year period. The APT power plant alone would require 6,600 worker-years of activity of a 5-year period. Employment characteristics, unemployment rates, and per capita income characteristics during construction of this option alone and with a tritium recycling facility are presented in appendix tables D.3–39A and D.3–40A, respectively. From the first year of construction to the peak year (2005), annual average increases in employment and per capita income would be 1 percent. Between 2005 and 2010, employment growth would be flat and per capita income would increase on an annual average of 1 percent. The unemployment rate during peak construction for this option with or without a recycling facility would be 4.9 and 5 percent, respectively.

Operation. Operation employment for the APT power plant would begin phasing in toward the end of the construction period and reach full employment in 2010. Full employment is expected to be maintained for the life of the facility. Employment characteristics, unemployment rates, and per capita income characteristics during operation of the APT power plant alone and with a tritium recycling facility are presented in appendix tables D.3–39A and D.3–40A, respectively. During operation annual employment growth would be flat and annual average growth in per capita income would be less than 1 percent. The unemployment rate for the APT power plant alone and with a recycling facility would be 5.7 and 6 percent, respectively.

Population and Housing

Changes to ROI population and housing expected from the proposed action at ORR are described in this section. Additional population could be expected to in-migrate to the ORR region and these people would be expected to reside in cities and counties within the ROI in the same relative proportion as the existing population. Increases to population could lead to a demand for additional housing units beyond existing vacant housing available during construction or operation phases of the proposed action. Figures 4.4.3.8–3 and 4.4.3.8–4 present the changes in population and housing for the tritium supply technologies and recycling facilities.

No Action. Population and housing annual average increases between 2001 and 2009 are projected to be 1 percent. Future annual average increases are projected to be less than 1 percent between 2010 and 2020. Population in the ROI is estimated to reach 561,000 in 2010 and 586,000 in 2020. Total housing units in the ROI are estimated to reach 239,800 in 2010 and 250,500 in 2020. No Action estimates are presented in appendix tables D.3–41 and D.3–44.

Tritium Supply and Recycling. It is expected that the proposed action would increase population and housing demands in the ROI slightly (less than 1 percent) over No Action projections during peak construction. The effects are expected to be fewer

(much less than 1 percent) during the operation phase of the proposed action.

Construction. Construction activities would be phased over a 5- to 9-year period. Figure 4.4.3.8–3 illustrates that during peak construction (year 2005), the ALWR and APT would create the largest population and housing demand increases over No Action, and the HWR and MHTGR would have the fewest effects. The increase in population could require some additional housing units beyond what is currently available in the existing housing mix. However, any requirements for additional housing units would be at annual average increases of 1 percent in the first 3 years of construction of the ALWR, followed by an increase of much less than 1 percent until peak operation. The other tritium supply technologies would have annual average population and housing demand growth of less than 1 percent. Therefore, there would not be any major effects on any of the ROI communities.

Operation. Operation of tritium supply technologies and recycling facilities is expected to reach full employment by 2010. In-migrating population is expected to demand housing units similar to the existing housing mix in the ROI. Figure 4.4.3.8–4 shows that population increases and potential demand for additional housing units over No Action projections is almost negligible (much less than 1 percent) in this peak year. Given that the operations of the proposed action would be phased in over a 4-year period, it is expected that existing vacancies would absorb much of this new demand and that No Action requirements would be exceeded by very few units.

Tritium Supply Alone. Locating only a tritium supply technology at ORR would not increase population or housing demands in the ROI more than 1 percent over No Action projections during the construction or operation periods.

Construction. Construction activities for the tritium supply technologies alone would be much lower than if collocated with the tritium recycling facilities. The greatest increase in population and housing demand would occur during peak construction in 2005. Appendix tables D.3–42 and D.3–45 show that available vacancies in the existing housing mix would probably accommodate the expected population growth. Estimated growth in the ROI is much less than 1 percent over the No Action projection.

Operation. Full employment levels for the tritium supply technologies alone would be reached by 2010. In-migrating population would be expected to require housing units similar to the existing mix in the ROI. These requirements would be lower than those for any of the tritium supply technologies with the recycling facilities. Potential demand for housing units would be very small (much less than 1 percent) in the first year of full employment as illustrated in appendix tables D.3–42 and D.3–45. It is expected that existing vacancies would absorb most of this new demand as employment would be phased in from 2007 through 2010.

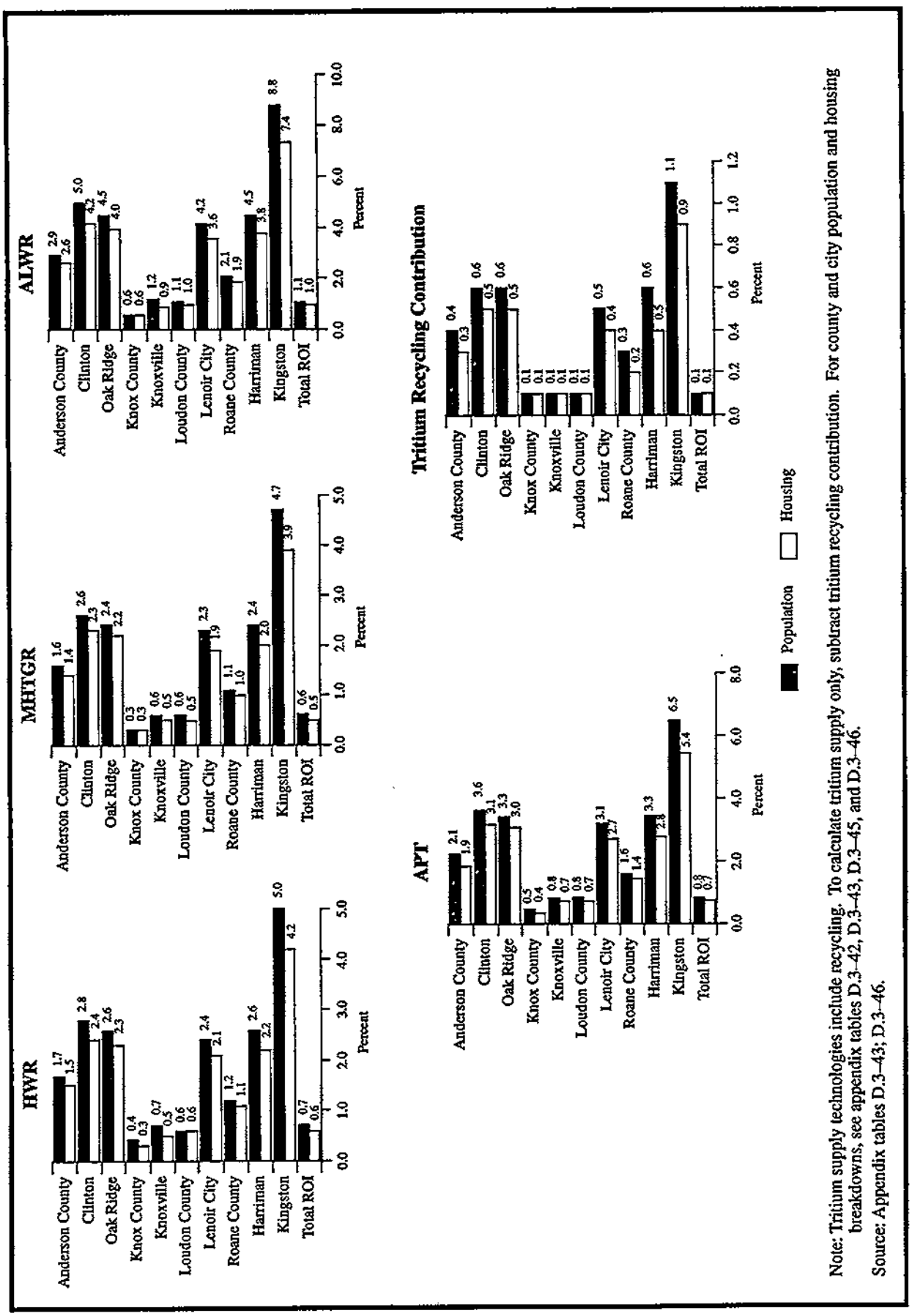
Less Than Baseline Operations. Population increases and housing demands would be the same or lower during construction and operation of tritium supply technologies operated at less than baseline tritium requirements than the alternatives discussed in the tritium supply and recycling and tritium supply only sections.

Construction. Population increases and housing demands would be the same as those given in figure 4.4.3.8–3 for the HWR, MHTGR, and ALWR. The Phased APT would increase population and housing demand during construction to the same level as the Full APT, but this would occur over a longer construction period with lower average annual increases (less than 1 percent). Also, the peak construction year would be 2003 instead of 2005. The effects of the Phased APT on population and housing are presented in appendix tables D.3–42 and D.3–45, respectively. Appendix tables D.3–43 and D.3–46, present the results of constructing the Phased APT with the tritium recycling facilities.

Operation. The effects on population and housing of operating the HWR, MHTGR, ALWR, and Phased APT at less than baseline tritium requirement would be the same as those given in figure 4.4.3.8–4.

Multipurpose Reactor. Locating the multipurpose reactor with or without a recycling facility at ORR would not increase population and housing demands more than 2 percent over No Action projections during the construction period and 1 percent during operation.

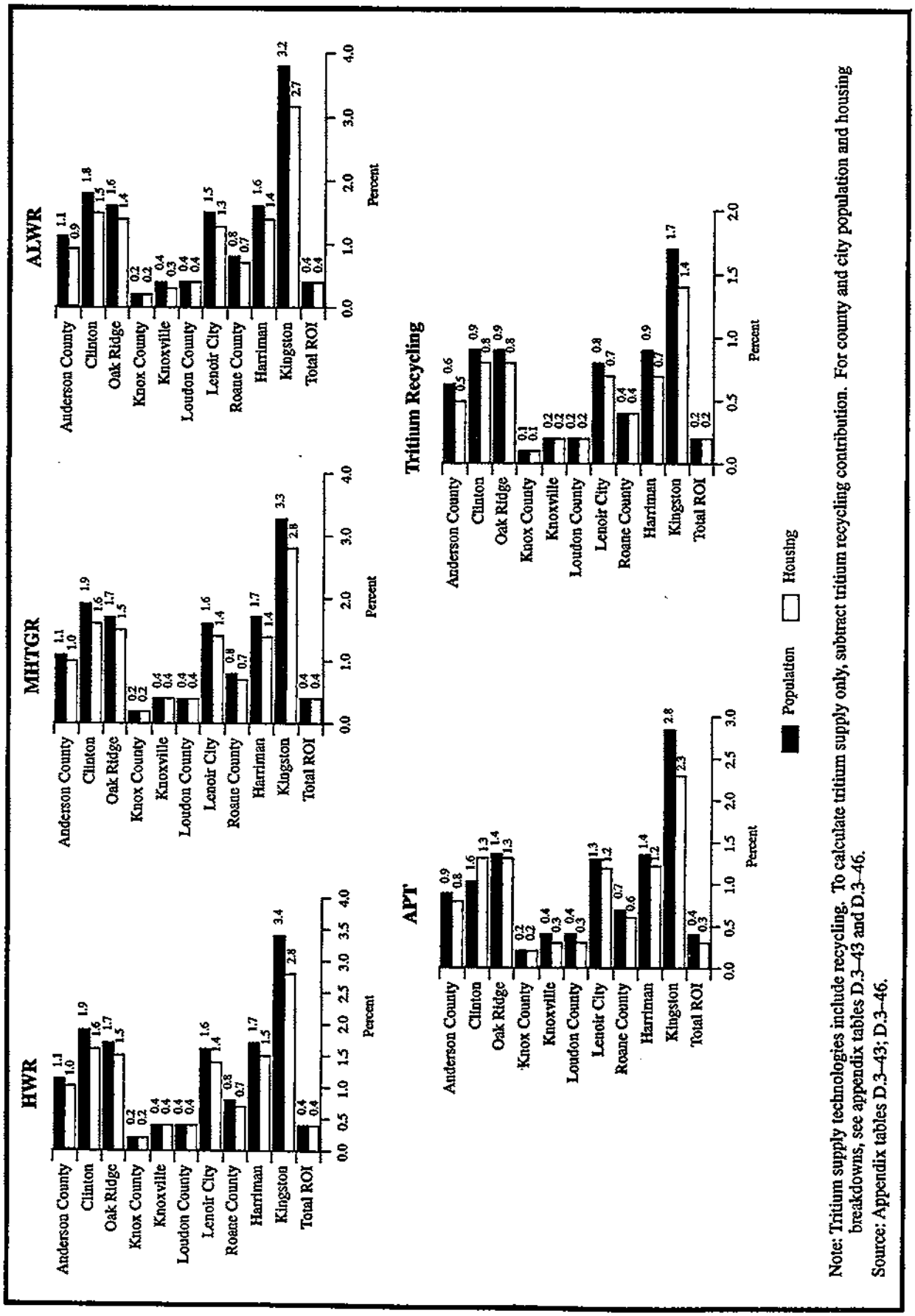
Construction. Because this option would perform three processes, it would result in greater changes in



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For county and city population and housing breakdowns, see appendix tables D.3-42, D.3-43, D.3-45, and D.3-46.

Source: Appendix tables D.3-43; D.3-46.

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



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For county and city population and housing breakdowns, see appendix tables D.3-43 and D.3-46.

Source: Appendix tables D.3-43; D.3-46.

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.*

population and housing characteristics than any of the four tritium supply technologies. Changes to population and housing characteristics resulting from multipurpose reactor with and without recycling facilities are presented in appendix tables D.3–42A, D.3–43A, D.3–45A, and D.3–46A. Population and housing growth in the ROI would be at an annual average rate of 1 percent until 2005 and would be flat between 2005 and 2010.

Operation. Full employment levels for the multipurpose reactor would be reached by 2010. As illustrated in appendix tables D.3–42A, D.3–43A, D.3–45A, and D.3–46A, potential demand for housing units would be less than 1 percent in the first year of full employment. It is expected that existing vacancies would absorb most of this new demand as employment would be phased in from 2007 through 2010.

Accelerator Production of Tritium Power Plant. Locating the APT power plant with or without a recycling facility at ORR would not increase population and housing demands more than 1 percent over No Action projections during the construction and operation periods.

Construction. This option is similar to the APT with an addition of a gas power plant. The changes in population and housing demands would be similar, but greater than those resulting from the APT. Changes to population and housing characteristics resulting from the APT power plant with and without recycling facilities are presented in appendix tables D.3–42A, D.3–43A, D.3–45A, and D.3–46A. Population and housing growth in the ROI would be at an annual average rate of 1 percent until 2005 and would be flat between 2005 and 2010.

Operation. Full employment levels for the APT power plant would be reached by 2010. As illustrated in appendix tables D.3–42A, D.3–43A, D.3–45A, and D.3–46A, potential demand for housing units would be less than 1 percent in the first year of full employment. It is expected that existing vacancies would absorb most of this new demand as employment would be phased in from 2007 through 2010.

Public Finance

Fiscal changes could occur in some ROI local jurisdictions from the proposed action. Factors influencing these changes include residence of project-related employees and their dependents, cost and duration of construction, and economic conditions in the ROI once the new facilities are operational.

Implementing the proposed action at ORR would increase population, resulting in more revenues for ROI local jurisdictions. Additional population would also increase public service expenditures.

Figures 4.4.3.8–5 and 4.4.3.8–6 present the potential fiscal changes that would occur with the different tritium supply technologies and recycling facilities.

No Action. Appendix table D.3–47, presents the 1992 public finance characteristics for the local ROI jurisdictions. Appendix tables D.3–48 through D.3–51, present the impacts from tritium supply technologies with or without recycling facilities compared to No Action during construction and operation for the local counties and cities. Funding for school districts is included in the finances for the county or city in which they are found. Between 2001 and 2005, all ROI counties and cities are projected to increase total revenues on an annual average of 1 percent or less. Total expenditures are projected to increase on an annual average of 1 percent or less for most ROI counties and cities between 2001 and 2005. Between the peak year of construction (2005) and full operation (2010), total revenues and expenditures are also expected to increase by less than 1 percent.

Between 2010 and 2020, projected annual average increases in total revenues are less than 1 percent for all counties and cities in the ROI. Total expenditures are also projected to increase on an annual average by 1 percent or less for ROI jurisdictions between 2010 and 2020.

Tritium Supply and Recycling. The proposed action at ORR would create some fiscal benefits to local jurisdictions within the ROI. Some local government finances would be affected during the construction and operation phases of the proposed action. Construction-related effects on revenues and expenditures could span a 5- to 9-year period with the peak occurring in 2005. The effects of the operation phase would peak in 2010 and remain at this level throughout the life of the proposed action.

Construction. The public finances of counties and cities within the ROI would be affected by the construction-related activities associated with the proposed action. Initially, there would be slight increases to some local government jurisdictions' revenues and expenditures, which would peak in 2005 and then decline as construction neared completion. Figure 4.4.3.8–5 presents the revenue and expenditure changes of ROI local government jurisdictions over No Action during peak construction for the four tritium supply technologies and recycling facilities. Over the construction phase of the proposed action and between 2005 to 2010, revenues and expenditures for ROI counties and cities would increase on an annual average of 1 percent or less for all the tritium supply technologies with recycling facilities. Under the No Action estimates, local government revenues and expenditures would also increase on an annual average of 1 percent or less.

Operation. The effects of phasing in operation together with the phasing out of construction on ROI local government finances would be fewer than the effects at peak or full operation (2010). The effects that the four tritium supply technologies and recycling facilities would have on county and city revenues and expenditures are presented in figure 4.4.3.8–6. Between 2010 and 2020, revenues and expenditures are expected to increase slightly but at an average annual rate of less than 1 percent for all ROI jurisdictions. The No Action local government revenues and expenditures would also increase at an average annual rate of less than 1 percent.

Tritium Supply Alone. Locating the tritium supply alone at ORR would create some fiscal benefits to local jurisdictions within the ROI, but these benefits would be fewer than if collocated with the recycling facilities.

Construction. Construction-related effects on the revenues and expenditures of counties and cities would be annual average increases of less than 1 percent until peak construction (2005) and between 2005 and 2010. Appendix table D.3–48 presents the revenue and expenditure changes of ROI local governments over No Action during peak construction of the tritium supply technologies alone.

Operation. The operation phase of the tritium supply only would affect the public finances of counties and cities in the ROI but these effects would be less than those resulting from operating the tritium supply technologies with the recycling facilities. Appendix table D.3–49 presents the effects that operation would have on these local jurisdictions in 2010. From 2010 to 2020 revenues and expenditures are expected to increase annually by less than 1 percent. In comparison, No Action local government revenues and expenditures would increase at an average annual rate of 1 percent.

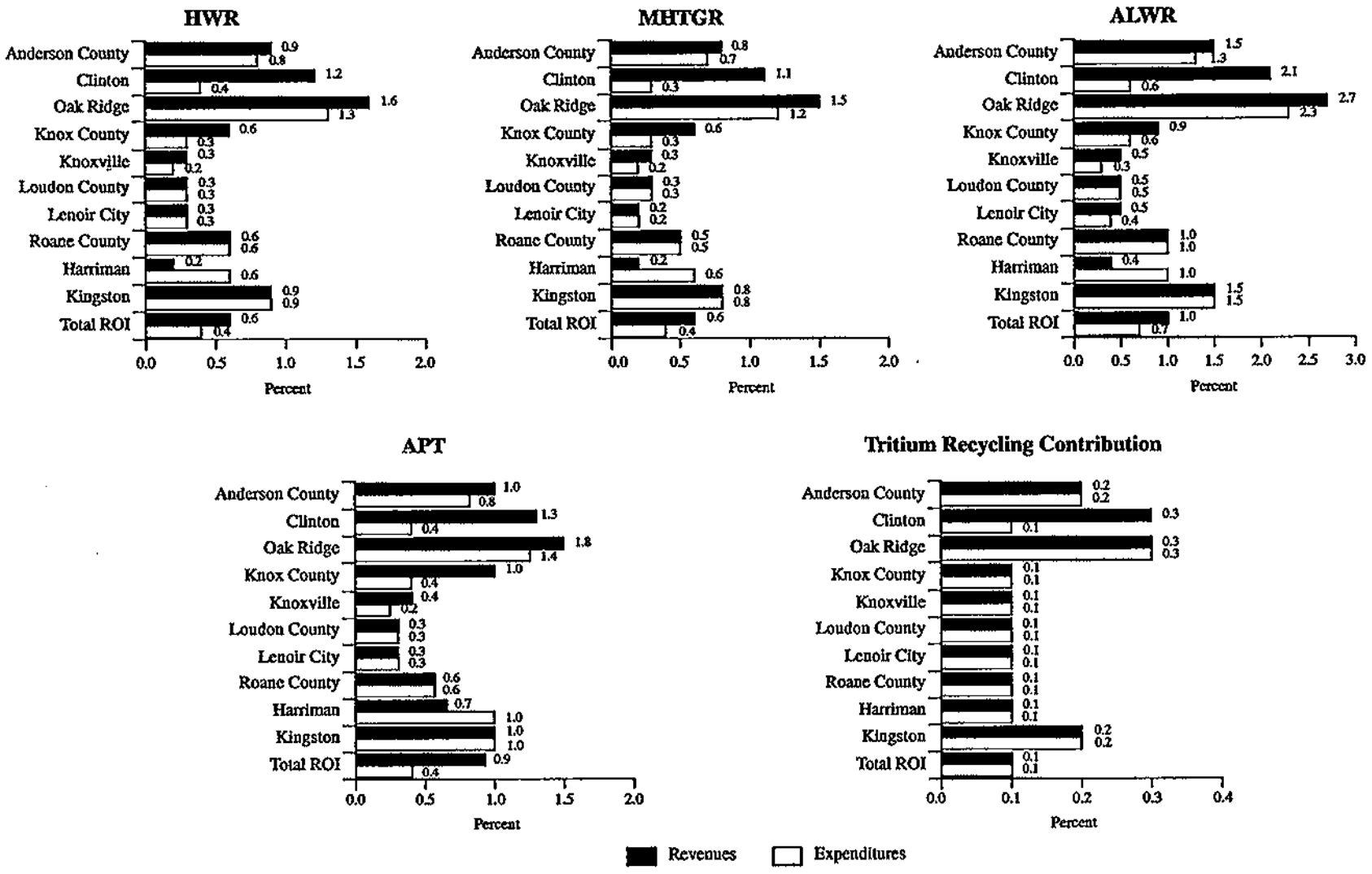
Less Than Baseline Operations. The fiscal benefits that local jurisdictions would accrue from the location of a tritium supply technology alone or collocated with recycling would be the same or less if the tritium supply technologies are operated at less than baseline tritium requirements.

Construction. Increases in local jurisdictions' revenues and expenditures would be the same as those given in figures 4.4.3.8–5 and 4.4.3.8–6 if the HWR, MHTGR, or ALWR is built. If the Phased APT is constructed, the effects would peak in 2003 instead of 2005, and the annual average increases would be lower (less than 1 percent). Appendix tables D.3–48 and D.3–49 present the revenue and expenditure changes as a result of constructing the Phased APT for all ROI jurisdictions. Revenue and expenditure changes resulting from the construction of the Phased APT with tritium recycling are presented in appendix tables D.3–50 and D.3–51.

Operation. Operation of the HWR, MHTGR, ALWR, and Phased APT at less than baseline tritium requirements would have the same effects on local jurisdictions' finances as those presented in figure 4.4.3.8–6.

Multipurpose Reactor. Locating the multipurpose reactor with or without a tritium recycling facility at ORR would create greater changes in public finance characteristics than the four tritium supply technologies because this option would perform three processes. Public finance characteristics for the multipurpose reactor with and without a recycling facility are presented in appendix tables D.3–48A through D.3–51A.

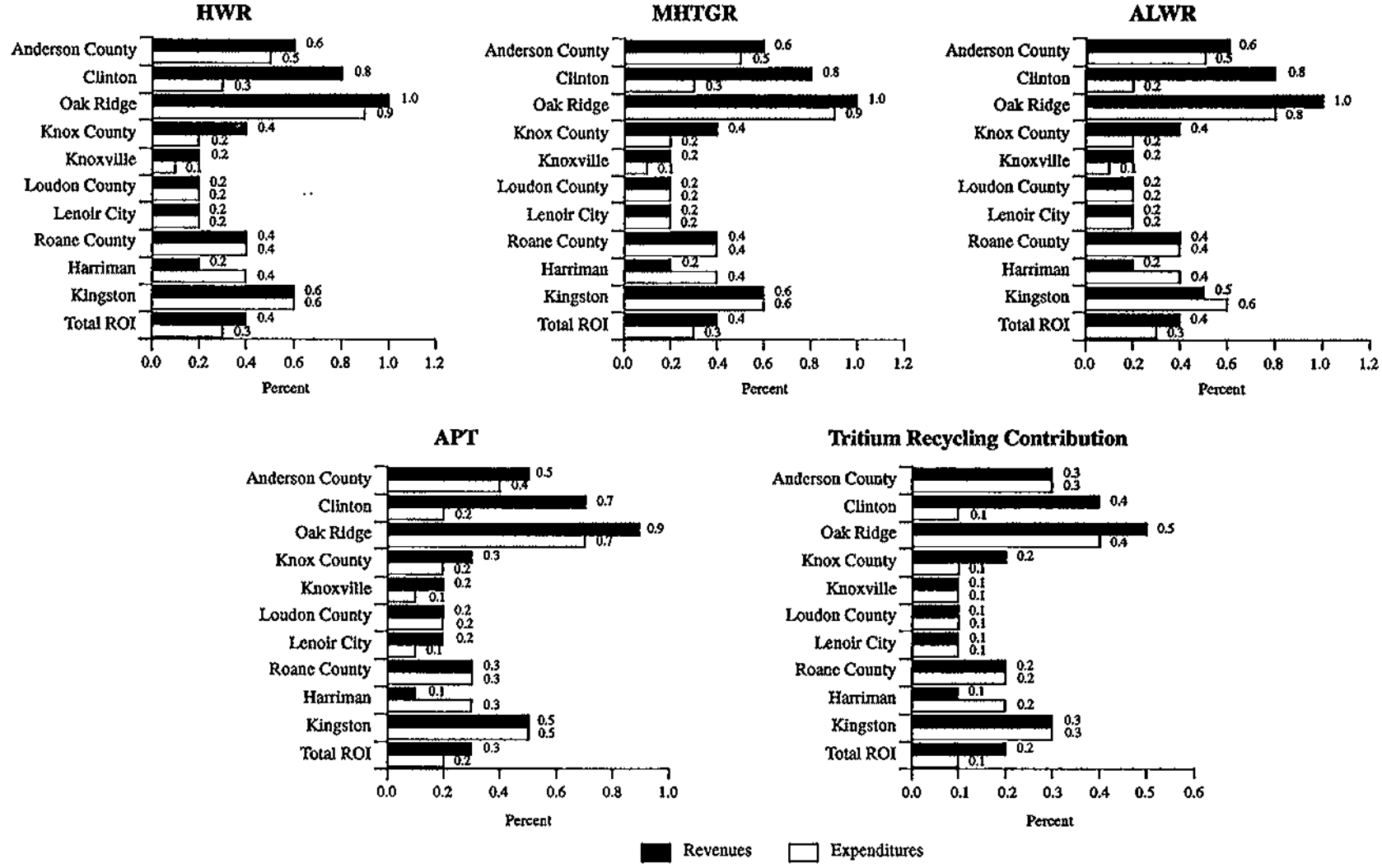
Construction. Between the first year of construction and the peak year, 2005, revenues and expenditures in the local jurisdictions would increase annually by 1 percent. Between 2005 and 2010, revenues and



Note: Revenue and expenditure values are in thousands of dollars. Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For a complete county and city breakdown of revenues and expenditures, see appendix tables D.3–48 and D.3–50.

Source: Appendix table D.3–50.

FIGURE 4.4.3.8–5.—*County, City, and School District Total Revenues and Expenditures Percentage Increase Over No Action During Peak Construction from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Region of Influence, 2005.*



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For a complete county and city breakdown of revenues and expenditures, see appendix tables D.3–49 and D.3–51.

Source: Appendix table D.3–51.

FIGURE 4.4.3.8–6.—*County, City, and School District Total Revenues and Expenditures Percentage Increase Over No Action at Full Operation from Tritium Supply Technologies and Recycling for Oak Ridge Reservation Region of Influence, 2010.*

expenditures would generally increase annually by less than 1 percent for most jurisdictions.

Operation. From the first year of full operation, 2010, to 2020, growth in revenues and expenditures is generally expected to increase by less than 1 percent annually for most cities, counties, and school districts.

Accelerator Production of Tritium Power Plant. Locating the APT power plant with or without a tritium recycling facility at ORR would create similar, but greater changes in public finance characteristics than the APT tritium supply technology. Public finance characteristics for the APT power plant with and without a recycling facility are presented in appendix tables D.3–48A through D.3–51A.

Construction. Between the first year of construction and the peak year, 2005, revenues and expenditures in the local jurisdictions would increase annually less than 1 percent. Between 2005 and 2010, revenues and expenditures would increase annually by less than 1 percent for most jurisdictions.

Operation. From the first year of full operation, 2010, to 2020, growth in revenues and expenditures is generally expected to increase at an annual average rate of less than 1 percent for most cities, counties, and school districts.

Potential Mitigation Measures. Adding new missions to ORR would create new jobs and generally benefit the local economy through increased earnings in the ROI. Some mitigation measures may be required, such as Federal aid to local school districts where additional school age children would attend as a result of the proposed action. These new missions at ORR would increase population and the demand for additional housing units. Temporary housing units and mobile homes would help to alleviate the demand for new housing during the construction phase of the proposed action. Generally, construction would be phased over a 5- to 9-year period with peak construction occurring in 2005. Phasing the start of operation employment and training between 2005 and 2010 would reduce the annual level of housing demand and smooth the peak and valley effect that would occur between peak construction and full operation.

Local Transportation

The following is a description of the effects on local transportation resulting from locating new missions at ORR. Construction and operation of a tritium supply technology and recycling facilities are expected to increase traffic flow on site access routes.

No Action. Under No Action, the worker population at ORR would not increase. Therefore, any increases in traffic would not be the result of DOE-related activities at ORR. Access to the nearest interstate highway is 10 miles via 2- and 4-lane roads that pass through rural and mountainous areas. Traffic conditions on site access roads would remain as described in section 4.4.2.8.

Tritium Supply and Recycling. The proposed action at ORR would result in increases, depending on the tritium supply technology, of worker population at the site. Traffic conditions on site access roads leading to and from ORR would worsen due to increased traffic volume. The primary access route to ORR is Bear Creek Road. This route would carry the greatest increase in traffic volume from site development. Locating the ALWR or MHTGR at ORR would have the greatest effect on traffic volume and flow.

Tritium Supply Alone. Locating a tritium supply without the recycling facility at ORR would result in increased worker population and traffic. However, the effects on traffic volume would be less than those from siting the tritium recycling facility with any one of the supply technologies.

Less Than Baseline Operations. The effects on traffic volume and flow would be the same whether or not the HWR, MHTGR, or ALWR were operated at baseline or less than baseline tritium requirements. Construction of the Phased APT would increase traffic volume and flow during the construction phase but less than the Full APT.

Potential Mitigation Measures. Mitigation of traffic conditions may be necessary due to the proposed action. Mitigation could include the widening and extension of Bear Creek Road, the primary access route to ORR, as well as possible realignment of roadways and construction of interchanges at roadway intersections overburdened by increased vehicle traffic and congestion.

4.4.3.9 *Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents*

This section describes the impacts of radiological and hazardous chemical releases resulting from either normal operation or accidents at facilities involved with the tritium supply and recycling facilities at ORR. The section first describes the impacts from normal operation followed by a description of impacts from facility accidents.

During normal operation at ORR, all tritium supply technologies and recycling facilities would result in impacts that are within regulatory limits. The risk of adverse health effects to the public and to workers would be small.

For facility accident impacts, the results indicate that for all tritium supply technologies and recycling facilities the risk of fatal cancers (taking into account both the probability of the accident and its consequences) from an accidental release of radioactive or hazardous chemical substances at ORR is low when compared to fatal cancers from all causes, even for a severe accident.

The impact methodology is described in section 4.1.9. Summaries of the radiological and chemical impacts associated with normal operation are presented in tables 4.4.3.9–1 and 4.4.3.9–2, respectively. Summaries of impacts associated with postulated accidents are given in tables 4.4.3.9–3 and 4.4.3.9–4. Detailed results are presented in appendix E for normal operation and in appendix F for accidents.

Normal Operation

No Action. The current missions at ORR are described in section 3.3.3. The site has identified facilities that will continue to operate and others, if any, which will become operational by 2010. Based on that information, the radiological and chemical releases for 2010 and beyond were developed and used in the impact assessments.

Radiological Impacts. As shown in table 4.4.3.9–1, No Action would result in a calculated annual dose of 17 mrem to the maximally exposed member of the public, which projects to an estimated fatal cancer risk of 3.5×10^{-4} from 40 years of total site operation. This annual dose is composed of a dose from liquid releases of 14 mrem (0.4 mrem is from drinking water; see appendix section E.2.6.1) and a dose from atmospheric releases of 3.9 mrem. Both the liquid and atmospheric doses are within radiological limits and when combined make up 5.7 percent of the natural background radiation received by the average person near ORR.

The population dose from total site operation in 2030 was calculated to be 57 person-rem, which projects to an estimated 1.1 fatal cancers from 40 years of total site operation. The population dose is composed of 18 person-rem from liquid releases and 39 person-rem from atmospheric releases and would be approximately 0.017 percent of the annual dose received by the surrounding population from natural background radiation.

The annual average dose to a site worker from No Action would be 17 mrem, which projects to an estimated fatal cancer risk of 2.8×10^{-4} from 40 years of total site operation. The annual dose to the total site workforce would be 320 person-rem, which projects to an estimated 5.1 fatal cancers from 40 years of total site operation. These estimates are based on the measured doses from 1989 to 1992 and projected employment levels in 2010.

Hazardous Chemical Impacts. As shown in table 4.4.3.9–2, No Action would result in a calculated HI of 0.36 and no cancer risk to the maximally exposed member of the public. The worker HI risk was calculated to be 0.26. These values are within the acceptable regulatory health limits.

Tritium Supply and Recycling. There will be no radiological releases during the construction of new tritium recycling facilities that are associated with all tritium supply technologies under consideration. Limited hazardous chemical releases are anticipated as a result of construction activities. However, their concentration will be within the regulated exposure limits and would not result in any adverse health effects. During normal operation, there would be both radiological and hazardous chemical releases to the environment and also direct in-plant exposures. The impacts from radiological and hazardous chemicals from each tritium supply technology considered are the summation of the impacts from the various facilities in operation for that technology.

TABLE 4.4.3.9–1.—*Potential Radiological Impacts to the Public and Workers Resulting from Normal Operation of Tritium Supply Technologies and Recycling at Oak Ridge Reservation*

Affected Environment	No Action	Tritium Supply Technologies and Recycling[a]							Tritium Recycling
		HWR	MHTGR	Large ALWR	Small ALWR	Full APT		Phased APT	
						Helium-3 Target System	SILC Target System	Helium-3 Target System	
Maximally Exposed Individual (Public)									
Atmospheric Release[b]									
Dose[c] (mrem/yr)	3.9	7.1	5.7	8.8	7.6	4.3	5.0	4.3	2.8
Percent of natural background[d]	1.3	2.3	1.8	2.9	2.5	1.4	1.6	1.4	0.92
40-year fatal cancer risk	7.8×10^{-5}	1.4×10^{-4}	1.1×10^{-4}	1.8×10^{-4}	1.5×10^{-4}	8.6×10^{-5}	1.0×10^{-4}	8.6×10^{-5}	5.6×10^{-5}
Liquid Release									
Dose[c] (mrem/yr)	14	14	14	14	14	14	14	14	0.0
Percent of natural background[d]	4.4	4.4	4.4	4.5	4.5	4.4	4.4	4.4	0.0
40-year fatal cancer risk	2.7×10^{-4}	2.7×10^{-4}	2.7×10^{-4}	2.8×10^{-4}	2.8×10^{-4}	2.7×10^{-4}	2.7×10^{-4}	2.7×10^{-4}	0.0
Atmospheric and Liquid Releases[b]									
Dose[c] (mrem/yr)	17	21	19	23	21	18	19	18	2.8
Percent of natural background[d]	5.7	6.8	6.2	74	7.0	5.8	6.1	5.8	0.92
40-year fatal cancer risk	3.5×10^{-4}	4.2×10^{-4}	3.8×10^{-4}	4.5×10^{-4}	4.3×10^{-4}	3.6×10^{-4}	3.7×10^{-4}	3.6×10^{-4}	5.6×10^{-5}
Population Within 50 Miles									
Atmospheric and Liquid Releases Year 2030									
Dose (person-rem)	57	82	76	90	87	68	73	68	11
Percent of natural background[d]	0.017	0.025	0.023	0.027	0.026	0.021	0.022	0.021	3.3×10^{-3}
40-year fatal cancers	1.1	1.6	1.5	1.8	1.7	1.4	1.5	1.4	0.22
Worker Onsite									
Average site worker dose[c] (mrem/yr)	17	19	18	26	22	18	19	18	4
40-year fatal cancer risk	2.8×10^{-4}	3.0×10^{-4}	2.9×10^{-4}	4.2×10^{-4}	3.6×10^{-4}	3.0×10^{-4}	3.0×10^{-4}	3.0×10^{-4}	6.4×10^{-5}
Total site workforce dose (person-rem/yr)	320	360	350	490	420	360	362	360	1.6
40-year fatal cancers	5.1	5.8	5.6	7.9	6.7	5.8	5.8	5.8	0.026

[a] Includes impacts from No Action facilities.

[b] The location of the maximally exposed individual varies depending on the tritium supply technology.

[c] The applicable radiological limits for an individual member of the public are 10 mrem per year resulting from site operations for the air pathways, 4 mrem from the drinking water pathway, and 100 mrem per year from all pathways combined (DOE Order 5400.5). The radiological limit for an individual worker is 5,000 mrem per year (10 CFR 835).

[d] Natural background levels: to the average individual is 306 mrem per year; to the population in 2030 is 329,800 person-rem.

Note: SILC - spallation-induced lithium conversion.

Source: Model results. See appendix sections E.2.2 and E.2.6.

TABLE 4.4.3.9–2.—*Potential Hazardous Chemical Impacts to the Public and Workers Resulting from Normal Operations at Oak Ridge Reservation*

		Tritium Supply Technologies and Recycling[a, b]				
Health Impact	**No Action**	**HWR**	**MHTGR**	**ALWR**	**APT**	**Tritium Recycling**
Maximally Exposed Individual (Public)						
Hazard Index	0.36	0.36	0.36	0.38	0.36	2.5×10^{-5}
Cancer risk	0	0	0	0	0	0
Worker Onsite						
Hazard Index[c]	0.26	0.27	0.32	0.35	0.26	4.0×10^{-5}
Cancer risk	0	0	0	0	0	0

[a] Includes impacts from No Action.

[b] To determine the contribution from any of the tritium supply technologies, subtract the tritium recycling values from the Hazard Index or from the cancer risk, respectively.

[c] The Hazard Index for the onsite worker is computed by using the permissible exposure limit as the denominator rather than the reference concentration which is used for the maximally exposed member of the public (appendix E).

Source: Model results. See appendix table E.3.4–21.

The resulting doses and potential health effects to the public and workers from each tritium supply technology are described below.

Radiological Impacts. Radiological impacts resulting from normal operation of tritium supply technology and recycling facilities considered for ORR are listed in table 4.4.3.9–1. The supporting analysis is provided in appendix section E.2.6.2.

The doses to the maximally exposed member of the public from annual site operations at ORR range from 18 mrem for both the APT with the helium-3 target and the Phased APT to 23 mrem for the Large ALWR. From 40 years of operation, the corresponding risks of fatal cancer to this individual would range from 3.6×10^{-4} to 4.5×10^{-4}. As a result of total site operations in 2030, the population doses would range from 68 person-rem for both the APT with the helium-3 target and the Phased APT to 90 person-rem for the Large ALWR. The corresponding numbers of fatal cancers in this population from 40 years of operation would range from 1.4 to 1.8.

The annual dose to the total site workforce would range from 350 person-rem for the MHTGR to 490 person-rem for the Large ALWR. The corresponding annual average doses to a site worker would be 18 mrem for the MHTGR, and 26 mrem for the Large ALWR. The risks and numbers of fatal cancers among workers from 40 years of operation are included in table 4.4.3.9–1.

Based on the radiological impacts associated with normal operation, as described above, all of the tritium supply technologies and recycling facilities are acceptable for siting at ORR. All resulting doses are within radiological limits and are well below levels of natural background radiation.

Hazardous Chemical Impacts. Hazardous chemical impacts resulting from normal operation of various tritium supply technologies and recycling facilities at ORR are listed in table 4.4.3.9–2. Locating the HWR, MHTGR, or APT at ORR would result in identical HIs of 0.36 and no cancer risk to the maximally exposed member of the public. The ALWR would have an HI of 0.38 and no cancer risk to the maximally exposed member of the public. The worker HIs ranged from 0.35 for ALWR to 0.26 for APT. There was no cancer risk for any of the supply technologies. All values are within regulatory health limits. For details on the derivation of the HIs and cancer risks, see appendix tables E.3.4–16 through E.3.4–19 and summary table E.3.4–21.

Tritium Supply Alone

Radiological Impacts. If the tritium recycling processes are not collocated with the tritium supply, the annual dose to the maximally exposed individual would be 2.8 mrem lower than from operation of both supply and recycling. This is 0.92 percent of the dose from natural background radiation received by the average person near ORR. The estimated risk of fatal

cancer to this individual would decrease by 5.6×10^{-5} over 40 years of total site operation.

Not collocating the tritium recycling processes at ORR would result in a decrease of 11 person-rem to the population within 50 miles in 2030, and 0.22 less fatal cancers over 40 years of operation.

If the tritium recycling processes are not collocated with the tritium supply, the total annual workforce dose would decrease by 1.6 person-rem, resulting in 0.026 less fatal cancers over the 40 years.

Hazardous Chemical Impacts. If the tritium recycling processes are eliminated from all of the supply technologies at ORR, the cancer risk would not change since there is no cancer risk resulting from any options. The HIs for the public would be reduced by about 0.01 to 0.02 percent for any of the supply technologies and the reduction would be about the same for workers. Based on the hazardous chemical impacts associated with normal operations at ORR all values are within regulatory health limits.

Less Than Baseline Operations

The normal operation radiological impacts for the HWR operating at reduced tritium production capacity to meet a less than baseline tritium operation requirement would be proportional to the level of operation (approximately 50 percent of baseline). The MHTGR or ALWR normal operation radiological impacts would not change because the reactor would maintain power requirements to produce steam or electricity.

The Phased APT is already less than the baseline tritium requirement and thus the impacts are as presently given in this PEIS.

Potential Mitigation Measures. Radioactive and hazardous chemical airborne emissions to the general population and onsite exposures to workers could be reduced by implementing the latest technology for process and design improvements. For example, to reduce public exposure from emissions, improved methods could be used to remove radioactivity from the releases to the environment. Similarly, remote, automated, and robotic production methods are examples of techniques being developed which could reduce worker exposure. Substitution of less toxic/noncancer causing solvents would result in reductions of the HI and possible complete elimination of the cancer risk.

Facility Accidents

No Action. Under No Action, the risk of accidents at ORR would be unchanged from that reported in safety documentation for existing facilities.

Tritium Supply and Recycling. The proposed action at ORR has the potential for accidents that may impact the health and safety of workers and the public. The potential for and associated consequences of reasonably foreseeable accidents have been assessed for each tritium supply technology at ORR and are summarized in this section and described in more detail in appendix F. The methodology used in the assessment is described in section 4.1.9.

The potential impacts from accidents, ranging from high consequence/low probability to low consequence/high probability events, have been evaluated in terms of the number of cancer fatalities that may result. The risk of cancer fatalities has also been evaluated to provide an overall measure of an accident's impacts and is calculated by multiplying the accident annual frequency (or probability) of occurrence by the consequences (number of cancer fatalities).

The analyses of postulated accidents for the tritium supply and recycling facilities at ORR indicate that, for the high consequence accident, the estimated risk of cancer fatalities to the public within 50 miles of the site is 1.2×10^{-4} cancer fatalities per year (table 4.4.3.9–3). This accident risk, which corresponds with the HWR, is low when compared to the risk of cancer fatalities each year to the same population from all other causes.

Details on the range of accidents for the tritium supply technologies and recycling facilities at ORR are presented in appendix F. Each of the technologies has been analyzed from the standpoint of identifying the consequences of design basis/operational accidents (using the GENII computer code) and beyond design basis, or severe accidents (using the MACCS computer code). The severe accident consequences are shown in table 4.4.3.9–3 for each technology. The table also shows the consequences of each accident for the population and for an individual who may be

located at the site boundary. The results of the analysis indicate that the tritium supply and recycling facility with the highest severe accident risk is the HWR. The technology with the lowest accident risk is the APT with the helium-3 target system. The MHTGR and APT have accident risks that are lower than the HWR and ALWR consequences. The tritium extraction and recycling facilities are common to all tritium supply technologies but, except for the APT, the consequences and risks are dominated by reactor accidents. The tritium extraction accident dominates the accelerator accidents.

Figure 4.4.3.9–1 shows the number of latent cancer fatalities that may result for each technology, including tritium extraction and recycling, if a high consequence accident were to occur. Specifically, each curve in the figure shows the annual probability (vertical axis) that the number of cancer fatalities (horizontal axis) will be exceeded if the accident occurred. The curves reflect the probability of the accident.

The secondary impacts of accidents affect elements of the environment other than humans. For example, a radiological release may contaminate farmland, surface and underground water, recreational areas, industrial parks, historical sites, or the habitat of an endangered species. As a result, farm products may have to be destroyed; the supply of drinking water may be reduced; recreational areas may have to be closed to visitors; and endangered species may move closer to extinction. In the region of the ORR, the natural background level of radiation (excluding radon) is 67 mrem per year. For a hypothetical design basis accidental release, the radiation levels exceeding 67 mrem per year are well within the site boundary. The size of the area in which exposure levels would exceed exposures from natural background radiation is 1.4×10^{7} square meters (3,459 acres).

Tritium Supply Alone. The analyses of reasonably foreseeable high consequence accidents for the tritium supply facilities at ORR are presented below.

Heavy Water Reactor. A set of five high consequence accident sequences were postulated for the HWR. These are described in appendix section F.2.1.1. In the event that any of these accidents were to occur, there would be an estimated 13 cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 0.015 to an individual who may be located at the site boundary and 0.035 to a collocated worker at 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is 1.2×10^{-4} cancer fatalities per year (table 4.4.3.9–3).

Modular High Temperature Gas-Cooled Reactor. A set of four high consequence accident sequences were postulated for the MHTGR. In the event that this accident were to occur, there would be an estimated 1.4 cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 1.5×10^{-3} to an individual who may be located at the site boundary. The risk to the population, that takes the probability of the accident into account, is 2.3×10^{-5} cancer fatalities per year (table 4.4.3.9–3).

Advanced Light Water Reactor. A range of accident sequences with various release categories was analyzed for the ALWR. One release category for a Large ALWR and one for a Small ALWR were selected to represent the accident consequences for an ALWR (appendix section F.2.1.3). In the event that such an accident were to occur, there would be an estimated 6.2 cancer fatalities for a Large ALWR and 33 cancer fatalities for a Small ALWR in the population within 50 miles and an increased likelihood of cancer fatality of 0.02 for a Large ALWR and 0.04 for a Small ALWR to an individual who may be located at the site boundary and 0.032 for a Large ALWR and 0.10 for a Small ALWR to a collocated worker at 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is 9.4×10^{-7} for a Large ALWR and 5.1×10^{-6} for a Small ALWR cancer fatalities per year (table 4.4.3.9–3).

Accelerator Production of Tritium with Helium-3 Target System. The large break loss of coolant accident with the total loss of the active emergency cooling system and the heat sink with and without confinement were postulated as the high consequence accidents for this APT and target option. In the event that any of these accidents were to occur, there would be an estimated 9.6×10^{-5} cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 1.3×10^{-7} to an individual located at the site boundary and 6.0×10^{-7} to collocated worker at 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is on the order of 6.8×10^{-11} cancer fatalities per year (table 4.4.3.9–3).

TABLE 4.4.3.9-3.—*Tritium Supply Technologies and Recycling High Consequence/Low Probability Radioactive Release Accidents and Consequences at Oak Ridge Reservation*

Parameter	Tritium Supply Technologies and Recycling						Tritium Target Extraction Facility[b]	Tritium Recycling Facility[c]
	HWR[a,b]	MHTGR[b,c]	Large ALWR[b,d]	Small ALWR[b,d]	Full/Phased APT	Full APT		
					Helium-3 Target System[f,g]	SILC Target System[b,h,i]		
Consequence								
Maximally Exposed Individual								
Cancer fatalities[j]	0.015	1.5×10^{-3}	0.02	0.042	1.3×10^{-7}	2.2×10^{-6}	1.5×10^{-4}	5.2×10^{-4}
Risk (cancer fatalities per year)	1.4×10^{-7}	2.4×10^{-8}	3.1×10^{-9}	6.6×10^{-9}	9.5×10^{-14}	1.6×10^{-12}	1.5×10^{-10}	5.2×10^{-10}
Population Within 50 Miles								
Cancer fatalities[j]	13	1.4	6.2	33	9.6×10^{-5}	1.0×10^{-3}	0.11	0.38
Risk (cancer fatalities per year)	1.2×10^{-4}	2.3×10^{-5}	9.4×10^{-7}	5.1×10^{-6}	6.8×10^{-11}	7.4×10^{-10}	1.1×10^{-7}	3.8×10^{-7}
Worker at 1,000 meters								
Cancer fatalities[j]	0.035	7.1×10^{-3}	0.032	0.1	6.0×10^{-7}	8.7×10^{-6}	6.7×10^{-4}	2.3×10^{-3}
Risk (cancer fatalities per year)	3.2×10^{-7}	1.1×10^{-7}	4.9×10^{-9}	1.6×10^{-8}	4.3×10^{-13}	6.2×10^{-12}	6.7×10^{-10}	2.3×10^{-9}
Worker at 2,000 meters								
Cancer fatalities[j]	0.019	2.4×10^{-3}	0.02	0.054	2.2×10^{-7}	3.4×10^{-6}	2.4×10^{-4}	8.4×10^{-4}
Risk (cancer fatalities per year)	1.4×10^{-7}	3.9×10^{-8}	3.0×10^{-9}	8.3×10^{-9}	1.5×10^{-13}	2.4×10^{-12}	2.4×10^{-10}	8.4×10^{-10}

[a] For detailed HWR accident discussion, see appendix section F.2.1.1.

[b] The tritium target extraction facility is required for the HWR, MHTGR, ALWR, and the APT with spallation-induced lithium conversion target system tritium supply configurations and not required for the APT with helium-3 target system tritium supply configuration. For detailed tritium target extraction facility discussion, see appendix section F.2.1.6.

[c] For detailed MHTGR accident discussion, see appendix section F.2.1.2.

[d] For detailed ALWR accident discussion, see appendix section F.2.1.3.

[e] For detailed tritium recycling facility discussion, see appendix section F.2.3.

[f] The values shown apply to either the Full helium-3 APT or the Phased APT. For detailed APT with helium-3 target system discussion, see appendix section F.2.1.4.2.

[g] Analysis postulated the total failure of the active emergency cooling system and the loss of the heat sink.

[h] For detailed APT with spallation-induced lithium conversion target system discussion, see appendix section F.2.1.4.3.

[i] Analysis postulated successful beam trip with the total failure of the active emergency cooling system.

[j] Increased likelihood of cancer fatality.

Note: SILC - spallation-induced lithium conversion.

Source: Appendix F.

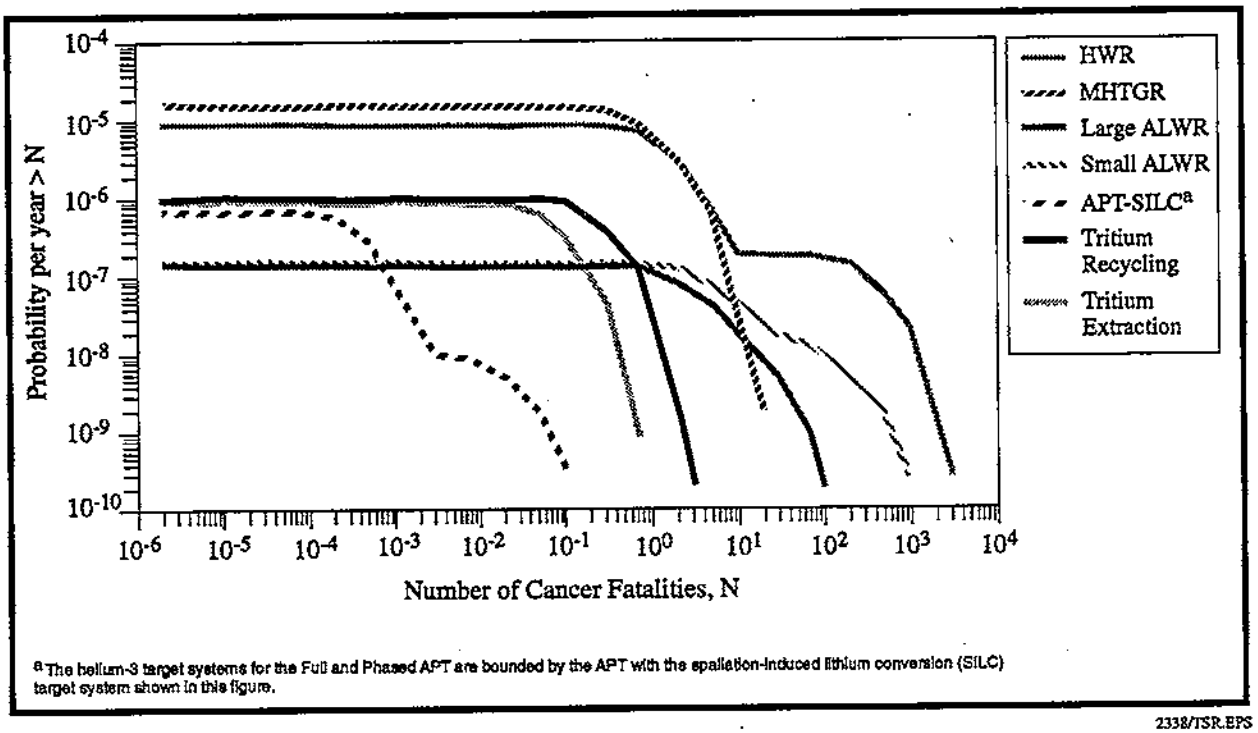


FIGURE 4.4.3.9–1.—*High Consequence Accident–Cancer Fatalities Complementary Cumulative Distribution Functions for Tritium Supply and Recycling Severe Accidents at Oak Ridge Reservation.*

Accelerator Production of Tritium with Spallation-Induced Lithium Conversion Target System. The large break loss of coolant accident with a successful beam trip and the total loss of the active emergency cooling system with and without confinement were postulated as the high consequence accidents for this APT and target option. In the event that this accident were to occur, there would be an estimated 1.0×10^{-3} cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 2.2×10^{-6} to an individual located at the site boundary and 8.7×10^{-6} to a collocated worker at 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is on the order of 7.4×10^{-10} cancer fatalities per year (table 4.4.3.9–3).

Tritium Extraction and Recycling. The tritium extraction facility is required to support all tritium supply technologies except the APT technology with the helium-3 target system. The tritium recycling facility is required to support all tritium supply technologies. The analyses of postulated high consequence accidents for the tritium extraction and recycling facilities at ORR are presented below.

Tritium Target Extraction Facility. An earthquake and release of process vessel tritium inventory postulated as the high consequence accident. In the event that this accident were to occur, there would be an estimated 0.11 cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatalities of 1.5×10^{-4} to an individual who may be located at the site boundary and 6.7×10^{-4} to a collocated worker at 1,000 meters from the accident. The risk to the population, that takes the probability of an accident into account, is less than 1.1×10^{-7} cancer fatalities per year (table 4.4.3.9–3).

Tritium Recycling Facility. An earthquake induced leak/ignition and fire in the unloading station carousel reservoir was postulated as the high consequence accident for the tritium recycling facility. In the event that this accident were to occur, there would be an estimated 0.38 cancer facilities in the population with 50 miles and an increased likelihood of cancer fatality of 5.2×10^{-4} to an individual located at the site boundary and 2.3×10^{-5} to a collocated worker at 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is on the order of 3.8×10^{-7} cancer fatalities per year (table 4.4.3.9–3).

For comparison purposes with high consequence tritium supply facility accidents, there is a risk of 2,125 cancer fatalities per year from all other natural causes for the same total population of 1,062,000 in 2050 within 50 miles of the site.

The analysis of facility accidents for tritium supply at ORR shows that, for high consequence accidents analyzed using the MACCS computer code, the HWR has the highest risk and the APT has the lowest risk. The risk of accidents for any of the tritium supply technologies, tritium extraction, and tritium recycling facilities common to all technologies is low when compared to the human risk of cancer fatalities from all other causes.

Design-Basis Accidents. The consequences of operational basis or design-basis accidents for the tritium extraction and recycling facilities at ORR are shown in table 4.4.3.9–4. The results in table 4.4.3.9–4 should not be compared with the severe accident analysis results in table 4.4.3.9–3 because different computer codes using different calculational approaches were used. More detailed description of design-basis accidents is included in appendix F.2.2.

Less Than Baseline Operations. Less than baseline tritium operation would have no significant change to the current accident analyses consequences for the HWR unless the baseline HWR core design was downsized. The baseline HWR configuration would adjust to the reduced target through-put requirements by reducing the time that the reactor is required to operate at 100 percent power. It is not anticipated that the overall risk from operating the reactor in this mode would decrease significantly. Accident analyses have not been performed to address accident sequences and initiating events when the reactor is in the cold shut down mode. In addition, operator error has a significant effect on facility risk and if the reactor is shutdown a high percentage of the time, operator error may actually increase when the reactor is at power.

Less than baseline tritium operation would have no significant change to the current accident analyses consequences for the MHTGR or ALWR. The reactor surplus capacity would be used to generate steam for electric power production.

Less than baseline tritium operation would have no change to the MHTGR accident analyses because the analyses assumed that only one of the modules would be involved in the accident.

Less than baseline tritium operation would have no significant change to the APT accident analyses consequences. The accident consequences Full and Phased APT accidents with low to moderate consequences were negligible. For the beyond design basis accident, there was no difference in the Full and Phased accident sequences. Review of the source terms is identical for both accidents. Review of the MACCS computer code out put date for each accident analysis indicated that the tritium component of the source term dominated the dose calculation results. The impact of the other source term isotopes on the dose calculation results is negligible.

Potential Mitigation Measures. The accidents postulated for tritium supply technologies and recycling facilities are based on operation and safety analyses that have been performed at similar facilities. One of the major design goals for tritium supply and recycling facilities is to achieve a reduced risk to facility personnel and to public health and safety relative to as low as reasonably achievable.

Current estimates are that there would be no collocated workers within 1,000 meters from an accident, 320 collocated workers between 1,000 meters and 2000 meters of an accident, and 14,110 collocated workers beyond 2,000 meters of the accident. Involved workers that are associated with the proposed action would be located in and around the facility.

Worker exposure that may result from the accidental release of radioactive material will be minimized through design features and administrative procedures that will be defined in conjunction with the facility design process. The radiological impacts to involved workers from accidents could not be quantitatively estimated for this PEIS because the facility design information needed to support the estimate has not yet been developed. The impacts on workers from accidents will analyzed as part of subsequent project-specific NEPA documentation and in detailed safety analysis documentation that are prepared in conjunction with the facility design process.

TABLE 4.4.3.9–4.—*Tritium Supply Technologies and Recycling Low-to-Moderate Consequence/High Probability Radioactive Release Accidents and Consequences at Oak Ridge Reservation*

Parameter	HWR[a,b]	MHTGR[b,c]	Large ALWR[b,d]	Small ALWR[b,d]	Full APT SILC Target System[b,f]	Tritium Target Extraction Facility[b]	Tritium Recycling Facility[e]
Accident							
Description	Fuel assembly failure during charge and discharge operations	Moderate break in primary system piping	Fuel handling	Fuel handling	Large break loss of coolant accident[g]	Deflagration[h]	Hydride Bed rupture
Frequency (per year)	1.0×10^{-3}	2.5×10^{-2}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-3}	2.0×10^{-5}	2.0×10^{-4}
Consequence							
Maximally Exposed Individual							
Cancer fatalities[i]	6.8×10^{-5}	4.4×10^{-8}	4.3×10^{-5}	5.8×10^{-5}	negligible	4.2×10^{-4}	1.8×10^{-6}
Risk (cancer fatalities per year)	6.8×10^{-8}	1.1×10^{-9}	4.3×10^{-10}	5.8×10^{-10}	negligible	8.4×10^{-9}	3.6×10^{-10}
Population Within 50 Miles							
Cancer fatalities[i]	0.75	4.3×10^{-4}	0.46	0.64	negligible	4.5	0.021
Risk (cancer fatalities per year)	7.5×10^{-4}	1.1×10^{-5}	4.6×10^{-6}	6.4×10^{-6}	negligible	9.0×10^{-5}	4.2×10^{-6}
Worker at 1,000 meters							
Cancer fatalities[i]	1.6×10^{-4}	1.9×10^{-7}	1.6×10^{-4}	2.1×10^{-4}	negligible	2.6×10^{-3}	1.1×10^{-5}
Risk (cancer fatalities per year)	1.6×10^{-7}	4.8×10^{-9}	1.6×10^{-9}	2.1×10^{-9}	negligible	5.2×10^{-8}	2.2×10^{-9}
Worker at 2,000 meters							
Cancer fatalities[i]	5.3×10^{-5}	6.5×10^{-8}	5.4×10^{-5}	6.7×10^{-5}	negligible	8.8×10^{-4}	3.6×10^{-6}
Risk (cancer fatalities per year)	5.3×10^{-8}	1.6×10^{-9}	5.4×10^{-10}	6.7×10^{-10}	negligible	1.8×10^{-8}	7.2×10^{-10}

[a] For detailed HWR accident discussion, see appendix section F.2.2.1.

[b] The tritium target extraction facility is required for the HWR, MHTGR, ALWR, and the APT with spallation-induced lithium conversion target system tritium supply configurations and not required for the APT with helium-3 target system tritium supply configuration. For detailed tritium target extraction facility discussion, see appendix section F.2.2.6.

[c] For detailed MHTGR accident discussion, see appendix section F.2.2.2.

[d] For detailed ALWR accident discussion, see appendix section F.2.2.3.

[e] For detailed tritium recycling facility discussion, see appendix section F.2.4.

[f] The APT with helium-3 target system bounding low to moderate consequence accident consequences are bounded by the APT with spallation-induced lithium conversion target system which is nil. For detailed APT discussion, see appendix section F.2.2.4.

[g] Analysis postulated all plant protection systems functioned as designed.

[h] Intense rapid burning.

[i] Increased likelihood of cancer fatality.

Note: SILC - spallation-induced lithium conversion.

Source: Appendix F.

The tritium supply and recycling facilities would be designed to comply with current Federal, state, and local laws, DOE orders, and industrial codes and standards. This would provide facilities that are highly resistant to the effects of severe natural phenomena, including earthquake, flood, tornado, and high wind, as well as credible events as appropriate to the site such as fire and explosions, and man-made threats to its continuing structural integrity for containing materials.

The tritium supply and recycling facilities would be designed to resist the effects of severe natural phenomena as well as the effects of man-made threats to its continuing structural integrity. It also would be designed to provide containment of the tritium inventory at all times through the use of multiple, high quality confinement barriers to prevent the accidental release of tritium to the environment. It also would be designed to produce a lower quantity of waste materials as compared to the tritium facilities of the existing weapons complex.

In addition, DOE orders specify the requirements for emergency preparedness at DOE facilities. ORR has comprehensive emergency plans to protect life and property within the facility and the health and welfare of surrounding areas. The emergency plans would be revised to incorporate future DOE requirements and expanded to incorporate the addition of tritium supply and recycling facilities to ORR. Section 4.4.2.9 presents emergency preparedness and emergency plan details at ORR.

4.4.3.10 *Waste Management*

Construction and operation of tritium supply and recycling facilities would impact existing ORR waste management operations, increasing the generation of low-level, mixed low-level, hazardous and nonhazardous wastes, and reintroducing the generation of spent nuclear fuel. There would be no high-level or TRU wastes associated with the proposed tritium supply technologies and recycling facilities. As part of their design, all reactor technologies would provide stabilization and storage of spent fuel for the life of the facility. The impacts of a decision to put new tritium supply and recycling facilities at ORR would involve the construction of new treatment facilities for liquid LLW for the HWR, MHGTR and ALWR. There would be no impacts on current facilities for mixed LLW and hazardous waste resulting from any of the tritium supply technologies and recycling facilities. All the technologies would generate enough nonhazardous solid waste to shorten the planned lifetime for the sanitary/industrial landfills or require a proportional expansion. All of the new technologies would require the construction of treatment facilities for sanitary liquid waste. This section provides a description of the waste generation, treatment, storage, and disposal requirements of the tritium supply technologies and recycling facilities and the potential impacts on waste management at ORR.

No Action. Under No Action, spent nuclear fuel, TRU, low-level, mixed low-level, hazardous, and nonhazardous wastes would continue to be managed from the missions outlined in section 3.3.3. Table 4.4.3.10–1 lists the projected waste generation rates and treatment, storage, and disposal capacities under *No Action*. Projections for No Action were derived from 1992 environmental data with appropriate adjustments made for those changing operational requirements where the volume of wastes generated are identifiable. The projection does not include wastes from future, yet uncharacterized, environmental restoration activities.

A small quantity of spent nuclear fuel could be generated by the Oak Ridge National Laboratory High-Flux Isotope Reactor in the production of isotopes for commercial applications and in conducting research. As indicated in table 4.4.2.10–2 only 40 percent of the reactor pool is currently full and it should be capable of storing the generated fuel rods for many years. Other fuel and irradiated nuclear material would be stored in various locations at ORR awaiting transport to INEL or SRS by fuel type in accordance with the ROD from the *Department of Energy Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Final EIS.* As reflected in this ROD, the DOE estimated inventory of spent nuclear fuel in 2035 is 2,742 metric tons. For comparison purposes, the commercial spent nuclear fuel inventory in 2030, assuming no reprocessing or new orders, is projected to be 85,700 metric tons of heavy metal (DOE 1994d:16).

Small quantities of TRU waste would be generated for isotope production and research activities at the Oak Ridge National Laboratory. Most of this type of

TABLE 4.4.3.10–1.—*Projected Spent Nuclear Fuel and Waste Management for No Action at Oak Ridge Reservation* [Page 1 of 2]

Category	Annual Generation Rate[a] (yd^3)	Treatment Method	Treatment Capacity[a] (yd^3/yr)	Storage Method	Storage Capacity[a] (yd^3)	Disposal Method	Disposal Capacity[a] (yd^3)
Spent Nuclear Fuel	None	None	NA	Pools and storage vaults	0.08	None	NA
Transuranic (Solid)							
Contact-handled	14	None	NA	Staged for shipment	800	None, Federal repository in future	NA
Remote-handled	5	None	NA	Staged for shipment	290	None, Federal repository in future	NA
Low-Level							
Liquid	2,900[b] (587,000 gal)	Neutralization & precipitaion	479,000 (97,000,000 GPY)	Stored onsite	1,500 (302,000 gal)	None	NA
Solid	9,300[c]	Compaction, smelting, incineration	Offsite	Stored onsite	202,000	Onsite	Planned
Mixed							
Liquid	2,330[d] (470,000 gal)	Settlement, incineration, ion exchange	802,000 (162,000,000 GPY)	Long-term storage onsite	128,000 (26,000,000 gal)	NA	NA
Solid	11,060	None	Planned	Staged for shipment	159,000	None - offsite to NTS pending	NA
Hazardous							
Liquid	94,000[e] (19,000,000 gal)	Neutralization, settlement	107,000 (21,000,000 GPY)	Tanks	1,440 (290,000 gal)	Offsite	NA
Solid	1,150	Compaction/ incineration	2,100	Staged for shipment	163,000	Offsite	NA

TABLE 4.4.3.10–1.—*Projected Spent Nuclear Fuel and Waste Management for No Action at Oak Ridge Reservation* [Page 2 of 2]

Category	Annual Generation Rate[a] (yd^3)	Treatment Method	Treatment Capacity[a] (yd^3/yr)	Storage Method	Storage Capacity[a] (yd^3)	Disposal Method	Disposal Capacity[a] (yd^3)
Nonhazardous (Sanitary)							
Liquid	2,400,000 (483,000,000 gal)	Offsite neutralization, biological degradation	3,500,000 (700,000,000 GPY)	None	NA	Offsite/NPDES outfall	NA
Solid	77,000	None	NA	None	NA	Landfill (onsite) Landfill (offsite)	640,000
Nonhazardous (Other)							
Liquid	988,000 [f] (199,000,000 gal)	Evaporation, incineration, neutralization	2,300,000 (464,000,000 GPY)	None	NA	Offsite, NPDES outfall	NA
Solid	9,040 [g]	None	NA	None; Scrap metal stockpiled	NA	Landfill (onsite) - Construction debris	1,700,000

[a] The generation rate, treatment, and storage data for the three sites at ORR were combined.

[b] Some liquid LLW included in liquid hazardous waste because K-25 does not separate these two wastes.

[c] Includes scrap metal and sludge from the Sanitary Wastewater Treatment Plant; may include some PCB-tainted waste.

[d] Some liquid mixed waste included in liquid hazardous waste because K-25 does not separate these two wastes.

[e] Includes 9,200 yd^3 of hydrogen softener blowdown from the steam plant, 50,000 yd^3 of TSCA Incinerator waste water.

[f] Includes wastewater treated at the Steam Plant Wastewater Treatment Facility and Plating Rinsewater Treatment Facility; includes 374,000 yd^3 from Process Waste Treatment Facility and steamplant blowdown.

[g] Includes construction/demolition spoil and scrap metal.

Note: NA - not applicable.

Source: ORR 1993a:8.

waste would be generated in remedial action projects. TRU waste previously buried and stored would be repackaged into TRUPACT-II containers to meet the WIPP waste acceptance criteria for eventual shipment to WIPP once it can demonstrate compliance with the environmental standards for the management and disposal of TRU wastes (40 CFR 191) and the land disposal standards of RCRA as amended (40 CFR 268), or to another TRU waste disposal facility should WIPP prove unsatisfactory. If shipments to WIPP are delayed, plans for additional TRU storage facilities would be required or the waste could be shipped to another TRU waste disposal facility.

Liquid LLW would be solidified, neutralized, and allowed to evaporate. Some liquid waste would also be incinerated. Solid LLW would be compacted and stored onsite at K-25 and the Oak Ridge National Laboratory as indicated in section 4.4.2.10. Contaminated scrap metal would be processed for beneficial reuse where possible, including the DOE Shielding Block Program, or be size-reduced for disposal. Hazardous waste would be treated in the same way as LLW, but sent offsite for disposal.

Mixed solid waste would be treated and disposed of according to the ORR Site Treatment Plan, which is being developed pursuant to the *Federal Facility Compliance Act*. Mixed liquid wastes would also be incinerated at the TSCA incinerator. The resulting waste would then be stored in a RCRA-permitted facility in DOT-approved containers until it is shipped to an offsite disposal facility. Some of the waste would be placed in interim storage until new technologies for treatment and disposal are identified and evaluated.

A new industrial pretreatment facility for liquid discharges from Y-12 to the city of Oak Ridge sanitary system would be constructed under the terms of its Industrial Pretreatment Permit. Nonhazardous sanitary and nonradioactive process waste liquids would be treated in conventional sewage treatment plants. The resultant solids would be disposed of with solid nonhazardous waste in a permitted landfill sized to handle projected future waste volumes.

Tritium Supply and Recycling. Tritium supply and recycling facilities that will support the nuclear weapons stockpile requirements would treat and package all waste generated in support of this activity into forms that would enable long-term storage and/or disposal in accordance with the *Atomic Energy Act*, RCRA, and other relevant statutes as outlined in chapter 5 and in appendix section H.1.2. The resultant waste effluents are shown in section 3.4. Waste generated during construction would consist of wastewater, nonhazardous solids, and hazardous waste. The nonhazardous wastes would be sent offsite to the city of Oak Ridge landfill. The hazardous wastes would be shipped to a commercial RCRA-permitted treatment and disposal facility. Operation of the three reactor-based tritium supply technologies and recycling facilities would generate spent fuel, and all four technologies would generate low-level, mixed low-level, hazardous, and nonhazardous wastes. The volume of the waste streams from tritium supply would vary according to the technology chosen. Table 4.4.3.10–2 lists the total estimated waste volumes projected to be generated at ORR as a result of various tritium supply technologies and recycling facilities. The data for the three major activities (K-25, Y-12, and Oak Ridge National Laboratory) at ORR were combined (ORR 1993a:8). The incremental waste volumes from the tritium supply technologies and recycling facilities that were added to the No Action projection can be found in appendix section A.2. Table 4.4.3.10–3 lists potential waste management impacts at ORR at the time of initial operation of the tritium facilities. Spent nuclear fuel storage for the life of the reactors is provided for in the reactor designs (appendix section A.2.1). Because spent nuclear fuel reprocessing is not planned, no HLW would be generated. Without plutonium production, no TRU waste would be generated. The treatment, storage, and disposal of mixed LLW and hazardous waste from all the technologies could be handled by current facilities.

Heavy Water Reactor. Spent nuclear fuel would be generated at the rate of 7 yd^3 per year. This would add 0.3 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The HWR would be designed to provide the necessary stabilization and storage of the spent nuclear fuel while awaiting final disposition. The HWR would produce quantities of liquid LLW which would increase by a factor of five the quantity of wastes as compared to No Action. Construction of a liquid radioactive waste facility would be required. The amount of solid LLW generated by the HWR would increase 60 percent

TABLE 4.4.3.10–2.—*Estimated Generated Annual Spent Nuclear Fuel and Waste Volumes for Tritium Supply Technologies and Recycling at Oak Ridge Reservation*

Category	No Action[a] (yd^3)	Tritium Supply Technologies and Recycling: HWR (yd^3)	MHTGR (yd^3)	ALWR/Large (yd^3)	ALWR/Small (yd^3)	APT (yd^3)[b]
Spent Nuclear Fuel	None	7[c]	80[d]	55[e]	36[f]	None
Low-level						
Liquid	2,910 (587,000 gal)	13,300 (2,690,000 gal)	5,510 (1,110,000 gal)	27,700 (5,590,000 gal)	6,820 (1,380,000 gal)	2,910 (587,000 gal)
Solid	9,300	14,900	11,000	10,400	10,300	10,200
Mixed Low-Level						
Liquid	2,330 (470,000 gal)	2,330 (470,000 gal)	2,330 (470,000 gal)	2,330 (470,000 gal)	2,330 (470,000 gal)	2,330 (470,000 gal)
Solid	11,100	11,200	11,100	11,100	11,100	11,100
Hazardous						
Liquid	94,400 (19,000,000 gal)	94,400 (19,000,000 gal)	94,400 (19,000,000 gal)	94,400 (19,000,000 gal)	94,400 (19,000,000 gal)	94,400 (19,000,000 gal)
Solid	1,150	1,190	1,250	1,190	1,190	1,150
Nonhazardous (Sanitary)						
Liquid	2,400,000 (483,000,000 gal)	14,100,000 (2,860,000,000 gal)	10,600,000 (2,140,000,000 gal)	33,700,000 (6,800,000,000 gal)	16,600,000 (3,360,000,000 gal)	3,730,000 (753,000,000 gal)
Solid	77,000	92,000	91,800	91,300	88,600	85,600
Nonhazardous (Other)						
Liquid	988,000 (199,000,000 gal)	988,000 (199,000,000 gal)	988,000 (199,000,000 gal)	988,000 (199,000,000 gal)	988,000 (199,000,000 gal)	988,000 (199,000,000 gal)
Solid	9,040	21,900[g]	21,800[h]	21,200[i]	18,900[j]	15,400[k]

[a] The No Action waste volumes are from table 4.4.3.10–1. The incremental waste volumes from the tritium alternatives that were added to the No Action projections can be found in appendix section A.2 (tables A.2.1.1–4, A.2.1.2–4, A.2.1.3–4, A.2.1.3–5, A.2.1.4–4, and A.2.2.1–4). The generation rate, treatment, and storage data for the three sites at ORR were combined (ORR 1993a:8). Waste volumes have been rounded to three significant figures.

[b] The APT and recycling waste volumes are based on the spallation-induced lithium conversion target. The helium-3 target waste volumes are approximately the same with the exception of solid LLW which is 9,722 yd^3.

[c] Residual heavy metal content is 660 lbs (0.3 metric tons).

[d] Residual heavy metal content is 530 lbs (0.24 metric tons).

[e] Residual heavy metal content is 230,000 lbs (105 metric tons).

[f] Residual heavy metal content is 150,000 lbs (68 metric tons).

[g] Includes 12,900 yd^3 of recyclable waste.

[h] Includes 12,800 yd^3 of recyclable waste.

[i] Includes 12,200 yd^3 of recyclable waste.

[j] Includes 9,900 yd^3 of recyclable waste.

[k] Includes 6,400 yd^3 of recyclable waste.

over the rate generated under No Action. Additional treatment and staging facilities may be required. Assuming a 1,700 yd^3 per acre LLW disposal usage factor, this would require approximately 1.2 acres per year for LLW disposal. Expansion of the planned LLW disposal facility would be necessary. With the addition of an HWR facility, the total amount of mixed and hazardous wastes would not change significantly compared to No Action. Thus no additional impacts from these wastes are anticipated if this technology is chosen for this site. The HWR would generate much larger quantities of nonhazardous liquid and solid wastes than currently projected for ORR under No Action. The amount of sanitary liquid waste would be greater by a factor of almost 7. The generation of solid sanitary waste would increase 19 percent. Therefore, additional treatment capacity and landfill capacity would be necessary. Additional treatment facilities or expansion of existing or planned facilities would be analyzed in a site-specific NEPA analysis.

Siting an HWR without tritium recycling facilities at ORR would not affect the generation of nor change the impacts from spent nuclear fuel or liquid LLW as described above and table 4.4.3.10–3. Liquid mixed LLW would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, and liquid nonhazardous wastes would not change from those described above and in table 4.4.3.10–3. The generation of solid LLW would increase by 56 percent over No Action, and would require approximately 1.1 acres per year of LLW disposal. The increase in generation rate Action for solid sanitary wastes would decrease from 19 percent to 10 percent; thus, proportionately decreasing the impact to the planned lifetime of the landfill.

Modular High Temperature Gas-Cooled Reactor. Spent nuclear fuel would be generated at the rate of 80 yd^3 per year. This would add 0.24 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The MHTGR would be designed to provide the necessary stabilization and storage of the spent nuclear fuel while awaiting final disposition. The MHTGR would produce quantities of liquid LLW which would increase by 90 percent the amount being generated under No Action. Construction of a liquid radioactive waste facility would be required. The MHTGR would increase by 18 percent the amount of solid LLW being generated under No Action. Expansion of existing or additional staging facilities may be needed. Expansion of the planned LLW disposal facility may be necessary to meet the 0.35 acres per year of LLW disposal. Approximately the same amount of mixed and hazardous wastes as in No Action would be generated by the MHTGR. Thus no additional impacts from these wastes are anticipated if this technology is chosen for this site. The MHTGR would generate greater quantities of nonhazardous liquid and solid wastes than normal operations at ORR. This would cause increased need for treatment and landfill capacity.

Siting an MHTGR without tritium recycling facilities at ORR would not affect the generation of nor change the impacts from spent nuclear fuel or liquid LLW as described above and table 4.4.3.10–3. Liquid mixed LLW would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, and liquid nonhazardous wastes would not change from those described above and in table 4.4.3.10–3. The generation of solid LLW would increase by 14 percent over No Action, and would require approximately 0.3 acres per year of LLW disposal. The increase in generation rate over No Action for solid sanitary wastes would decrease from 19 percent to 10 percent; thus, proportionately decreasing the impact to the planned lifetime of the landfill.

Advanced Light Water Reactor (Large). Spent nuclear fuel would be generated at the rate of 55 yd^3 per year. This would add 105 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The ALWR would be designed to provide the necessary stabilization and storage facilities for spent nuclear fuel. The Large ALWR would increase the generation of liquid LLW by a factor of 9. Construction of a liquid radioactive waste facility would be required. The 11 percent increase in the generation of solid LLW would require 0.4 acres per year of LLW disposal. Expansion of existing, or additional, staging facilities and planned LLW disposal facility may be required. Approximately the same amount of mixed and hazardous wastes as in No Action would be generated if the Large ALWR facility is added to ORR. No additional impacts from these wastes are anticipated. The Large ALWR does generate greater quantities of nonhazardous liquid and solid wastes

TABLE 4.4.3.10–3.—*Potential Spent Nuclear Fuel and Waste Management Impacts from Tritium Supply Technologies and Recycling at Oak Ridge Reservation* [Page 1 of 2]

	Tritium Supply Technologies and Recycling									
	HWR		MHTGR		ALWR/Large		ALWR/Small		APT	
Category	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact
Spent Nuclear Fuel	New[b]	New storage facility	New[b]	New storage facility	New[b]	New storage facility	New[b]	New storage facility	None	None
Low-Level										
Liquid	+358	New treatment facility	+89	New treatment facility	+852	New treatment facility	+135	New treatment facility	None	None
Solid	+60	1.2 acres per year of LLW disposal	+18	.35 acres per year of LLW disposal	+11	0.4 acres per year of LLW disposal	+11	0.2 acres per year of LLW disposal	+10	0.2 acres per year of LLW disposal
Mixed Low-Level										
Liquid	<+1	None	<+1	None	<+1	None	<+1	None	<+1	None
Solid	<+1	None	<+1	None	<+1	None	<+1	None	<+1	None
Hazardous										
Liquid	None	None	None	None	None	None	None	None	None	None
Solid	+4	None	+9	None	+3	None	+3	None	<+1	None
Nonhazardous (Sanitary)										
Liquid	+491	New treatment facilities	+342	New treatment facilities	+1,310	New treatment facilities	595	New treatment facilities	+56	New treatment facilities
Solid	+19	Landfill life reduced or expansion required	+19	Landfill life reduced or expansion required	+19	Landfill life reduced or expansion required	15	Landfill life reduced or expansion required	+11	Landfill life reduced or expansion required

TABLE 4.4.3.10–3.—*Potential Spent Nuclear Fuel and Waste Management Impacts from Tritium Supply Technologies and Recycling at Oak Ridge Reservation* [Page 2 of 2]

	Tritium Supply Technologies and Recycling									
	HWR		MHTGR		ALWR/Large		ALWR/Small		APT	
Category	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact
Nonhazardous (Other)										
Liquid	None	None	None	None	None	None	None	None	None	None
Solid	+143	None - Project wastes are recyclable	+142	None - Project wastes are recyclable	+135	None - Project wastes are recyclable	+110	None - Project wastes are recyclable	+71	None - Project wastes are recyclable

[a] This column reflects percentage change in generation rate for No Action. Percentage change was calculated using waste volumes prior to rounding. Do not use rounded numbers in table 4.4.3.10–2 to calculate percentage change.

[b] ORR generated small quantities in 1992 but was projected to generate none in 2010; thus, in 2010 spent fuel generation was considered to be new.

Source: Tables 4.4.3.10–1 and 4.4.3.10–2.

than normal operations at ORR. This would cause increased need for treatment and landfill capacity.

Siting a Large ALWR without tritium recycling facilities at ORR would not affect the generation of nor change the impacts from spent nuclear fuel or liquid LLW as described above and table 4.4.3.10–3. Liquid mixed LLW would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, and liquid nonhazardous wastes would not change from those described above and in table 4.4.3.10–3. The generation of solid LLW would increase by 8 percent over No Action, and would require approximately 0.33 acres per year of LLW disposal. The increase in generation rate over No Action for solid sanitary wastes would decrease from 19 percent to 9 percent; thus, proportionately decreasing the impact to the planned lifetime of the landfill.

Advanced Light Water Reactor (Small). Spent nuclear fuel would be generated at the rate of 36 yd^3 per year. This would add 68 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The Small ALWR facility would be designed to have the necessary stabilization and storage facilities for spent fuel. The Small ALWR facility would produce approximately the same quantity of wastes as the Large ALWR except for liquid LLW and nonhazardous wastes. The amount of liquid LLW generated from the Small ALWR is approximately 25 percent of the Large ALWR generated wastes while the amount of solid LLW is approximately the same. A solid LLW disposal rate of 0.2 acres per year would be required. The amount of nonhazardous liquid waste generated by the Small ALWR is about half the amount generated by the Large ALWR while the amount of solid waste is about the same. In general, as seen in table 4.5.3.10–3 the impacts on treatment and staging facilities are the same.

Siting a Small ALWR without tritium recycling facilities at ORR would not affect the generation of nor change the impacts from spent nuclear fuel or liquid LLW as described above and table 4.4.3.10–3. Liquid mixed LLW would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, and liquid nonhazardous wastes would not change from those described above and in table 4.4.3.10–3. The generation of solid LLW would increase by 7 percent over No Action, and would require approximately 0.16 acres per year of LLW disposal. The increase in generation rate over No Action for solid sanitary wastes would decrease from 15 percent to 5 percent; thus, proportionately decreasing the impact to the planned lifetime of the landfill.

Accelerator Production of Tritium. The APT does not generate spent nuclear fuel. Any liquid LLW can be solidified at the point of generation. Mixed low-level and hazardous wastes generation increase is less than 1 percent; thus, no impacts are expected. The APT would increase the generation of nonhazardous sanitary solid waste by 11 percent over No Action. Thus, there would be no additional impact for this facility except for an increased need for LLW at the rate of 0.2 acres per year and landfill capacity.

Siting an APT without tritium recycling facilities at ORR would not affect the generation of nor change the impacts from liquid LLW as described above and table 4.4.3.10–3. Liquid mixed LLW would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, and liquid nonhazardous wastes would not change from those described above and in table 4.4.3.10–3. The generation of solid LLW would increase by 6 percent over No Action, and would require approximately 0.13 acres per year of LLW disposal. A less than 2 percent increase in the generation of solid sanitary nonhazardous wastes over No Action would have minimal impact on the planned lifetime of the landfill.

Less Than Baseline Operations. In the event of a reduced baseline tritium requirement the waste volumes shown in table 4.4.3.10–2 would not appreciably change as a result of the HWR operating at less power, and the MHTGR and ALWR irradiating fewer target rods. In the case of a Phased APT using the helium-3 target, the waste volumes with the exception of cooling tower blowdown, which decreases by 36 percent (86 MGY), are approximately the same as the Full APT using the helium-3 target.

Multipurpose Reactor

Multipurpose Modular High Temperature Gas-Cooled Reactor. The volume of spent nuclear fuel generated by the six-reactor module multipurpose

MHTGR would be approximately double the spent nuclear fuel from the three-reactor module tritium supply MHTGR. Similar to the mixed-oxide fuel assemblies, the plutonium-oxide fuel assemblies would have greater decay heat. Because the increased decay heat reduces storage density in the pool area and increases the fuel pool dwell time before dry storage, the spent nuclear fuel storage requirement would more than double that required for the three-reactor module tritium supply MHTGR. No increases in waste generation rates or characteristics are expected due to the change from uranium-oxide reactor fuel to plutonium-oxide reactor fuel. However, there would be increases in waste generation for all waste categories due to operation of the Pit Disassembly/Conversion Facility to include the introduction of mixed TRU and TRU wastes from both the Pit Disassembly/Conversion Facility and the fabrication of plutonium-oxide fuel. These increases are in addition to those listed in table 4.4.3.10–2 for the tritium supply MHTGR. Table 4.8.3.1–8 provides the quantity of waste effluents from the Pit Disassembly/Conversion Facility. In addition approximately 385 yd^3 of mixed TRU and TRU wastes would result from the fabrication of plutonium-oxide fuel. The 399 yd^3 of mixed TRU and TRU wastes would require transport to a geologic repository (assuming one is available) after they have been processed to meet the WIPP waste acceptance criteria. The only TRU waste handling facilities at ORR exist at ORNL; thus, siting at other than ORNL would require TRU waste handling facilities to process the TRU waste to WIPP waste acceptance criteria.

The transport of the mixed TRU and TRU wastes to WIPP would require 35 truck shipments per year, 18 regular train shipments per year, or six dedicated train shipments per year. One hundred gallons of liquid and 0.2 yd^3 of solid mixed LLW would require treatment in accordance with the ORR Site Treatment Plan. Approximately 0.003 acres per year of LLW disposal area would be required to dispose of the 10 yd^3 of solid LLW. Sufficient staging capacity exists to accumulate the 1,000 gallons of liquid and 1 yd^3 of solid hazardous wastes while awaiting shipment to a RCRA-permitted treatment and disposal facility. An additional 87 yd^3 of solid nonhazardous wastes would require disposal in the sanitary landfill. Additional liquid sanitary and industrial wastewater treatment facilities may be required if the Pit Disassembly/Conversion Facility is not collocated with the multipurpose reactor.

Multipurpose Advanced Light Water Reactor. Spent fuel would be generated at the same rate with approximately the same amount of residual heavy metal content as the tritium supply ALWR. The decay heat in the mixed-oxide fuel assemblies could be 10 to 20 percent greater than the heat in spent uranium-oxide fuel assemblies. The increased decay heat load could reduce the fuel assembly storage density in the fuel pool and dry storage casks or increase fuel pool dwell time before dry storage. No increases in waste generation rates or characteristics are expected due to the change from uranium-oxide reactor fuel to mixed-oxide reactor fuel. However, there would be increases in waste generation for all waste categories due to operation of the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility to include the introduction of mixed TRU and TRU wastes. These increases are in addition to those listed in table 4.4.3.10–2 for the Large and Small tritium supply ALWR. As shown in table 4.8.3.1–4, approximately 399 yd^3 of mixed TRU and TRU wastes would require transport to a geologic repository (assuming one is available) after they have been processed to meet the WIPP waste acceptance criteria.

The only TRU waste handling facilities at ORR exist at ORNL; thus, siting at other than ORNL would require TRU waste handling facilities to process the TRU waste to WIPP waste acceptance criteria. The transport of the mixed TRU and TRU wastes to WIPP would require 35 truck shipments per year, 18 regular train shipments per year, or six dedicated train shipments per year. Two hundred gallons of liquid and 13 yd^3 of solid mixed LLW would require treatment in accordance with the ORR Site Treatment Plan. Approximately 0.16 acres per year of LLW disposal area would be required to dispose of the 524 yd^3 of solid LLW. Sufficient staging capacity exists to accumulate the 200 gallons of liquid and 13 yd^3 of solid hazardous wastes while awaiting shipment to a RCRA-permitted treatment and disposal facility. An additional 3,920 yd^3 of solid nonhazardous wastes would require disposal in the sanitary landfill. Additional liquid sanitary and industrial wastewater treatment facilities may be required if the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility is not collocated with the multipurpose reactor.

Potential Mitigation Measures. Each new tritium supply technology and recycling facility would be designed to process its own waste into a form suitable for storage or disposal and would use proven waste minimization and pollution prevention technologies whenever possible. Some facility designs produce waste quantities or waste forms that could undergo additional reductions by utilizing the emerging technologies, thereby further reducing or mitigating impacts. Pollution prevention and waste minimization would be major factors in determining the final design of any facility constructed as part of the proposed action at ORR. Pollution prevention and waste minimization would also be analyzed as part of the site-specific analyses and tiered NEPA documents.

Some of the facilities, such as the Above Grade Storage Facility at Y-12, planned for or under construction at ORR to handle wastes generated from past and current operations and from environmental restoration activities may be able to treat, store, or dispose of tritium-related wastes. The use of existing incineration capability at ORR could reduce the volume of solid LLW to be disposed of by a factor of 20. Utilization of existing facilities, or the need for the construction of new facilities, would be addressed in site-specific NEPA documents.

4.5 PANTEX PLANT

Pantex was established in 1951, and currently occupies approximately 10,000 acres near Amarillo, TX. The current defense program mission at Pantex is to assemble and disassemble nuclear weapons, perform weapons repair, modification and disposal, conduct stockpile evaluation and testing, and provide interim storage for plutonium. Section 3.3.5 provides a description of all the DOE mission and support facilities at Pantex. The location of Pantex is illustrated in figure 4.5–1.

4.5.1 Description of Alternatives

Under the proposed action, any one of the four tritium supply technologies (HWR, MHTGR, ALWR, or APT) alone or collocated with a new tritium recycling facility could be sited at Pantex. Section 3.4.2 provides a description of the tritium supply technologies and section 3.4.3.1 describes the tritium recycling facility. Figure 4.5.1–1 shows the location of existing facilities within Pantex and areas for the proposed TSS.

Under No Action, Pantex would continue to operate its current and planned missions, developing and fabricating HE components, assembling and disassembling weapons as required to support the projected stockpile requirements, and other missions as described in section 3.3.5. No facilities at Pantex would be phased out as a result of the proposed action alternatives discussed in this PEIS.

4.5.2 Affected Environment

The following sections describe the affected environment at Pantex for land resources, air quality and acoustics, water resources, geology and soils, biotic resources, cultural and paleontological resources, and socioeconomics. In addition, the infrastructure at Pantex, the radiation and hazardous chemical environment, and the waste management conditions are described.

4.5.2.1 *Land Resources*

The discussion of land resources at Pantex includes land use and visual resources.

Land Use. The Pantex site is located within Carson County in the Panhandle region of Texas, 17 miles east-northeast of downtown Amarillo. The Pantex site covers 15,000 acres of land of which approximately 9,000 acres are owned by the Federal government and approximately 6,000 acres are leased from Texas Technological University (Texas Tech). All owned and leased buildings on the site are administered, managed, and controlled by DOE. DOE owns an additional remote tract of 1,080 acres of undeveloped land at Pantex Lake. This property is held by DOE to retain the water rights. Generalized land uses at Pantex and the vicinity are shown on figure 4.5.2.1–1. Future land uses proposed in the Pantex Site Development Plan are shown on figure 4.5.2.1–2. Future land uses concentrate on centralization of facilities by relocations away from site boundaries into an interior core.

Plant operations are currently located on approximately 1,800 acres of developed land. Three additional parcels, totaling 2,240 acres, are designated for future industrial sites as shown in figure 4.5.2.1–3. Any of these three future industrial sites could support the potential tritium supply and recycling facilities.

The Texas Tech Agriculture Research operations use DOE-leased land not actively used for Pantex operations for agricultural use. Agricultural activities generally consist of dry farming and livestock grazing. A limited amount of crop irrigation occurs. Except for the playas, the Soil Conservation Service considers these lands prime farmland when irrigated. Texas Tech land also contains four dwelling units located approximately 3 miles southwest of the weapons assembly and disassembly, and high explosives production core.

The land surrounding Pantex is rural private property. The closest offsite residences are approximately 100 feet west of the plant boundary along Farm-to-Market Road 683. Most of the surrounding land is prime farmland when irrigated, with the exception of the area northwest of the plant site, which is rangeland. Some property owners have enrolled their land in the Federal Conservation Reserve Program. Under terms of this program, the land is placed in a dormant state for 10 years and cannot be cultivated or grazed. The majority of the land, however, is cultivated. The land is generally dry farmed; however, some fields are irrigated from local playas or from the Ogallala aquifer. The

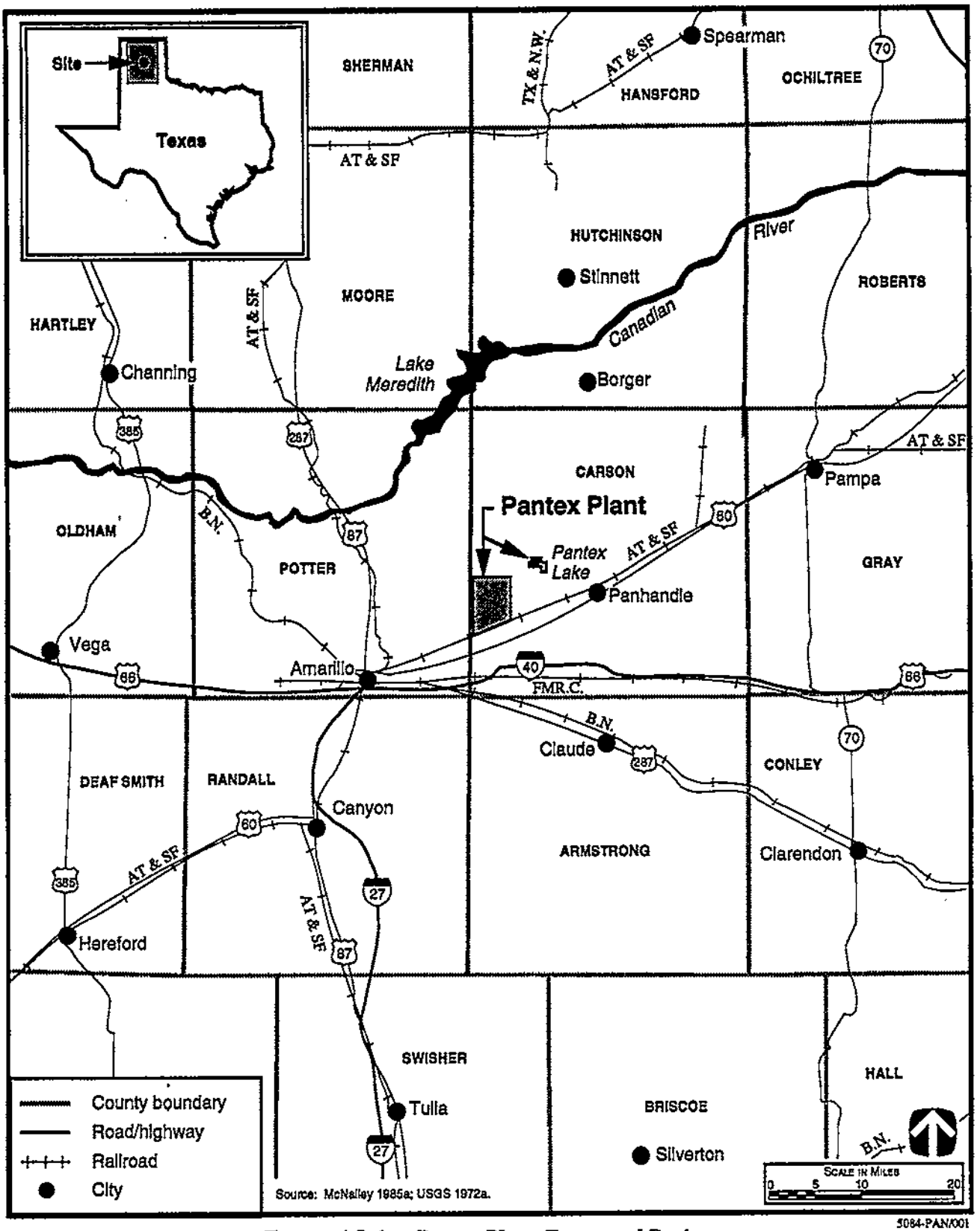


FIGURE 4.5–1.—*Pantex Plant, Texas, and Region.*

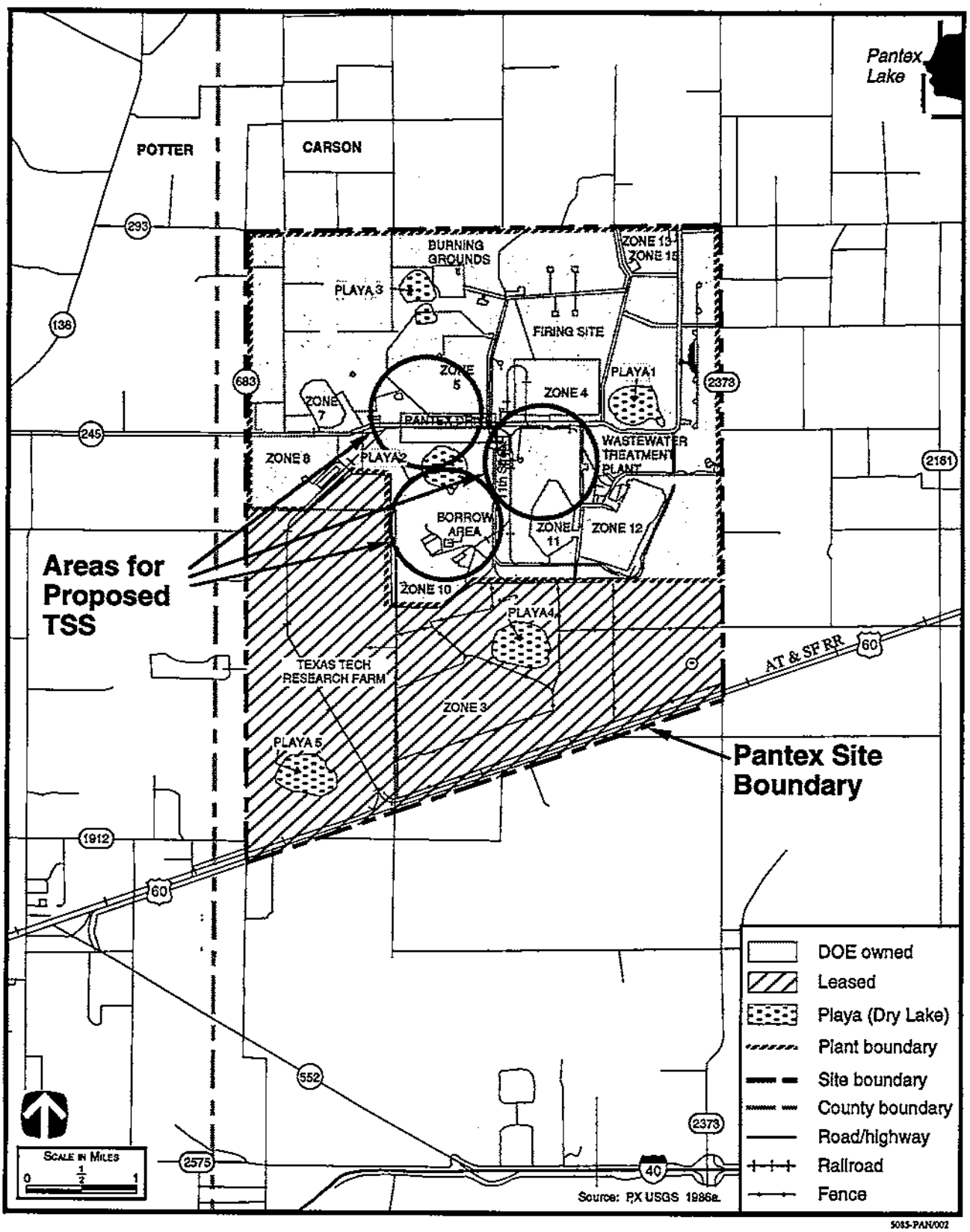


FIGURE 4.5.1–1.—***Primary Facilities, Proposed Tritium Supply Sites, and Testing Areas at Pantex Plant.***

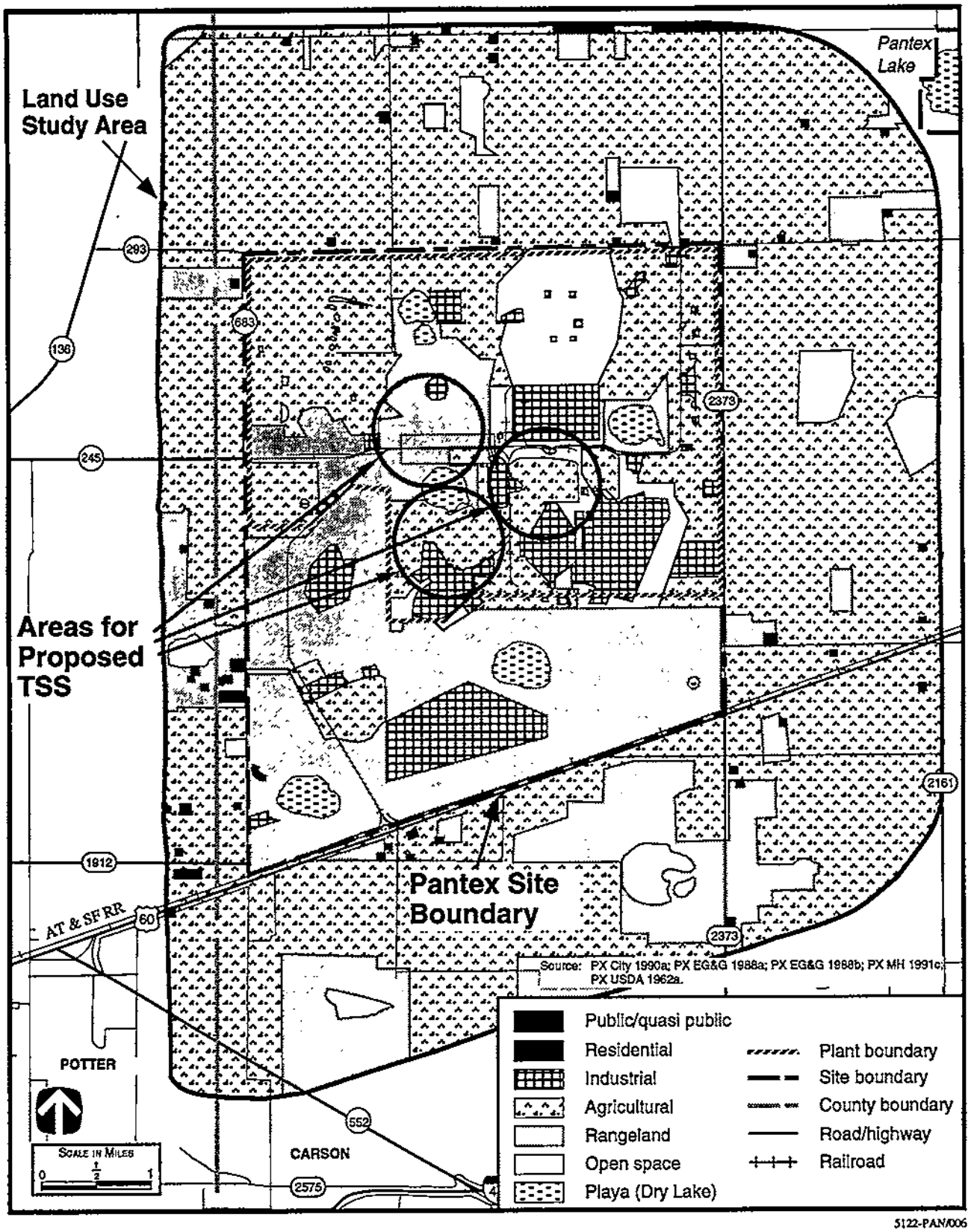


FIGURE 4.5.2.1–1.—*Generalized Land Use at Pantex Plant and Vicinity.*

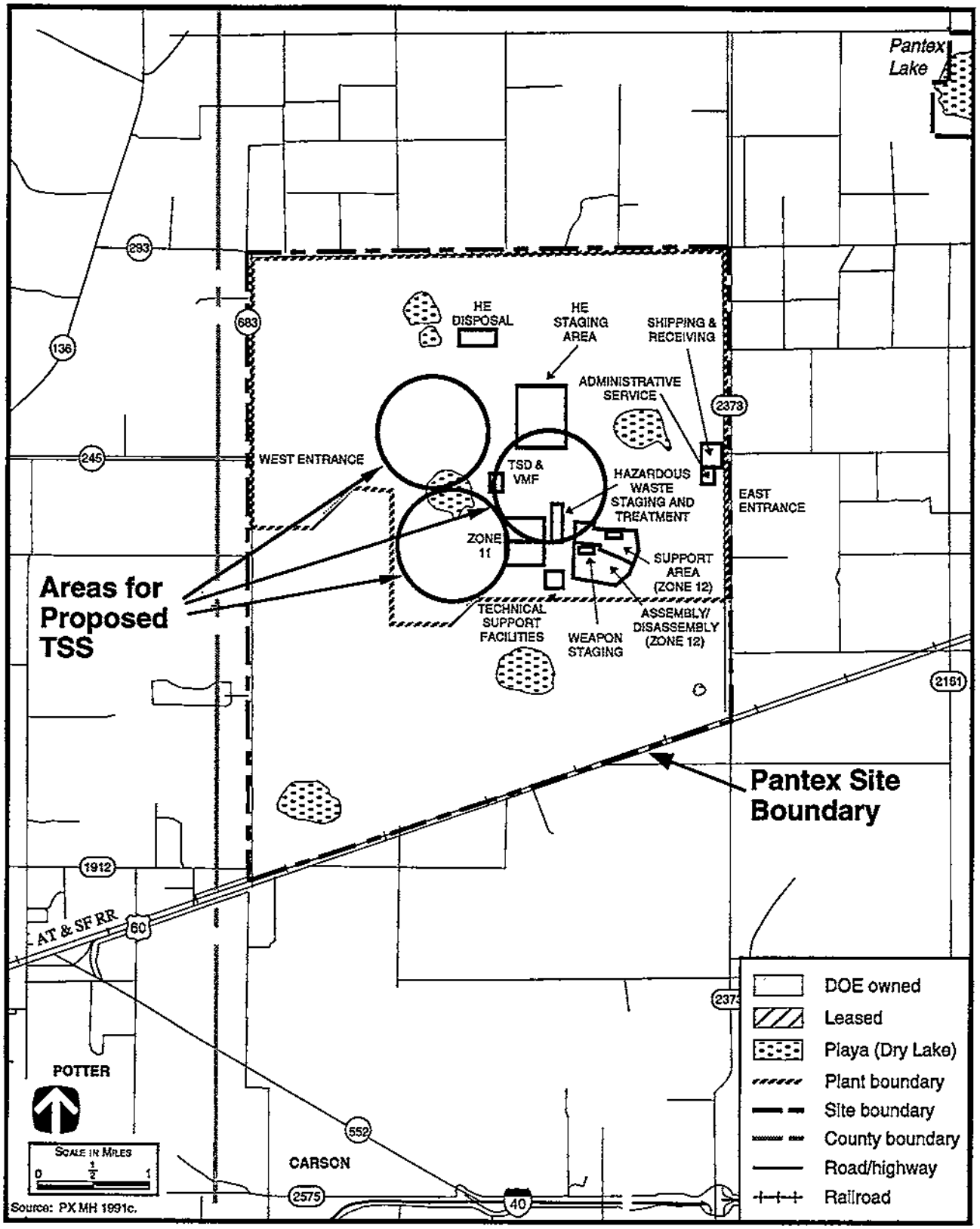


FIGURE 4.5.2.1–2.—*Future Land Use at Pantex Plant.*

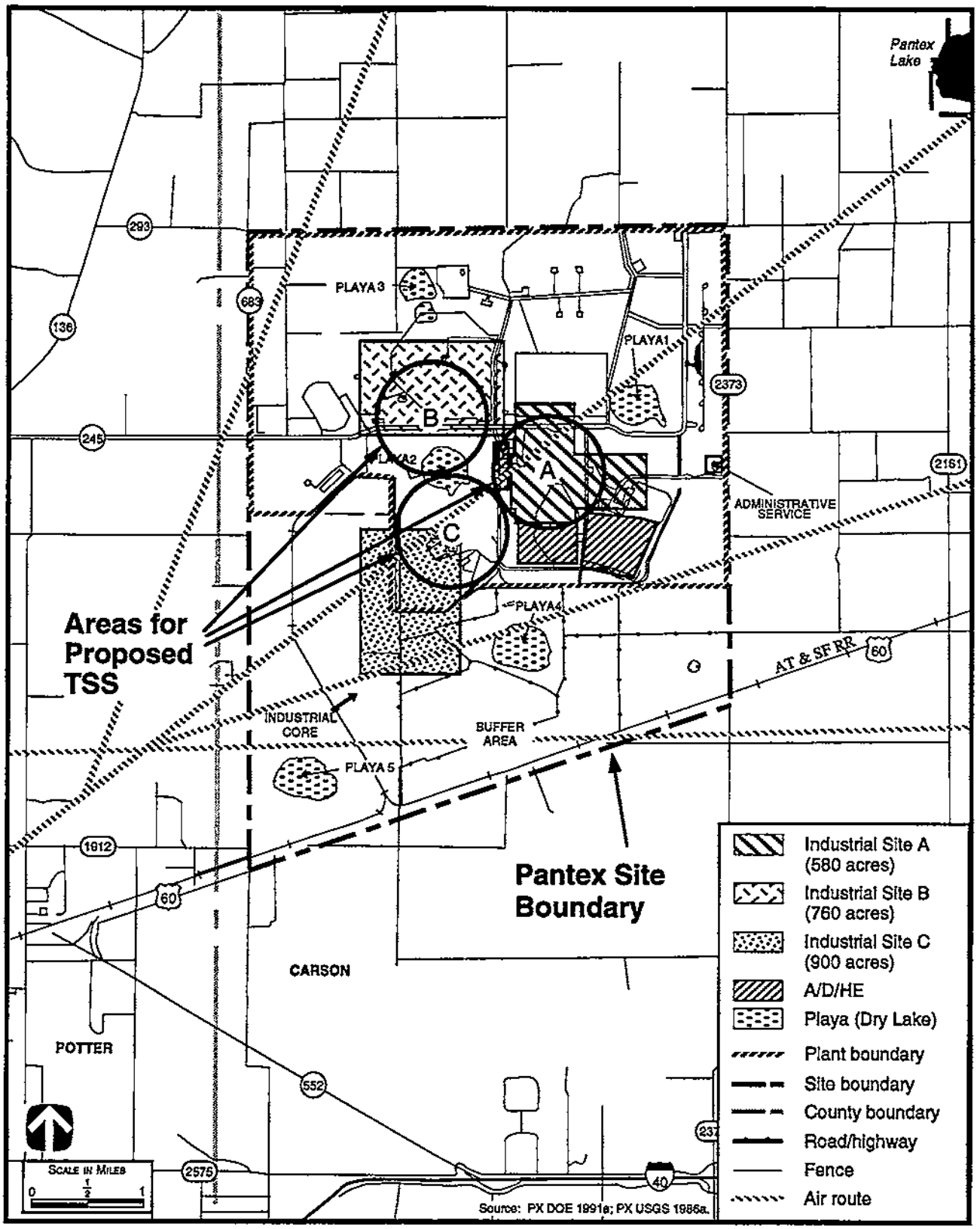


FIGURE 4.5.2.1–3.—*Designated Industrial Sites at Pantex Plant.* 5153-PAN/013

packing plant of Iowa Beef Packers, Inc., is the only industrial activity within 2 miles of the plant.

Pantex is crossed by four low-altitude Federal airways used by the Amarillo International Airport for aircraft landings and takeoffs. The runway is located approximately 7 miles southwest of the site boundary. The Height Hazard and Land Use Ordinance for Amarillo International Airport overlays approximately 75 percent of Pantex, with building height limits ranging from 750 to 1,425 feet above the ground surface (PX BDC 1989a).

The Amarillo Comprehensive Plan has designated land for future growth. The direction for future residential development is anticipated to occur toward the southwest, away from the plant. The East Planning Area of the city, which extends to within 2 miles of the plant site, has historically been one of the slower growing residential areas. Because of the presence of the airport and important industrial use in this area, the comprehensive plan encourages compatible use rather than residential use. The largest residential area in this planning area is the site of the base housing of the former Amarillo Air Force Base. The base housing, which has been converted to rental housing, is located approximately 5 miles southwest of the plant boundary.

Visual Resources. Pantex is sited within a landscape typical of the High Plains region of Texas consisting of cultivated cropland and rangeland. The Pantex site consists of operational facilities of the plant and the inactive facilities of the former World War II ammunition plant. These industrial land uses are surrounded by cropland and rangeland that blend into the offsite viewscape. This mixed use of industrial and agricultural uses is consistent with the Bureau of Land Management's VRM Class 4 designation.

The most sensitive viewpoint of the plant site is located 1.5 miles southeast of the plant at the intersection of U.S. Route 60 and Farm-to-Market Road 2373. U.S. Route 60 is part of the Texas Plains Trail, a scenic road with Pantex as a designated point of interest. Much of the view of the plant along this highway is obscured by the elevated railroad right-of-way. The plant is still visible, appearing as low clusters of buildings on a flat horizon. The cylindrical water towers are the most visible feature because of their height. The operations areas are well defined at night by the intense security lighting. The plant operations areas are also visible from Interstate 40, with the closest viewpoint being the rest area approximately 6 miles away. This viewpoint is similar to that described for U.S. Route 60; however, because of the greater distance, the plant facilities are not as prominent.

Public access to Pantex and its buffer areas is strictly controlled and limited to authorized personnel, visitors, and the agricultural lessee. Public access adjacent to the plant perimeter is limited to three Farm-to-Market Roads and U.S. Route 60. The plant facilities are generally visible from the low-density rural housing that surrounds the site.

4.5.2.2 *Site Infrastructure*

Section 3.3.5 describes the current missions at Pantex. To support these missions, an extensive infrastructure exists as shown in table 4.5.2.2–1. Of critical importance to the proposed action is the electrical power infrastructure at each potential site. Pantex is located in the Southwest Power Pool Region and draws its power from the West Central Power Pool Subregion. Characteristics of this subregion are listed in table 4.5.2.2–2.

TABLE 4.5.2.2–1.—*Baseline Characteristics for Pantex Plant*

Current Characteristics	Value
Land	
Area (acres)	16,000
Roads (miles)	47
Railroads (miles)	17
Electrical	
Energy consumption (MWh/yr)	77,000
Peak load (MWe)	13
Fuel	
Natural gas (ft^3/yr)	520,000,000
Oil (GPY)	274,000
Coal (ton/yr)	0
Steam (lb/hr)	75,000

Source: PX 1993a:2

4.5.2.3 *Air Quality and Acoustics*

The following describes existing air quality and acoustics including a review of the meteorology and climatology in the vicinity of Pantex. More detailed discussions of the air quality and acoustics

TABLE 4.5.2.2–2.—*Subregional Power Pool Electrical Summary for Pantex Plant*

Type Fuel	Production (percent)
Coal	59
Nuclear	7
Hydro/geothermal	1
Oil/gas	32
Other[a]	1
Total Annual Production: 107,607,000 MWh	
Total Annual Load: 104,681,000 MWh	
Energy Exported Annually[b]: 2,926,000 MWh	
Generating Capacity: 24,642 MWe	
Peak Demand: 20,578 MWe	
Capacity Margin[c]: 4,064 MWe	

[a] Includes power from both utility and nonutility sources.
[b] Energy exported is not the difference of production and load due to system losses and pumped storage.
[c] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.
Source: NERC 1993a.

methodologies, input data, and atmospheric dispersion characteristics are presented in appendix section B.1.3.5.

Meteorology and Climatology. The climate at Pantex and in the surrounding region is characteristically that of a continental steppe (Trewartha 1954a). It is typified by large variations in temperature and precipitation from year to year, with summers that are hot and dry and winters that are mild. The annual average temperature in the Amarillo region is 57.2 °F; average daily temperatures vary from a minimum of 21.7 °F in January to a maximum of 91.4 °F in July. The average annual precipitation is approximately 19 inches (NOAA 1991c:3). Prevailing wind directions are from the south to southwest. The annual average wind speed is 13.6 mph. Additional information related to meteorology and climatology at Pantex is presented in appendix section B.1.3.5.

Ambient Air Quality. Pantex is located within the Amarillo-Lubbock Intrastate AQCR 211, which is currently designated as "attainment" or "unclassified" by EPA (40 CFR 81.344) with respect to the NAAQS for criteria pollutants (40 CFR 50). Applicable NAAQS and the State of Texas ambient air quality standards are presented in appendix table B.1.3.1-1. There are no Prevention of Significant Deterioration (40 CFR 52.21) Class I areas in the vicinity of Pantex.

Pantex does not operate any ambient air quality monitoring stations that measure criteria pollutant emissions. Ambient air quality monitoring data are supplied by the State of Texas from stations located in Amarillo. Appendix table B.1.3.5–1, presents ambient air quality monitoring data from 1986 to 1991 for PM_{10} and Pb. The data indicate that these regulated pollutants were in compliance with applicable ambient standards.

Historically, the primary emission sources of criteria pollutants are the steam plant boilers, the explosives burning operation, and emissions from vehicles (appendix table B.1.3.5–2) (PX DOE 1983a:3-8). Potential emission sources of hazardous/toxic air pollutants include the high explosives synthesis facility, the explosive burning operation, miscellaneous laboratories, and other small operations (appendix table B.1.3.5–2). With the exception of high explosives disposal burning at the Burning Ground, most stationary points of nonradioactive atmospheric releases are from fume hoods and building exhaust systems with HEPA filters.

Table 4.5.2.3–1 presents the baseline ambient air concentration for criteria pollutants and other pollutants of concern at Pantex. As shown in the table, with the exception of the 30-minute standards for hydrogen chloride, baseline concentrations are in compliance with applicable guidelines and regulations.

Acoustic Conditions. Major noise emission sources within Pantex include various industrial facilities, equipment, and machines. No sound-level measurements have been made around Pantex. At the site boundary, away from most of the industrial facilities at Pantex, noise emitted from the site would be barely distinguishable from background noise levels. However, some noise from explosives detonation can be heard at residences north of the site.

The acoustic environment along the Pantex boundary and at nearby residences away from traffic noise is assumed to be that of a rural location with typical day/night levels in the range of 35 to 50 dBA (EPA 1974a:B-4). Traffic is the primary source of

TABLE 4.5.2.3–1.—*Comparison of Baseline Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines at Pantex Plant, 1991* [Page 1 of 2]

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutant			
Carbon monoxide (CO)	8-hour	10,000 [a]	1,352
	1-hour	40,000 [a]	7,836
Lead (Pb)	Calendar quarter	1.5[a]	0.07
Nitrogen dioxide (NO_2)	Annual	100 [a]	2
Ozone (O_3)	1-hour	235 [a]	[b]
Particulate matter (PM_{10})	Annual	50 [a]	27
	24-hour	150 [a]	114
Sulfur dioxide (SO_2)	Annual	80 [a]	0.03
	24-hour	365 [a]	24
	3-hour	1,300 [a]	194
Mandated by Texas			
Hydrogen fluoride	30-day	0.8[c]	[d]
	7-day	1.6[c]	[d]
	24-hour	2.9[c]	0.69
	12-hour	3.7[c]	[d]
Hazardous and Other Toxic Compounds			
1,1,1-Trichloroethane	30-minute[e]	19,100 [c]	8.3
	Annual	1,910 [c]	<0.01
1,1,2-Trichloro-1,2,2-Trifluoroethane	30-minute[e]	[f]	12.6
	Annual	[f]	<0.01
2-Butoxyethanol	30-minute[e]	1,210 [c]	208.9
	Annual	121 [c]	0.13
Acetone	30-minute[e]	5,900 [c]	341.1
	Annual	590 [c]	0.02
Aliphatic hydrocarbons	30-minute[e]	[f]	19
	Annual	[f]	<0.01
Aromatic hydrocarbons	30-minute[e]	[f]	27.2
	Annual	[f]	<0.01
Aromatic petroleum distillates	30-minute[e]	3,500 [c]	13.6
	Annual	350 [c]	<0.01
Butyl acetate	30-minute[e]	1,850 [c]	87
	Annual	710 [c]	0.01
Butyl alcohol	30-minute[e]	1,220 [c]	31.6
	Annual	150 [c]	0.01
Chlorodifluoromethane	30-minute[e]	18,000 [c]	4.9
	Annual	1,800 [c]	<0.01
Cyanogen	30-minute[e]	210 [c]	161.8
	Annual	21 [c]	0.01

TABLE 4.5.2.3–1.—*Comparison of Baseline Ambient Air Concentrations with Most Stringent Applicable Regulations and Guidelines at Pantex Plant, 1991* [Page 2 of 2]

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (Continued)			
Dichlorodifluoromethane	30-minute[e]	49,500 [c]	23.3
	Annual	4,950 [c]	<0.01
Diesel	30-minute[e]	90 [c]	2.4
	Annual	9 [c]	<0.01
Epoxy solvent	30-minute[e]	[f]	16.5
	Annual	[f]	<0.01
Ethyl alcohol	30-minute[e]	18,800 [c]	12.2
	Annual	1,880 [c]	<0.01
Freon TF	30-minute[e]	[f]	24.8
	Annual	[f]	0.02
Hydrocarbons	30-minute[e]	[f]	1,812
	Annual	[f]	0.08
Hydrogen chloride	30-minute[e]	75 [c]	232.3
	Annual	0.1[c]	0.01
Isopropyl alcohol	30-minute[e]	7,856 [c]	127.3
	Annual	980 [c]	0.02
Methyl alcohol	30-minute[e]	2,620 [c]	178.3
	Annual	262 [c]	0.11
Methyl ethyl ketone	30-minute[e]	3,900 [c]	92.8
	Annual	590 [c]	0.02
Tert-butyl-ether	30-minute[e]	[f]	1.9
	Annual	[f]	0.01
Tetrahydrofuran	30-minute[e]	5,900 [c]	29.6
	Annual	590 [c]	0.02
Toluene	30-minute[e]	3,750 [c]	236.2
	Annual	375 [c]	0.13
Trichlorotrifluoroethane	30-minute[e]	10,000 [c]	7.3
	Annual	1,000 [c]	<0.01
VM&P naphtha	30-minute[e]	3,500 [c]	23.3
	Annual	350 [c]	<0.01
Xylene	30-minute[e]	3,700 [c]	44.2
	Annual	435 [c]	0.01

[a] Federal standard (40 CFR 50).
[b] Not monitored because the background concentration is insignificant compared with the standard.
[c] State standard.
[d] Not calculated.
[e] One-hour predicted concentrations were used for 30-minute standard.
[f] No standard.
Source: PX 1992a:9; PX 1992a:10; PX ACB 1991a.

noise at the site boundary and at residences near roads. The contribution of plant traffic to traffic noise levels in the area is small. However, traffic noise is expected to dominate sound levels along major roads in the area such as U.S. Route 60. The residents that have the highest potential for being affected by noise from plant traffic along access routes to Pantex are those living along Farm-to-Market Roads 2373 and 683.

Other sources of noise include aircraft, wind, insect activity, and agricultural activity. Except for the prohibition of nuisance noise, neither the State of Texas nor its local governments have established specific numerical environmental noise standards applicable to Pantex.

4.5.2.4 *Water Resources*

This section describes the surface water and groundwater resources at Pantex.

Surface Water. There are no streams or rivers at Pantex, and all site water requirements are met by groundwater. All surface water drains to playas, natural closed depressions that collect runoff to form ephemeral lakes. There are six playas associated with Pantex. Playas 1 through 5 are located on the main site, and Pantex Lake (also a playa) is located approximately 3 miles northeast of the main site (figure 4.5.1–1) (PX DOE 1992a).

The Pantex Plant Wastewater Treatment Facility is discharging approximately 400,000 GPD (146 MGY) of treated sanitary waste effluent to Playa 1, which is a known wetland. Discharge to Playa 1 is continuous. Building discharges and stormwater runoff are directed to Playas 1, 2, and 4. Playa 3 receives stormwater runoff from the Pantex Burning Ground. Current Pantex activities do not involve Playa 5 or Pantex Lake, although wastewater has been discharged to Pantex Lake in the past. There are also a number of playas adjacent to Pantex that receive drainage from perimeter portions of the site (PX DOE 1992a). Playas recharge groundwater, although the rate of recharge is unknown. The Texas Bureau of Economic Geology is currently conducting a study to determine this rate (PX Battelle 1992a).

Since the 1960s, reclaimed waste effluent has been used for cooling water processes on the Texas High Plains. There are two potential sources of reusable wastewater available in the vicinity of Pantex Plant: the Hollywood Road Wastewater Treatment Plant and the Pantex Plant Wastewater Treatment Facility.

The Hollywood Road Wastewater Treatment Plant is located on the south side of Amarillo, approximately 20 miles from Pantex. Currently the plant is discharging approximately 7 MGD (2,225 MGY) of advanced secondary treated water that has gone through a filter treatment and is then discharged to the Prairie Dog Town Fork of the Red River. This amount is anticipated to increase to 12 MGD (4,380 MGY) by 2010. An agreement has been negotiated with the city of Amarillo to develop this wastewater to support Pantex operations.

Because there are no onsite or nearby flowing streams, floodplains exist only in association with the playas. A previous floodplain assessment concluded that the only incidence of flooding would be at some sites southeast of Playa 3 and some relict World War II bunkers southwest of Playa 4 (PX DOE 1982a). This limited flooding would not affect the operations of Pantex (PX Battelle 1992a). Information about the 500-year flood is unavailable; however, a site-specific assessment is currently being considered that may address the 500-year flood event for Pantex.

Surface Water Quality. The NPDES program of the CWA is administered by the EPA in the State of Texas. In addition, discharge of wastewaters to waters defined as "Waters of the United States" within the State of Texas requires a wastewater discharge permit from the Texas Natural Resources Conservation Commission in accordance with the Texas Water Code (PX Battelle 1992a).

Pantex submitted an NPDES permit application for Playas 1, 2, and 4 in November 1990 that is still under EPA Region 6 review. Pantex also submitted an NPDES stormwater discharge permit application in October 1991 for Playa 3. This application is also under EPA Region 6 review.

The Texas Natural Resources Conservation Commission allows Pantex to discharge wastewaters into Playas 1 and 2. On December 26, 1990, Pantex filed an application to modify its wastewater discharge permit to allow discharge of both industrial wastewater and rainwater runoff into Playa 4. An application for a

renewal of the Texas Natural Resources Conservation Commission wastewater discharge permit 2296 is on file and is currently under negotiation.

The Texas Natural Resources Conservation Commission's annual wastewater inspection in 1991 noted two deficiencies with permit requirements, one for pH excursions in effluent outside of the 6 to 9 range, and another for no delineation of the extent of the natural clay liner of the playas to indicate permeable areas. Both deficiencies have been corrected.

Surface water monitoring is conducted at all five playas at the main plant and Pantex Lake as well as at Bushland Playa, an offsite control playa used for comparative purposes. There are some differences in the parameters monitored among the playas, but the results of 1991 monitoring activities at Playa 1 are presented as representative of the water quality of the playas at Pantex (table 4.5.2.4–1) (PX DOE 1992a). Bushland playa was dry during 1991. No parameters exceeded applicable water quality criteria.

Surface Water Rights and Permits. Water rights in Texas fall under the Doctrine of Prior Appropriations. Under this doctrine, the user who first appropriated water for a beneficial use has priority to use available water supply over a user claiming rights at a later time. Courts also recognize riparian rights legally granted from Spanish-American Agreements. The Texas Natural Resources Conservation Commission is the administrator for water rights and is the permit-issuing authority.

Groundwater. Pantex is located on the Texas High Plains aquifer, which is the southernmost extension of a regional aquifer that extends from Texas to South Dakota (PX WDB 1993a). The two principal water-bearing units beneath Pantex and adjacent areas are the Ogallala aquifer and the Dockum Group aquifer (PX DOE 1983a). Deep wells, completed at depths of 600 to 850 feet into the Ogallala Formation, have provided the water supply at Pantex for over 40 years. In 1990, the recoverable volume of water in storage in the Ogallala aquifer in the High Plains aquifer system was estimated at approximately 136×10^6 million gallons (417 million acre-feet).

The Ogallala aquifer beneath Pantex has not been classified by EPA. However, it is the only source of drinking water at Pantex. Depth to water in the Ogallala aquifer ranges from 340 feet at the southern boundary of Pantex to 460 feet at the northern boundary. The saturated thickness of the Ogallala Formation ranges from 50 feet to more than 400 feet and in some areas is capable of producing yields in excess of 1,000 gpm (525.6 MGY) (PX DOE 1983a). Estimates of annual recharge rates to the Ogallala aquifer vary from 0.01 to 1.6 inches per year based on earlier studies that investigated slow regional infiltration of precipitation and recent studies that explored percolation of water through playa lakes (Native 1990) and leakage from the Dockum Group aquifer into the Ogallala aquifer (PX WDB 1993a).

The withdrawal of water from the Ogallala aquifer continues to exceed recharge, causing water levels to decline in the Pantex area at a rate of approximately 2 to 5 feet per year. During 1980 to 1990, the city of Amarillo well field north of Pantex experienced up to 60 feet of water-level decline, causing a depression in the groundwater surface northeast of Pantex (PX WDB 1991a). This depression has caused the groundwater flow direction beneath Pantex to shift from the southeast to the present northeast direction (DOE 1991a). Figure 4.5.2.4–1 shows the potentiometric surface of the Ogallala aquifer beneath Pantex.

Recently an agreement between Pantex and the city of Amarillo was negotiated to develop reclaimed wastewater from the city of Amarillo Hollywood Road Waste Treatment Plant. Currently, the waste treatment plant is discharging approximately 2,555 MGY of the advanced treated wastewater and will be discharging approximately 4,380 MGY by 2010. The use of reclaimed wastewater will reduce the amount of future Pantex groundwater withdrawals and slow the annual decline rate of the Ogallala aquifer.

Groundwater Quality. Pantex's groundwater monitoring program includes monitoring wells, onsite Ogallala production wells, and onsite drinking wells distributed throughout the facility. Wells located in the vicinity of the proposed TSS are shown in figure 4.5.2.4–1. Groundwater samples collected from the monitoring wells are analyzed for a standard suite of parameters and constituents, including volatile organics, high explosives, pesticides, herbicides, semi-volatile organics, trace metal, radioactive materials (gross alpha and gross beta), and field parameters (total dissolved solids and pH).

TABLE 4.5.2.4–1.—*Summary of Surface Water Quality Monitoring Data for Playa 1 at Pantex Plant, 1991*

Parameter	Unit of Measure	Water Quality Criteria[a]	Average Water Body Concentration
Alpha (gross, dissolved)	pCi/l	15[b]	6.09
Alpha (gross, suspended)	pCi/l	NA	3.00
Ammonia (as N)	mg/l	NA	<0.4
Arsenic	mg/l	0.05[c]	<0.011
Barium	mg/l	1[c]	<0.18
Beta (gross, dissolved)	pCi/l	50[d]	20.70
Beta (gross, suspended)	pCi/l	NA	5.64
Cadmium	mg/l	0.005[b]	<0.005
Chloride	mg/l	250[e]	89
Chromium	mg/l	0.1[b]	<0.008
Copper	mg/l	1.3[b]	<0.009
Cyanide	mg/l	0.2[b]	<0.005
Fluoride	mg/l	2.0[c]	2.1
HMX*	mg/l	NA	<0.020
Iron	mg/l	0.3[e]	5.5
Lead	mg/l	0.015[b]	<0.006
Manganese	mg/l	0.05[e]	0.35
Mercury	mg/l	0.002[b]	<0.0001
Oil and grease	mg/l	NA	<1
PETN*	mg/l	NA	<0.40
Plutonium-239, -240	pCi/l	1.2[f]	0
Radium-226	pCi/l	4.0[f]	0.60
Radium-228	pCi/l	4.0[f]	1.10
RDX*	mg/l	NA	<0.020
Selenium	mg/l	0.01[c]	<0.005
Silver	mg/l	0.05[c]	<0.005
Sulfate (as SO_4)	mg/l	250[e]	<11
TNT*	mg/l	NA	<0.020
Total organic carbon	mg/l	NA	20
Tritium	pCi/l	20,000[b]	70
Uranium-234	pCi/l	20[f]	4.26
Uranium-238	pCi/l	24[f]	2.20
Zinc	mg/l	5[e]	<0.025

[a] For comparison only, except for parameters that have Texas state water quality criteria.

[b] National Primary Drinking Water Regulations (40 CFR 141).

[c] Texas state water quality criteria. Parameters are considered in exceedance only when their concentrations surpass state water quality criteria. General criteria do not apply to instances in which surface water, as a result of natural phenomena, exhibit characteristics beyond the limits established.

[d] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

[e] National Secondary Drinking Water Regulations (40 CFR 143).

[f] DOE Derived Concentration Guides for water (DOE Order 5400.5). Derived Concentration Guides values are based on a committed effective dose equivalent of 100 mrem per year; however, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the Derived Concentration Guides. All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored concentration. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the environmental level and there is no significant impact from the facility.

Note: * Denotes high explosive(s) compounds.

Note: The less than symbol (<) indicates concentration below the analysis detection limit.

Note: NA - not applicable.

Source: DOE 1993u.

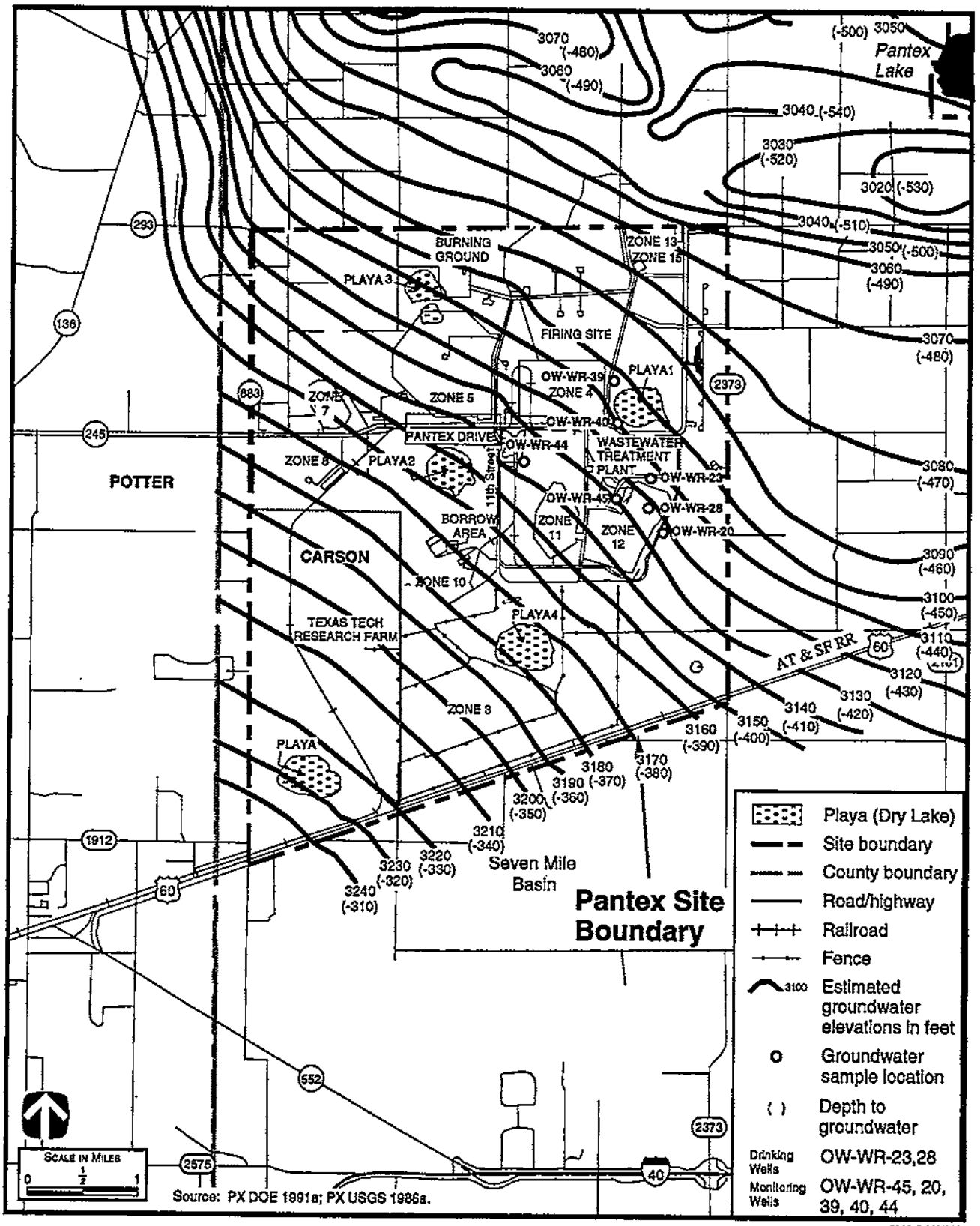


FIGURE 4.5.2.4–1.—*Potentiometric Surface of the Ogallala Aquifer at Pantex Plant.* 5089-PAN/010

The groundwater of the perched zone and the Ogallala aquifer beneath Pantex is monitored for both organic and radiological constituents. No radiological and only limited metal concentrations have been found in some of the wells monitoring the Ogallala aquifer. Table 4.5.2.4–2 shows the water quality in the Ogallala aquifer. Groundwater samples from the perched zone, however, contain a variety of constituents that are either above background levels or drinking water standards or not naturally occurring. These include: 1,2-dichloroethane; chromium; iron; and the RDX and HMX (PX DOE 1991d). Table 4.5.2.4–3 shows the water quality in the perched zone. No maps of the perched zone contaminant levels are currently available as to the extent of contamination.

Groundwater Availability, Use, and Rights. Five production wells in the northeast corner of Pantex serve the plant's industrial and potable water needs. In 1991, the plant pumped 303 million gallons of water from the Ogallala aquifer, while the city of Amarillo pumped 4.9 billion gallons from its well

TABLE 4.5.2.4–2.—*Groundwater Quality Monitoring Data for the Ogallala Aquifer Wells at Pantex Plant, 1990*

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Drinking Water		Monitoring	
			Well No. WR-23	Well No. WR-28	Well No. WR-39	Well No. WR-40
Alpha (gross)	pCi/l	15[b]	0-2	0	0-3	0
Barium	mg/l	2[b]	0.11-0.14	0.11-0.14	0.01-0.15	0.3-0.16
Beta (gross)	pCi/l	50[c]	0-2	0-1	0-2	0-1
Chromium	mg/l	0.1[b]	<0.005-0.007	<0.005-0.009	<0.005	<0.005-0.006
Copper	mg/l	1.3[b]	0.038-0.910	<0.005-0.021	<0.005-0.005	<0.005-0.006
1,2 Dichloroethane	mg/l	0.005[b]	<0.005	<0.005	<0.005	<0.005
HMX	mg/l	NA	<0.020	<0.020	<0.020	<0.020
Iron	mg/l	0.3[d]	<0.01-0.19	<0.01-0.03	0.26-2.70	0.12-2.10
Lead	mg/l	0.015[b]	<0.005-0.022	<0.005-0.028	<0.005-0.066[e]	<0.005
Nitrate	mg/l	10[b]	1.2-1.5	1.3-1.5	0.75-1.4	1.1-1.3
pH	pH units	6.5-8.5[f]	7.8	7.8	7.7	7.8
RDX	mg/l	NA	<0.020	<0.020	<0.020	<0.020
Sulfate	mg/l	250[d]	18-19	18-22	9-21	11-21
Total dissolved solids	mg/l	500[d]	288	292	273	288
Total organic carbons	mg/l	NA	[g]	[g]	<1.0-7	<1-24
Total organic halogens	mg/l	NA	[g]	[g]	<3,000-10,000	<3,000-24,000
Trichloroethylene	mg/l	0.005[b]	<0.005	<0.005	<0.005	<0.005
Tritium	pCi/l	20,000[b]	30-150	20-250	120-220	20-300
Uranium-233, -234, -235, -238	pCi/l	20[h]	1.5-2.4	1.7-1.9	1.6-2.2	1.8-2.4
Zinc	mg/l	5[d]	0.023-0.160	0.042-0.110	0.61-10	0.170-1.30

[a] For comparison only.

[b] National Primary Drinking Water Regulations (40 CFR 141).

[c] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).

[d] National Secondary Drinking Water Regulations (40 CFR 143).

[e] The maximum contaminant level for lead cited has been replaced by a treatment criteria based on statistical methods. Drinking water requires treatment if the 90th percentile level of lead concentration exceeds the action level concentration of 0.015 mg/l. Eleven samples were taken in 1990, the 90th percentile concentration was 0.009 mg/l, below the action level of 0.015 mg/l. The water from WR-39 and the Ogallala aquifer would, therefore, meet the drinking water criteria.

[f] State of Texas water quality criteria.

[g] Not sampled.

[h] DOE Derived Concentration Guides for water (DOE Order 5400.5). Number used is 4 percent of Derived Concentration Guides.

Note: NA - not applicable.

Source: PX MH 1991c.

TABLE 4.5.2.4–3.—*Groundwater Quality Monitoring for the Perched Zone Wells at Pantex Plant, 1990*

Contaminant	Unit of Measure	Water Quality Criteria and Standards[a]	Well No. WR-44	Well No. WR-45	Well No. WR-20
Alpha (gross)	pCi/l	15 [b]	0-1	0-1	0-5
Barium	mg/l	2 [b]	0.12-0.17	0.19-0.23	0.13-0.18
Beta (gross)	pCi/l	50 [c]	0-1	0-2	0-2
Chromium	mg/l	0.1[b]	<0.005-0.005	<0.005-0.014	0.062-0.120
Copper	mg/l	1.3[d]	<0.005-0.003	<0.005-0.005	<0.005-0.003
1,2 Dichloroethane	mg/l	0.005[b]	<0.005	<0.005	<0.005-0.010
HMX	mg/l	NA	<0.020	<0.020	<0.020-0.083
Iron	mg/l	0.3[d]	0.01-0.09	<0.04-0.21	<0.005-5.00
Lead	mg/l	0.015[b]	<0.005	<0.005	<0.005
Nitrate	mg/l	10 [b]	0.83-2.10	0.93-1.30	1.80-2.70
pH	pH units	6.5-8.5[e]	7.8	7.6	7.8
RDX	mg/l	NA	<0.020	<0.020	0.73-2.40
Sulfate	mg/l	250 [d]	6-15	13-25	16-27
Total dissolved solids	mg/l	500 [d]	190-230	380-430	270-340
Total organic carbons	mg/l	NA	<0.005	1-5.0	<1.0-5.6
Total organic halogens	mg/l	NA	<3,000-21,000	5,000-36,000	19,000-40,000
Trichloroethylene	mg/l	0.005[b]	<0.005	<0.005	<0.005
Tritium	pCi/l	20,000 [b]	60-220	20-200	0-160
Uranium-233, -234, -235, -238	pCi/l	20 [f]	0.8-1.6	2-2.6	0.8-4.9
Zinc	mg/l	5 [d]	0.013-0.970	0.006-1.30	<0.005-0.040

[a] For comparison only.
[b] National Primary Drinking Water Regulations (40 CFR 141).
[c] Proposed National Primary Drinking Water Regulations; Radionuclides (56 FR 33050).
[d] National Secondary Drinking Water Regulations (40 CFR 143).
[e] State of Texas water quality criteria.
[f] DOE Derived Concentration Guides for water (DOE Order 5400.5). Number used is 4 percent of Derived Concentration Guides.
Note: NA - not applicable.
Source: PX MH 1991c.

field located immediately north of the plant. The estimated sustainable groundwater producing capacity of the Ogallala is approximately 0.53 BGY. Pantex Lake, located adjacent to the Amarillo water-well field, is available for drilling additional water wells if needed for future operations.

The Ogallala Formation is also a source for municipal and industrial water to nearby towns and cities and irrigation water to nearby farms. In the Pantex area, the cities of Amarillo and Canyon maintain community water systems. The city of Amarillo draws its raw water from groundwater and Lake Meredith and has the capacity to supply 75 MGD. The city of Canyon maintains the capacity to supply approximately 7 MGD from its own wells and may purchase up to 5 MGD from the city of Amarillo.

Groundwater is controlled by the individual landowner in Texas. The Texas Department of Health and the Texas Water Development Board are the two state agencies with major involvement in groundwater fact finding, data gathering, and analysis. Groundwater management is the responsibility of local jurisdictions through Groundwater Management Districts. The Pantex facility is located in Panhandle Groundwater District 3, which has the authority to require permits and limit the quantity of water pumped. Presently, the Panhandle Groundwater District does not limit the quantity of water pumped.

4.5.2.5 *Geology and Soils*

Geology. Pantex is located on the southern High Plains of the Texas panhandle. The topography at Pantex consists of flat to gently rolling plains; there are no unique landforms. The only distinctive features are playas that are spaced more or less uniformly over the site. The playas are about 1,500 to 2,000 feet across with clay bottoms and depths to 30 feet.

The site itself is underlain by the Blackwater Draw Formation. At Pantex this geologic formation consists of a sequence of buried soils with an upper unit of mostly silt, clay, and caliche and a 20-foot lower unit of silty sand with caliche. The Ogallala Formation underlies the Blackwater Draw Formation.

No capable faults within the definition of 10 CFR 100, Appendix A, are present in the vicinity of Pantex. The plant is located at the edge of a large Permian fault block, but there is no indication of faulting in the immediate area in the last 250 million years.

Pantex lies on the boundary between Seismic Zones 0 and 1 (figure 4.2.2.5–2). Since 1906, only nine earthquakes of Richter magnitude 3.0 or greater have been recorded in the more seismically active Amarillo Highlands 20 miles northeast of Pantex. Seismicity in the Palo Duro Basin and at Pantex is low. There is no volcanic hazard at Pantex.

Soils. Pantex is underlain by soils of the Pullman-Randall association. These soils are typically deep, very low permeability clays and clay loams. Pullman soils underlie most of the plant area, but Randall soils occur in the vicinity of the playas and depressions. Water and wind erosion and shrink-swell potential is moderate-to-severe for most of the soil units (PX USDA 1962a; PX USDA 1980a). However, the soils are acceptable for standard construction techniques.

4.5.2.6 *Biotic Resources*

The following description of biotic resources at Pantex includes terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. Scientific names of species identified in the text are presented in appendix C. Also presented in appendix C is a list of threatened and endangered species that may occur on the site or in the vicinity of Pantex.

Terrestrial Resources. Pantex is located within a treeless portion of the High Plains that is classified as mixed prairie. The High Plains vegetational area is a southern extension of the short- and mid-grass prairies of the Western Great Plains. The primary vegetation of the High Plains includes short-grasses (i.e., buffalo-grass and blue grama) and mid-grasses (i.e., little bluestem, sideoats grama, and western wheatgrass) (PX DOE 1991a:2). Twenty-three percent of the site, including land leased from Texas Tech University, has been developed. Much of the remainder of the site has been disturbed by past agricultural practices, and is currently being managed as native and improved pasture or cultivated by the University or its tenant farmers (PX DOE 1983a:3-20,3-23). Small areas of undisturbed vegetation, primarily grasses and herbs, exist around playas. Plant communities on the site have not been mapped. A total of 229 plant species have been identified on the site (PX DOE 1993c:2).

Terrestrial wildlife species occurring on Pantex include 7 amphibians, 8 reptiles, 43 birds, and 19 mammals (PX DOE 1994c:2-5; PX DOE 1994d:7-11). Common bird species known to occur in the vicinity of Pantex include the western meadowlark, mourning dove, horned lark, and several species of sparrows. Common species of mammals found in the vicinity of Pantex include the black-tailed jackrabbit, black-tailed prairie dog, and hispid cotton rat PX DOE 1991a). Among the game animals occurring onsite are cottontails, scaled and bobwhite quail, mourning dove, and numerous waterfowl species. Hunting is not permitted at Pantex. Common raptors on Pantex include the red-tailed hawk, American kestrel, and burrowing owl (PX DOE 1994b). Carnivores present include the badger and coyote. A variety of migratory birds has been found at Pantex. Migratory birds, their nests and eggs, are protected by the *Migratory Bird Treaty Act.* Eagles are similarly protected by the *Bald and Golden Eagle Protection Act.*

Wetlands. Wetlands at Pantex are associated with the five playa basins occurring on the site (figure 4.5.1–1), and Pantex Lake (also a playa), located approximately 3 miles northeast of the site. The National Wetland Inventory map identifies playas 1 through 5 and part of Pantex Lake as wetlands (PX DOI nda). Playas 1, 2, and 3 are classified by the USFWS as palustrine (nontidal wetlands dominated by trees, shrubs, and emergent vegetation) systems.

The larger playas, 4 and 5, and Pantex Lake are classified as lacustrine (lakes, ponds, and other enclosed open waters at least 20 acres in extent and not dominated by trees, shrubs, or emergent vegetation) systems. Playas 1, 2, and 4 currently receive wastewater discharge (section 4.5.3.4). There are numerous smaller wetlands (approximately 10 acres or less) located on western and southwestern parts of Pantex in areas that are largely grazed or farmed (PX DOI nda). These wetlands are classified as palustrine systems. Two of these wetlands are located near the southern-most proposed TSS. Situated along the Central Flyway Migratory Route, the Pantex playas are important to migratory birds and provide valuable habitat for nesting and wintering birds and waterfowl.

Aquatic Resources. Aquatic habitat is limited to four ephemeral playas, one permanent playa, and several ditches (figure 4.5.1–1). Although the playas and ditches may provide habitat for amphibians and macroinvertebrates, they do not support any fish populations. Pantex Lake, located 3 miles northeast of the site, also does not contain any fish.

Threatened and Endangered Species. Eighteen Federal- or state-listed threatened, endangered, and special status species have been identified on the site and in the vicinity of Pantex (appendix table C–5). Table 4.5.2.6–1 lists the species (including two subspecies of peregrine falcon) that may occur on the site or near the proposed TSS. Field surveillance would be required to determine their presence. No critical habitat for threatened and endangered species, as defined in the *Endangered Species Act* (50 CFR 17.11; 50 CFR 17.12), exists on Pantex.

The bald eagle is a winter resident that has been observed foraging at playas on the site each year. The whooping crane, an infrequent migrant in the Texas panhandle, was observed foraging onsite and in the surrounding area in the fall of 1990. Migratory peregrine falcons (undetermined subspecies) have been observed hunting shorebirds and waterfowl near area playas.

Federal candidate species observed on Pantex include the swift fox, black tern, ferruginous hawk, loggerhead shrike, white-faced ibis, and Texas horned lizard. Possible swift fox dens have been found on Pantex. The Texas horned lizard is known to reside on the site and the loggerhead shrike is a common permanent resident which probably nests onsite. The ferruginous hawk forages in shortgrass

TABLE 4.5.2.6–1.—*Federal- and State-Listed Threatened, Endangered, and Other Special Status Species That May be Found On the Site or In the Vicinity of Proposed Tritium Supply Site on Pantex Plant*

Species	Status[a]		Potential Habitat/Location
	Federal	State	
Mammals			
Swift fox[b]	C2	NL	Open plains
Birds			
American peregrine falcon[c]	E	E	Forages at playas, migrant
Arctic peregrine falcon	T	T	Forages at playas, migrant
Bald eagle[b,c]	T	E	Playa, winter resident
Black tern[b]	C2	NL	Forages at playas, migrant
Ferruginous hawk[b]	C2	NL	Forages in shortgrass prairie
Loggerhead shrike[b]	C2	NL	Semi-open areas with lookout perch
White-faced ibis[b]	C2	T	Forages at playas
Whooping crane[b,c]	E	E	Forages at playas, rare migrant
Reptiles			
Texas horned lizard[b]	C2	ST	Arid open country

[a] Status code: C2 - candidate Category 2 (possibly appropriate for protection); E - endangered; NL - not listed; ST - state, threatened (animals); T - threatened.

[b] Species observed on the Pantex Plant.

[c] USFWS Recovery Plan exists

Source: 50 CFR 17:11; 50 CFR 17:12; PX 1992a:2; PX 1994a:1; PX DOE 1994b; PX MH 1994c; PX PWD 1991b; PX PWD 1993a; PX PWD 1993b; PX WTS 1992a.

prairie, and the black tern and white-faced ibis forage at the playas.

There is little undisturbed habitat at Pantex that would accommodate any of the threatened, endangered, and other special status species listed in table 4.5.2.6–1. Most of these species are attracted to the playas, which provide water and foraging habitat. According to a recent floristic survey (PX DOE 1993c), there are no Federal- or state-listed plant species known to occur on Pantex. However, there are three cactus species at Pantex that may be proposed for a watchlist of potentially threatened plant species.

4.5.2.7 *Cultural and Paleontological Resources*

Prehistoric Resources. Prehistoric site types identified at Pantex include small temporary campsites and limited activity locations characterized by surface scatters of artifacts. Archaeological surveys at Pantex have systematically covered approximately one-third of the facility. Fifty-five prehistoric sites have been recorded, some of which contain heat-altered rock that suggests food processing. These prehistoric campsites tend to be clustered near the Pantex playas. Twenty-three sites have been tested, and one has been determined potentially eligible for the NRHP. Prehistoric sites are not specifically known in the proposed project locations, though some possibility of their presence exists.

Historic Resources. The Pantex facility was originally constructed in 1942, as a World War II bomb-loading plant on land claimed from local farmers. Remains of eight of these farmsteads have been recorded as historic archaeological sites, none of which have been evaluated for NRHP eligibility. One of these is located within proposed Industrial Site C (figure 4.5.2.1–3). Additional sites are possible in the project areas, but are not likely.

The entire Pantex site has been surveyed for World War II-era structures and foundations, and all such properties have been systematically recorded. The Texas SHPO has listed 45 of these structures as potentially eligible for NRHP listing. No World War II-era properties are in the proposed industrial sites for this project.

The Cold War/Nuclear Technology historic context has not yet been defined for Pantex. When this occurs, it is probable that a number of plant structures will be determined NRHP-eligible.

Native American Resources. Historic Native American groups known to have occupied or used the Pantex region included Apache, Arapaho, Cheyenne, Comanche, Kiowa and Kiowa-Comanche. Native American resources associated with these groups have not yet been identified at Pantex, but the remains of temporary campsites, hunting locations, ceremonial locations, or isolated burials are possible. In addition, the Caddo, Delaware and Wichita have expressed an interest in Native American resources at Pantex.

Paleontological Resources. The surficial geology of the Pantex area consists of silts, clays, and sands of the Blackwater Draw Formation. In other areas of the High Plains this formation contains Late Pleistocene vertebrate remains, including bison, camel, horse, mammoth, and mastodon, with occasional and significant evidence of their use by early humans. Evidence of woolly mammoth has recently been found north of Pantex (PX 1992a:7), and a recent archaeological testing program at the Pantex Plant recovered possible bison bones eroding from one small incised drainage near a playa. These remains have not yet been positively identified as paleontological or cultural materials.

4.5.2.8 *Socioeconomics*

Socioeconomic characteristics presented for Pantex include employment and local economy, population, housing, public finance, and local transportation. Statistics for economy characteristics are presented for the regional economic area that encompasses 15 counties around Pantex (appendix table D.2.1–2). The regional economic area is a broad labor and product market-based region linked by trade among economic sectors within the region. Statistics for population and housing, public finance, and local transportation are based on the ROI, a 3-county area in which 90 percent of all Pantex employees reside: Carson County (5 percent) and Potter and Randall Counties (85 percent). (See figure 4.5–1 for a map of counties and cities). Fiscal characteristics of the jurisdictions in the ROI are presented in the public finance section in appendix tables D.3–62 and

D.3–63. The independent school districts most likely to be affected by the proposed action include Groom, Panhandle, White Deer, Amarillo, and Canyon. Assumptions, assessment methodologies, and supporting data are presented in appendix D.

Regional Economy Characteristics. Employment and local economy statistics for the Pantex regional economic area are presented in appendix table D.3–53, and summarized in figure 4.5.2.8–1. Between 1970 and 1990, the civilian labor force in the regional economic area increased approximately 43 percent. In 1990, the unemployment rate in the regional economic area was lower than the State of Texas rate. The 1990 per capita income in the regional economic area was approximately 6 percent higher than the state's per capita income.

As shown in figure 4.5.2.8–1, the percentage of total employment involving farming and governmental activities in the regional economic area was approximately the same as the percentage for the state. Nonfarm private sector activities of manufacturing, retail trade, and services in the regional economic area were greater than the state. In 1990, Pantex employed 2,394 persons (1.6 percent of the total regional economic area employment), increasing from 1,630 persons in 1970. Historical and future employment at Pantex and the distribution of Pantex employees by place of residence in the ROI are presented in appendix tables D.2.1–1 and D.3–52, respectively.

Population and Housing. Population and housing distribution in the ROI is presented in appendix tables D.3–56 and D.3–59, and summarized in figure 4.5.2.8–2. The percent increase in population in the ROI from 1970 to 1990 was approximately half the state percent increase except for Randall County, which experienced a 66-percent increase. The percentage increase in housing units in the ROI between 1970 and 1990 was approximately 28 percent lower than the state increase except for Randall County, which experienced a 118-percent increase. Homeowner and rental vacancy rates in the ROI in 1990 were similar to those experienced by the state.

Public Finance. Financial characteristics of the local jurisdictions in the ROI that are most likely to be affected by the proposed action include total revenues and expenditures of each jurisdiction's general fund, special revenue funds, and, as applicable, debt service, capital project, and expendable trust funds. School district boundaries may or may not coincide with county or city boundaries, but the districts are presented under the county where they primarily provide services. Major revenue and expenditure fund categories for counties, cities, and school districts are presented in appendix tables D.3–62 and D.3–63, and figure 4.5.2.8–3 summarizes local government's revenues less its expenditures.

Local Transportation. Vehicular access to Pantex is provided by Farm-to-Market Roads 683 to the west and 2373 to the east. Both roads connect with Farm-to-Market Road 293 to the north and U.S. Highway 60 to the south (figure 4.5–1). Road segments providing access to Pantex experience varying levels of service. Traffic on State Route 60 generally experiences slightly more congestion than other access routes. Potential disruptions to the traffic flow caused by accidents or maintenance activities are usually minor. No major improvements are scheduled for roadway segments providing immediate access to Pantex (figure 4.5.1–1).

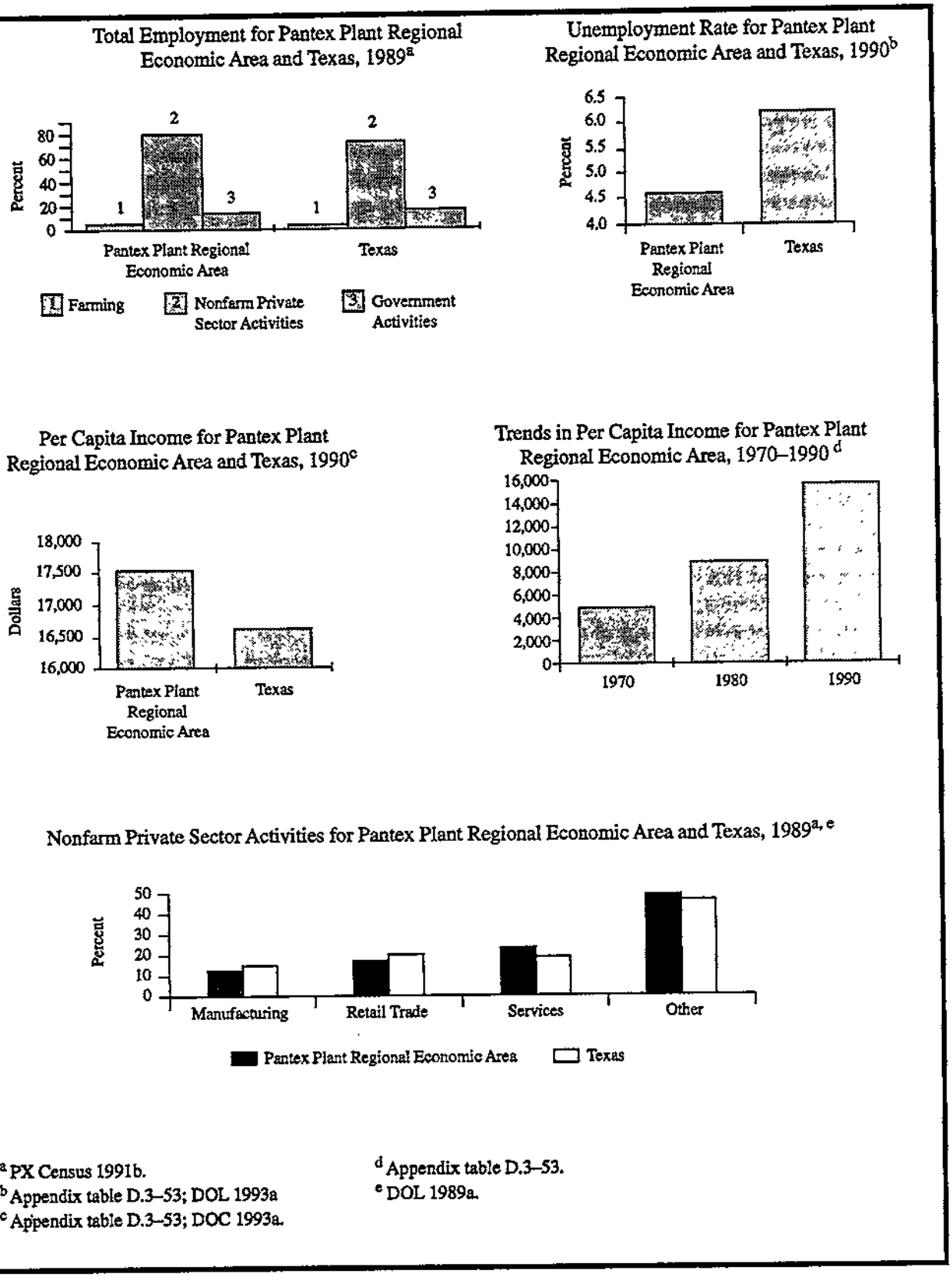
Amarillo receives public transport service from Amarillo City Transit; however, no service is provided to Pantex. Major railroads in the ROI include the Burlington-Northern Railroad and the Atchison, Topeka and Santa Fe Railroad. The mainline of the Atchison, Topeka, and Santa Fe Railroad parallels the southern boundary of Pantex and provides direct access to the site. There are no navigable waterways within the ROI capable of accommodating material transports to the plant.

Amarillo International Airport receives jet air passenger and cargo service from national and local carriers. Several smaller private airports are located throughout the ROI (DOT 1991a).

4.5.2.9 *Radiation and Hazardous Chemical Environment*

The following provides a description of the radiation and hazardous chemical environment at Pantex. Also included are discussions of health effects studies, emergency preparedness considerations, and an accident history.

Radiation Environment. Major sources of background radiation exposure to individuals in the vicinity of Pantex are shown in table 4.5.2.9–1. All



[a] PX Census 1991b.
[b] Appendix table D.3–53; DOL 1993a
[c] Appendix table D.3–53; DOC 1993a.
[d] Appendix table D.3–53.
[e] DOL 1989a.

FIGURE 4.5.2.8–1.—*Economy for Pantex Plant Regional Economic Area.*

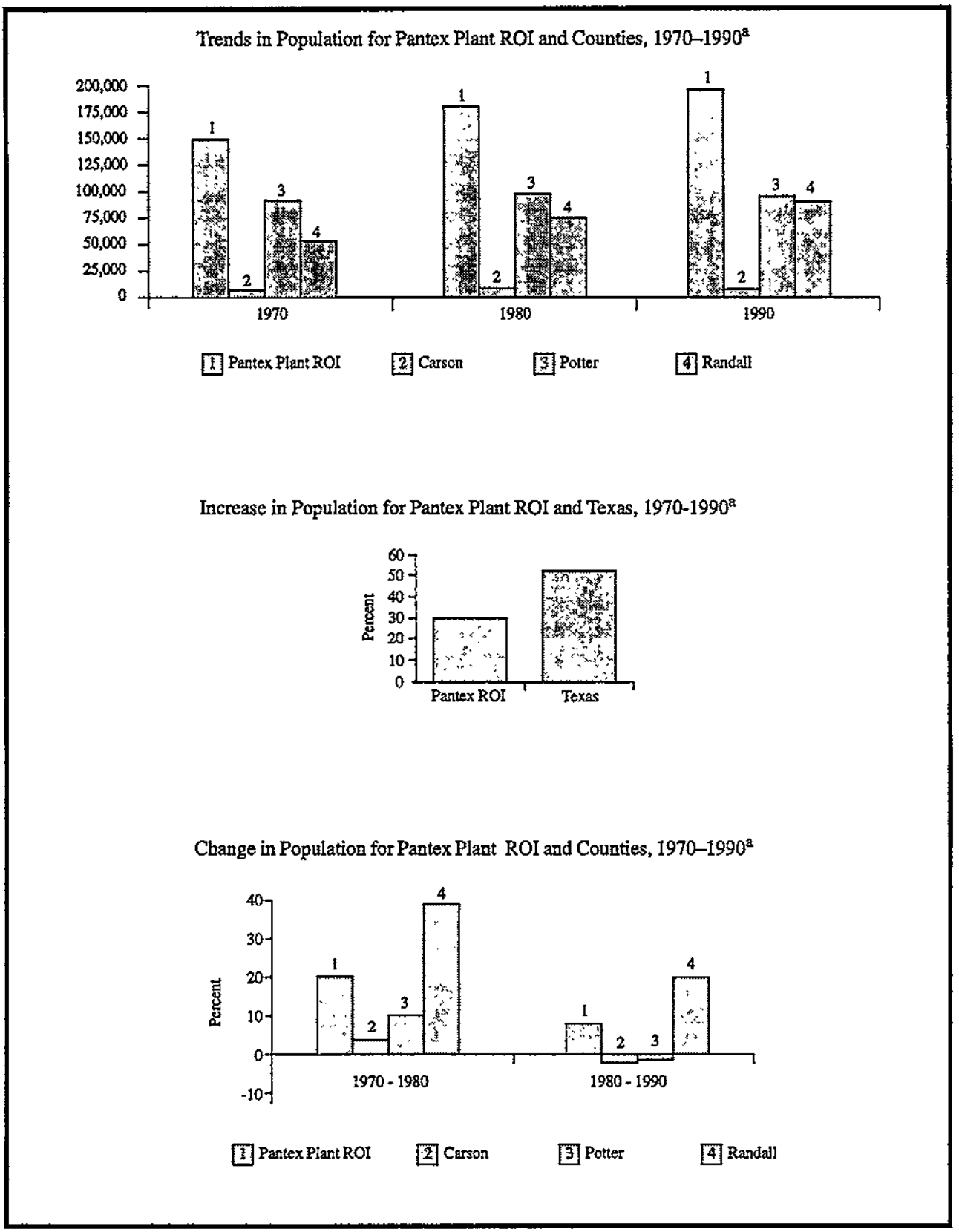
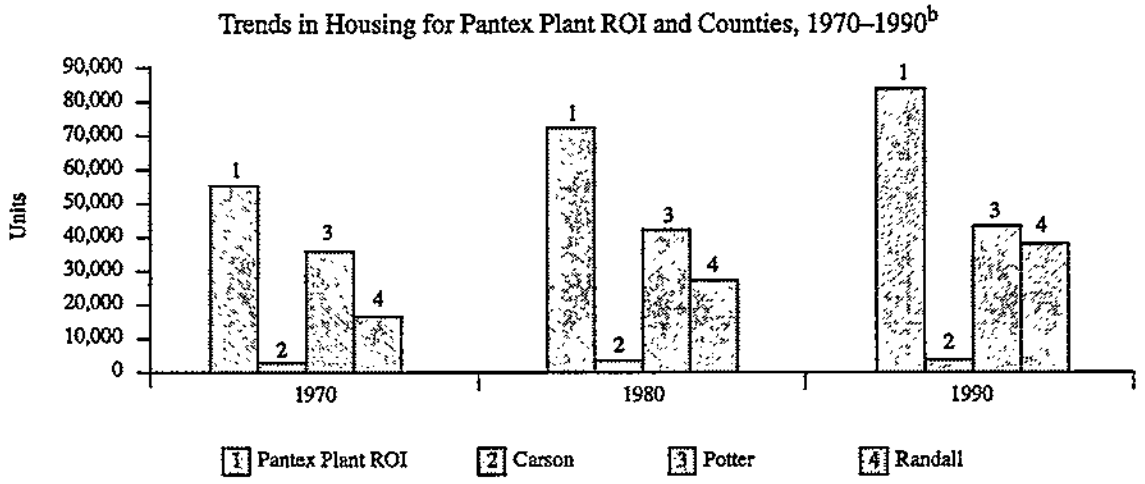
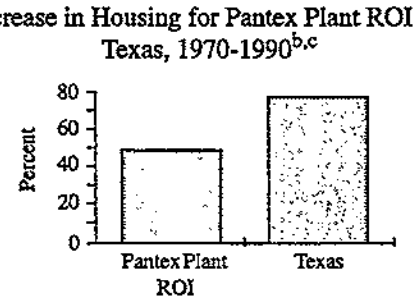
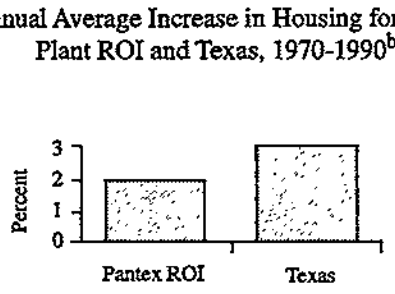
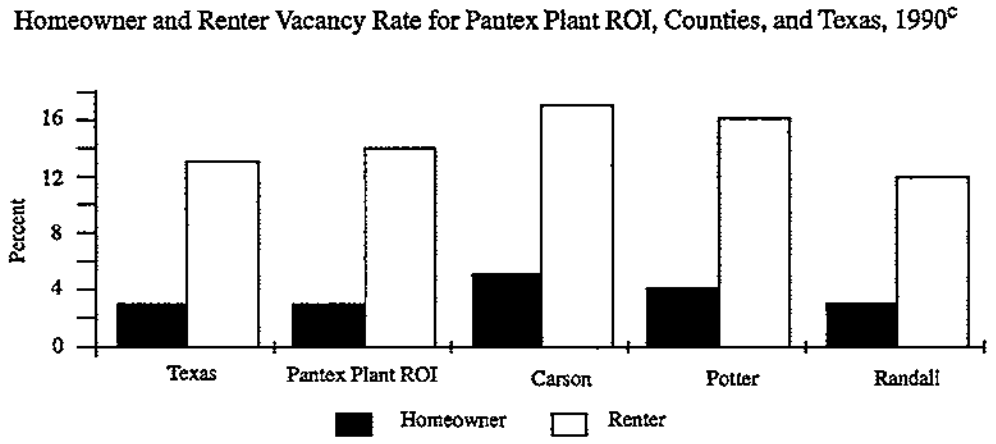


FIGURE 4.5.2.8–2.—*Population and Housing for Pantex Plant Region of Influence* [Page 1 of 2].



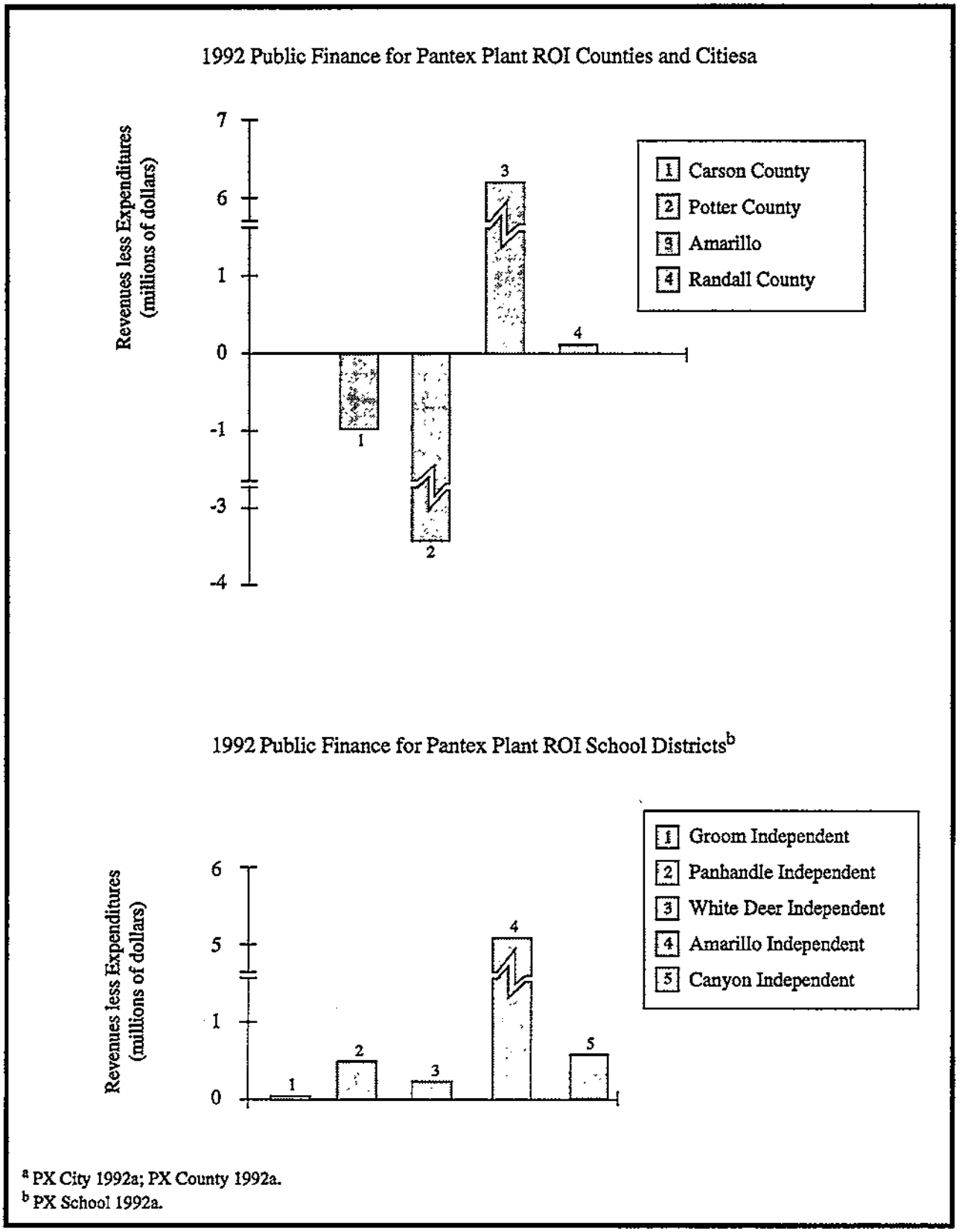






[a] Appendix table D.3–56.
[b] Appendix table D.3–59.
[c] Census 1972a; Census 1982a; PX Census 1991a.

FIGURE 4.5.2.8–2.—*Population and Housing for Pantex Plant Region of Influence* [Page 2 of 2].



[a] PX City 1992a; PX County 1992a.
[b] PX School 1992a.

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FIGURE 4.5.2.8–3.—***1992 Local Government Public Finance for Pantex Plant Region of Influence.***

TABLE 4.5.2.9–1.—*Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Pantex Plant Operations*

Source	Committed Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic and external terrestrial radiation	107
Internal terrestrial radiation	39
Radon in homes (inhaled)	200
Other Background Radiation[b]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	411

[a] NCRP 1987a; PX Battelle 1993a. Value for radon is an average for the United States.
[b] NCRP 1987a.

annual doses to individuals from background radiation are expected to remain constant over time. Accordingly, the incremental total dose to the population would result only from changes in the size of the population. Background radiation doses are unrelated to Pantex operations.

Releases of radionuclides into the environment from Pantex operations provide another source of radiation exposure to people in the vicinity of Pantex. The radionuclides and quantities released from Pantex operations in 1992 are listed in the *Pantex Plant Site Environmental Report for Calendar Year 1992* (RPT7). The doses to the public resulting from these releases are given in table 4.5.2.9–3. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1992 report were used in the development of the reference environment (No Action) radiological releases at Pantex in 2010 (section 4.5.3.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (appendix section E.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from Pantex operations in 1992 is estimated to be approximately 1.4×10^{-11}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of Pantex operations is less than 14 chances in 1 trillion. (Note that it takes several to many years from the time of exposure to radiation for a cancer to manifest itself.)

Approximately 2.5×10^{-8} excess fatal cancers were estimated from normal operations in 1992 to the population living within 50 miles of Pantex. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this mortality rate, the number of fatal cancers from all causes expected to occur during 1992 in the population living within 50 miles of Pantex was 550. This number of expected fatal cancers is much higher than the estimated 2.5×10^{-8} fatal cancers that could result from Pantex operations in 1992.

Workers at Pantex receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 4.5.2.9–3 includes the average, maximum, and total occupational doses to Pantex workers from operations in 1992. These doses fall within radiological limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (appendix section E.2), the number of excess fatal cancers to Pantex workers from operations in 1992 is estimated to be 0.0.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Pantex Plant Site Environmental Report for Calendar Year 1992* (RPT7). In addition, the concentrations of radioactivity in various environmental media (e.g., air, water, and soil) in the site region (onsite and offsite) are presented in the same reference. Pantex operations contribute only small amounts of radioactivity to all these media. Past discharges to Playa 1 (see figure 4.5.1–1) were substantial, but mainly nonradiological. However, this playa is located onsite and is not used as a drinking water source. Appropriate monitoring is conducted to ensure that contamination of any kind

TABLE 4.5.2.9–2.—*Doses to the General Public from Normal Operation at Pantex Plant, 1992 (committed effective dose equivalent)*

	Atmospheric Releases		Liquid Releases		Total	
Affected Environment	Standard[a]	Actual[b]	Standard[a]	Actual[b]	Standard[a]	Actual
Maximally exposed individual (mrem)	10	$2.7x10^{-5}$	4	0.0	100	$2.7x10^{-5}$
Population within 50 miles[c] (person-rem)	None	$5.0x10^{-5}$	None	0.0	100	$5.0x10^{-5}$
Average individual within 50 miles[d] (mrem)	None	$1.8x10^{-7}$	None	0.0	None	$1.8x10^{-7}$

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem per year limit from airborne emissions is required by the *Clean Air Act*, the 4 mrem per year limit is required by the *Safe Drinking Water Act*, and the total dose of 100 mrem per year is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 58 FR 16268 (10 CFR 834). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] PX Battelle 1993a.

[c] In 1992, this population was approximately 275,000.

[d] Obtained by dividing the population dose by the number of people living within 50 miles of the site.

TABLE 4.5.2.9–3.—*Doses to the Worker Onsite from Normal Operation at Pantex Plant, 1992 (committed effective dose equivalent)*

	Onsite Releases and Direct Radiation	
Affected Environment	Standard[a]	Actual[b]
Average worker (mrem)	None	21.1
Maximally exposed worker (mrem)	5,000	1,000
Total workers (person-rem)	None	51

[a] 10 CFR 835. DOE's goal is to maintain radiological exposure as low as reasonably achievable.

[b] DOE 1993n:7. The number of badged workers in 1992 was approximately 2,410.

from this playa will not reach drinking water supplies.

Chemical Environment. The background chemical environment important to human health consists of: the atmosphere, which may contain toxic chemicals that can be inhaled; drinking water, which may contain toxic chemicals that can be ingested; and other environmental media with which people may come in contact; e.g., surface waters during swimming, soil through direct contact, or via the food pathway. The baseline data for assessing potential health impacts from the chemical environment are those presented in sections 4.5.2.3 and 4.5.2.4.

Health impacts to the public can be minimized through effective administrative and design controls for decreasing pollutant releases to the environment and achieving compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at Pantex via inhalation of air containing pollutants released to the atmosphere by Pantex operations. Risks to public health from other possible pathways such as ingestion of contaminated drinking water or by direct exposure are low relative to the inhalation pathway.

Baseline air emission concentrations for hazardous/toxic air pollutants and their applicable standards are presented in section 4.5.2.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. All annual concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous/toxic chemicals is presented in appendix section E.3.

Health impacts to Pantex workers during normal operation may include those from inhalation of the workplace atmosphere, drinking Pantex potable water, and possible other contact with hazardous materials associated with particular work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and man-

agement controls. Pantex workers are also protected by adherence to occupational standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Monitoring ensures that these standards are not exceeded. Additionally, DOE requirements (DOE Order 3790.1B) ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at Pantex are expected to be substantially better than required by the standards.

Health Effects Studies. One mortality and one cancer incidence epidemiologic study on the general population in communities surrounding Pantex have been performed and one study on workers has been done. No significant excess cancer mortality was found and the analysis on excess cancer incidence had too few cases to be considered reliable. Workers were reported to show a non-statistically significant excess of brain cancer and leukemia in the one study conducted, but the small number of cases could be attributed to chance alone. For a more detailed description of the studies reviewed and the findings, refer to appendix section E.4.5.

Accident History. There have been no plutonium-dispersing detonation accidents during nuclear weapons operations at Pantex. In 1989, during a weapon disassembly and retirement operation, a release of deuterium-tritium in the assembly cell occurred. As a result, four workers received negligible doses and a fifth worker received a dose of approximately 1.4 mrem. This was the first accidental release of radioactivity to occur at Pantex in 25 years.

Emergency Preparedness. In order to handle accidents, each DOE site has established an emergency management program. This program has been developed and maintained to ensure adequate response to accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with planning, preparedness, and response. Section 4.1.9 provides a description of DOE's emergency preparedness program.

Pantex has an Emergency Management Plan with guidance on implementation provided by a series of Emergency Preparedness Procedures manuals to protect life and property within the facility, the health and welfare of surrounding areas, and the defense interests of the Nation during any credible emergency situation. Formal mutual assistance agreements have been made with the Amarillo Fire Department, the National Guard, and St. Anthony's Hospital. Under accident conditions, an emergency coordinating team of DOE and Pantex contractor management personnel would initiate the Pantex Emergency Plan and coordinate all onsite actions.

If offsite areas could be affected, the Texas Department of Public Safety would be notified immediately, and would make emergency announcements to the public and local governmental agencies in accordance with Annex R of the State of Texas Emergency Management Plan. Pantex has radiological assistance teams with a total of 46 personnel who are equipped and trained to respond to an accident involving radioactive contamination either onsite or offsite.

In addition, the Joint Nuclear Accident Coordination Center in Albuquerque, NM, can be called upon should the need arise. This would mobilize radiation emergency response teams from DOE, DOD, and other participating Federal agencies (PX DOE 1983a).

4.5.2.10 *Waste Management*

This section outlines the major environmental regulatory structure and ongoing waste management activities for Pantex. A more detailed discussion of the ongoing waste management operations is provided in appendix section H.2.4. Table 4.5.2.10–1 presents a summary of waste management activities at Pantex for 1992.

The Department is working with Federal and state regulatory authorities to address compliance and cleanup obligations arising from its past operations at Pantex. The Department is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for achieving compliance with applicable requirements, and financial penalties for nonachievement of agreed upon milestones.

TABLE 4.5.2.10–1.—*Waste Management at Pantex Plant*

Category	1992 Generation (yd^3)	Treatment Method	Treatment Capacity (yd^3/yr)	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity (yd^3)
Low-level							
Liquid	14 (3,300 gal)	Solidification	14 (3,300 GPY)	Staged for processing	113 (23,000 gal)	NA	NA
Solid	220	Compaction	220	Staged for shipment	Included in liquid low-level	Shipped offsite to NTS	NA
Mixed Low-Level							
Liquid	18 (3,600 gal)	None-onsite encapsulation pending	Planned	Staged for processing	95 (19,000 gal)	NA	NA
Solid	48	Compaction and incineration	1.6	Staged for shipment	Included in liquid mixed LLW	Shipped offsite	NA
Hazardous[a]							
Liquid	180 (36,100 gal)	Incineration[b]	Variable	Staged for shipment	308[c] (62,000 gal)	Shipped offsite	NA
Solid	720	Incineration[b]	Variable	Staged for shipment	Included in liquid hazardous waste	Shipped offsite	NA
Nonhazardous (Sanitary)							
Liquid	542,000[d] (109,300,000 gal)	Evaporation and filtration	1,030,000 (207,000,000 GPY)	None	NA	Lagoon and NPDES outfall (stormwater)	1,200,000 yd^3/yr (237,000,000 GPY)
Solid	500[e]	Compaction and incineration	270,000	None	NA	Landfill (offsite)	NA
Nonhazardous (Other)							
Liquid	54,400[f] (11,000,000 gal)	Carbon absorption/ filtration	Included in liquid sanitary waste	None	NA	Lagoon and NPDES outfall	Included in liquid sanitary
Solid	8,500[g]	Compaction and incineration	Included in solid sanitary waste	None	NA	Landfill (onsite) – construction debris only	Expandable

[a] Includes PCB and asbestos-contaminated wastes and some industrial wastewater.
[b] HE-contaminated wastes only.
[c] 135 yd^3 RCRA-permitted storage and 173 yd^3 for non-RCRA regulated storage.
[d] Sewage wastewater.
[e] May not include sewage sludge.
[f] Based on ratio of industrial wastewater to construction debris in 1991.
[g] Construction debris.
Note: NA - not applicable.
Source: DOE 1993a; PX 1993a:1; PX Battelle 1992a; PX DOE 1994a; PX MH 1991c.

EPA Region 6 on July, 29, 1991, proposed Pantex for listing on the NPL of Superfund cleanup sites. Independent evaluations questioned this proposed listing and DOE dissented on the proposal. In September 1991, DOE submitted to EPA its technical comments regarding the proposed listing. EPA placed Pantex on the NPL on May 31, 1994.

Pantex's waste management goals are to minimize the volumes of wastes it generates to the extent that is technologically and economically practicable, recycle those wastes applicable to the best available technology, minimize contamination of existing or proposed real property and facilities, minimize exposure and associated risk to human health and the environment to as low as reasonably achievable, and ensure safe and efficient long-term management of all wastes. Pantex manages the following waste categories: low-level, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

Spent Nuclear Fuel. Pantex does not generate or manage spent nuclear fuel.

High-Level Waste. Pantex does not generate or manage HLW.

Transuranic Waste. Pantex does not generate or manage TRU waste as a result of normal operations. In the unlikely event that any TRU waste is generated, there are established provisions to manage this waste.

Low-Level Waste. LLW generated at Pantex consists of contaminated parts from weapons assembly and disassembly functions and radioactive waste materials associated with these functions, such as protective clothing, cleaning materials, filters, and other similar materials. As shown in table 4.5.2.10–1, Pantex generates a small quantity of liquid LLW. Liquid LLW is being stored onsite awaiting a planned solidification process. Compactible components are processed at Pantex's Solid Waste Compaction Facility and stored along with the noncompactible components for shipment to a DOE-approved disposal site and/or a commercial vendor. Pantex's LLW is presently shipped to NTS for disposal.

Mixed Low-Level Waste. Mixed LLW is generated during various component testing functions. These wastes consist primarily of small quantities of materials such as radioactively-contaminated solvents and wipes contaminated by organic solvents. Mixed LLW is currently stored onsite in RCRA-permitted facilities (PX Battelle 1992a:2-4). Pantex has received exemptions to DOE Order 5280.2A for mixed waste shipments to two RCRA-permitted commercial facilities. Pantex is currently developing its Site Treatment Plan with the State of Texas and the EPA in order to provide mixed waste treatment capability for all mixed waste streams and to comply with the *Federal Facility Compliance Act* of 1992 and RCRA treatment, storage, and disposal requirements.

Hazardous Waste. Pantex received a RCRA Part B hazardous waste permit from the EPA and the Texas Natural Resources Conservation Commission on April 25, 1991. This permit authorizes Pantex to manage hazardous and industrial solid wastes listed in the permit. The permit also requires Pantex to notify the Texas Natural Resources Conservation Commission of the discovery of any release of hazardous waste or hazardous constituents that may have occurred from any solid waste management unit. The hazardous waste permit specifically excluded the 17 RCRA units at the high explosives burning ground that are currently operated under interim status with a written grant of authority from the Texas Natural Resources Conservation Commission. Pantex has submitted a request to the Texas Natural Resources Conservation Commission for a RCRA Part B permit modification to add these units at the Burning Ground. A decision on this modification has not been reached.

Most of the hazardous waste generated by Pantex results from HE operations; however, electroplating, photographic, and various other operations also generate additional hazardous waste streams. Liquid hazardous wastes, generally HE-contaminated wastewater, are filtered and settled to remove the majority of the HE and then treated at Pantex's wastewater treatment plant. This procedure is in compliance with the RCRA Administrative Order on Consent issued by EPA on September 7, 1989. The resulting solid HE-contaminated residue, along with other HE-contaminated solid hazardous waste (such as filters, cleaning materials, and protective clothing), HE scrap, and retired HE components are burned at Pantex's Burning Ground. Ash, debris, and residue resulting from this burning is transported offsite for approved disposal at a commercial RCRA-

permitted facility (PX MH 1990b:2). All other hazardous wastes generated at Pantex, including various chemicals, solvents, heavy metals, and other hazardous constituents, are manifested and shipped offsite by DOT-certified transporters for recycle or disposal at a commercial RCRA-permitted facility.

Nonhazardous Waste. Nonhazardous solid and liquid sanitary wastes are generated at Pantex. Sewage and some pretreated industrial wastewater is treated at the wastewater treatment plant. Liquid effluent from the plant flows into a lagoon, which then either evaporates or infiltrates into the ground. Liquid industrial waste is also treated in a tank system that removes metals from plating solutions and then neutralizes this solution. The effluent from this process is discharged to a playa, which is permitted by the Texas Natural Resources Conservation Commission. Stormwater discharges are regulated by a National Pollutant Discharge Elimination system permit (PX Battelle 1992a:1-4,5-1). When the wastewater treatment plant is upgraded, all industrial waste and sewage will be treated at that one location.

Nonhazardous solid waste generated onsite consists primarily of paper, cardboard, construction wastes, and cafeteria waste. Only construction wastes are disposed of onsite. Prior to late 1989, sanitary waste was disposed of at the onsite sanitary landfill. Since then, sanitary waste has been transported to the city of Amarillo landfill for disposal. Waste asbestos is sent to an offsite permitted landfill (PX MH 1991c:20).

4.5.3 Environmental Impacts

This section describes the environmental impacts of constructing and operating various tritium supply technologies and recycling facilities at Pantex which are described in sections 3.4.2 and 3.4.3. It begins by describing potential impacts to existing and planned facilities at Pantex, followed by descriptions of potential impacts and the environmental impacts of the proposed action on potentially affected environmental resources. The section concludes by describing the potential impacts of tritium supply and recycling on human health during normal operation, the consequences of facility accidents, and regulatory considerations and waste management. Each description addresses the effects of No Action and the potential impacts and environmental impacts of constructing and operating a tritium supply and collocated recycling facilities or a tritium supply facility alone at Pantex.

4.5.3.1 *Land Resources*

Construction and operation of tritium supply and recycling facilities at Pantex would affect land resources, including land use and visual resources. As discussed in section 4.5.2.1, the proposed facilities could be located in any of three industrial sites. Potential land use impacts for each of these areas are discussed below. In general, each of these three areas contains sufficient land area to accommodate any of the proposed tritium supply technologies and recycling facilities (section 4.5.2.1). The proposed sites would meet and/or exceed a 1-mile buffer zone between plant operations and site boundary. The following sections describe effects of the proposed action on land resources.

Land Use

No Action. Under No Action, DOE would continue existing and planned land use activities at Pantex. Any impacts to land use from these actions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Any one of the tritium supply technologies and collocated recycling facilities (section 3.4) or tritium supply alone could be sited within one of the three designated areas located in the existing industrial core (figure 4.5.2.1–2). Table 4.5.3.1–1 shows the land area required for the tritium supply and recycling facilities. The land area affected ranges from 360 acres for the MHTGR to 173 acres for the APT. An additional 196 acres would be required if the tritium supply facility is collocated with a new recycling facility. As shown in the table, adequate land exists at each of the three designated areas. The only land use impact would be the displacement of existing agricultural uses on soils classified as prime farmland.

TABLE 4.5.3.1–1.—*Potential Changes to Land Use Resulting from Tritium Supply Technologies and Recycling at Pantex Plant*

	Tritium Supply Technologies and Recycling														
Indicator	HWR			MHTGR			ALWR[a]			APT[b]			Tritium Recycling		
Land requirements[c] (acres)	260			360			350			173			196		
Industrial sites	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Available land[d,e] (percent)	45	34	29	62	47	40	60	46	39	30	23	19	34	26	22
Total available land[f] (percent)	3.3			4.5			4.4			2.2			2.5		

[a] Land requirements for both Large and Small ALWR are the same.
[b] Land requirements for both Full and Phased APT are the same.
[c] Land area requirements are estimated to be the same for construction and operation.
[d] Industrial site A is 580 acres; Industrial site B is 760 acres; Industrial site C is 900 acres.
[e] Any land requirement less than 100 percent means sufficient land.
[f] Undeveloped land is approximately 8,000 acres.
Source: DOE 1994a; FDI 1993d; FDI 1994a; FDI 1994b; SNL 1993a; PX DOE 1991a.

No tritium facilities would be constructed offsite, and offsite land use would not be directly affected. Land is available within the region that could be converted to residential developments to house workers. Such development would be subject to city land use controls and zoning ordinances, which vary by city jurisdiction, and is unregulated in county jurisdictions.

Less Than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced capacity to meet a tritium supply requirement less than baseline, or the construction and operation of a Phased APT would not change potential baseline tritium requirement land use impacts. Land requirements would be the same in both operation scenarios.

Multipurpose Reactor. The land requirements for the multipurpose MHTGR and ALWR (section 4.8.3.2 and 4.8.3.3) with recycling would be 925 and 675 acres, respectively. The site requirements for both the multipurpose MHTGR and ALWR exceed the 600-acre proposed TSS study area. The multipurpose ALWR with recycling would exceed the available land in industrial Site A. The MHTGR would exceed the available land in Industrial Sites A, B, and C. The major land-use impacts would be the displacement of soils classified as prime farmland and the change in land-use designation from agricultural to industrial. The 925 and 675 acres represent approximately 7 and 5 percent, respectively, of the total available land at Pantex. Construction and operation of the multipurpose MHTGR or ALWR would not affect grazing allotments, other agricultural activities, or other land uses on the site.

Potential Mitigation Measures. Facilities that are turned over to waste management outside the protected area could be totally removed so the land could be reclaimed for agricultural uses. New facilities could be designed to incorporate new technologies and be reduced in size.

Visual Resources

No Action. Under No Action, the existing landscape characteristics would remain the same, consistent with VRM Class 4 (mixed use of industrial and open space) (figure 4.5.2.1–3).

Tritium Supply and Recycling. Construction and operation of any of the proposed tritium supply technologies and collocated recycling facilities or tritium supply alone would be consistent with the existing views that already include large industrial facilities. Of the tritium supply technologies, the APT would be much less visually obtrusive because of its low profile structures and cooling system (figure 3.4.2.4–1). The key viewpoint is located 1.5 miles southeast of Pantex at the intersection of Farm-to-Market Road 2377 and U.S. Route 60, which is designated a Texas Plains Trail and a scenic road. Pantex is noted as a point of interest. Tritium facilities in any of the three industrial areas would probably be visible from the key viewpoint. There would be no change to the VRM classification and no apparent change of the visual baseline from the key viewpoint.

Less Than Baseline Operations. Baseline visual impacts would not change due to operation of the HWR, MHTGR, or ALWR at reduced capacity or the construction and operation of a Phased APT.

Potential Mitigation Measures. Because no change in VRM classification is anticipated, no mitigation measures are proposed.

4.5.3.2 *Site Infrastructure*

This section discusses the site infrastructure for No Action and the modifications needed for actions due to construction and operation of new tritium supply and recycling facilities. With a new electrical substation, additional electrical transmission lines, and nominal increases to fuel procurement, the Pantex infrastructure would be capable of supporting any of the proposed technologies selected for the site. A comparison of site infrastructure and facilities resource needs for No Action and the proposed tritium supply alternatives is presented in table 4.5.3.2–1.

No Action. The missions discussed in section 3.3.5 would continue under No Action. It is anticipated that certain process improvements to be implemented in the near future would eliminate specific effluents and emissions and reduce or eliminate some waste streams. These process improvements would result in reduced utilities infrastructure requirements for Pantex. Estimated reductions are shown in table 4.5.3.2–1. No modifications are necessary under No

TABLE 4.5.3.2–1.—*Modifications to Site Infrastructure for Tritium Supply Technologies and Recycling at Pantex Plant*

Alternative	Transportation		Electrical		Fuel		
	Road (miles)	Railroad (miles)	Energy (MWh/yr)	Peak Load (MWe)	Oil (GPY)	Natural Gas (million ft^3/yr)	Coal (tons/yr)
Current Resources	47	17	77,000	13	274,000	520	0
No Action							
Total site requirement	47	17	70,000	12	260,000	470	0
Change from current resources	0	0	-7,000	-1	-14,000	-50	0
Heavy Water Reactor							
Total site requirement	47	17	698,000	97	392,000	717	0
Change from current resources	0	0	621,000	84	118,000	197	0
Modular High Temperature Gas-Cooled Reactor							
Total site requirement	47	17	518,000	74	391,000	483	0
Change from current resources	0	0	441,000	61	117,000	-37	0
Large Advanced Light Water Reactor							
Total site requirement	47	17	1,258,000	168	510,000	477	0
Change from current resources	0	0	1,181,000	155	236,000	-43	0
Small Advanced Light Water Reactor							
Total site requirement	47	17	738,000	103	420,000	477	0
Change from current resources	0	0	661,000	90	146,000	-43	0
Full Accelerator Production of Tritium							
Total site requirement	47	17	3,898,000	578	323,200	477	0
Change from current resources	0	0	3,821,000	565	49,200	-43	0
Phased Accelerator Production of Tritium							
Total site requirement	47	17	2,558,000	383	323,200	477	0
Change from current resources	0	0	2,481,000	370	49,200	-43	0

Note: A negative number (-) indicates that sufficient resources exist to meet the demands.
Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; NERC 1993a; SNL 1995a; PX 1993a:2.

Action. The existing site infrastructure would adequately support all No Action missions.

Tritium Supply and Recycling. The modifications to the infrastructure at Pantex to support the various tritium supply technologies and recycling facilities are summarized in table 4.5.3.2–1. For each technology under consideration, additional electrical energy and electrical load capability would be required to support the new site mission. Table 4.5.3.2–2 summarizes the demands the mission would place on the subregional electrical power pool. The West Central Power Pool would be able to meet the additional Pantex requirements for any of the tritium supply technologies. The alternatives would require between 1.53 and 13.93 percent of the subregional power pool capacity margin, and between 0.47 and 4.31 percent of the Southwest Power Pool regional capacity margin. However, to make the additional energy and power available at Pantex within the required time frame, approximately 9 miles of electrical transmission lines would need to be rerouted

TABLE 4.5.3.2–2.—*Impacts on Subregional Electrical Power Pool from Tritium Supply Technologies and Recycling at Pantex Plant*

Tritium Supply Technology and Recycling	Peak Power Required (MWe)	Capacity Margin (percent)	Annual Energy Required (MWh)	Total Electricity Production (percent)
Heavy Water Reactor	85	2.09	628,000	0.58
Modular High Temperature Gas-Cooled Reactor	62	1.53	448,000	0.42
Large Advanced Light Water Reactor	156	3.84	1,188,000	1.10
Small Advanced Light Water Reactor	91	2.24	668,000	0.62
Full Accelerator Production of Tritium	566	13.93	3,828,000	3.56
Phased Accelerator Production of Tritium	371	9.13	2,488,000	2.31

Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; NERC 1993a; SNL 1995a; PX 1993a:2.

and connected to a new electrical substation. With this new substation, Pantex could accommodate anticipated electrical requirements for each of the technologies under consideration. Additional natural gas and fuel oil requirements could be satisfied through increased procurement through normal contractual means.

Coal requirements specified for the HWR are for providing steam energy. If the HWR is selected for Pantex, this requirement could be satisfied using the existing natural gas steam-producing facilities. No other modifications would be necessary.

Tritium Supply Alone. If new tritium recycling facilities are not collocated with the tritium supply facilities at Pantex, and the upgraded recycling facilities at SRS is utilized, the overall impact at Pantex would be reduced. Onsite transportation network and electrical transmission line requirements would not be affected. The electrical power requirements associated with each of the technologies would decrease by 88,000 MWh per year with the peak load decreasing by 16 MWe. This represents a reduction in the total site peak power requirement of between 3 and 22 percent with no appreciable change to the capacity margin of the subregional power pool. Even with these reductions, additional power would still be required from the West Central Power Pool but the impact would be marginally less than previously discussed. The natural gas requirement would decrease by 7 million ft^3 per year and the fuel oil requirement would decrease by 50,000 gallons per year. This represents a decrease in the overall site requirement of less than 2 percent for natural gas and from 10 to 15 percent for fuel oil.

Less Than Baseline Operations. In the event that only the steady state component of the baseline tritium requirement is required, the impacts on the site infrastructure for some supply technologies would change. There would be no appreciable change for the HWR, MHTGR, and ALWR technologies. The Phased APT would reduce electrical consumption by approximately 35 percent but the fuel, onsite transportation infrastructure, and power line requirements would not change.

Multipurpose Reactor. The MHTGR or the ALWR multipurpose reactor option described in section 4.8.3 could be sited at Pantex. The site infrastructure impacts would vary depending on the technology.

The MHTGR multipurpose reactor option would require construction of the Pit Disassembly/Conversion Facility described in section 4.8.3.1 along with three additional MHTGR reactor modules. Fabrication of the plutonium-oxide fuel could be accomplished in the fuel fabrication facility already included in the tritium supply MHTGR design. Operation of this facility along with the six module MHTGR multipurpose reactor would increase the total site electrical requirement by about 373,000 MW per year (55 percent) and the total site fuel requirement by about 651,000 GPY (16 percent) over that for operation of the three module tritium supply MHTGR.

The ALWR multipurpose reactor option would require construction of the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility described in section 4.8.3.1. Operation of this facility along with the ALWR multipurpose reactor

would increase the total site electrical requirement by about 20,000 MWh per year (less than 2 percent) and the total site fuel requirement by about 830,000 GPY (20 percent) over that for operation of the tritium supply ALWR.

Accelerator Production of Tritium Power Plant. A dedicated gas-fired power plant at Pantex to provide the necessary power for the APT could be construction (see section 4.8.2.2). This would decrease the annual amount of electricity required to be purchased from commercial sources by up to 3,740,000 MWh per year for the Full APT and 2,400,000 MWh for the Phased APT. This gas plant would require 54,200 million ft^3 per year of natural gas to provide the full APT requirement of 3,740,000 MWh per year and 34,800 million ft^3 per year of natural gas to provide the full APT requirement of 3,740,000 MWh per year and 344,800 million ft^3 per year of natural gas to provide the Phased APT requirement of 2,400,000 MWh per year. Since this is a large increase (70 to 100 times) over normal usage, the existing gas line would likely have to be expanded.

Potential Mitigation Measures. The siting of new tritium supply and recycling facilities would require only minor modifications to the existing site infrastructure. Siting of electrical transmission lines could follow existing rights-of-way to minimize impacts to natural resources. Where new rights-of-way would need to be constructed, alignment would consider existing sensitive habitat (e.g., wetlands and prime farmland) to minimize the potential for impacts.

4.5.3.3 *Air Quality and Acoustics*

Construction and operation of a tritium supply and recycling facility at Pantex would generate criteria and toxic/hazardous pollutants that have the potential to exceed Federal and state ambient air quality standards and guidelines. To determine the impacts on air quality, criteria and toxic/hazardous concentrations from each technology have been compared with Federal and state standards and guidelines. Impacts for radiological airborne emissions are discussed in section 4.5.3.9.

In general, all of the proposed technologies would emit the same types of air pollutants during construction. Emissions would typically not exceed Federal, state, or local air quality regulations or guidelines, except that PM_{10} concentrations may be close to or exceed the 24-hour standard during peak construction periods, which is not uncommon for large construction projects.

During operation, impacts from each of the tritium supply technologies and recycling facilities with respect to the concentrations of criteria and toxic/hazardous air pollutants are predicted to be in compliance with Federal, state, and local air quality regulations or guidelines. The estimated pollutant concentrations presented in table 4.5.3.3–1 for each of the tritium supply technologies and recycling facilities indicate little difference between technologies with respect to impacts to air quality.

The Prevention of Significant Deterioration regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modifications to existing sources. Based on the emission rates presented in appendix table B.1.4–4, Prevention of Significant Deterioration permits may be required for each of the proposed alternatives at Pantex. This may require "offsets," reductions of existing emissions, to permit any additional or new emission source.

Noise emissions during either construction or operation are expected to be low. Air quality and acoustic impacts for each technology are described separately. Supporting data for the air quality and acoustics analysis, including modeling results, are presented in appendix B.

Air Quality

An analysis was conducted of the potential air quality impacts of emissions from each of the tritium supply technologies and recycling facilities. The air quality modeling analysis used the Industrial Source Complex Short-Term model recommended by EPA. The resulting air quality concentrations were then evaluated against local, state, air quality regulations, and NAAQS (40 CFR 50). The potential exceedance of Prevention of Significant Deterioration (40 CFR 52.21) increments for PM_{10}, SO_2, or NO_2 was also determined.

No Action. No Action utilizes estimated air emissions data from operations in the year 2010

assuming continuation of site missions as described in section 3.3.4. These data reflect conservative estimates of criteria and toxic/hazardous emissions at Pantex. The emission rates for the criteria and toxic/hazardous pollutants for No Action are presented in appendix table B.1.4–4. Table 4.5.3.3–1 presents the No Action concentrations. Pollutant concentrations are in compliance with all air quality regulations and guidelines except the 30-minute hydrogen chloride standard. It is conservatively assumed that PM_{10} concentrations are equal to TSP concentrations. Emissions of hydrogen chloride result from the open air burning of explosives.

Tritium Supply and Recycling. Alternatives for Pantex consist of four candidate technologies: HWR, MHTGR, ALWR, and APT, alone or collocated with tritium recycling facilities. Air pollutants would be emitted during construction of the tritium supply and recycling facilities. The principal sources of such emissions during construction include the following:

- Fugitive dust from land clearing, site preparation, excavation, wind erosion of exposed ground surfaces, and operation of a concrete batch plant.
- Exhaust from, and road dust raised by, construction equipment, vehicles delivering construction material, and vehicles carrying construction workers.

PM_{10} concentrations are expected to be close to or exceed the 24-hour ambient standard during the peak construction period. Exceedances would be expected to occur during dry and windy conditions. Appropriate control measures would be followed, such as watering to reduce emissions. With the exception of PM_{10}, it is expected that concentrations of all other pollutants at the Pantex boundary would remain within applicable Federal and state ambient air quality standards.

Air pollutant emission sources associated with the operation of each of the technologies include all or part of the following:

- Increased operation of existing boilers to generate additional steam for space heating.
- Operation of diesel generators and periodic testing of emergency diesel generators.
- Recycling operations.
- Exhaust from, and road dust raised by, vehicles delivering supplies and bringing employees to work.

Appendix table B.1.4–4, presents emissions from each of the proposed tritium supply technologies and recycling facilities. There are no gaseous releases associated with the APT (SNL 1995a), although emissions are associated with operation of the tritium supply facility included with the APT and with recycling facilities. Emissions from the Large ALWR were used to determine pollutant concentrations since these represent the maximum emission rates from either the Large or Small ALWR. Consequences from operation of each of the tritium supply and recycling facilities at Pantex are presented in table 4.5.3.3–1. Pollutant concentrations, combined with the No Action concentrations, are in compliance with Federal and state standards except for the 30-minute standard for hydrogen chloride.

Pollutant emissions resulting from the operation of tritium supply technologies alone (HWR, MHTGR, ALWR, and APT) consist of criteria pollutants from the operation of boilers and diesel generators and toxic/hazardous pollutant emissions from facility processes. Criteria pollutant emissions from the MHTGR are the highest among the other tritium supply technologies and would increase existing total site criteria pollutant emissions by greater than 100 percent above No Action emissions. Concentrations of criteria and toxic/hazardous pollutants, added to No Action concentrations, are in compliance with Federal and state standards except the 30-minute hydrogen chloride standard.

Less Than Baseline Operations. Air emissions from the HWR would be reduced slightly when operated at reduced capacity. However, the reduction would be negligible because most emissions are attributed to support equipment and facilities that are not related to the reactor operating level. The MHTGR or ALWR would have no change in air emissions because it would continue to operate at the same level as the baseline requirement to maintain power levels

TABLE 4.5.3.3–1.—*Estimated Cumulative Concentrations of Pollutants Resulting from Tritium Supply Technologies and Recycling Including No Action at Pantex Plant* [Page 1 of 4]

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	2010 No Action ($\mu g/m^3$)	Tritium Supply Technologies and Recycling				
				HWR ($\mu g/m^3$)	MHTGR ($\mu g/m^3$)	ALWR ($\mu g/m^3$)	APT ($\mu g/m^3$)	Tritium Recycling[a] ($\mu g/m^3$)
Criteria Pollutant								
Carbon monoxide (CO)	8-hour	10,000	1,352	1,374	1,427	1,380	1,361	9
	1-hour	40,000	7,836	7,964	8,269	7,997	7,886	50
Lead (Pb)	Calendar Quarter	1.5	0.07	0.07	0.07	0.07	0.07	[b]
Nitrogen dioxide (NO_2)	Annual	100	2	2	3	3	2	0.2
Ozone (O_3)	1-hour	235	[b]	[b]	[b]	[b]	[b]	[b]
Particulate matter (PM_{10})	Annual	50	27	27	27	27	27	0.04
	24-hour	150	114	116	115	116	115	0.9
Sulfur dioxide (SO_2)	Annual	80	0.03	0.04	0.04	0.05	0.03	<0.01
	24-hour	365	24	25	25	25	24	0.1
	3-hour	1,300	194	196	196	198	195	0.6
Mandated by Texas								
Hydrogen fluoride	30-day	0.8	[c]	[c]	[c]	[c]	[c]	[b]
	7-day	1.6	[c]	[c]	[c]	[c]	[c]	[b]
	24-hour	2.9	0.7	0.7	0.7	0.7	0.7	[b]
	12-hour	3.7	[c]	[c]	[c]	[c]	[c]	[b]
Hazardous and Other Toxic Compounds								
Acetone	30-minute[d]	5,900	341.1	341.1	341.1	363.3	341.1	[b]
	Annual	590	0.2	0.2	0.2	0.3	0.2	[b]
Acetylene	30-minute[d]	26,620	[b]	7.1	7.1	7.1	7.1	7.1
	Annual	2,660	[b]	0.02	0.02	0.02	0.02	0.02
Aliphatic hydrocarbons	30-minute[d]	[e]	19	19	19	19	19	[b]
	Annual	[e]	<0.01	<0.01	<0.01	<0.01	<0.01	[b]
Ammonia	30-minute[d]	170	[b]	[b]	[b]	11.7	[b]	[b]
	Annual	17	[b]	[b]	[b]	0.03	[b]	[b]

TABLE 4.5.3.3–1.—*Estimated Cumulative Concentrations of Pollutants Resulting from Tritium Supply Technologies and Recycling Including No Action at Pantex Plant* [Page 2 of 4]

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	2010 No Action ($\mu g/m^3$)	Tritium Supply Technologies and Recycling				
				HWR ($\mu g/m^3$)	MHTGR ($\mu g/m^3$)	ALWR ($\mu g/m^3$)	APT ($\mu g/m^3$)	Tritium Recycling[a] ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (continued)								
Aromatic hydrocarbons	30-minute[d]	[e]	27.2	27.2	27.2	27.2	27.2	[b]
	Annual	[e]	<0.01	<0.01	<0.01	<0.01	<0.01	[b]
Aromatic petroleum distillate	30-minute[d]	3,500	13.6	13.6	13.6	13.6	13.6	[b]
	Annual	350	<0.01	<0.01	<0.01	<0.01	<0.01	[b]
2-Butoxyethanol	30-minute[d]	1,210	208.9	208.9	208.9	208.9	208.9	[b]
	Annual	121	0.13	0.13	0.13	0.13	0.13	[b]
Butyl acetate	30-minute[d]	1,850	87	87	87	87	87	[b]
	Annual	710	0.01	0.01	0.01	0.01	0.01	[b]
Butyl alcohol	30-minute[d]	1,220	31.6	31.6	31.6	31.6	31.6	[b]
	Annual	150	0.01	0.01	0.01	0.01	0.01	[b]
Chlorodifluoromethane	30-minute[d]	18,000	4.9	4.9	4.9	4.9	4.9	[b]
	Annual	1,800	<0.01	<0.01	<0.01	<0.01	<0.01	[b]
Cyanogen	30-minute[d]	210	161.8	161.8	161.8	161.8	161.8	[b]
	Annual	21	0.01	0.01	0.01	0.01	0.01	[b]
Cyclohexane	30-minute[d]	1,435	2.9	2.9	2.9	2.9	2.9	[b]
	Annual	340	<0.01	<0.01	<0.01	<0.01	<0.01	[b]
Dichlorodifluoromethane	30-minute[d]	49,500	23.3	23.3	23.3	23.3	23.3	[b]
	Annual	4,950	<0.01	<0.01	<0.01	<0.01	<0.01	[b]
Diesel fuel	30-minute[d]	90	2.4	2.4	2.4	2.4	2.4	[b]
	Annual	9	<0.01	<0.01	<0.01	<0.01	<0.01	[b]
Epoxy solvent	30-minute[d]	[e]	16.5	16.5	16.5	16.5	16.5	[b]
	Annual	[e]	<0.01	<0.01	<0.01	<0.01	<0.01	[b]
Ethyl alcohol	30-minute[d]	18,800	12.2	14.8	14.8	14.8	14.8	2.6
	Annual	1,880	<0.01	0.01	0.01	0.01	0.01	0.01
Freon TF	30-minute[d]	[e]	24.8	24.8	24.8	24.8	24.8	[b]
	Annual	[e]	0.02	0.02	0.02	0.02	0.02	[b]

TABLE 4.5.3.3–1.—*Estimated Cumulative Concentrations of Pollutants Resulting from Tritium Supply Technologies and Recycling Including No Action at Pantex Plant* [Page 3 of 4]

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	2010 No Action ($\mu g/m^3$)	Tritium Supply Technologies and Recycling				
				HWR ($\mu g/m^3$)	MHTGR ($\mu g/m^3$)	ALWR ($\mu g/m^3$)	APT ($\mu g/m^3$)	Tritium Recycling[a] ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (continued)								
Hydrocarbons	30-minute[d]	[e]	1,812	1,812	1,812	1,812	1,812	[b]
	Annual	[e]	0.08	0.08	0.08	0.08	0.08	[b]
Hydrogen chloride	30-minute[d]	75	232.3	232.3	232.3	232.3	232.3	[b]
	Annual	0.1	0.01	0.01	0.01	0.01	0.01	[b]
Isopropyl alcohol	30-minute[d]	7,856	127.3	127.3	127.3	127.3	127.3	[b]
	Annual	980	0.02	0.02	0.02	0.02	0.02	[b]
Methane	30-minute[d]	[e]	[b]	7.1	7.1	7.1	7.1	7.1
	Annual	[e]	[b]	0.02	0.02	0.02	0.02	0.02
Methyl alcohol	30-minute[d]	2,620	178.3	181.0	181.0	181.0	181.0	2.6
	Annual	262	0.11	0.12	0.12	0.12	0.12	0.01
Methyl ethyl ketone	30-minute[d]	3,900	92.8	92.8	92.8	92.8	92.8	[b]
	Annual	590	0.02	0.02	0.02	0.02	0.02	[b]
Methyl isobutyl ketone	30-minute[d]	2,050	5.4	5.4	5.4	5.4	5.4	[b]
	Annual	205	<0.01	<0.01	<0.01	<0.01	<0.01	[b]
Nitric acid	30-minute[d]	52	[b]	13.3	[b]	155.3	[b]	[b]
	Annual	5.2	[b]	0.03	<0.01	0.41	[b]	[b]
Tetrahydrofuran	30-minute[d]	5,900	29.6	29.6	29.6	29.6	29.6	[b]
	Annual	590	0.02	0.02	0.02	0.02	0.02	[b]
Toluene	30-minute[d]	3,750	236.2	236.2	236.2	236.2	236.2	[b]
	Annual	375	0.13	0.13	0.13	0.13	0.13	[b]
1,1,1-Trichloroethane	30-minute[d]	19,100	8.3	10.5	9.0	59.3	8.3	[b]
	Annual	1,910	<0.01	0.01	<0.01	0.14	<0.01	[b]
1,1,2-Trichloro-1,2,2-Trifluoroethane	30-minute[d]	76,000	12.6	12.6	12.6	12.6	12.6	[b]
	Annual	7,600	<0.01	<0.01	<0.01	<0.01	<0.01	[b]
Trichlorotrifluoroethane	30-minute[d]	10,000	7.3	101.6	7.3	7.3	7.3	[b]
	Annual	1,000	<0.01	0.25	<0.01	<0.01	<0.01	[b]

TABLE 4.5.3.3–1.—*Estimated Cumulative Concentrations of Pollutants Resulting from Tritium Supply Technologies and Recycling Including No Action at Pantex Plant* **[Page 4 of 4]**

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	2010 No Action ($\mu g/m^3$)	Tritium Supply Technologies and Recycling				
				HWR ($\mu g/m^3$)	MHTGR ($\mu g/m^3$)	ALWR ($\mu g/m^3$)	APT ($\mu g/m^3$)	Tritium Recycling[a] ($\mu g/m^3$)
Hazardous and Other Toxic Compounds (continued)								
VM&P naphtha	30-minute[d]	3,500	23.3	23.3	23.3	23.3	23.3	[b]
	Annual	350	<0.01	<0.01	<0.01	<0.01	<0.01	[b]
Xylene	30-minute[d]	3,700	44.2	44.2	44.2	44.2	44.2	[b]
	Annual	435	<0.01	<0.01	<0.01	<0.01	<0.01	[b]

[a] Concentrations for tritium supply and recycling include 2010 No Action concentrations. To determine the concentrations of pollutants from each tritium supply technology, subtract the pollutant concentration for tritium recycling from each of the tritium supply and recycling concentrations.

[b] No sources indicated.

[c] Data unavailable.

[d] One-hour predicted concentrations were used for 30-minute standard.

[e] There is no standard.

Note: DOE is committed to the phaseout of ozone-depleting substances and will discontinue use of these substances according to EPA phaseout schedules.

Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; SNL 1995a; PX 1992a:10; PX 1993a:2; PX ACB 1987a; PX ACB 1991a.

for steam or electric production. The Phased APT construction and operation emissions and impacts would be the same as the Full APT.

Accelerator Production of Tritium Power Plant. Operation of a 500 to 600 MWe natural gas electric generating facility (section 4.8.2.2) would generate a substantial amount of emissions consisting of sulfur dioxide, particulate matter, nitrogen oxides, carbon monoxide, and volatile organic compounds.

These emissions would be controlled using the best available control technology to minimize impacts and comply with the NAAQS and state mandated emission standards. Estimated emissions are based upon emission factors for a large controlled gas turbine (EPA 1995a; SPS 1995a). Table B.1.3.1–3 presents the emission factors and resulting annual emission rates for a 600 MWe natural gas-fired turbine power plant.

For a natural gas-fired power plant located at Pantex, the increase in carbon monoxide emissions with respect to the 2010 No Action emissions at Pantex would be approximately 443 percent (75 tons per year); for nitrogen oxides the increase would be approximately 628 percent (314 tons per year); for particulate matter the increase would be approximately 7,799 percent (179 tons per year); for sulfur dioxide the increase would be approximately 538'-percent (5 ton per year); and for volatile organic compounds the increase would be approximately 1,538 percent (215 tons per year). In addition, the gas turbine generating facility would generate 126 tons per year of methane, 58 tons per year of ammonia, 29'tons per year of nonmethane hydrocarbons, and 24 tons per year of formaldehyde.

Any power plant facility constructed to meet the power needs of the APT would be required to meet the Federal NAAQS and state mandated regulations for toxic/hazardous pollutants. Appropriate pollution control equipment would be incorporated into the design of that facility to meet these standards.

Potential Mitigation Measures. Potential mitigation measures during construction include: watering to reduce dust emissions; applying nontoxic soil stabilizers to all inactive construction areas; cover, water or apply nontoxic soil binders to exposed piles (i.e., gravel, sand, and dirt); suspend all excavation and grading operations when wind speeds warrant; pave construction roads that have a traffic volume of more than 50 daily trips by construction equipment; and using electricity from power poles rather than temporary gasoline and diesel power generators. Potential mitigation measures during operation include incorporating additional HEPA filters to reduce particulate emissions from processing facilities; substituting cleaning solvents for those which present health hazards or exceed the applicable standards; and switching from coal or fuel oil to natural gas to reduce criteria pollutants.

Acoustics

The location of the tritium supply technologies and recycling facilities relative to the site boundary and sensitive receptors were examined to determine the potential for onsite and offsite impacts.

No Action. The continuation of operations at Pantex would result in no appreciable change in traffic noise and onsite operational noise sources from current levels (section 4.5.2.3). Sources of nontraffic noise associated with operations are located at sufficient distances from offsite noise-sensitive receptors that the contribution to offsite noise levels would continue to be small.

Tritium Supply and Recycling. Noise sources during construction may include heavy-construction equipment and increased traffic. Increased traffic would occur onsite and along major offsite transportation routes used to bring construction material and workers to the site.

Most nontraffic noise sources associated with operation of any tritium supply, technologies, and recycling facilities would be located at sufficient distance from offsite areas that the contribution to offsite noise levels would continue to be small. Due to the size of the site, noise emissions from construction and operation activities would not be expected to cause annoyance to the public.

Noise impacts associated with increased traffic on access routes would be considered in tiered NEPA documents. Some nontraffic noise sources associated with construction and operation of the tritium supply technologies and recycling facilities, may be

located close enough to offsite noise receptors that they could experience some increase in noise levels.

Less Than Baseline Operations. Baseline noise impacts would not change due to reactors operating at reduced capacity or the construction and operation of a Phased APT.

Potential Mitigation Measures. Potential measures to minimize noise impacts on workers include the use of standard silencing packages on construction equipment and providing workers in noisy environments with appropriate hearing protection devices meeting OSHA standards. As required, noise levels would be measured in worker areas, and a hearing protection program would be conducted.

4.5.3.4 *Water Resources*

Environmental impacts associated with the construction and operation of the proposed tritium supply technologies and recycling facilities at Pantex would affect surface water and groundwater resources. All water required for construction or operation would be supplied from reclaimed wastewater. Reclaimed wastewater from the city of Amarillo Hollywood Road Wastewater Treatment Plant will be used to accommodate water requirements at Pantex which have been projected to increase from 2,555 MGY to 4,380 MGY by the year 2010. The proposed sites for the tritium supply and recycling facilities would be outside the 100-year floodplain. Information on the location of the 500-year floodplain at Pantex is currently not available.

During construction, treated sanitary wastewater would be discharged to playa lakes. Although the potential impacts to surface waters during the construction phase for any of the proposed facilities would be erosion of disturbed land and sedimentation in drainage channels, the relatively dry climate and application of appropriate management measures should preclude adverse impacts. All wastewater would be treated and either recycled for cooling system makeup or released to playa lakes. No wastewater would be discharged to surface waters during operation of tritium facilities; therefore, no impacts to surface water quality are expected. Stormwater runoff would be collected and treated if necessary before discharge to natural drainage channels.

Table 4.5.3.4–1 presents existing surface water and groundwater resources and the potential changes to water resources at Pantex resulting from the proposed tritium supply and recycling facilities. Resource requirements for each tritium supply technology shown in this table represent the total requirements at the site, including No Action. Resource requirements for tritium recycling are added to these values to obtain the water resource requirements for assessing impacts associated with combined tritium supply and recycling.

Surface Water

No Action. Under No Action, no additional impacts to surface water resources are anticipated beyond the effects of existing and future activities which are independent of and unaffected by the proposed action. A description of the activities that would continue at Pantex is provided in section 3.3.5. No demands on surface water supplies would occur; however, wastewater discharges to Playas 1, 2, and possibly 4, would continue.

Tritium Supply and Recycling. There are no unique construction characteristics associated with water requirements and discharges among any of the candidate technologies. No surface water would be withdrawn for any construction or operation activities associated with any of the tritium supply technologies whether collocated with recycling facilities or sited alone. Consequently, it is not anticipated that there would be any impacts to surface water availability or surface water quality. Nonhazardous wastewater generated during construction and operation of the tritium facilities would either be recycled or treated and released to the playa lakes. The potential impacts to surface water during the construction phase for any of the tritium supply technologies would be erosion of disturbed land and sedimentation in drainage channels. The potential for erosion would be greatest for the construction of the MHTGR (table 4.5.3.1–1).

To minimize impacts of soil erosion, standard construction stormwater management and erosion control measures would be employed. The dry climate and application of appropriate management measures should preclude adverse impacts from stormwater runoff. It is anticipated that impacts from runoff would be temporary and manageable.

TABLE 4.5.3.4–1.—*Potential Changes to Water Resources Resulting from Tritium Supply Technologies and Recycling at Pantex Plant* [Page 1 of 2]

Affected Resource Indicator	No Action	Tritium Supply Technologies and Recycling						
		HWR	MHTGR[a]	Large ALWR[a]	Small ALWR[a]	Full APT	Phased APT	Tritium Recycling[b]
Construction (2005)								
Water Availability and Use								
Water source	Ground	Reclaimed wastewater	Reclaimed wastewater	Reclaimed wastewater	Reclaimed wastewater	Reclaimed wastewater	Reclaimed wastewater	Reclaimed wastewater
Total water requirement[c] (MGY)	286	21.3	17.8	33.3	20	8.3	8.3	1.5
Percent of projected available reclaimed wastewater (4,380 MGY)	0	<1	<1	<1	<1	<1	<1	NA
Percent of county projected pumpage (22,306 MGY)	1	NA	NA	NA	NA	NA	NA	NA
Water Quality								
Wastewater discharge to playas[d] (MGY)	183	199	196	210	198	183	183	0.9
Percent change in flow of wastewater to playas[e]	0	9	7	15	8	<1	<1	NA
NPDES permit required[f]	NA	Yes	Yes	Yes	Yes	Yes	Yes	NA
Operation (2010)								
Water Availability and Use								
Water source	Ground	Reclaimed wastewater	Reclaimed wastewater	Reclaimed wastewater	Reclaimed wastewater	Reclaimed wastewater	Reclaimed wastewater	Reclaimed wastewater
Total water requirement[g] (MGY)	286	48	30	90	50	1,200	770	14
Percent of projected available reclaimed wastewater (4,380 MGY)	0	1	1	2	2	28	18	NA
Percent of county projected pumpage (22,306 MGY)	1.3	NA	NA	NA	NA	NA	NA	NA

TABLE 4.5.3.4–1.—*Potential Changes to Water Resources Resulting from Tritium Supply Technologies and Recycling at Pantex Plant* [Page 2 of 2]

Affected Resource Indicator	No Action	Tritium Supply Technologies and Recycling						
		HWR	MHTGR[a]	Large ALWR[a]	Small ALWR[a]	Full APT	Phased APT	Tritium Recycling[b]
Water Quality								
Wastewater discharge to playas[d] (MGY)	183	231	213	273	233	183	183	0
Percent change in flow of wastewater to playas	0	26	16	49	27	<1	<1	NA
NPDES permit required[d]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
Floodplain								
Actions in 100-year floodplain	NA	No	No	No	No	No	No	NA
Critical actions in 500-year floodplain	NA	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	NA
Floodplain assessment required	NA	Yes 500-year	Yes 500-year	Yes 500-year	Yes 500-year	Yes 500-year	Yes 500-year	NA

[a] Operational water requirements for MHTGR and ALWR include utilization of steam turbine generators.

[b] Resource requirements for tritium recycling do not include No Action. The values presented in this column are added to the requirements of each tritium supply technology to assess the impacts associated with combined tritium supply and recycling.

[c] Total water requirements at Pantex are calculated by adding No Action requirements (286 MGY) with that for each tritium supply: HWR (21.3 MGY), MHTGR (17.8 MGY), ALWR (33.3 MGY for Large and 20 MGY for Small), and APT (8.3 MGY for Full and Phased).

[d] The total wastewater discharged to playas for construction and operation is the sum of the tritium facilities wastewater generation rate and the projected discharge rate (183 MGY).

[e] Percent change in flow of wastewater to playas includes tritium recycling discharge.

[f] All discharges to natural drainages require NPDES permits.

[g] Total water requirements at Pantex are calculated by adding No Action requirements (286 MGY) with that for each tritium technology: HWR (48 MGY), MHTGR (30 MGY), ALWR (90 MGY for Large and 50 MGY for Small), and APT (1,200 MGY for Full and 770 MGY for Phased).

Note: NA - not applicable.

Note: Construction impacts are considered to be temporary, lasting only throughout the construction period.

Source: DOE 1995d; DOE 1995e; DOE 1995f; DOE 1995g; SNL 1995a; PX 1993a:2; SR DOE 1995a.

Nonhazardous wastewater, including sanitary wastewater, generated during the construction of either the collocated tritium supply technologies and recycling facilities (which ranges from 28.4 MGY for the Large ALWR to 1.2 MGY for the APT) or the tritium supply facilities alone (which ranges from 27.5 MGY for the Large ALWR to 0.3 MGY for the APT) would be discharged to playas. Discharge of wastewater generated during construction of these facilities to playas would not result in an exceedance of the Texas Natural Resources Conservation Commission-permitted limit of 1.05 MGD.

During operation, utility, process, and sanitary wastewater for the HWR, MHTGR, and ALWR not recycled would be treated prior to discharge into the playas. However, cooling system blowdown and sanitary wastewater for the APT would be treated and recycled for reuse as cooling system makeup. The treated effluent from the process wastewater treatment would be discharged to playas. Treated effluent would be monitored to comply with the NPDES permit and other discharge requirements. The extent to which treated effluent or stormwater would be recycled for reuse within the plant would be determined during site-specific studies.

An analysis of wastewater discharged to the playas indicated that the volume of the release would be within the Texas Natural Resources Conservation Commission-permitted limit of 1.05 MGD. Stormwater runoff from either the collocated tritium supply and recycling facilities or the tritium supply alone would be collected in detention ponds. Runoff from site support facilities outside the main plant, except those that require onsite management measures by regulation such as sanitary wastewater plants and landfill areas, would be discharged directly to natural drainage channels. Uncontaminated stormwater runoff would be released to natural drainage channels. Contaminated runoff would be retained, treated in the radioactive waste treatment system, and released. All discharges to playas would be monitored and subject to NPDES permit requirements.

No construction activities would take place in areas delineated as 100-year floodplains. However, there is no information on the location of the 500-year floodplain at Pantex. Because operation of the tritium supply facility may constitute a critical action, an assessment of the 500-year floodplain should be made before construction activities are initiated. This study would be conducted in site-specific tiered NEPA documents.

Less Than Baseline Operations. Baseline surface water impacts described previously for the construction and operation phases would not change due to changes in reactor operating capacity, or construction and operation of a Phased APT.

Multipurpose Reactor. The MHTGR or ALWR a multipurpose reactor option at Pantex would require a Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility or a Pit Disassembly/Conversion Facility to be constructed in conjunction with the reactors. Water use for both of the reactors and support facilities would be obtained from reclaimed wastewater resources.

All wastewater during construction and operation would be treated prior to discharge to the playas, with no impacts to groundwater quality expected. Discharges of wastewater generated during construction and operation of these facilities would not result in exceedance of the Texas Natural Resources Conservation Commission-permitted limit of 1.05 MGD.

Accelerator Production of Tritium Power Plant. If the APT technology is selected, a dedicated power plant as discussed in section 4.8.2.2, could be used to support the technology at Pantex. Water requirements (approximately 80 MGY) for the natural gas-fired power plant would be obtained from reclaimed wastewater from the Hollywood Road Wastewater Treatment Plant. No surface water would be used for the project. Operation of the Full APT (with tritium recycling) and the dedicated power plant would require approximately 1,294 MGY or 30 percent of the projected available reclaimed wastewater (4,380 MGY) from the Hollywood Road Plant. This amount would be an increase of 5 percent over the amount of water required for the Full APT (with tritium recycling) without the dedicated power plant (1,214 MGY).

Demineralized backwash generated during operations would contain dilute concentrations of trace metals, and low-to-moderate concentrations of calcium, sodium and sulfate. With the appropriate

wastewater treatment prior to discharge to the playas, no impacts to surface water quality are expected.

Potential Mitigation Measures. Because appropriate erosion and runoff management measures would be implemented during construction to comply with NPDES stormwater management regulations, no additional mitigation measures should be necessary. Stormwater measures include erosion control measures such as silt fences, dikes, and sediment traps to divert runoff away from disturbed areas and stabilization practices that cover soils with materials such as riprap or mulch, in order to prevent direct exposure of soils to runoff.

Groundwater

No Action. Under No Action, baseline conditions and operations, described in section 3.3.5, would continue at the plant, and current groundwater usage of 257 MGY would increase to 286 MGY by the year 2005. Groundwater used would continue to be withdrawn from the Ogallala aquifer through wells located on the Pantex property. No additional impacts to groundwater quality are anticipated since there are no direct discharges to groundwater.

Groundwater Availability and Use

Tritium Supply and Recycling. Groundwater would not be used for construction and operation of the proposed facilities. Tertiary treated sanitary wastewater would be available from the city of Amarillo Hollywood Road Wastewater Treatment Plant. Although not strictly groundwater or surface water, the reclaimed wastewater is discussed under this section because Pantex would still be withdrawing approximately 286 MGY from the aquifer in the year 2000.

Construction water requirements for either the collocated tritium supply and recycling facilities or the tritium supply alone are small relative to the projected available wastewater (4,380 MGY) from the city of Amarillo Hollywood Road Wastewater Treatment Plant. As shown in table 4.5.3.4–1, construction of either a Large ALWR with recycling (34.8 MGY) or a Large ALWR alone (33.3 MGY) would represent approximately 4 percent of the projected available reclaimed wastewater (4,380 MGY).

Reclaimed wastewater required for both construction and operation and the percent increase in projected water use for each technology are shown in table 4.5.3.4–1. Operating the HWR, MHTGR, or ALWR, collocated with recycling or alone, would be less than 3 percent of the projected available reclaimed wastewater (4,380 MGY). Operating a Full APT (with tritium recycling) at 3/8 capacity would require the highest groundwater withdrawal (1,214 MGY) and would be 28 percent of the projected available recycled wastewater. However, the more likely operating scenario for the APT would be to operate at 3/8 level for 5 years (requiring total site reclaimed wastewater of 1,214 MGY), to operate at 3/16 capacity for 30 years (requiring 784 MGY), and then to not operate for 5 years. Over the 40-year operating period, the average total site reclaimed wastewater required would be 1,026 MGY, or 23 percent of the available projected reclaimed wastewater (4,380 MGY).

Less Than Baseline Operations. Operation of the HWR at reduced capacity to meet a tritium supply requirement less than baseline would not change the operation water requirements or the quantity of water discharges. The MHTGR or ALWR water requirements and discharges would not change from the baseline; therefore, the potential impacts would remain the same.

Operation of the Phased APT (with tritium recycling) would require 784 MGY which is 18 percent of the projected available reclaimed wastewater (table 4.5.3.4–1). This is approximately two-thirds of the 28-percent increase required by the Full APT. All other requirements of the Phased APT are identical to those of the Full APT.

Groundwater Quality

Tritium Supply and Recycling. As discussed in the surface water section, construction and operation of the tritium facilities would not result in direct discharges to groundwater. However, treated wastewater discharged to playas could percolate into the groundwater. All contaminants that have entered the aquifer are expected to move downgradient to the north, away from existing facilities. Because no groundwater would be withdrawn for the project from the aquifer, the project would have no effect on plume migration. Pantex will continue to evaluate

groundwater contamination in both the Perch and Ogallala aquifers.

Less Than Baseline Operations. Potential groundwater quality impacts described previously would not change due to changes in reactor operating capacities, or the construction and operation of a Phased APT.

Multipurpose Reactor. For the multipurpose MHTGR, a Pit Disassembly/Conversion Facility would be constructed and operated to support the 6 reactors. Water used during construction (24.33 MGY) and operation (64 MGY) would be a 35 and 113 percent increase, respectively, over the water use for the MHTGR tritium supply facility, and 0.55 and 1.5 percent, respectively, of the projected available reclaimed wastewater from the Hollywood Road Plant (4,380 MGY).

Nonhazardous wastewater, including sanitary wastewater, generated during construction and operation of the multipurpose MHTGR and Pit Disassembly/Conversion Facility would be discharged to playas. Discharge of wastewater generated during construction and operation of these facilities would not result in an exceedance of the Texas Natural Resources Conservation Commission-permitted limit of 1.05 MGD.

Water requirements during construction and operation of an ALWR multipurpose reactor would be the same as previously discussed for an ALWR tritium supply facility. However, as discussed in section 4.8.3, a Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would have to be constructed and operated in conjunction with an ALWR multipurpose reactor. A Pit Disassembly/Conversion/Fuel Fabrication Facility would require an additional 0.5 MGY of water during construction and 10 MGY during operation, which would be a 1.5 and 11 percent increase, respectively, over the water use for the ALWR tritium facility and 0.8 and 2.3 percent, respectively, of the projected available reclaimed wastewater from the Hollywood Road Plant (4,380 MGY).

Nonhazardous wastewater, including sanitary wastewater, generated during the construction (3.3 MGY) and operation (10 MGY) of the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would be a slight increase over the ALWR tritium supply facility, but would not result in an exceedance of the Texas Natural Resources Conservation Commission-permitted limit of 1.05 MGD.

Accelerator Production of Tritium Power Plant. If the APT technology is selected, a dedicated power plant as discussed in section 4.8.2.2, could be used to support the technology at Pantex. Water requirements (approximately 80 MGY) for the natural gas-fired power plant would be obtained from reclaimed wastewater from the Hollywood Road Wastewater Treatment Plant. Groundwater, except for that projected for No Action, would not be required to support the project. Therefore, no impacts to the declining water levels of the Ogallala aquifer would occur due to the tritium project. As previously mentioned, operation of the Full APT (with tritium recycling) and the dedicated power plant would require approximately 1,294 MGY or 30 percent of the projected available reclaimed wastewater from the Hollywood Road Plant (4,380 MGY). This amount would be an increase of 7 percent over the amount of water required for the Full APT without the dedicated power plant (1,214 MGY).

Demineralized backwash generated during operations would contain dilute concentrations of trace metals, and low-to-moderate concentrations of calcium, sodium and sulfate. With the appropriate wastewater treatment prior to discharge to the playas, no impacts to groundwater quality are expected.

Potential Mitigation Measures. Impacts from reclaimed wastewater usage would not require mitigation. However, mitigation measures to reduce wastewater seepage could include building lined evaporation ponds.

4.5.3.5 *Geology and Soils*

Construction of tritium facilities at Pantex would have no impact on geological resources described in section 4.5.2.5. Hazards posed by geological conditions would be negligible. Construction would disturb up to a few hundred surface acres of soil, the amount depending on the tritium supply technology and recycling facilities. Control measures would be used to minimize soil erosion. Impacts would depend on the specific soil units in the disturbed area, the extent of land disturbing activities, and the

amount of soil disturbed. Potential changes to geology and soils associated with the construction and operation of the tritium supply and recycling facilities are discussed below.

No Action. Under No Action DOE would continue existing and planned activities at Pantex. Any impacts to geology and soils from these actions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Construction activities would not affect geological conditions. Design of the facilities would ensure that they would not be adversely affected by geologic conditions.

There are no known capable faults within the boundaries of Pantex. There is little chance for ground rupture as a result of an earthquake; minor ground shaking is more likely but is not anticipated during the life of the project. Intensities of more than IV on the modified Mercalli scale are not likely at Pantex. Ground shaking could affect the integrity of poorly designed or nonreinforced structures but would not affect newly designed facilities. Based on the seismic history of the area, a very low seismic risk exists at Pantex but should not preclude safe construction and operation of tritium supply and collocated recycling facilities or tritium supply alone. In addition, all facilities would be designed for earthquake-generated ground acceleration in accordance with DOE Order 5480.28 and accompanying safety guides.

Volcanic activity has not occurred in the area for millions of years and is extremely unlikely to impact the project. It is also highly unlikely that landslides, sinkhole development, or other nontectonic events would affect project activities. Slopes and underlying foundation materials are stable.

Properties and conditions of soils underlying the proposed sites have no limitations on construction with the exception of a moderate-to-severe shrink-swell potential in nearly all areas. This factor would be considered in facility design and site preparation. Soils would be impacted during construction of any of the facilities. The amount of acreage that would be potentially disturbed by the tritium supply technologies and tritium recycling facilities is shown in table 4.5.3.1–1. Soils therefore would not adversely affect the safe operation of project activities.

The surface area of soil disturbance from construction of new facilities would be as much as 562 acres for a MHTGR collocated with recycling facilities. Disturbance would occur at building, parking, and construction laydown areas, destroying the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil losses would depend on frequency of storms; wind velocities; size and location of the facilities with respect to drainage and wind patterns; slopes, shape, and area of the tracts of ground disturbed; and, particularly during the construction period, the duration of time the soil is bare. Construction of both the MHTGR and the APT would also necessitate deep excavations to accommodate reactor modules and an accelerator tunnel, respectively (sections 3.4.2.2 and 3.4.2.4). A considerable volume of soil would be removed as a result of excavations. Most of the material removed would be sand or shale fragments derived from bedrock and could be stockpiled for use as fill. Some of this material could be used to cover the accelerator tunnel of the APT. Site-specific NEPA studies would evaluate in detail impacts to geology and soils at Pantex resulting from deep excavations required for the MHTGR and the APT and would identify appropriate mitigation measures.

Net soil disturbance during operations would be less than for construction, because areas temporarily used for laydown would be restored. Although erosion from stormwater runoff and wind action could occur occasionally during operations, they are anticipated to be minimal.

Appropriate erosion and sediment control measures would be used to minimize soil loss. Wind erosion is likely to occur on an intermittent basis, depending on the wind velocities, the amount of soil exposed, and the effectiveness of control measures.

Less Than Baseline Operations. Under the less than baseline tritium requirement operation, geological and soil impacts would not change for the HWR, MHTGR, or ALWR technologies. Disturbed acreage for the Phased APT would be the same as the baseline tritium requirement for the Full APT; therefore, impacts would be the same.

Multipurpose Reactor. The multipurpose MHTGR would disturb an additional 270 acres of land to

accommodate the construction of three additional reactor modules and a Pit Disassembly/Conversion Facility. The additional land area disturbances would result in the destruction of the soil profile and potential temporary increase in erosion as a result of stormwater runoff and wind action. The three additional reactor modules would also double the excavation requirements over that for the tritium supply MHTGR. The excavated soil would substantially increase the volume of soil needing storage and/or disposal. Impacts on ground water resources from the excavation are not expected.

Construction impacts for the multipurpose ALWR would be the same as those described for the tritium supply ALWR. Additional soil impacts would be expected from the construction of the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility needed to support the multipurpose ALWR. Approximately 129 acres would be disturbed for the new facility, destroying the soil profile and leading to a possible temporary increase in erosion as a result of stormwater runoff and wind action. Soil losses would depend on frequency of storms; wind velocity; location of the facility with respect to drainage and wind pattern; slope, shape, and area of the tracts of ground disturbed; and the duration of time the soil is bare.

Soil impacts during operation are expected to be minimal. Appropriate erosion and sediment control measures would be used to minimize any long-term soil losses.

Potential Mitigation Measures. Mitigation measures would be required to control erosion of soil, especially during construction. Potential mitigation measures include standard practices for erosion, sediment, and dust control such as silt fences, sediment traps, runoff diversion dikes, drainageways, Sedimentation ponds, establishment of ground cover and windbreaks, grading of slopes, and construction of berms or other controls appropriate to the sites. Standard control for wind erosion, such as wetting the surface, would be done on a day-to-day basis. Exposing only small areas for limited periods of time, as necessary, could also reduce erosional effects. After the construction period, long-term control measures could include grading, revegetation, or landscaping.

4.5.3.6 *Biotic Resources*

Construction and operation of tritium supply and recycling facilities at Pantex would have the potential to affect biotic resources. Impacts resulting from the construction of the HWR, MHTGR, ALWR, or Full APT to meet the baseline tritium requirement would occur only at the beginning of the project lifecycle. The less than baseline tritium requirement, Phased APT could incur some additional construction-related impacts if expansion is needed to meet baseline tritium requirements. The potential impacts would be minor since the expansion would occur in the already developed main plant site. Impacts to terrestrial resources would result from the loss of habitat during construction and operation. Wastewater discharge to the playas could cause a general degradation of the naturally occurring ephemeral wetland system and an increase in open water habitat. The only consistently occurring Federal-listed threatened or endangered species that would potentially be disturbed by the proposed action are wintering bald eagles that forage at playas. Several special-status species could be affected, primarily through the loss of potential foraging, denning, and nesting habitat or by the destruction of less mobile species during construction. Where impacts could occur, mitigation measures would be developed in consultation with the USFWS. This consultation would be conducted at the site-specific level in tiered NEPA documents. Table 4.5.3.6–1 summarizes the potential changes to biotic resources resulting from the proposed action. In general, no major difference in impacts to biotic resources exists among the four tritium supply technologies and recycling facilities.

The following discussion of impacts from a multipurpose reactor and a dedicated power plant for the APT applies to the biotic resources at Pantex as a whole. Where potential impacts to a specific biotic resource are notable for the tritium supply technologies, the discussion on multipurpose reactors identifies the potential impacts to the same resource.

Multipurpose Reactor. The selection of the multipurpose reactor option could result in additional impacts to biotic resources at Pantex. The MHTGR Pit Disassembly/Conversion Facility and the ALWR Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility would require an additional 129 acres of land. However, it is expected that during the

TABLE 4.5.3.6–1.—*Potential Impacts to Biotic Resources During Construction and Operation Resulting from Tritium Supply Technologies and Recycling at Pantex Plant*

Affected Resource Indicator	No Action	Tritium Supply Technologies and Recycling				
		HWR	MHTGR	ALWR	APT	Tritium Recycling
Acres of habitat disturbed	0	462[a]	562[a]	552[a]	375[a]	202
Wetlands potentially impacted	None	Yes	Yes	Yes	Yes	Yes
Aquatic resources potentially impacted	None	None	None	None	None	None
Number of threatened and endangered species potentially affected[b]	0/0	1/6	1/6	1/6	1/6	1/6

[a] Acreage disturbed by each tritium supply technology may be obtained by subtracting the acreage for the tritium recycling facility from the tritium supply technologies and recycling acreage.

[b] The number of threatened and endangered species are represented by two data inputs (a/b) where: a = the number of Federal-listed threatened and endangered species, and b = the number of all other special status species (i.e., Federal candidate and/or state-listed species) that are potentially impacted.

Source: DOE 1992b; DOE 1992o.

design phase, land requirements for this facility would be substantially reduced with integrated into the reactor and recycling facility design. In addition an MHTGR would require three additional modules which would displace about 240 acres. Thus, total land requirements for the MHTGR and ALWR multipurpose reactors would be 931 and 691 acres, respectively. In general, impacts to terrestrial resources would be similar to, but greater than, those described for the tritium supply and recycling facility.

The fuel fabrication facility supporting the multipurpose reactor would result in some additional wastewater being discharged to site playas. Selection of a MHTGR or ALWR as the multipurpose reactor would not result in wastewater discharge beyond that associated with the fuel fabrication facility. Mitigation measures would be required to address these additional impacts.

For both the MHTGR and ALWR multipurpose reactor options, impacts to threatened and endangered species would be similar to, but greater than, those described for the tritium supply and recycling facility. This is the case since more land would be required.

Accelerator Production of Tritium Power Plant. A dedicated natural gas-fired power plant, similar to that described in section 4.8.2.2, could be an option to support an APT at Pantex. This facility, which would be constructed on the proposed TSS, would occupy 25 acres of land. Construction of the gas-fired power plant would increase the land disturbance associated with the APT from 375 to 400 acres. This would result in a slight increase in impacts to biotic resources over those described for the tritium supply and recycling facility. Infrastructure requirements, such as parking and laydown areas, would be incorporated into and take advantage of similar requirements associated with the APT power plant. Rights-of-way would be sited to take advantage of existing corridors to the maximum extent practical.

Terrestrial Resources

No Action. Under No Action, the mission described in section 3.3.4 would continue. This would result in no additional impacts to terrestrial resources. Vegetation bordering playas would remain and those portions of the site currently used for agricultural purposes would be maintained. These areas would continue to provide the same amount of wildlife habitat as in the past.

Tritium Supply and Recycling. Construction and operation of the HWR, MHTGR, ALWR, or APT and recycling facilities at the proposed TSS would result in the disturbance of 462, 562, 552, and 375 acres, respectively, or between 2.5 and 3.7 percent of the site (table 4.5.3.6–1). The acreage includes areas on which plant facilities would be constructed, as well as areas revegetated following construction. Vegetation

within the proposed TSS would be lost during land clearing activities. Since development would not occur on playas, new construction would take place on open land, agricultural land, or previously developed areas.

Constructing any of the tritium supply technologies and recycling facilities would have some adverse effects on animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would be destroyed during land clearing activities. Construction activities would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. Nests of migratory birds and young animals living within the proposed TSS could be lost during construction. Areas that would be re-established as farmland or revegetated upon completion of construction would be recolonized by animal species present in nearby, undisturbed habitats.

Activities associated with facility operation, such as noise and human presence, could affect wildlife living immediately adjacent to the facility. These disturbances may cause some species to move from the area.

A nonevaporative cooling design is proposed for all tritium supply technologies at Pantex except for the APT. While there would be no impacts to vegetation from salt drift from an HWR, MHTGR, or ALWR, this may not be the case for the APT. A total of 10 separate cooling towers would be located along the length of the facility (section 3.4.2.4). Since design parameters for these towers are not known at this time, it is not possible to estimate impacts. This would be determined in future tiered NEPA documentation.

Construction and operation of a tritium supply facility alone would result in similar impacts to terrestrial resources but less than those described for a collocated tritium supply and recycling facility. Impacts would be less since 202 fewer acres of habitat would be disturbed.

Less Than Baseline Operations. Operation of the HWR, MWTGR, or ALWR at reduced tritium production capacity would have the same impacts described above for production at baseline tritium requirements.

Construction-related impacts of the less than baseline tritium requirement Phased APT would be similar to those described above. Some additional construction-related impacts could occur if expansion is needed to meet baseline tritium requirements. The potential impacts would be minor since the expansion activities would occur in the already developed main plant site.

Potential Mitigation Measures. Loss of habitat due to construction and operation of any of the tritium supply technologies and recycling facilities may be mitigated by returning land to agricultural use or revegetating disturbed areas, as appropriate. Disturbance to wildlife living in areas adjacent to the new facilities may be reduced by limiting worker access to these areas. It may be necessary to survey the proposed TSS for the nests of migratory birds prior to clearing operations and/or avoid clearing operations during the breeding season.

Wetlands

No Action. Under No Action, the missions described in section 3.3.4 would continue. No new impacts to wetlands would occur. Wastewater discharges to Playas 1, 2, and 4 would continue in compliance with the current Texas Natural Resources Conservation Commission permit and the pending NPDES permit.

Tritium Supply and Recycling. Impacts to wetlands (e.g., sedimentation) may result from land disturbances and treated wastewater disposal during construction. Construction-related ground disturbance increases the potential for sediment runoff to the playa wetlands. This impact would be controlled through the implementation of standard soil erosion and sediment control measures. Playas 1 through 5 would be avoided during construction. Depending on the final site layout, smaller areas of potential wetlands indicated on site National Wetlands Inventory maps could be impacted. Determination of the extent and jurisdictional status of these small wetlands would require site evaluation and concurrence by the U.S. Army Corps of Engineers. Any potential impacts to wetlands resulting from construction activities would be mitigated according to U.S. Army Corps of Engineers requirements.

During construction, the HWR, MHTGR, ALWR, or APT would discharge treated wastewater to the

playas (section 4.5.3.4). Part of the discharge water would be lost to the atmosphere due to the high regional evapotranspiration rate. However, temporary impacts to the playas could include shifts in the composition of wetland plant communities and limited increases in the area of open water. The plant community shifts would favor plants tolerant of longer and deeper inundation. Furthermore, disturbed plant communities provide an opportunity for establishment of invasive exotic plant species. These changes would alter the naturally occurring ephemeral wetland system characteristic of the playas.

During operation of any of the four technologies, treated wastewater would be discharged to the playa basins (section 4.5.3.4). The discharge of wastewater to the playas could adversely affect the playa ecosystem. Impacts to playa wetlands could include shifts in the composition of wetland plant communities, opportunities for establishment of exotic vegetation, and increases in the areas of open water. Any discharge to the playa(s) would be required to conform to water quality requirements of NPDES and Texas Natural Resources Conservation Commission permits. For the APT tritium supply alternative it is also possible, depending on the location of the cooling tower, that salt drift could impact wetlands. Impacts to wetlands would depend upon the sensitivity of plant species present, but could lead to a shift in species composition.

Construction and operation of a tritium supply facility alone would result in similar impacts to wetlands but slightly less than those described for a collocated tritium supply and recycling facility. This is the case since both land and water requirements would be less.

Less than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced tritium production capacity would have similar wetland impacts described above for production at baseline tritium requirements. Construction and operation of a Phased APT would have similar wetland impacts but potentially slightly less than the Full APT.

Potential Mitigation Measures. Construction and operation activities would be designed to avoid or minimize, as much as possible, any potential impacts to wetlands. Any unavoidable impacts would be mitigated according to DOE policy set forth in 10 CFR 1022 and in accordance with U.S. Army Corps of Engineers requirements. Mitigation could include creation of lined evaporation ponds to limit areas of open water in playas or restoration or creation of compensatory wetlands to offset any unavoidable wetland losses. All effluent discharges to wetlands would be regulated through the provision of NPDES and Texas Natural Resources Conservation Commission permits.

Aquatic Resources

No Action. Under No Action, the missions described in section 3.3.4 would continue. This would not change the condition of aquatic resources at Pantex.

Tritium Supply and Recycling. Construction of tritium supply technologies and recycling facilities would result in discharges of wastewater to the playas. As discussed for wetlands, the discharges could potentially result in a small increase in open water area. During construction, aquatic communities resulting from the creation of open water bodies would be temporary in nature. Playas could also be affected by sediment runoff during construction; however, this impact would be controlled through the use of soil erosion and sediment control measures.

During operation, discharges to playas would not be sufficient to create large permanent areas of aquatic habitat, but may increase the availability of habitat for amphibians. Discharges to playas would conform to the requirements of NPDES and Texas Natural Resources Conservation Commission permits.

Construction and operation of a tritium supply facility alone would result in similar impacts to playas, but slightly less than those described for a collocated tritium supply and recycling facility. This is the case since both land and water requirements would be less.

Less than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced tritium production capacity would have similar impacts to aquatic resources at Pantex. Construction and operation of a Phased APT would have similar aquatic resource impacts, but potentially slightly less than the Full APT.

Potential Mitigation Measures. Potential impacts to aquatic resources would be mitigated through the implementation of a soil erosion and sediment control plan. All discharges would be required to meet NPDES and Texas Water Commission permit requirements.

Threatened and Endangered Species

No Action. Under No Action, the missions described in section 3.3.4 would continue. There would be no changes to the current status of threatened and endangered species at Pantex described in section 4.5.2.6.

Tritium Supply and Recycling. The bald eagle is the only consistently occurring Federal-listed species that has the potential to be affected by construction activities. Bald eagles avoid areas where humans are active; thus, wintering eagles would not be expected to forage at playas during project construction.

Six Federal candidate (Category 2) species may be affected by construction activities. Similar to the bald eagle, the black tern and white-faced ibis may be discouraged from foraging at site playas during construction. The ferruginous hawk also would lose some foraging habitat (i.e., grasslands and agricultural areas) and the possible disturbance of prairie dog towns could reduce a relied-upon food source. The swift fox and loggerhead shrike would also lose potential foraging and denning or nesting habitat. The Texas horned lizard is less mobile and would be destroyed during land-clearing activities. Preactivity surveys would be required prior to construction to determine the occurrence of these species in the area to be disturbed.

During operation, the ferruginous hawk and swift fox would not use areas in close proximity to the operating plant. New fencing would create foraging lookout perches for loggerhead shrikes.

Construction and operation of a tritium supply facility alone would result in similar impacts to threatened and endangered species, but slightly less than those described for a collocated tritium supply and recycling facility. Impacts would be less since fewer acres of habitat would be disturbed.

Less than Baseline Operations. Operation of the HWR, MHTGR, or ALWR at reduced tritium production capacity would be expected to result in similar impacts to threatened, endangered, or sensitive species as described for the baseline tritium production requirement. Construction and operation of a Phased APT would also have similar impacts on these species.

Potential Mitigation Measures. Since most impacts are temporary in nature, few mitigative efforts would be required for threatened and endangered species that may occur at Pantex. Consultation with the USFWS would be pursued as required and, if deemed necessary, a detailed plan to mitigate impacts to Federal-listed threatened and endangered species at Pantex would be developed. No critical habitat has been designated for threatened and endangered species at Pantex.

4.5.3.7 *Cultural and Paleontological Resources*

Cultural and paleontological resources may be affected directly through ground disturbance during construction, building modifications, visual intrusion of the project to the historic setting or environmental context, visual and audio intrusions to Native American resources, reduced access to traditional use areas, and unauthorized artifact collecting and vandalism. Intensive cultural resources surveys and site evaluations have not been completed for the majority of the proposed TSS. Site-specific surveys and evaluations would be conducted in conjunction with tiered NEPA documentation. Although the location and acreage for the proposed tritium supply facility or the combined tritium supply and recycling facilities will vary, their potential effects on cultural and paleontological resources are based primarily on the amount of ground disturbance; therefore, the facilities with the greatest ground disturbance will have the greatest potential effect on cultural and paleontological resources. A small number of NRHP-eligible prehistoric and historic properties, or important Native American or paleontological resources may be affected by the proposed action.

Multipurpose Reactor. Total land requirements for the MHTGR and ALWR multipurpose reactors would be 931 and 691 acres, respectively. NRHP-eligible prehistoric and historic sites, Native American resources, and paleontological resources may occur within these acreages and may be effected by the construction of a multipurpose reactor. In

general, impacts to prehistoric and historic resources, Native American resources, and paleontological resources would be similar to, but potentially greater than, those described for the tritium supply and recycling facility.

Prehistoric and Historic Resources

No Action. Under No Action, DOE would continue existing and planned missions at Pantex. Any impacts to prehistoric and historic resources from these missions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Land disturbance at Pantex for the proposed tritium facilities (section 3.4) would range from 173 acres for the APT to 360 acres for the MHTGR (section 4.5.3.1). Acreages for the HWR and ALWR would be 260 and 350, respectively. Acreage required by the recycling facilities would be an additional 196 acres. Potentially NRHP-eligible prehistoric or historic archaeological properties may occur within the acreages that would be disturbed during construction. Such NRHP-eligible properties would be identified through project-specific inventories and evaluations, and any project-related effects would be addressed in tiered NEPA documentation. Operation of facilities does not involve additional ground disturbance, increased activity or building modification; therefore, prehistoric or historic properties would not be affected.

Less Than Baseline Operations. No change in impacts to prehistoric and historic resources would be expected from operating the HWR at reduced capacity. Impacts for the MHTGR or ALWR would also not change from those described for the baseline requirement because the MHTGR or ALWR would not be a reduced size or operate at reduced capacity.

Construction and operation of the Phased APT would not change the expected impacts from the baseline tritium requirement since the disturbed area would be the same.

Potential Mitigation Measures. If any NRHP-eligible properties cannot be avoided through project design or siting, and would result in an adverse effect, then a Memorandum of Agreement would need to be negotiated among DOE, the Texas SHPO, and the Advisory Council on Historic Preservation describing and implementing intensive inventory and evaluation studies, data recovery plans, site treatments, and monitoring programs. The appropriate level of data recovery for mitigation would be determined through consultation with the Texas SHPO and the Advisory Council on Historic Preservation, in accordance with Section 106 of the *National Historic Preservation Act.*

Native American Resources

No Action. Under No Action, DOE would continue existing and planned missions at Pantex. Any impacts to Native American resources from these missions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Some Native American resources could occur within any areas disturbed during construction of the tritium supply plant or combined tritium supply and recycling facilities. Such resources may include campsites, ritual or traditional use areas, or burials. Operation of tritium facilities may create visual intrusions on sacred sites in the vicinity or reduce access to traditional use areas. Specific concerns about the presence, type, and locations of Native American resources would be identified through consultation with affected Native American groups, and any project-related effects would be addressed through direct consultation with the affected group(s) in tiered NEPA documents.

Less Than Baseline Operations. Impacts to Native American resources would not change due to less than baseline operation of the HWR, MHTGR, or ALWR. Construction and operation of a Phased APT would have similar impacts on Native American resources as those described for the baseline requirement Full APT.

Potential Mitigation Measures. If Native American resources cannot be avoided through project design or siting, then acceptable mitigation measures to reduce project effects on them would be determined in consultation with the affected Native American groups. In accordance with the *Native American Graves Protection and Repatriation Act* and the *American Indian Religious Freedom Act*, such mitigations may include, but not be limited to, appropriate relocation of human remains, planting vegetation screens to reduce visual or noise intrusions, increasing access to traditional use areas during operations,

or transplanting or harvesting important Native American plant resources.

Paleontological Resources

No Action. Under No Action, DOE would continue existing and planned missions at Pantex. Any impacts to paleontological resources from these missions would be independent of and unaffected by the proposed action.

Tritium Supply and Recycling. Paleontological resources may occur within the acreages disturbed during construction of the tritium supply plant or combined tritium supply and recycling facilities. Any project-related effects to scientifically important paleontological resources would be identified in tiered NEPA documentation and addressed through project-specific evaluation studies. Operation of tritium facilities does not involve additional ground disturbance or increased activity; therefore, paleontological resources would not be affected.

Less Than Baseline Operations. No change in impacts to paleontological resources would be expected due to reduced operation of the HWR, MHTGR, ALWR, or construction of a Phased APT.

Potential Mitigation Measures. Because scientifically important buried paleontological materials could be affected, paleontological monitoring of construction activities and data recovery of fossil remains would be appropriate mitigation measures.

4.5.3.8 *Socioeconomics*

Locating any of the tritium supply technologies alone or with recycling facilities at Pantex would affect socioeconomics in the region. Section 3.2 provides descriptions for No Action, the tritium supply technologies, and tritium recycling. Siting a tritium supply technology with or without the recycling facilities at Pantex would create changes in some of the communities in both the ROI and the regional economic area. The in-migrating population could increase the demand for housing units. Additionally, there could be an associated increased burden on community infrastructure and subsequent effects on the public finances of local governments in the ROI. The increase of population could also burden transportation routes in the ROI.

During the construction period, the greater changes in socioeconomic characteristics would result from the ALWR and APT. During operation, the ALWR, HWR, and MHTGR would exhibit similar characteristics. The APT would result in the smallest changes during operation. None of these tritium supply technologies would increase population, the need for additional housing, or local government spending in the ROI beyond 7 percent over No Action during peak construction or operation. Although the greatest percent increases in employment, population and housing, and public finance during construction and operation occur in the peak years of 2005 and 2010, respectively, the annual average increases over the construction period (2001 to 2005) are between 1 and 3 percent average growth annually and less than 1 percent average annual growth during operation (2010 to 2050). Between peak construction (2005) and full operation (2010) annual average growth would vary from decreases of 1 percent to increases of 1 percent.

The effects of locating any of the tritium supply technologies alone or with recycling facilities at Pantex are summarized in section 4.5.3. The following sections describe the effects that locating one of these technologies would have on the local region's economy and employment, population, housing, public finances, and local transportation.

Employment and Local Economy

Changes in employment and levels of economic activity in the 15-county regional economic area from the proposed location of a tritium supply technology and recycling facility at Pantex are described in this section. Although specialized personnel, materials, and services required for construction and operation would be imported from outside the area, a significant portion of these requirements would be available in this regional economic area. Figures 4.5.3.8–1 and 4.5.3.8–2 present the potential changes in employment and local economy that would occur with all of the technologies.

No Action. Under No Action, employment at Pantex increased to approximately 3,400 persons in 1994. This is an increase of approximately 1,000 persons over the 1990 employment. Pantex employment is projected to decrease to 1,790 persons in 2010 and remain at this level through 2020. Historical and future employment projections at Pantex are found in appendix table D.2.1–1. The total Pantex payroll was approximately $174 million in 1994 and is projected to decrease to $85 million in 2010.

Total employment in the regional economic area is projected to grow less than 1 percent annually between 2001 and 2009, reaching 167,800 persons, and then decrease slightly (much less than 1 percent) annually between 2010 and 2020, reaching 162,000 persons. The unemployment rate in the regional economic area is expected to remain at 4.6 percent between 2001 and 2020. Per capita income is projected to increase from $22,300 to $25,700 during this 20-year period. No Action estimates are presented in appendix table D.3–53.

Tritium Supply and Recycling. Construction activities would begin between 2001 and 2003 and would be completed between 2007 and 2009. Phasing in of employment for the operation of the new facilities would begin in 2007 or 2008, peak at full employment by 2010, and continue at this level into the future.

Locating any of the tritium supply technologies and recycling facilities at Pantex would create new jobs (direct) at the site. Indirect job opportunities, such as community support services, also would be created in the regional economic area as a result of these new

jobs. The total new jobs (direct and indirect) created would reduce unemployment and increase income in the economic region surrounding Pantex during both the construction and operation periods of the proposed action.

Construction. Siting tritium supply technologies and recycling facilities at Pantex would require a total of approximately 7,400 to 13,600 worker-years of activity over a 5- to 9-year construction period. This construction-related employment would indirectly create other jobs in the regional economic area and total employment would grow at an annual average rate of 1 to 2 percent until the peak year of 2005. Between 2005 and 2010, employment would decrease by less than 1 percent annually. Figure 4.5.3.8–1 gives the estimates of total jobs (direct and indirect) that would be created during peak construction (2005) for each of the tritium supply technologies with recycling and the recycling facility's contribution to employment growth.

As employment opportunities grow in the regional economic area due to the proposed action, the unemployment rate would be reduced from the No Action estimate of 4.6 percent. Figure 4.5.3.8–2 presents a comparison of unemployment rates for the different tritium supply technologies and recycling during peak construction in 2005. During the project's peak construction phase, the unemployment rate would range from 2.7 to 2.2 percent, depending upon the tritium supply technologies with recycling selected.

Income in the regional economic area would also increase, particularly during peak construction, as shown in figure 4.5.3.8–2. Per capita income is expected to increase at an annual average of 1 percent until the peak construction year (2005) and between 2005 and 2010.

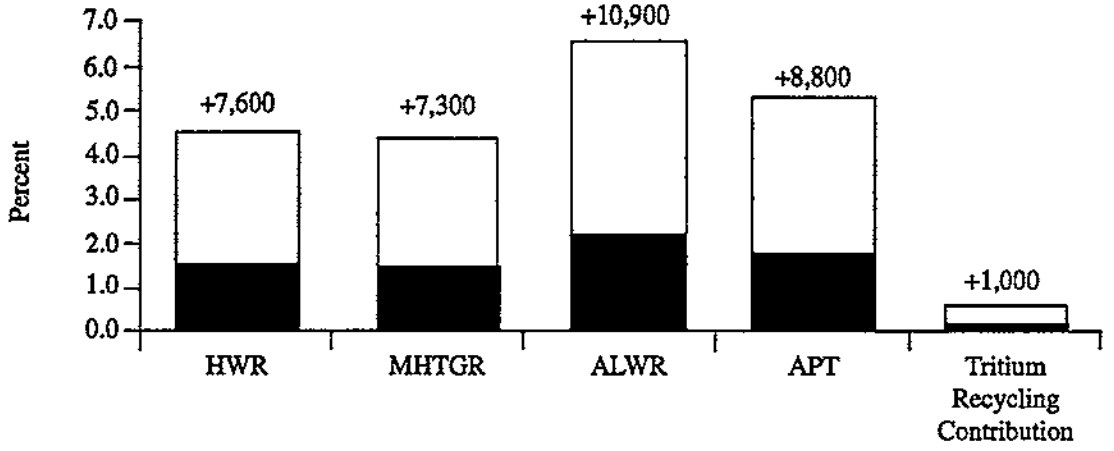
Operation. Employment for operation would begin phasing in as construction neared completion and the construction-related employment would begin phasing out. It is expected that full operation employment would peak in 2010 and continue at this level into the future. Figure 4.5.3.8–1 gives the total project-related jobs projections (direct and indirect) for each of the tritium supply technologies and recycling facilities for 2010. Total employment in the regional economic area would decrease slightly over the next 10 years at an annual average decrease of less than 1 percent, similar to the No Action annual rate of decrease.

Creation of additional job opportunities would reduce the unemployment rate below that projected for No Action. Figure 4.5.3.8–2 presents the differences in unemployment rates during the first year of full operation employment (2010) for each of the tritium supply technologies and recycling facilities. From 2010 to 2020, unemployment would be reduced from the No Action projection of 4.6 percent to between 2.8 and 2.5 percent, depending upon the technology selected for the proposed action.

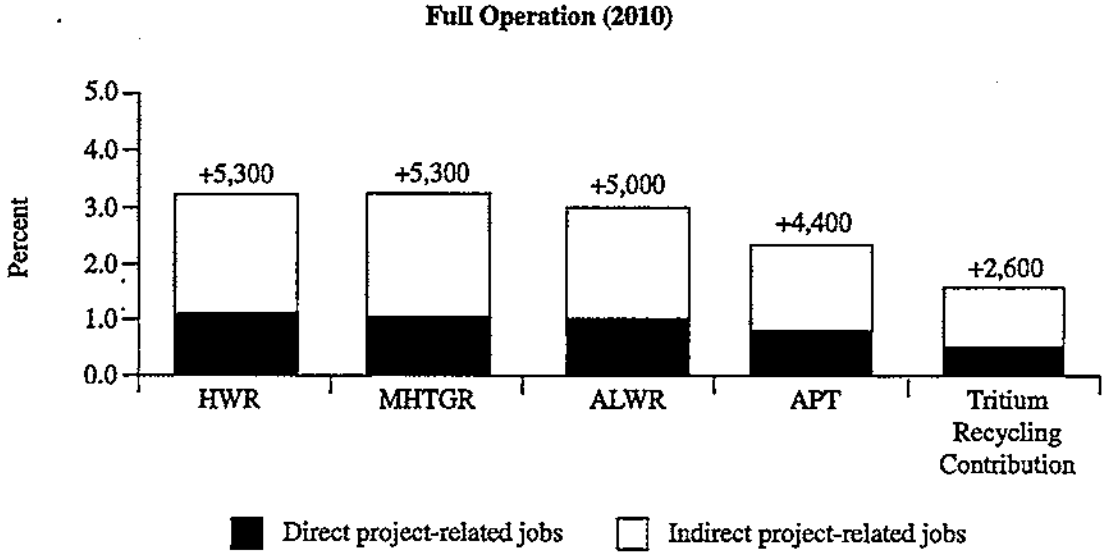
Income also would increase slightly in the regional economic area as a result of the proposed action. Per capita income differences for tritium supply technologies and recycling facilities for 2010 are given in figure 4.5.3.8–2. Per capita income annual average increases would be less than 1 percent between 2010 to 2020 for any of the tritium supply technologies and recycling facilities located at Pantex. The No Action projected annual average increase during the same period would also be less than 1 percent.

Tritium Supply Alone. Construction of a tritium supply technology only without a recycling facility would begin between 2001 and 2003 and would be completed between 2007 and 2009. Employment for the operation of the facility would begin in 2007 and reach full employment by 2010. Locating any of the tritium supply technologies at Pantex would create new jobs at the site and indirectly create other jobs in the region. However, this job creation and the additional economic effects that would occur would be less than the effects expected with the collocation of tritium supply with the recycling facility.

Construction. Construction of a tritium supply technology alone would require a total of 6,380 to 12,600 worker-years of activity over a 5- to 9-year period. New jobs would be created at an annual average rate of 1 to 2 percent until the peak year of construction, 2005. Between 2005 and 2010, employment would range from no employment growth to an annual average decrease of 1 percent for the four technologies. Appendix table D.3–54 presents the estimates of total employment that would be created during peak construction in 2005, or these new jobs can be calculated by subtracting the



Note: For No Action, total employment is 166,400 jobs.

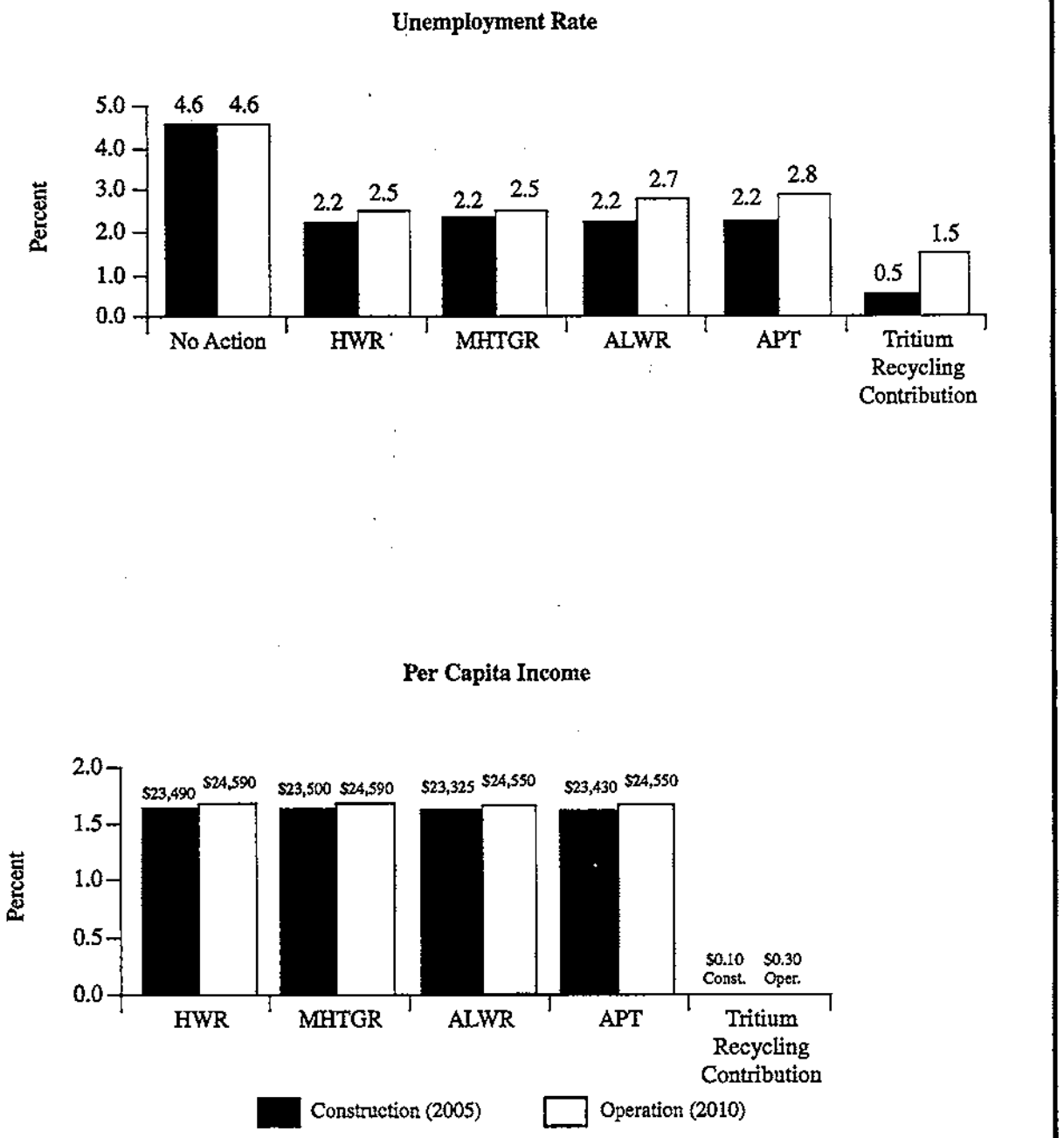


Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For No Action, total employment is 168,150 jobs. The percent increase in total employment during construction and operations was calculated by dividing the total project-related jobs by the total employment for No Action.

Source: Appendix table D.3–55.

2271

FIGURE 4.5.3.8–1.—*Total Project-Related Employment (Direct and Indirect) and Percentage Increase Over No Action from Tritium Supply Technologies and Recycling for Pantex Plant Regional Economic Area.*



Note: For No Action, per capita income is projected to be $23,130 in 2005 and $24,200 in 2010.
Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution.
Source: Appendix table D.3–55.

2272

FIGURE 4.5.3.8–2.—*Unemployment Rate, Per Capita Income, and Percentage Increase Over No Action from Tritium Supply Technologies and Recycling for Pantex Plant Regional Economic Area.*

tritium recycling contribution from tritium supply technologies and recycling in figure 4.5.3.8–1.

Although the construction of the facility would create new jobs, the effects would not be enough to greatly affect the unemployment rate projected for No Action. Additionally, per capita income in the region would rise only slightly above the per capita income increase estimated for No Action. Estimates of unemployment rate and per capita income are presented in appendix table D.3–54 or can be derived for tritium supply alternatives by subtracting the tritium recycling contributions in figures 4.5.3.8–2.

Operation. Operation employment for the tritium supply technology only would begin phasing in at the end of the construction period and be at full employment in 2010. Full employment is expected to be maintained for the life of the facility. Estimates for full employment in 2010 are presented in appendix table D.3–54. Total project related jobs (direct and indirect) for the tritium supply technologies alone can be calculated by subtracting the tritium supply contribution in figure 4.5.3.8–1.

The addition of new jobs during operation would reduce the unemployment rate below the projection for No Action. The unemployment rate for 2010, the first year of full operation employment, is given in appendix table D.3–54 or can be derived by subtracting the tritium recycling contribution in figure 4.5.3.8–2.

The creation of new jobs as a result of the tritium supply operation would also increase income slightly over the No Action estimates. Appendix table D.3–54 gives the per capita income for the tritium recycling facility for 2010. Per capita income growth can also be calculated by subtracting the tritium recycling contribution in figure 4.5.3.8–2. From 2010 through 2020, per capita income annual increases would be 1 percent, the same annual increase projected under No Action.

Less Than Baseline Operation. Tritium supply technologies that provide less than the baseline tritium operation capacities are described in section 3.1. These options may or may not be collocated with the tritium recycling facilities. The options include lowering the power in the HWR, using fewer target rods in the MHTGR or ALWR, and the phased approach for the APT.

Construction. The less than baseline operations case for the HWR, MHTGR, and ALWR would have the same construction workforce requirements as discussed in the tritium supply and recycling and tritium supply only sections. Therefore, employment and economic effects in the region would be the same.

The Phased APT would require the same total number of construction workers as the Full APT, but the construction period would span 1999 to 2008 instead of 2003 to 2007. Additionally, peak construction would occur in 2003 instead of 2005. The effects on the regional economic area's employment, unemployment rate, and per capita income as a result of constructing the Phased APT are presented in appendix table D.3–54. Appendix table D.3–55 presents the effects on employment, unemployment rate, and per capita income for constructing the Phased APT with tritium recycling facilities. Generally, average annual increases in employment and income would be similar to those for the Full APT, but these increases are over a longer period of time. These increases are between less than 1 percent and 2 percent, respectively.

Operation. Operation workforce requirements for the less than baseline tritium requirement case for the HWR, MHTGR, ALWR, and the Phased APT would be the same as those described in the tritium supply and recycling and tritium supply only sections. Thus, regional employment and economic effects would be the same.

Multipurpose Reactor. Construction activities for the multipurpose reactor would begin in 2001 and would be completed by 2009. Phasing in of employment for the operation of the multipurpose reactor would begin in 2007, peak at full employment by 2010, and continue at that level into the future. Because this option would perform three processes, it would result in greater changes in employment and local economy characteristics than any of the four tritium supply technologies.

Construction. Siting the multipurpose reactor and a recycling facility at Pantex would require 19,140 worker-years of activity over a 9-year period. The

multipurpose reactor alone would require 18,150 worker-years of activity over a 9-year period. Employment characteristics, unemployment rates, and per capita income characteristics during construction of the multipurpose reactor alone and with a tritium recycling facility are presented in appendix tables D.3–54A and D.3–55A, respectively. From the first year of construction to the peak year (2005), annual average increases in employment and per capita income would range 1 to 3 percent. Between 2005 and 2010, employment would decrease annually by less than 1 percent and per capita income would increase on an annual average of 1 percent. The unemployment rate during peak construction for this option with or without a recycling facility would be 2.2 percent.

Operation. Operation employment for the APT power plant would begin phasing in toward the end of the construction period and reach full employment in 2010. Full employment is expected to be maintained for the life of the facility. Employment characteristics, unemployment rates, and per capita income characteristics during operation of the APT power plant alone and with a tritium recycling facility are presented in appendix tables D.3–54A and D.3–55A, respectively. During operation annual employment would decrease annually by less than 1 percent and annual average growth in per capita income would be less than 1 percent. The unemployment rate for the multipurpose reactor alone and with a recycling facility would be 2.4 percent and 2.9 percent, respectively.

Accelerator Production of Tritium Power Plant. Construction activities for the APT power plant would begin in 2003 and would be completed by 2007. Phasing in of employment for the operation of the APT power plant would begin in 2007, peak at full employment by 2010, and continue at that level into the future. This option is similar to the APT with an addition of a gas power plant. The changes in employment and local economy would be similar, but greater than those resulting from the APT.

Construction. Siting this option with a recycling facility at Pantex would require 7,600 worker-years of activity over a 5-year period. The APT power plant alone would require 6,600 worker-years of activity of a 5-year period. Employment characteristics, unemployment rates, and per capita income characteristics during construction of this option alone and with a tritium recycling facility are presented in appendix tables D.3–54Aand D.3–55A, respectively. From the first year of construction to the peak year (2005), annual average increases in employment and per capita income would range from less than 1 to 3 percent. Between 2005 and 2010, employment would decrease annually by less than 1 percent and per capita income would increase on an annual average of 1 percent. The unemployment rate during peak construction for this option with or without a recycling facility would be 2 percent.

Operation. Operation employment for the APT power plant would begin phasing in toward the end of the construction period and reach full employment in 2010. Full employment is expected to be maintained for the life of the facility. Employment characteristics, unemployment rates, and per capita income characteristics during operation of the APT power plant alone and with a tritium recycling facility are presented in appendix tables D.3–54A and D.3–55A, respectively. During operation annual employment would decrease by less than 1 percent annually and annual average growth in per capita income would be less than 1 percent. The unemployment rate for the APT power plant alone and with a recycling facility would be 2.7 percent and 3.7 percent, respectively.

Population and Housing

Changes to ROI population and housing expected from the proposed action are described in this section. Additional population could be expected to in-migrate to the Pantex region and these people would be expected to reside in cities and counties within the ROI in the same relative proportion as the existing population. Increases to population could lead to a demand for additional housing units beyond existing vacant housing available during construction or operation phases of the proposed action. Figures 4.5.3.8–3 and 4.5.3.8–4 present the changes in population and housing over No Action for the tritium supply technologies and recycling facilities.

No Action. Population and housing annual average increases between 2001 and 2009 are projected to be less than 1 percent. Future annual average increases are also projected to be much less than 1 percent between 2010 and 2020. Population in the ROI is

estimated to reach 205,100 in 2010 and 209,000 in 2020. Total housing units in the ROI are estimated to reach 88,400 in 2010, and 90,000 in 2020. No Action estimates are presented in appendix tables D.3–56 and D.3–59.

Tritium Supply and Recycling. It is expected that the proposed action at Pantex would increase population and housing demands in the ROI (7 percent) over No Action projections during peak construction. The effects are expected to be fewer (2 percent) during the operation phase of the proposed action.

Construction. Construction activities would be phased over a 5- to 9-year period. Figure 4.5.3.8–3 illustrates that during peak construction (2005), the ALWR and APT would create the largest population and housing demand increases over No Action, and the HWR and MHTGR would have the least effects. The increase in population could require some additional housing units beyond what is currently available in the existing housing mix. However, any requirements for additional housing units would be at annual average increases of less than 1 percent in the first 3 years of construction of the ALWR and APT, followed by an approximately less than 1 percent decrease until peak operation. The other tritium supply technologies would also have annual average population and housing demand growth of less than 1 percent. Therefore, there would not be any major effects on any of the ROI communities.

Operation. Operation of a tritium supply technology and recycling facility is expected to reach full employment by 2010. In-migrating population is expected to demand housing units similar to the existing housing mix in the ROI. Figure 4.5.3.8–4 shows the population increases and potential demand for additional housing units over No Action projections (much less than 1 percent) in this peak year. Given that the operation of the proposed action would be phased in over a 4-year period, it is expected that existing vacancies would absorb much of this new demand and that No Action requirements would be exceeded by very few units.

Tritium Supply Alone. Locating only a tritium supply technology at Pantex would not increase population or housing demands in the ROI more than 6 percent over No Action projections during the construction or operation periods.

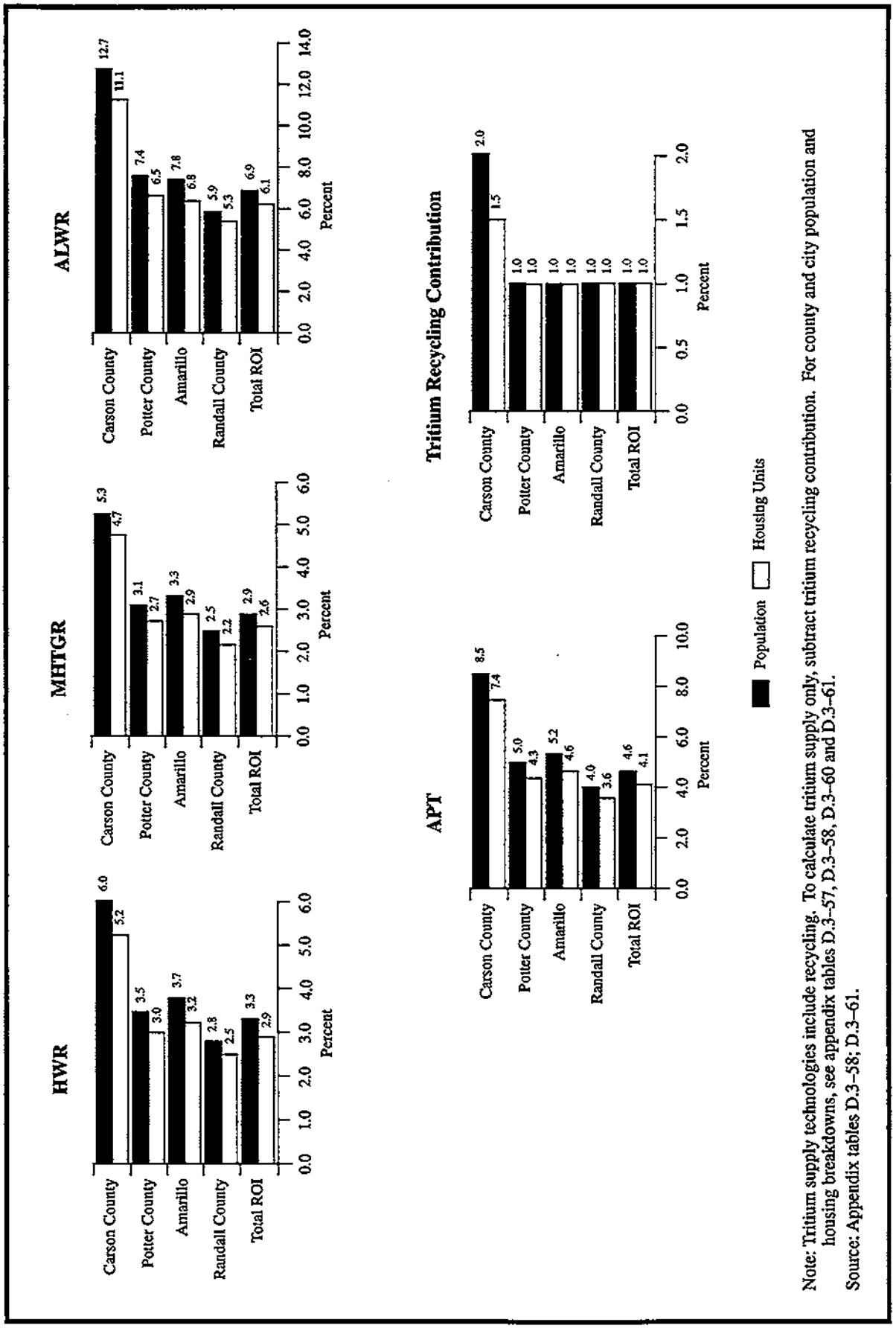
Construction. Construction activities for the tritium supply technologies alone would be much lower than if collocated with the tritium recycling facilities. The greatest increase in population and housing demand would occur during peak construction in 2005. Appendix tables D.3-57 and D.3-60 show that available vacancies in the existing housing mix would probably accommodate the expected population growth. Estimated growth in the ROI is much less than 1 percent over the No Action projection.

Operation. Full employment levels for tritium supply technologies alone would be reached by 2010. Inmigrating population would be expected to require housing units similar to the existing mix in the ROI, but these requirements would be lower than those for any of the tritium supply technologies with the recycling facilities. Potential demand for housing units is very small (much less than 1 percent) in the first year of full employment as illustrated in appendix tables D.3–57 and D.3–60. It is expected that existing vacancies would absorb most of this new demand as employment would be phased in from 2007 through 2010.

Less Than Baseline Operations. Population increases and housing demands would be the same or lower during construction and operation of tritium supply technologies operated at less than baseline tritium requirements than the alternatives discussed in the tritium supply and recycling and tritium supply only sections.

Construction. Population increases and housing demands would be the same as those given in figure 4.5.3.8–3 for the HWR, MHTGR, and ALWR. The Phased APT would increase population and housing demand during construction to the same level as the Full APT, but this would occur over a longer construction period with lower average annual increases (less than 1 percent). Also, the peak construction year would be 2003 instead of 2005. The effects of the Phased APT on population and housing are given in appendix tables D.3-57 and D.3-60, respectively. Appendix tables D.3-58 and D.3-61 present the results of constructing the Phased APT with the tritium recycling facilities.

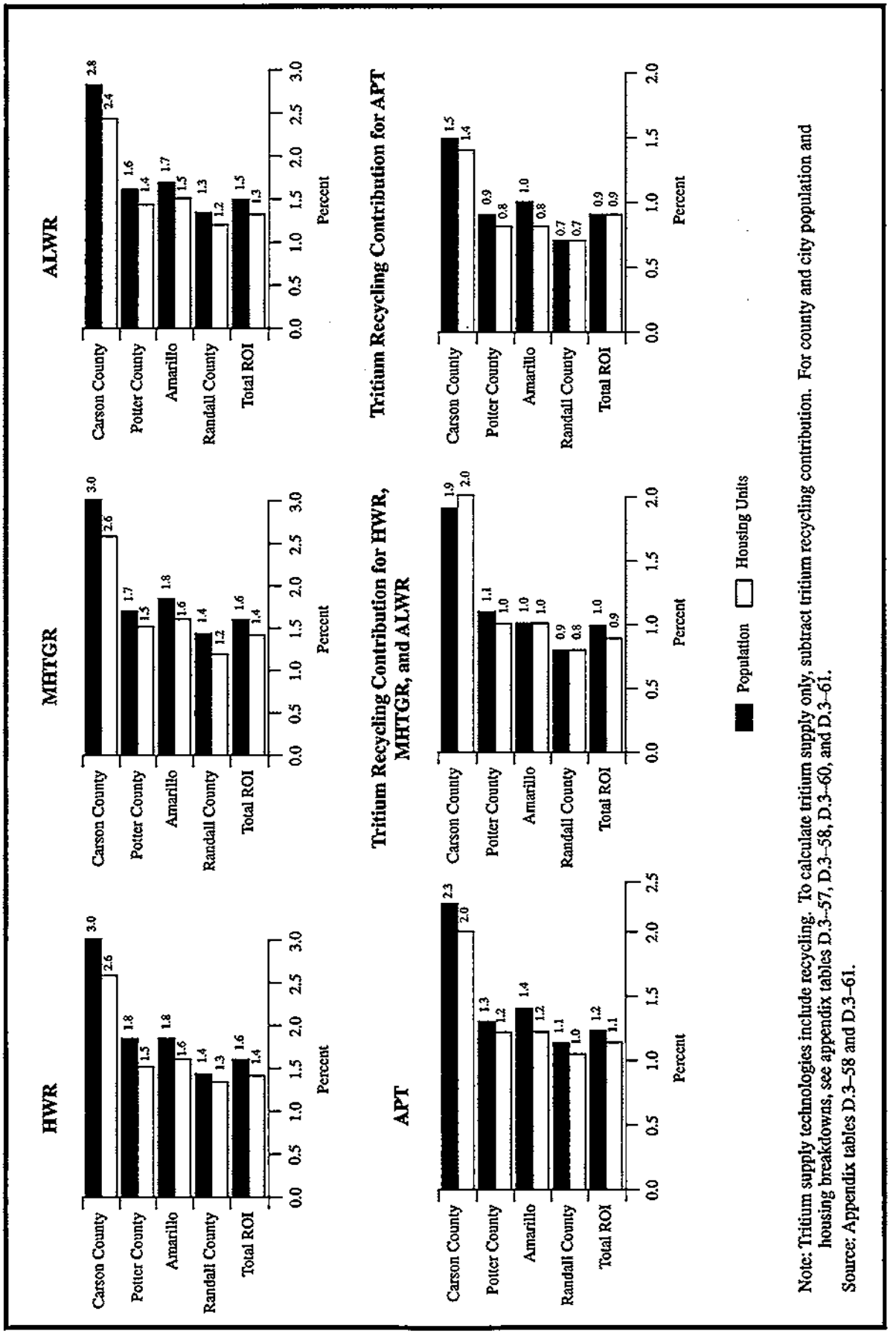
Operation. The effects on population and housing of operating the HWR, MHTGR, ALWR, and Phased



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For county and city population and housing breakdowns, see appendix tables D.3–57, D.3–58, D.3–60 and D.3–61.

Source: Appendix tables D.3–58; D.3–61.

FIGURE 4.5.3.8–3.—*Total Population and Housing Percentage Increase over No Action During Peak Construction from Tritium Supply Technologies and Recycling for Pantex Plant Region of Influence, 2005.*



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For county and city population and housing breakdowns, see appendix tables D.3–57, D.3–58, D.3–60, and D.3–61.

Source: Appendix tables D.3–58 and D.3–61.

FIGURE 4.5.3.8–4.—*Total Population and Housing Percentage Increase over No Action at Full Operation from Tritium Supply Technologies and Recycling for Pantex Plant Region of Influence, 2010.*

APT at less than baseline tritium requirements would be the same as those given in figure 4.5.3.8–4.

Multipurpose Reactor. Locating the multipurpose reactor with or without a recycling facility at Pantex would not increase population and housing demands more than 10 percent over No Action projections during the construction period and 4 percent during operation.

Construction. Because this option would perform three processes, it would result in greater changes in population and housing characteristics than any of the four tritium supply technologies. Changes to population and housing characteristics resulting from multipurpose reactor with and without recycling facilities are presented in appendix tables D.3–57A, D.3–58A, D.3–60A, and D.3–61A. Population and housing growth in the ROI would be at an annual average rate of 2 percent until 2005 and would decrease by 1 percent annually between 2005 and 2010.

Operation. Full employment levels for the multipurpose reactor would be reached by 2010. As illustrated in appendix tables D.3–57A, D.3–58A, D.3–60A, and D.3–61A, potential demand for housing units would be less than 4 percent in the first year of full employment. It is expected that existing vacancies would absorb most of this new demand as employment would be phased in from 2007 through 2010.

Accelerator Production of Tritium Power Plant. Locating the APT power plant with or without a recycling facility at Pantex would not increase population and housing demands more than 5 percent over No Action projections during the construction period and 1 percent during operation.

Construction. This option is similar to the APT with an addition of a gas power plant. The changes in population and housing demands would be similar, but greater than those resulting from the APT. Changes to population and housing characteristics resulting from the APT power plant with and without recycling facilities are presented in appendix tables D.3–57A, D.3–58A, D.3–60A, and D.3–61A. Population and housing growth in the ROI would be at an annual average rate of 3 percent until 2005 and would be flat between 2005 and 2010.

Operation. Full employment levels for the APT power plant would be reached by 2010. As illustrated in appendix tables D.3–57A, D.3–58A, D.3–60A, and D.3–61A, potential demand for housing units would be less than 1 percent in the first year of full employment. It is expected that existing vacancies would absorb most of this new demand as employment would be phased in from 2007 through 2010.

Public Finance

Fiscal changes could occur in some ROI local jurisdictions from the proposed action. Factors influencing these changes include residence of project-related employees and their dependents, cost and duration of construction, and economic conditions in the ROI once the new facilities are operational.

Adding the proposed action to Pantex would increase population, resulting in more revenues for ROI local jurisdictions. Additional population would also increase public service expenditures. Figures 4.5.3.8–5 through 4.5.3.8–8 present the potential fiscal changes that would occur with the different tritium supply technologies and recycling facilities.

No Action. Appendix tables D.3–62 and D.3–63 present the 1992 public finances for ROI local jurisdictions. Appendix tables D.3–64 through D.3–67, and D.3–68, through D.3–71 present the impacts from the tritium supply technologies with or without recycling facilities compared to No Action during construction and operation for the local counties, cities, and school districts. Between 2001 and 2005, most ROI counties, cities, and school districts are projected to increase total revenues on an annual average of less than 1 percent. Total expenditures are projected to increase on an annual average of less than 1 percent for all ROI counties, cities, and school districts between 2001 and 2005.

Between 2010 and 2020, projected annual average increases in total revenues are less than 1 percent for most counties, cities, and school districts in the ROI. Total expenditures are projected to increase, on an average, by less than 1 percent for ROI jurisdictions between 2010 and 2020.

Tritium Supply and Recycling. The proposed action at Pantex would create some fiscal benefits to local

jurisdictions within the ROI. Some local government finances would be affected during the construction and operation phases of the proposed action. Construction-related effects on revenues and expenditures could span a 5- to 9-year period with the peak occurring in 2005. The effects of the operation phase would peak in 2010 and remain at this level throughout the life of the proposed action.

Construction. The public finances of counties, cities, and school districts within the ROI would be affected by the construction-related activities associated with the proposed action. Initially, there would be slight increases to some local government jurisdictions' revenues and expenditures, which would peak in 2005 and then decline as construction neared completion. Figures 4.5.3.8–5 and 4.5.3.8–7 give the revenue and expenditure changes of the ROI local government jurisdictions over No Action during peak construction for the four tritium supply technologies and recycling facilities. Over the construction phase of the proposed action, revenues and expenditures would increase at an annual average of 1 percent to 3 percent. Between 2005 and 2010 total revenues and expenditures in the ROI would decrease 1 percent annually. Under the No Action estimates, local government revenues and expenditures would increase on an annual average of less than 1 percent until peak construction (2005) and between 2005 and 2010.

Operation. The effects on the ROI local government finances of phasing in operation together with the phasing out of construction would be fewer than the effects at peak or full operation (2005). The effects that the four tritium supply technologies and recycling facilities would have on county, city, and school district revenues and expenditures are presented in figures 4.5.3.8–6 and 4.5.3.8–8. Between 2010 and 2020, revenues are expected to increase slightly at an average annual rate of less than 1 percent for all ROI jurisdictions. Expenditures would also increase through 2020 at an annual average of less than 1 percent. No Action local government revenues would also increase at an average annual rate of less than 1 percent, and expenditures would grow annually at less than 1 percent.

Tritium Supply Alone. Locating the tritium supply without the recycling facilities at Pantex would create some fiscal benefits to local jurisdictions within the ROI, but these effects would be less than the effect of collocation with tritium recycling.

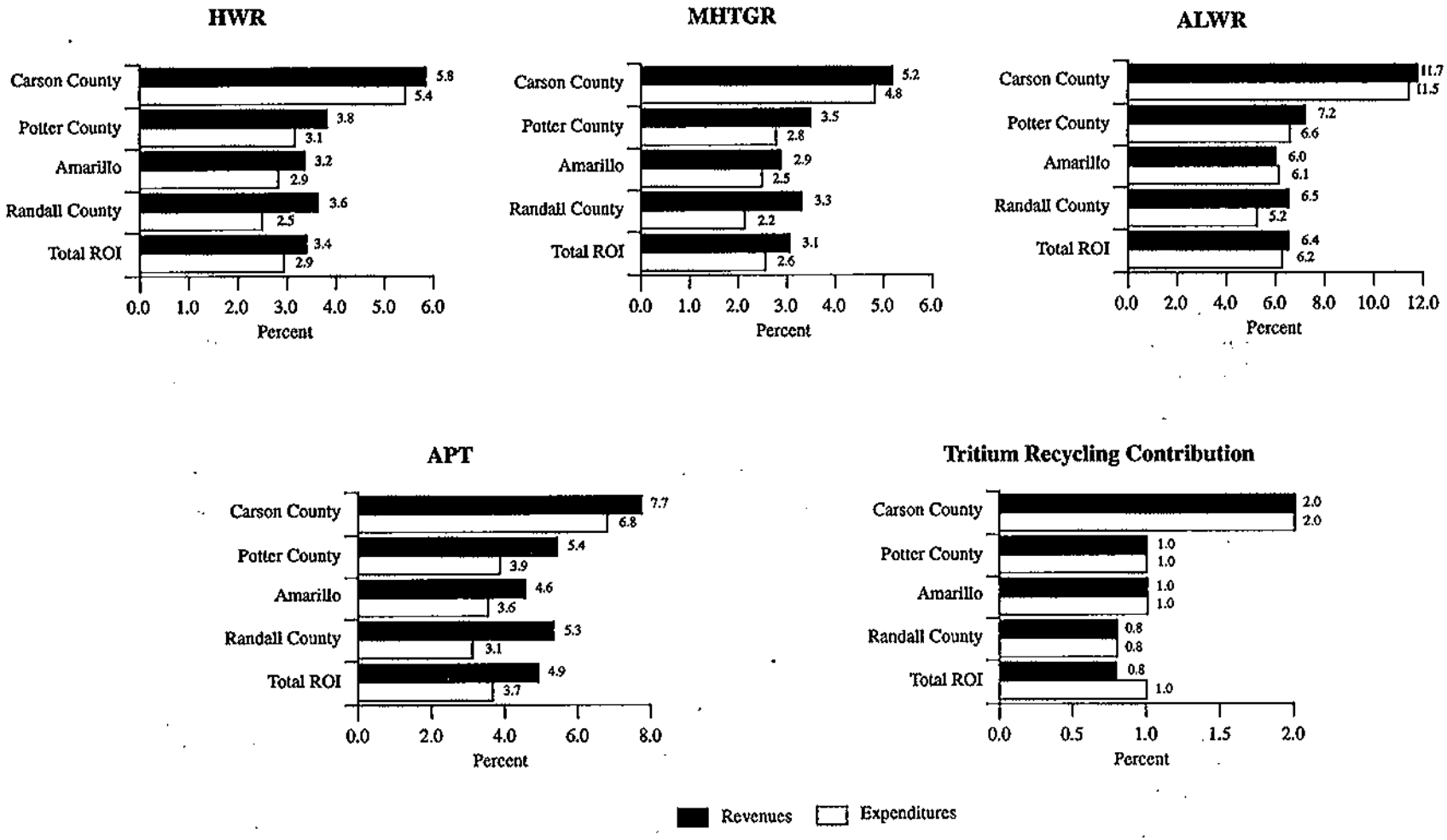
Construction. Construction-related effects on the revenues and expenditures of counties, cities, and school districts would be less than the effects from locating tritium supply technologies with recycling facilities. Appendix tables D.3-64 and D.3-66 present the revenue and expenditure changes of the ROI local governments over No Action during peak construction of the tritium supply technologies alone.

Operation. The operation phase of the tritium supply technologies alone would affect the public finances of counties, cities, and school districts in the ROI, but these effects would be less than those occurring with the recycling facilities. Appendix tables D.3–65 and D.3–67 present the effects that operation would have on these local jurisdictions in 2010. From 2010 to 2020, annual growth in revenues and expenditures would be flat. No Action local government revenues and expenditures would increase at an average annual rate of less than 1 percent.

Less Than Baseline Operations. The fiscal benefits that local jurisdictions would accrue from the location of a tritium supply technology alone or collocated with recycling would be the same or less if the tritium supply technology is operated at less than baseline tritium requirements.

Construction. Increases in local jurisdictions' revenues and expenditures would be the same as those given in figures 4.5.3.8–5 and 4.5.3.8–7 if the HWR, ALWR, or MHTGR is built. If the Phased APT is constructed, the effects would peak in 2003 instead of 2005, and the annual average increases would be lower (less than 1 percent). Appendix tables D.3–64 through D.3–67 give the revenue and expenditure changes as a result of constructing the Phased APT for all ROI jurisdictions. Revenue and expenditure changes resulting from the construction of the Phased APT with tritium recycling are presented in appendix tables D.3–68 through D.3–71.

Operation. Operation of the HWR, MHTGR, ALWR, and Phased APT at less than baseline tritium requirements would have the same effects on local jurisdictions' finances as those presented in figures 4.5.3.8–6 and 4.5.3.8–8.

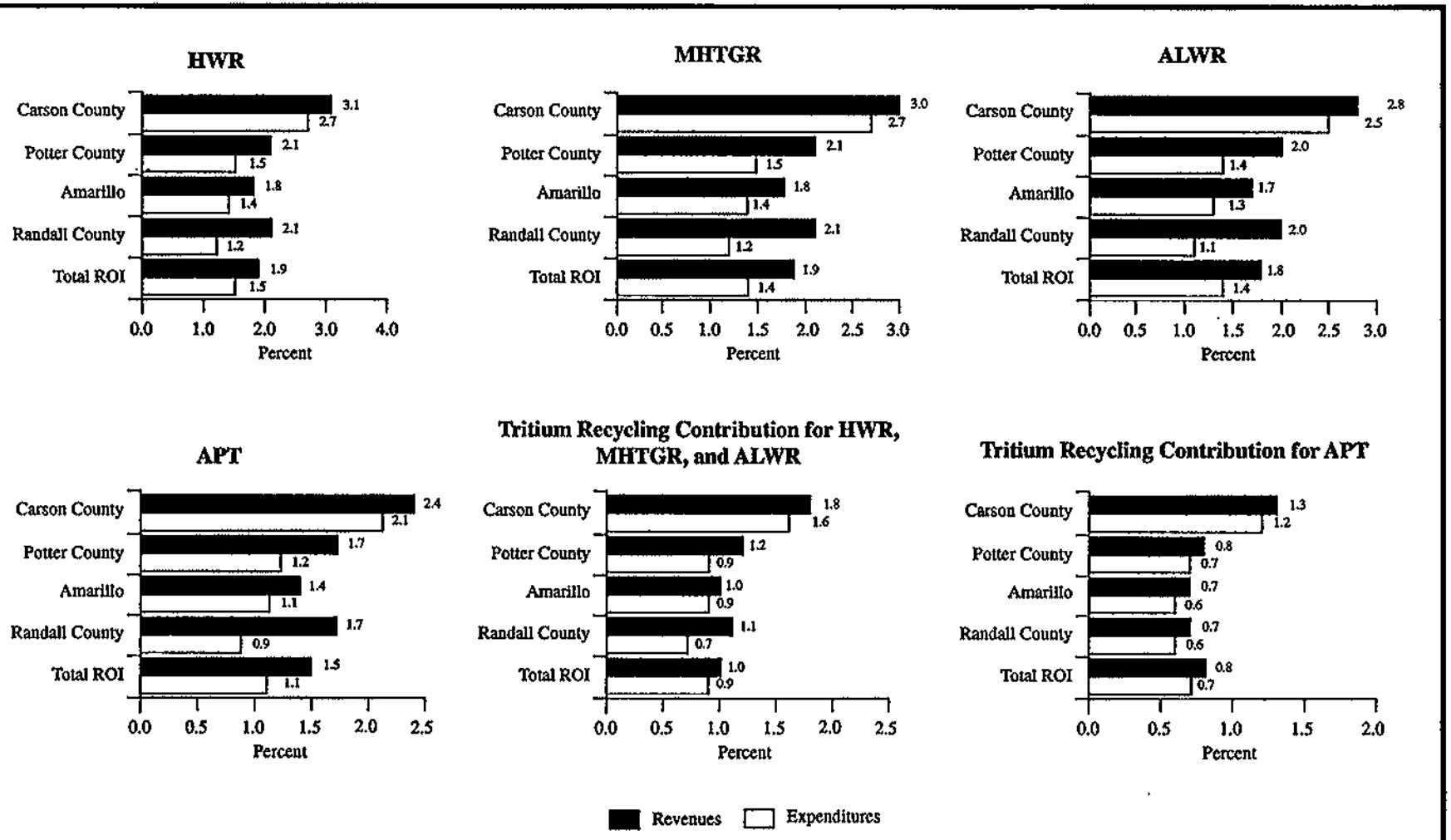


Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For a complete breakdown of county and city revenues and expenditures, see appendix table D.3–68.

Source: Appendix table D.3–68.

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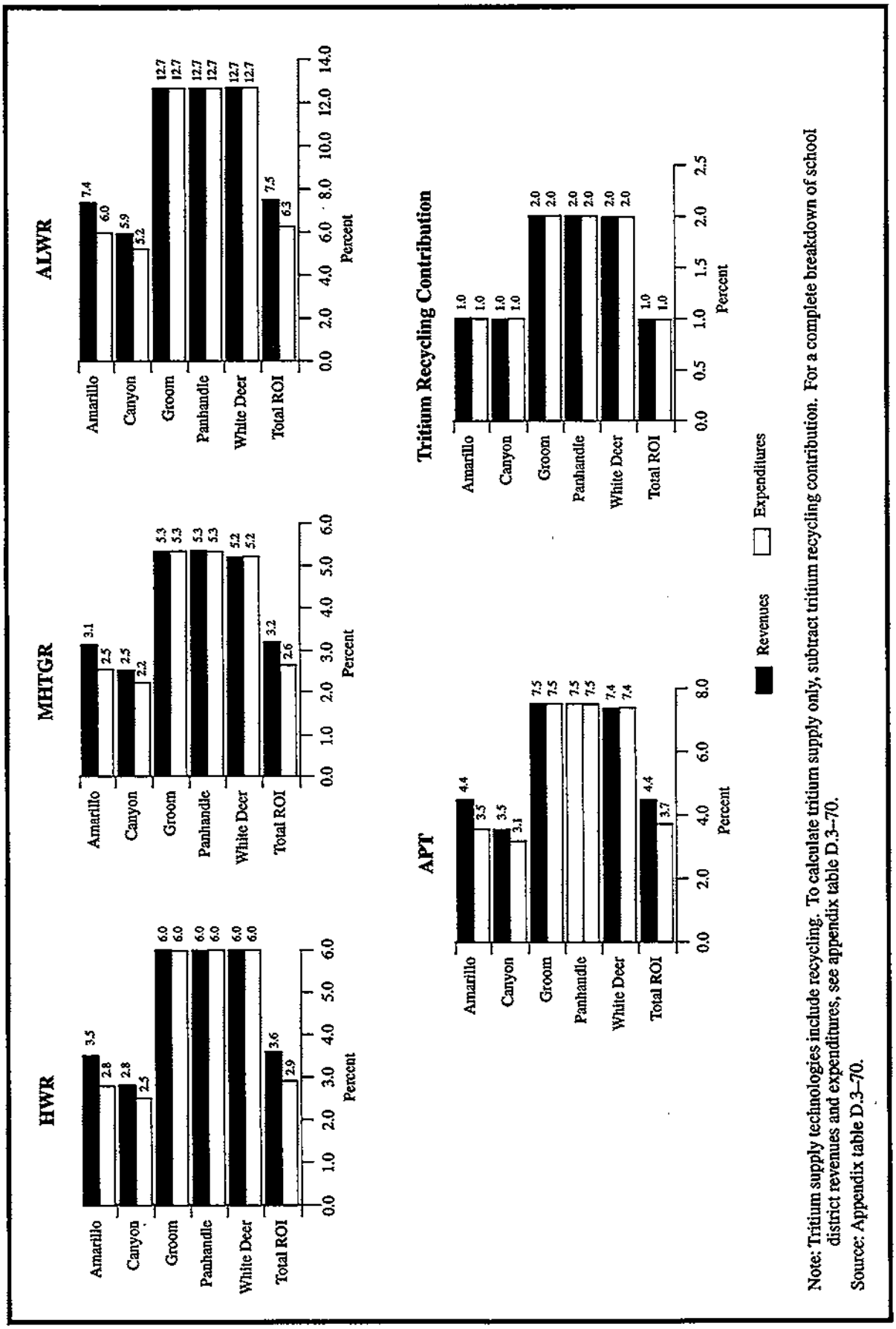
FIGURE 4.5.3.8–5.—*County and City Total Revenues and Expenditures Percentage Increase over No Action During Peak Construction from Tritium Supply Technologies and Recycling for Pantex Plant Region of Influence, 2005.*



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For a complete breakdown of county and city revenues and expenditures, see appendix table D.3–69.

Source: Appendix table D.3–69.

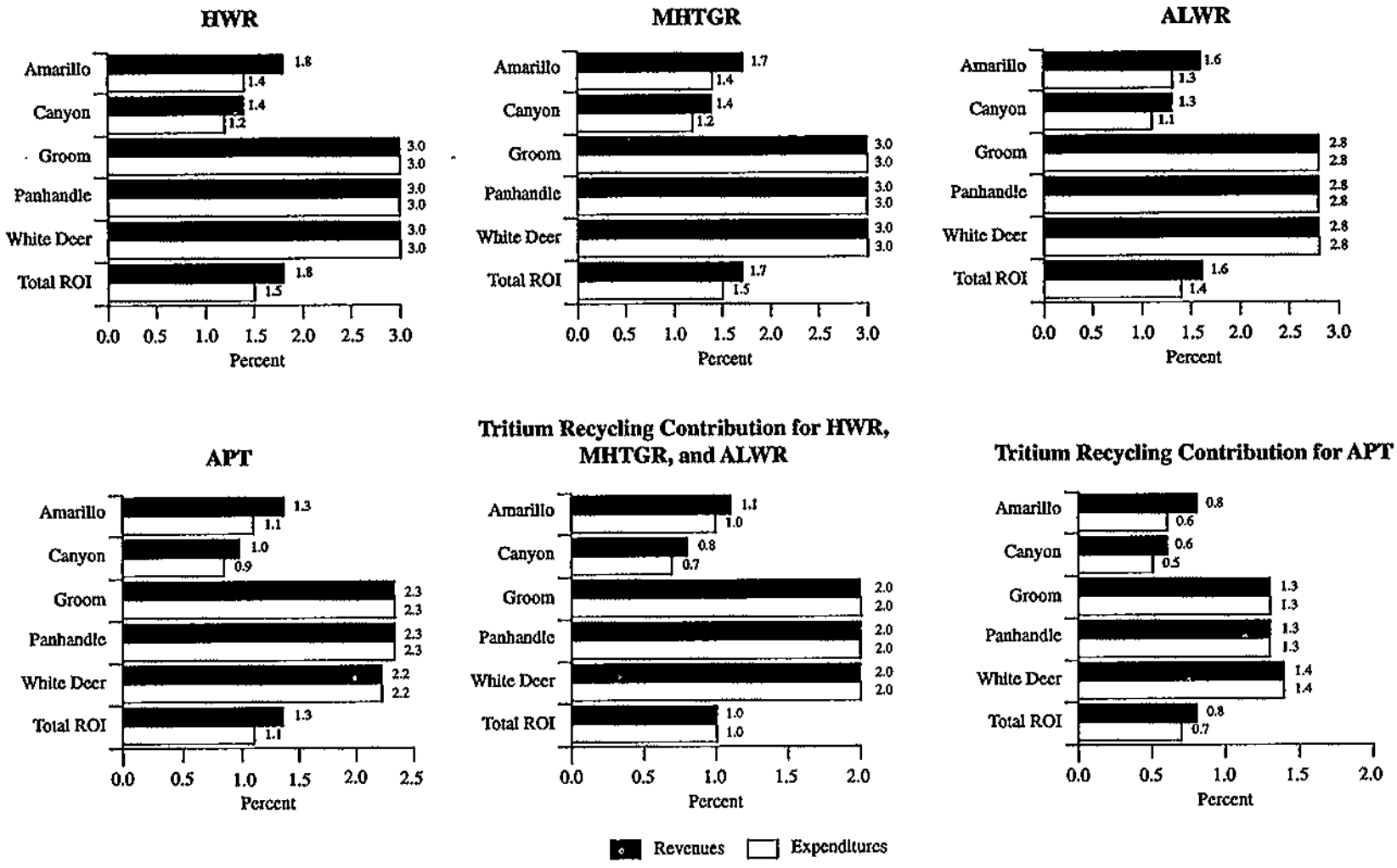
FIGURE 4.5.3.8–6.—*County and City Total Revenues and Expenditures Percentage Increase over No Action at Full Operation from Tritium Supply Technologies and Recycling for Pantex Plant Region of Influence, 2010.*



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For a complete breakdown of school district revenues and expenditures, see appendix table D.3–70.

Source: Appendix table D.3–70.

FIGURE 4.5.3.8–7.—*School District Total Revenues and Expenditures Percentage Increase over No Action During Peak Construction from Tritium Supply Technologies and Recycling for Pantex Plant, 2005.*



Note: Tritium supply technologies include recycling. To calculate tritium supply only, subtract tritium recycling contribution. For a complete breakdown of school district revenues and expenditures, see appendix table D.3–71.

Source: Appendix table D.3–71.

FIGURE 4.5.3.8–8.—*School District Total Revenues and Expenditures Percentage Increase over No Action at Full Operation from Tritium Supply Technologies and Recycling at Pantex Plant, 2010.*

Multipurpose Reactor. Locating the multipurpose reactor with or without a tritium recycling facility at Pantex would create greater changes in public finance characteristics than the four tritium supply technologies because this option would perform three processes. Public finance characteristics for the multipurpose reactor with and without a recycling facility are presented in appendix tables D.3–64A through D.3–71A.

Construction. Between the first year of construction and the peak year, 2005, revenues and expenditures in the local jurisdictions would increase annually from 1 to 3 percent. Between 2005 and 2010, revenues and expenditures would generally decrease annually by less than 1 percent for most jurisdictions.

Operation. From the first year of full operation, 2010, to 2020, growth in revenues and expenditures is generally expected to be flat for most cities, counties, and school districts.

Accelerator Production of Tritium Power Plant. Locating the APT power plant with or without a tritium recycling facility at Pantex would create similar, but greater changes in public finance characteristics than the APT tritium supply technology. Public finance characteristics for the APT power plant with and without a recycling facility are presented in appendix tables D.3–64A through D.3–71A.

Construction. Between the first year of construction and the peak year, 2005, revenues and expenditures in the local jurisdictions would increase annually between 1 and 2 percent. Between 2005 and 2010, revenues and expenditures would decrease annually by less than 1 percent for most jurisdictions.

Operation. From the first year of full operation, 2010, to 2020, growth in revenues and expenditures is generally expected to be flat for most cities, counties, and school districts.

Potential Mitigation Measures. Adding new missions to Pantex would create new jobs and generally benefit the local economy through increased earnings in the ROI. Some mitigation measures may be required, such as Federal aid to local school districts where additional school age children would attend as a result of the proposed action. These new missions at Pantex would increase population and the demand for additional housing units. Temporary housing units and mobile homes would help to alleviate the demand for new housing during the construction phase of the proposed action. Generally, construction would be phased over a 5- to 9-year period with peak construction occurring in 2005. Phasing the start of operation employment and training between 2005 and 2010 would reduce the annual level of housing demand and smooth the peak and valley effect that would occur between peak construction and full operation.

Local Transportation

The following is a description of the effects on local transportation resulting from locating new missions at Pantex. Construction and operation of a tritium supply technology and recycling facility are expected to increase traffic volume and flow on site access routes.

No Action. Under No Action, the worker population at Pantex would not increase. Therefore, any increases in traffic would not be the result of DOE-related activities at Pantex. Access to the 4-lane U.S. Highway 60 is 2 miles from the nearest access gate. The nearest interstate highway is 7 miles via 2- and 4-lane roads that pass through rural areas. The ROI could be affected by winter weather conditions that could restrict access to the plant. Traffic conditions on site access roads would remain as described in section 4.5.2.8.

Tritium Supply and Recycling. The proposed action would result in increases, depending on the tritium supply technology, of worker population at the site. Traffic conditions on site access roads leading to and from Pantex would worsen due to increased traffic volume and flow. Locating the MHTGR or ALWR at Pantex would have the greatest effect on traffic volume and flow.

Tritium Supply Alone. Locating a tritium supply technology without the recycling facility at Pantex would result in increased worker population and traffic. However, the effects on traffic would be less than those from siting the tritium recycling facility with any one of the supply technologies.

Less Than Baseline Operations. The effects on traffic volume and flow would be the same whether or not the HWR, MHTGR, or ALWR were operated at baseline or less than baseline tritium requirements. Construction of the Phased APT would increase traffic volume and flow during the construction phase but less than for the Full APT.

Potential Mitigation Measures. Mitigation of traffic conditions may be necessary due to the proposed action at Pantex. Potential mitigation of impacts to the local transportation network could include widening and extension of Farm-to-Market Road 683, the primary access route to Pantex, as well as possible realignment of roadways and construction of interchanges at U.S. Highway 60 roadway intersections overburdened by increased vehicle traffic and congestion (PX DOT 1991a).

4.5.3.9 *Radiological and Hazardous Chemical Impacts During Normal Operation and Accidents*

This section describes the impacts of radiological and hazardous chemical releases resulting from either normal operation or accidents at facilities involved with tritium supply technologies and recycling facilities at Pantex. The section first describes the impacts from normal operations followed by a description of impacts from facility accidents.

During normal operation at Pantex, all tritium supply technologies and recycling facilities would result in impacts that are within regulatory limits. The risk of adverse health effects to the public and to workers would be small.

For facility accident impacts, the results indicate that for all technologies, the risk of fatal cancers (taking into account both the probability of the accident and its consequences), from an accidental release of radioactive or hazardous chemical substance at Pantex is low when compared to fatal cancers from all causes, even for a severe accident.

The impact methodology is described in section 4.1.9. Summaries of the radiological and chemical impacts associated with normal operation are presented in tables 4.5.3.9–1 and 4.5.3.9–2, respectively. Summaries of impacts associated with postulated accidents are given in tables 4.5.3.9–3 and 4.5.3.9–4. Detailed results are presented in appendix E for normal operation and in appendix F for accidents.

Normal Operation

No Action. The current missions at Pantex are described in section 3.3.4. Site representation has identified facilities that will continue to operate and others, if any, that will become operational by 2010. Based on that information, the radiological releases for 2010 and beyond were developed and used in the impact assessments.

Radiological Impacts. As shown in table 4.5.3.9–1, No Action would result in a calculated annual dose of 1.3×10^{-3} mrem to the maximally exposed member of the public, which projects to an estimated fatal cancer risk of 2.6×10^{-8} from 40 years of total site operation. This annual dose is within radiological limits and is 3.8×10^{-4} percent of the natural background radiation received by the average person near Pantex.

The population dose from total site operation in 2030 was calculated to be 5.7×10^{-4} person-rem, which projects to an estimated 1.1×10^{-5} fatal cancers over 40 years of total site operation. This population dose would be approximately 5.7×10^{-7} percent of the annual dose received by the surrounding population from natural background radiation.

The annual average dose to a site worker from No Action would be 15 mrem, which projects to an estimated fatal cancer risk of 2.4×10^{-4} from 40 years of site operation. The annual dose to the total site workforce would be 37 person-rem, which projects to in an estimated 0.59 fatal cancers from 40 years of total site operation. The estimated worker doses are based on the measured annual average worker doses at Pantex from 1989 to 1992 and the projected employment for 2010.

Hazardous Chemical Impacts. As shown in table 4.5.3.9–2, No Action would result in a calculated HI of 3.7×10^{-3} and a cancer risk of 1.8×10^{-9} to the maximally exposed member of the public. The worker HI and cancer risk were calculated to be 0.26 and 7.7×10^{-7}, respectively. All values are within the acceptable regulatory health limits. For details on the derivation of these HIs and cancer risks, see appendix table E.3.4–22 and summary table E.3.4–28.

TABLE 4.5.3.9–1.—*Potential Radiological Impacts to the Public and Workers Resulting from Normal Operation of Tritium Supply Technologies and Recycling at Pantex Plant*

Affected Environment	No Action	Tritium Supply Technologies and Recycling[a]							
		HWR	MHTGR	Large ALWR	Small ALWR	Full APT		Phased APT	Tritium Recycling
						Helium-3 Target System	SILC Target System	Helium-3 Target System	
Maximally Exposed Individual[b] (Public)									
Dose[c] (mrem/yr)	1.3×10^{-3}	3.8	2.4	4.9	4.8	1.4	2.1	1.4	1.4
Percent of natural background[d]	3.8×10^{-4}	1.1	0.7	1.4	1.4	0.42	0.61	0.42	0.40
40-Year Fatal cancer risk	2.6×10^{-8}	7.6×10^{-5}	4.8×10^{-5}	9.8×10^{-5}	9.6×10^{-5}	2.9×10^{-5}	4.2×10^{-5}	2.9×10^{-5}	2.8×10^{-5}
Population Within 50 Miles									
Year 2030									
Dose (person-rem)	5.7×10^{-4}	28	16	37	35	9.2	14	9.2	9.0
Percent of natural background[d]	5.7×10^{-7}	0.028	0.016	0.037	0.035	9.3×10^{-3}	0.014	9.3×10^{-3}	9.0×10^{-3}
40-Year Fatal cancers	1.1×10^{-5}	0.55	0.31	0.73	0.69	0.18	0.27	0.18	0.18
Worker Onsite									
Average site worker dose[c] (mrem/yr)	15	25	22	68	46	25	25	25	4
40-Year Fatal cancer risk	2.4×10^{-4}	4.0×10^{-4}	3.5×10^{-4}	1.1×10^{-3}	7.4×10^{-4}	3.9×10^{-4}	4.0×10^{-4}	3.9×10^{-4}	6.4×10^{-5}
Total site workforce dose (person-rem/yr)	37	78	67	210	140	77	79	77	1.6
40-Year Fatal cancers	0.59	1.2	1.1	3.3	2.2	1.2	1.3	1.2	0.026

[a] Includes impacts from No Action facilities.

[b] The location of the maximally exposed individual varies depending on the tritium supply technology.

[c] The applicable radiological limits for an individual member of the public from site operations are 10 mrem per year for the air pathways and 100 mrem per year from all pathways combined (DOE Order 5400.5). The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 835).

[d] Natural background levels: to the average individual is 346 mrem per year; to the population in 2030 is 99,470 person-rem.

Note: SILC - spallation-induced lithium conversion.

Note: Model results. See appendix sections E.2.2 and E.2.7.

TABLE 4.5.3.9–2.—*Potential Hazardous Chemical Impacts to the Public and Workers Resulting from Normal Operation at Pantex Plant*

Health Impact	Tritium Supply Technologies and Recycling[a,b]					
	No Action	HWR	MHTGR	ALWR	APT	Tritium Recycling
Maximally Exposed Individual (Public)						
Hazard Index	3.7×10^{-3}	4.1×10^{-3}	3.7×10^{-3}	7.5×10^{-3}	3.8×10^{-3}	3.2×10^{-5}
Cancer risk	1.8×10^{-9}	1.8×10^{-9}	1.8×10^{-9}	1.8×10^{-9}	1.8×10^{-9}	0
Worker Onsite						
Hazard Index[c]	0.26	0.26	0.26	0.26	0.26	1.6×10^{-5}
Cancer risk	7.7×10^{-7}	7.7×10^{-7}	7.7×10^{-7}	7.7×10^{-7}	7.7×10^{-7}	0

[a] Includes impacts from No Action.

[b] To determine the contribution from any of the tritium supply technologies, subtract the tritium recycling values from the Hazard Index or the cancer risk, respectively.

[c] The Hazard Index for the onsite worker is computed by using the permissible exposure level as the denominator rather than the reference concentration which is used for the maximally exposed member of the public (appendix E).

Note: Model results. See appendix table E.3.4–28.

Tritium Supply and Recycling. There will be no radiological releases during the construction of either new tritium recycling facilities or new facilities that are associated with all tritium supply technologies under consideration.

Limited hazardous chemical releases are anticipated as a result of construction activities. However, their concentration will be well within the regulated exposure limits and would not result in any adverse health effects. During normal operation, there would be both radiological and hazardous chemical releases to the environment plus direct in-plant exposures. The impacts from radiological and hazardous chemicals from each tritium supply technology considered are the summations of the impacts from the various facilities in operation for that technology. The resulting doses and potential health effects to the public and workers from each alternative are described below.

Radiological Impacts. Radiological impacts to the public resulting from normal operations of various tritium supply technologies and recycling facilities at Pantex are listed in table 4.5.3.9–1. The supporting analysis is provided in appendix section E.2.7.2.

The doses to the maximally exposed member of the public from annual site operations at Pantex range from 1.4 mrem for both the APT with the helium-3 target option and the Phased APT to 4.9 mrem for the Large ALWR. From 40 years of operation, the corresponding risks of fatal cancer to this individual would range from 2.9×10^{-5} to 9.8×10^{-5}. As a result of total site operations in 2030, the population doses would range from 9.2 person-rem for the same two APT technologies to 37 person-rem for the Large ALWR. The corresponding numbers of fatal cancers in this population from 40 years of operation would range from 0.18 to 0.73.

The annual dose to the total site workforce would range from 67 person-rem for the MHTGR to 210 person-rem for the Large ALWR. The corresponding annual average doses to a site worker would be 22 mrem for the MHTGR and 68 mrem for the Large ALWR. The risks and numbers of fatal cancers among workers from 40 years of operation are included in table 4.5.3.9–1.

Based on the radiological impacts associated with normal operation, as described above, all of the tritium supply technologies and recycling facilities are acceptable for siting at Pantex. All resulting doses are within radiological limits and are below levels of natural background radiation.

Hazardous Chemical Impacts. Hazardous chemical impacts resulting from normal operation of various tritium supply technologies and recycling facilities at Pantex are listed in table 4.5.3.9–2. Locating the HWR, MHTGR, ALWR, or APT at Pantex would result in HIs to the maximally exposed member of the public ranging from 3.7×10^{-3} (MHTGR) to 7.5×10^{-3}

(ALWR) and identical cancer risks of 1.8×10^{-9} for all technologies. All technologies operated at Pantex would result in identical HIs of 0.26 for workers and identical cancer risks of 7.7×10^{-7}. All of these values are within regulatory health limits. For details on the derivation of the HIs and cancer risks, see appendix E.3.4–22 through E.3.4–26 and summary table E.3.4–28.

Tritium Supply Alone

Radiological Impacts. If the tritium recycling processes is not collocated with the tritium supply, the annual dose to the maximally exposed individual would be 1.4 mrem lower than from operation of both supply and recycling. This is 0.4 percent of the dose from natural background radiation received by the average person near Pantex. The estimated risk of fatal cancer to this individual would decrease by 2.8×10^{-5} over 40 years of total site operation. Not collocating the tritium recycling processes at Pantex would result in a decrease of 9 person-rem to the population within 50 miles in year 2030, and 0.18 fewer fatal cancers over 40 years of operation.

If the tritium recycling processes are not collocated with the tritium supply, the total annual workforce dose would decrease by 1.6 person-rem, resulting in 0.026 fewer fatal cancers over the 40 years.

Hazardous Chemical Impacts. If the tritium recycling processes are not collocated with the supply technologies at Pantex, the cancer risk would remain at 1.8×10^{-9}. The HIs for the public would be reduced by approximately 0.4 to 0.86 percent for any of the supply technologies. The worker HIs would be almost unchanged (i.e., 0.006 percent reduction) and the cancer risk to workers would remain at 7.7×10^{-7}. Based on the hazardous chemical impacts, the HIs and cancer risks are all within regulatory limits. For details on the derivation of these HIs and cancer risks, see appendix E, tables E.3.4–24 through E.3.4–26 and summary table E.3.4–28.

If the tritium recycling processes are not collocated with the supply technologies, the cancer risks to the public and the worker remain the same at 1.8×10^{-9} and 7.7×10^{-7} respectively, because the entire cancer risks is due to the No Action contribution. The HIs for the public would be reduced by 0.84 percent (APT) to 0.42 percent (ALWR) and the HIs for workers would be virtually unaffected by a 0.006 percent reduction for all technologies. All HI values and cancer risks for the public and worker are within acceptable health regulatory limits.

Less Than Baseline Operations. The normal operation radiological impacts for the HWR operating at reduced tritium production capacity to meet a less than baseline operations requirement would be proportional to the level of operation (approximately 50 percent of baseline). The MHTGR or ALWR normal operation radiological impacts would not change because the reactor would maintain power requirements to produce steam or electricity.

The Phased APT is already less than the baseline tritium requirement and thus the impacts are as presently given in this PEIS.

Potential Mitigation Measures. Radioactive and hazardous chemical airborne emissions to the general population and onsite exposures to workers could be reduced by implementing the latest technology for process and design improvements. For example, to reduce public exposure from emissions, improved methods could be used to remove radioactivity from the releases to the environment. Similarly, the use of remote, automated and robotic production methods are examples of techniques that are being developed which could reduce worker exposure. Substitution of less toxic/noncancer causing solvents would result in reductions of the HI and possible complete elimination of the cancer risk.

Facility Accidents

No Action. Under No Action, the risk of accidents at Pantex would be unchanged from that reported in safety analysis reports for existing facilities.

Tritium Supply and Recycling. The proposed action at Pantex has the potential for accidents that may impact the health and safety of workers and the public. The potential for and associated consequences of reasonably foreseeable accidents have been assessed for each tritium supply and recycling facilities at Pantex and are summarized in this section and described in more detail in appendix F. The methodology used in the assessment is described in section 4.1.9.

The potential impacts from accidents, ranging from high-consequence/low-probability to low-consequence/high-probability events, have been evaluated in terms of the number of cancer fatalities that may result. The risk of cancer fatalities has also been evaluated to provide an overall measure of accident impacts and is calculated by multiplying the accident annual frequency (or probability) of occurrence by the consequences (number of cancer fatalities).

The analyses of accidents for the tritium supply and recycling facilities at Pantex indicate that, for the high consequence accident, the risk of cancer fatalities to the public within 50 miles of the site would be 1.5×10^{-5} cancer fatalities per year (table 4.5.3.9–3). This accident risk, which corresponds with the HWR, is low when compared to the risk of cancer fatalities each year to the same population from all other causes.

Details on the range of accidents for the tritium supply technologies and recycling facilities at Pantex are presented in appendix F. Each of the technologies has been analyzed from the standpoint of identifying the consequences of design basis/operational accidents (using the GENII computer code) and beyond design basis, or severe accidents (using the MACCS computer code). The severe accident consequences are shown in table 4.5.3.9–3 for each technology. The table also shows the consequences of each accident for the population and for an individual located at the site boundary during the accident. The results of the analysis indicate that the HWR has the highest severe accident risk. The technology with the lowest accident risk is the APT. The tritium recycling facility is common to all tritium supply technologies but, except for the APT, the consequences and risks are dominated by reactor accidents. The tritium extraction accident dominates the accelerator accidents.

Figure 4.5.3.9–1 shows the number of latent cancer fatalities that may result for each technology, including tritium extraction and recycling, if a high consequence accident were to occur. Specifically, each curve in the figure shows the annual probability (vertical axis) that the number of cancer fatalities (horizontal axis) will be exceeded if the accident occurred. The curves reflect the probability of the accident.

The secondary impacts of accidents affect elements of the environment other than humans. For example, a radiological release may contaminate farmland, surface and underground water, recreational areas, industrial parks, historical sites, or the habitat of an endangered species. As a result, farm products may have to be destroyed; the supply of drinking water may be reduced; recreational areas may be closed; industrial parks may suffer economic losses; historical sites may have to be closed to visitors; and the endangered species may move closer to extinction. In the region of Pantex, the natural background level of radiation (excluding radon) is 107 mrem per year. For a hypothetical design basis accidental release, the radiation levels exceeding 107 mrem per year extends beyond the site boundary. The size of the area in which exposure levels would exceed exposures from natural background radiation is 9.3×10^{7} square meters (22,980 acres).

Tritium Supply Alone. The analyses of reasonably foreseeable high consequence accidents for the tritium supply facilities at Pantex are presented below.

Heavy Water Reactor. A set of five high consequence accident sequences were postulated for the HWR. In the event that any of these accidents were to occur, there would be an estimated 1.7 cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 0.01 to an individual who may be located at the site boundary and 0.024 to a collocated worker located within 1,000 meters of the accident. The risk to the population, that takes the probability of the accident into account, is 1.5×10^{-5} cancer fatalities per year (table 4.5.3.9–3).

Modular High Temperature Gas-Cooled Reactor. A set of four high consequence accident sequences were postulated for the MHTGR. In the event that any of these accidents were to occur, there would be an estimated 0.19 cancer fatalities in the population within 50 miles and an increased likelihood of cancer of 1.0×10^{-3} to an individual who may be located at the site boundary and 3.1×10^{-3} to a collocated worker at 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is less than 3.0×10^{-6} cancer fatalities per year (table 4.5.3.9–3).

TABLE 4.5.3.9–3.—*Tritium Supply Technologies and Recycling High Consequence/Low Probability Radioactive Release Accidents and Consequences at Pantex Plant*

Parameter	Tritium Supply Technologies						Tritium Target Extraction Facility[b]	Tritium Recycling Facility[e]
	HWR[a,b]	MHTGR[b,c]	Large ALWR[b,d]	Small ALWR	Full/Phased APT Helium-3 Target System[f,g]	Full APT SILC Target System[b,h,i]		
Consequence								
Maximally Exposed Individual								
Cancer fatalities[j]	0.010	1.0×10^{-3}	0.015	0.029	9.0×10^{-8}	1.4×10^{-6}	1.0×10^{-4}	3.5×10^{-4}
Risk (cancer fatalities per year)	9.5×10^{-8}	1.6×10^{-8}	2.3×10^{-9}	4.6×10^{-9}	6.4×10^{-14}	1.0×10^{-12}	1.0×10^{-10}	3.5×10^{-10}
Population Within 50 Miles								
Cancer fatalities[j]	1.7	0.19	0.72	4.3	1.3×10^{-5}	1.3×10^{-4}	0.014	0.049
Risk (cancer fatalities per year)	1.5×10^{-5}	3.0×10^{-6}	1.1×10^{-7}	6.7×10^{-7}	8.9×10^{-12}	9.6×10^{-11}	1.4×10^{-8}	4.9×10^{-8}
Worker at 1,000 meters								
Cancer fatalities[j]	0.024	3.1×10^{-3}	0.023	0.070	2.6×10^{-7}	3.8×10^{-6}	2.9×10^{-4}	1.0×10^{-3}
Risk (cancer fatalities per year)	2.2×10^{-7}	5.0×10^{-8}	3.5×10^{-9}	1.1×10^{-8}	1.9×10^{-13}	2.7×10^{-12}	2.9×10^{-10}	1.0×10^{-9}
Worker at 2,000 meters								
Cancer fatalities[j]	0.011	1.1×10^{-3}	0.014	0.031	1.0×10^{-7}	1.6×10^{-6}	1.1×10^{-4}	3.9×10^{-4}
Risk (cancer fatalities per year)	1.0×10^{-7}	1.8×10^{-8}	2.1×10^{-9}	4.9×10^{-9}	7.1×10^{-14}	1.1×10^{-12}	1.1×10^{-10}	3.9×10^{-10}

[a] For detailed HWR accident discussion see Appendix section F.2.1.1.

[b] The tritium target extraction facility is required for the HWR, MHTGR, ALWR, and the APT with spallation-induced lithium conversion (SILC) target system tritium supply configurations and not required for the APT with helium-3 target system tritium supply configuration. For detailed tritium target extraction facility discussion, see Appendix section F.2.1.6.

[c] For detailed MHTGR accident discussion see Appendix section F.2.1.2.

[d] For detailed ALWR accident discussion see Appendix section F.2.1.3

[e] For detailed tritium recycling facility discussion, see Appendix section F.2.3.

[f] For detailed APT with helium-3 target system discussion, see Appendix section F.2.1.4.2.

[g] Analysis postulated the total failure of the active emergency cooling system and the loss of the heat sink.

[h] For detailed APT with spallation-induced lithium conversion target system discussion, see Appendix section F.2.1.4.3.

[i] Analysis postulated successful beam trip with the total failure of the active emergency cooling system.

[j] Increased likelihood of cancer fatality.

Note: SILC - spallation-induced lithium conversion.

Source: Appendix F.

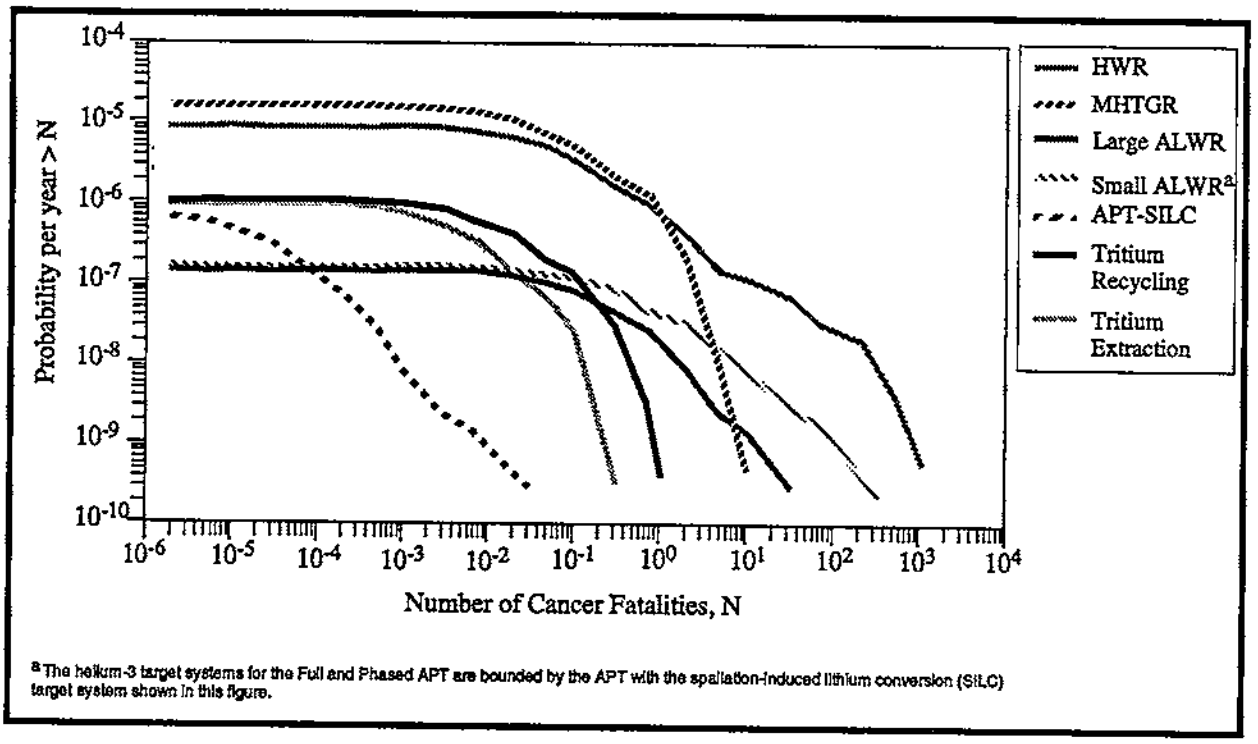


FIGURE 4.5.3.9–1.—*High Consequence Accident–Cancer Fatalities Complementary Cumulative Distribution Functions for Tritium Supply and Recycling Severe Accidents at Pantex Plant.*

Advanced Light Water Reactor. A range of accident sequences with various release categories was analyzed for the ALWR. One release category for a Large ALWR and one for a Small ALWR were postulated and were selected to represent the accident consequences for an ALWR (appendix section F.2.1.3). In the event that such an accident were to occur, there would be an estimated 0.72 cancer fatalities for the Large ALWR, and 4.3 cancer fatalities for the Small ALWR, in the population within 50 miles and an increased likelihood of cancer of 0.015 for the Large and 0.029 for the Small ALWR to an individual who may be located at the site boundary and 0.023 for a Large ALWR and 0.07 for a Small ALWR to a collocated worker at 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is 1.1×10^{-7} cancer fatalities per year for the Large ALWR, and 6.7×10^{-7} cancer fatalities per year for the Small ALWR (table 4.5.3.9–3).

Accelerator Production of Tritium with Helium-3 Target System. The large break loss of coolant accident with the total loss of the active emergency cooling system and the heat sink with and without confinement were postulated as the high consequence accident for this APT and target option. In the event that this accident were to occur, there would be an estimated 1.3×10^{-5} cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 9.0×10^{-8} to an individual located at the site boundary and 2.6×10^{-7} to a collocated worker at 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is on the order of 8.9×10^{-12} cancer fatalities per year (table 4.5.3.9–3).

Accelerator Production of Tritium with Spallation-Induced Lithium Conversion Target System. The large break loss of coolant accident with a successful beam trip and the total loss of the active emergency cooling system with and without confinement were postulated as the high consequence accidents for this APT and target option. In the event that this accident were to occur, there would be an estimated 1.3×10^{-4} cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 1.4×10^{-6} to an individual located at the site boundary and 3.8×10^{-6} to a collocated worker at 1,000 meters from the accident. The risk to the population, that takes the

probability of the accident into account, is on the order of 9.6×10^{-11} cancer fatalities per year (table 4.5.3.9–3).

Tritium Extraction and Recycling. The tritium extraction facility is required to support all tritium supply technologies except the APT technology with the helium-3 target system. The tritium recycling facility is required to support all tritium supply technologies. The analyses of postulated high consequence accidents for the tritium extraction and recycling facilities at Pantex are presented below.

Tritium Target Extraction Facility. An earthquake and release of process vessel tritium inventory was postulated as the high consequence accident. The consequences and risk of any accident associated with the accelerator beam and target would be much lower. In the event that this accident were to occur, there would be an estimated 0.014 cancer fatalities in the population within 50 miles and an increased likelihood of cancer 1.0×10^{-4} to an individual who may be located at the site boundary and 2.9×10^{-4} to a collocated worker at 1,000 meters from the accident. The risk to the population, that takes the probability of the accident into account, is on the order 1.4×10^{-8} cancer fatalities per year (table 4.5.3.9–3).

Tritium Recycling Facility. An earthquake induced leak/ignition and fire in the unloading station carousel reservoir was postulated as the high consequence accident for a tritium recycling facility. In the event that this accident were to occur, there would be an estimated 0.049 cancer fatalities in the population within 50 miles and an increased likelihood of cancer fatality of 3.5×10^{-4} to an individual located at the site boundary during and 1.0×10^{-3} to a collocated worker at 1,000 meters from the accident. The risk to the population, that takes the probability of accident into account, is on the order of 4.9×10^{-8} cancer fatalities per year (table 4.5.3.9–3).

For comparison purposes with high consequence tritium supply facility accidents, including extraction and recycling, for the same total population of 287,000 in 2050 within 50 miles of the site, there is a risk of 574 cancer fatalities per year from all other natural causes.

The analysis of facility accidents for tritium supply at Pantex shows that for high consequence accidents analyzed using the MACCS computer code, the HWR has the highest risk and the APT has the lowest risk. The risk of accidents for any of the tritium supply technologies, tritium extraction, and tritium recycling facilities common to all technologies is low when compared to the human risk of cancer fatalities from all other causes.

Design-Basis Accidents. The consequences of operational basis or design-basis accidents for the tritium extraction and recycling facilities at Pantex are shown in table 4.5.3.9–4. The results in table 4.5.3.9–4 should not be compared with the severe accident analysis results in table 4.5.3.9–3 because different computer codes using different calculational approaches were used. More detailed description of design-basis accidents is included in appendix F.2.2.

Less Than Baseline Operations. Less than baseline tritium operation would have no significant change to the current accident analyses consequences for the HWR unless the baseline HWR core design was downsized. The baseline HWR configuration would adjust to the reduced target throughput requirements by reducing the time that the reactor is required to operation at 100 percent power. It is not anticipated that the overall risk from operating the reactor in this mode would decrease significantly. Accident analyses have not been performed to address accident sequences and initiating events when the reactor is in the cold shutdown mode. In addition, operator error has a significant effect on facility risk, and if the reactor is shutdown a high percentage of the time, operator error may actually increase when the reactor is at power.

Less than baseline tritium operation would have no significant change to the current accident analyses consequences for the ALWR. The reactor surplus capacity would be used to generate steam for electric power production.

Less than baseline tritium operation would have no change to the MHTGR accident analyses because the analyses assumed that only one of the modules would be involved in the accident.

Less than baseline tritium operation would have no significant change to the APT accident analyses consequences. The accident consequences for Full and

TABLE 4.5.3.9–4.—*Tritium Supply Technologies and Recycling Low to Moderate Consequence Radioactive Release Accidents and Consequences at Pantex Plant*

Parameter	Tritium Supply Technologies and Recycling					Tritium Target Extraction Facility[b]	Tritium Recycling Facility[e]
	HWR[a,b]	MHTGR[b,c]	Large ALWR[b,d]	Small ALWR	Full APT SILC Target System[b,f]		
Accident							
Description	Fuel Assembly failure during charge and discharge operations	Moderate break in primary system piping	Fuel Handling	Fuel Handling	Large break loss of coolant accident[g]	Deflagration[h]	Hydride Bed Rupture
Frequency (per year)	1.0×10^{-3}	2.5×10^{-2}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-3}	2.0×10^{-5}	2.0×10^{-4}
Consequence							
Maximally Exposed Individual							
Cancer fatalities[i]	6.2×10^{-6}	4.0×10^{-9}	3.9×10^{-6}	5.2×10^{-6}	negligible	3.9×10^{-5}	1.7×10^{-7}
Risk (cancer fatalities per year)	6.2×10^{-9}	1.0×10^{-10}	3.9×10^{-11}	5.2×10^{-11}	negligible	7.8×10^{-10}	3.4×10^{-11}
Population Within 50 Miles							
Cancer fatalities[i]	0.026	1.2×10^{-5}	0.015	0.021	negligible	0.16	7.0×10^{-4}
Risk (cancer fatalities per year)	2.6×10^{-5}	3.0×10^{-7}	1.5×10^{-7}	2.1×10^{-7}	negligible	3.2×10^{-6}	1.4×10^{-7}
Worker at 1,000 meters							
Cancer fatalities[i]	1.2×10^{-5}	1.5×10^{-8}	1.2×10^{-5}	1.6×10^{-5}	negligible	2.4×10^{-4}	8.8×10^{-7}
Risk (cancer fatalities per year)	1.2×10^{-8}	3.8×10^{-10}	1.2×10^{-10}	1.6×10^{-10}	negligible	4.8×10^{-9}	1.8×10^{-10}
Worker at 2,000 meters							
Cancer fatalities[i]	3.5×10^{-6}	4.2×10^{-9}	3.4×10^{-6}	4.4×10^{-6}	negligible	5.6×10^{-5}	2.4×10^{-11}
Risk (cancer fatalities per year)	3.5×10^{-9}	1.1×10^{-10}	3.4×10^{-11}	4.4×10^{-11}	negligible	1.1×10^{-9}	4.8×10^{-15}

[a] For detailed HWR accident discussion, see appendix section F.2.2.1.

[b] The tritium target extraction facility is required for the HWR, MHTGR, ALWR, and the APT with spallation-induced lithium conversion target system tritium supply configurations and not required for the APT with helium-3 target system tritium supply configuration. For detailed tritium target extraction facility discussion, see appendix section F.2.2.6.

[c] For detailed MHTGR accident discussion, see appendix section F.2.2.2.

[d] For detailed ALWR accident discussion, see appendix section F.2.2.3.

[e] The APT with helium-3 target system bounding low to moderate consequence accident consequences are bounded by the APT with spallation-induced lithium conversion target system which is nil. For detailed APT discussion, see appendix section F.2.2.4.

[f] For detailed tritium recycling facility discussion, see appendix section F.2.4.

[g] Analysis postulated all plant protection systems functioned as designed.

[h] Intense rapid burning.

[i] Increased likelihood of cancer fatality.

Note: SILC - spallation-induced lithium conversion.

Source: Appendix F.

Phased APT accident with low to moderate consequences were negligible. For the beyond design basis accident, there was no difference in the Full and the Phased accident consequences. Review of the source terms for the Full and the Phased APT indicated that the tritium component of the source term is identical for both accidents. Review of the MACCS computer code output data for each accident analysis indicated that the tritium component of the source term dominated the dose calculation results. The impact of the other source term isotopes on the dose calculation results is negligible.

Potential Mitigation Measures. The accidents postulated for tritium supply technologies and recycling facilities are based on operations and safety analyses that have been performed at similar facilities. One of the major design goals for tritium supply and recycling facilities is to achieve a reduced risk to facility personnel and to public health and safety to as low as reasonably achievable.

Current estimates are that there would be 180 collocated workers within 1,000 meters from an accident, 87 collocated workers between 1,000 meters and 2,000 meters of an accident, and 1,114 collocated workers beyond 2,000 meters of the accident. Involved workers that are associated with the proposed action would be located in and around the facility.

Worker exposures that may result from the accidental release of radioactive material will be minimized through design features and administrative procedures that will be defined in conjunction with the facility design process. The radiological impacts to involved workers from accidents could not be quantitatively estimated for this PEIS because the facility design information needed to support the estimate has not yet been developed. The impacts on workers from accidents will be analyzed as part of subsequent project-specific NEPA documentation and in detailed safety analysis documentation that are prepared in conjunction with the facility design process.

The tritium supply and recycling facilities would be designed to comply with current Federal, state, and local laws, DOE orders, and industrial codes and standards. This would provide facilities that are highly resistant to the effects of severe natural phenomena, including earthquake, flood, tornado, high wind, as well as credible events as appropriate to the site, such as fire and explosions, and man-made threats to its continuing structural integrity for containing materials. Because of the proximity of Pantex to the Amarillo airport, special provisions may be necessary in the design to harden the facility against the potential forces of an aircraft crash into the facility.

The tritium supply and recycling facilities would be designed to resist the effects of severe natural phenomena as well as the effects of man-made threats to its continuing structural integrity. It also would be designed to provide containment of the tritium inventory at all times through the use of multiple, high quality confinement barriers to prevent the accidental release of tritium to the environment. It also would be designed to produce a lower quantity of waste materials as compared to the tritium facilities of the existing weapons complex.

In addition, DOE orders specify the requirements for emergency preparedness at DOE facilities. Pantex has comprehensive emergency plans to protect life and property within the facility and the health and welfare of surrounding areas. The emergency plans would be revised to incorporate future DOE requirements and expanded to incorporate the addition of tritium supply and recycling facilities to Pantex. See section 4.5.2.9 for emergency preparedness and emergency plan details at Pantex.

4.5.3.10 *Waste Management*

Construction and operation of tritium supply and recycling facilities would impact existing waste management operations, increasing the generation of low-level, mixed low-level, hazardous, and nonhazardous waste, and initiating the generation of spent nuclear fuel. There are no high-level or TRU wastes associated with the proposed action. As part of their design, all reactor technologies would provide stabilization and storage of spent fuel for the life of the facility. Siting tritium supply and recycling facilities at Pantex would involve the construction of new treatment and staging facilities for solid LLW generation for all the technologies. New liquid LLW treatment facilities for the HWR, MHTGR, and ALWR would be necessary. Due to the increased generation of solid mixed LLW, new or expanded storage facilities would be necessary for the HWR and ALWR.

All technologies would generate enough solid sanitary waste to shorten the planned lifetime of the city of Amarillo landfill or require its expansion. All technologies would require additional or expansion of existing treatment facilities for liquid sanitary waste. This section provides a description of waste generation, treatment, storage, and disposal requirements of the tritium supply and recycling facilities and the potential impacts on waste management. Because Pantex does not currently dispose of radioactive waste onsite, the incremental increase in shipments of LLW to NTS is estimated. The incremental increased risk due to these shipments is analyzed in section 4.7.

No Action. Under No Action, low-level, mixed low-level, hazardous, and nonhazardous waste would continue to be managed from the missions described in section 3.3.4. Table 4.5.3.10–1 lists the projected waste generation rates, and treatment, storage, and disposal capacities under No Action. Projections for No Action were derived from 1992 environmental data with appropriate adjustments made for those changing operational requirements where the volume of wastes generated are identifiable. The projection does not include wastes from future, yet uncharacterized, environmental restoration activities. Pantex might also store, over the long term, certain quantities of sealed plutonium pits; however, no impact on waste management is expected since such storage generates minimal additional waste.

Pantex's assembly/disassembly and high explosives programs would continue to generate low-level, mixed low-level, and hazardous waste. Compactible components of solid LLW would continue to be processed at the onsite solid waste compaction facility. Mixed waste would be treated and disposed of according to the Pantex Site Treatment Plan, which is currently being developed pursuant to the *Federal Facility Compliance Act* of 1992. Although the predominant workload in 1992 was disassembly operations, the activity levels were assumed to be representative of projected workload levels that characterize No Action operations. It is expected that through waste minimization efforts, generation rates would decrease.

Tritium Supply and Recycling. Tritium supply and recycling facilities that would support the nuclear weapons stockpile requirements (both new and existing facilities) would treat and package all waste generated in support of this activity into forms that would enable long-term storage and/or disposal in accordance with the *Atomic Energy Act*, RCRA, and other relevant statutes as outlined in chapter 5 and in appendix section H.1.2. The resultant waste effluents are shown in section 3.4. Waste generated during construction would consist of wastewater, solid nonhazardous, and hazardous waste. The nonhazardous wastes would be recycled or disposed of as part of the construction project by the contractor except for solid sanitary waste, which would be sent offsite to the city of Amarillo sanitary/industrial landfill. The hazardous wastes would be shipped offsite to a RCRA-permitted treatment and disposal facility. Operation of the three reactor-based tritium supply technologies and recycling facilities would generate spent fuel, and all four technologies would generate low-level, mixed low-level, hazardous, and nonhazardous wastes. The volume of the waste streams from tritium supply would vary according to the tritium supply technology chosen. Table 4.5.3.10–2 lists the total estimated waste volumes projected to be generated as a result of various tritium supply technologies and recycling facilities. The incremental waste volumes from the tritium supply technologies that were added to the No Action projection can be found in appendix section A.2. Table 4.5.3.10–3 lists potential waste management impacts at the time of initial operation of the tritium facilities.

Spent nuclear fuel storage for the life of the reactors is provided for in the reactor designs (appendix section A.2.1). Because spent nuclear fuel reprocessing is not planned, no HLW would be generated. Without plutonium production, no TRU waste would be generated. The treatment, storage, and disposal of mixed LLW would be in accordance with the Pantex Plant Site Treatment Plan, which is currently being developed pursuant to the *Federal Facility Compliance Act* of 1992. LLW would continue to be shipped to NTS for disposal. Hazardous waste would be treated, staged in new hazardous waste staging facilities, and shipped offsite to a RCRA-permitted disposal facility. Nonhazardous waste would be treated utilizing current, expanded, or new facilities.

Heavy Water Reactor. Spent nuclear fuel would be generated at the rate of 7 yd^3 per year. This would add 0.3 metric tons of heavy metal per year to the

TABLE 4.5.3.10–1.—*Projected Waste Management for No Action at Pantex Plant, 1992*

Category	Annual Generation Rate (yd^3)	Treatment Method	Treatment Capacity (yd^3/yr)	Storage Method	Storage Capacity (yd^3)	Disposal Method	Disposal Capacity (yd^3)
Low-Level							
Liquid	2 (403 gal)	Solidification	14 (3,300 GPY)	Staged for processing	113 (23,000 gal)	NA	NA
Solid	25	Compaction	220	Staged for shipment	Included in low-level	Shipped offsite to NTS	NA
Mixed Low-Level							
Liquid	2 (403 gal)	None - onsite encapsulation pending	Planned	Staged for processing	95 (19,000 gal)	NA	NA
Solid	5	Compaction and incineration	Planned[a]	Staged for shipment	Included in mixed low-level	Shipped offsite	NA
Hazardous[b]							
Liquid	12 (2,420 gal)	Incineration[c]	Variable	Staged for shipment	308[d] (62,000 gal)	Shipped offsite	NA
Solid	63	Incineration[c]	Variable	Staged for shipment	Included in hazardous	Shipped offsite	NA
Nonhazardous (Sanitary)							
Liquid	198,000 (39,900,000 gal)	Evaporation and filtration	1,030,000 (207,000,000 GPY)	None	NA	Lagoon and NPDES outfall (stormwater)	1,200,000 (237,000,000 gal)
Solid	734	Compaction and incineration	270,000	None	NA	Landfill (offsite)	NA
Nonhazardous (Other)							
Liquid	36,600 (7,400,000 gal)	Carbon absorption/ filtration	Included in liquid sanitary	None	NA	See liquid sanitary	Included in sanitary
Solid	5,830	Compaction and incineration	Included in solid sanitary	None	NA	Landfill (onsite)	Expandable

[a] Only HE-contaminated material treatment currently exists. Estimated quantity treated in 1992 was 1.6 yd^3/yr.

[b] Includes PCB and asbestos-contaminated wastes and some industrial wastewater.

[c] HE-contaminated wastes only.

[d] Includes 135 yd^3 RCRA-permitted storage and 173 yd^3 for non-RCRA regulated storage.

Note: NA - not applicable

Source: DOE 1993a; PX 1993a:1; PX 1993a:2; PX Battelle 1992a; PX MH 1991c.

TABLE 4.5.3.10–2.—*Estimated Annual Generated Spent Nuclear Fuel and Waste Volumes for Tritium Supply Technologies and Recycling at Pantex Plant*

Category	No Action[a] (yd^3)	Tritium Supply Technologies and Recycling				
		HWR (yd^3)	MHTGR (yd^3)	Large ALWR (yd^3)	Small ALWR (yd^3)	APT[b] (yd^3)
Spent Nuclear Fuel	None	7[c]	80[d]	55[e]	36[f]	None
Low-Level						
Liquid	2 (403 gal)	10,400 (2,100,000 gal)	2,600 (525,000 gal)	24,800 (5,000,000 gal)	3,910 (790,000 gal)	2 (402 gal)
Solid	25	5,580	1,680	1,090	1,040	919
Mixed Low-Level						
Liquid	2 (403 gal)	2 (409 gal)	2 (409 gal)	2 (409 gal)	2 (409 gal)	2 (409 gal)
Solid	5	127	8	13	13	14
Hazardous						
Liquid	12 (2,420 gal)	12 (2,420 gal)	12 (2,420 gal)	12 (2,420 gal)	12 (2,420 gal)	12 (2,420 gal)
Solid	63	104	164	99	99	67
Nonhazardous (Sanitary)						
Liquid	198,000 (39,900,000 gal)	507,000 (102,000,000 gal)	417,000 (84,200,000 gal)	715,000 (144,000,000 gal)	517,000 (104,000,000 gal)	1,480,000 299,000,000 gal)
Solid	734	15,700	15,500	15,000	12,300	9,370
Nonhazardous (Other)						
Liquid	36,600 (7,400,000 gal)	36,600 (7,400,000 gal)	36,600 (7,400,000 gal)	36,600 (7,400,000 gal)	36,600 (7,400,000 gal)	36,600 (7,400,000 gal)
Solid	5,830	18,700[g]	18,600[h]	18,000[i]	15,700[j]	12,200[k]

[a] The No Action waste volumes are from table 4.5.3.10–1. Waste volumes for tritium supply technologies and recycling were derived by adding the waste volumes of the various tritium supply technologies and recycling found in appendix section A.2 (tables A.2.1.1–4, A.2.1.2–4, A.2.1.3–4, A.2.1.3–5, A.2.1.4–4, and A.2.2.1–4) to the No Action volumes. Waste volumes have been rounded to three significant figures.

[b] The APT and recycling waste volumes are based on the spallation-induced lithium conversion target. The helium-3 target waste volumes are approximately the same with the exception of solid LLW which is 447 yd^3.

[c] Residual heavy metal content is 660 lb (0.3 metric tons).

[d] Residual heavy metal content is 530 lb (0.24 metric tons).

[e] Residual heavy metal content is 230,000 lb (105 metric tons).

[f] Residual heavy metal content is 150,000 lb (68 metric tons).

[g] Includes 12,900 yd^3 of recyclable waste.

[h] Includes 12,800 yd^3 of recyclable waste.

[i] Includes 12,200 yd^3 of recyclable waste.

[j] Includes 9,900 yd^3 of recyclable waste.

[k] Includes 6,400 yd^3 of recyclable waste.

DOE spent nuclear fuel inventory. The HWR would be designed to provide the necessary stabilization and storage of the spent nuclear fuel while awaiting final disposition. The liquid LLW generated from the HWR would far exceed the limited existing treatment capability at Pantex. The HWR would have to provide a liquid radioactive waste treatment capability that would treat the liquid LLW into a solid form that would meet the waste acceptance criteria of the selected offsite LLW disposal facility. The solid LLW generated from the HWR would also exceed the Pantex capability to stage solid LLW prior to shipment to the offsite disposal facility, which is currently NTS. Expansion of existing facilities or the construction of a new facility would be examined in a site-specific NEPA analysis. Locating the HWR at Pantex would require an additional 92 shipments of solid LLW to NTS per year. Assuming a 4,000 ft^3/acre LLW disposal usage factor, these additional LLW shipments would require 0.6 acres of LLW disposal area at NTS. The 2 percent increase in liquid mixed LLW could be handled by adding the appropriate treatment capability to planned mixed waste facilities. The increase in solid mixed LLW from the HWR would require an expansion of the treatment and storage capabilities currently being studied pursuant to complying with the *Federal Facility Compliance Act* of 1992. The generation of solid hazardous waste could be handled within the existing capability at Pantex. The capacity of the staging area is approximately 300 yd^3 with hazardous waste continually being shipped offsite. The HWR would generate larger quantities (factor of 3) of liquid sanitary waste than currently projected for Pantex under No Action. Additional treatment facilities or expansion of existing or planned facilities would be analyzed in a site-specific NEPA analysis. The HWR would increase by a factor of 21 the quantities of solid sanitary waste for the city of Amarillo landfill as compared to No Action. This would cause an increase in the need for landfill capacity at the city of Amarillo sanitary/industrial landfill.

Siting an HWR without tritium recycling facilities at Pantex would not affect the generation of nor change the impacts from spent nuclear fuel and liquid LLW as described above and in table 4.5.3.10–3. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.5.3.10–3. The generation of solid LLW would increase by a factor of 208 over No Action and would exceed the Pantex capability to stage while awaiting shipment to NTS. However, the total number of additional shipments would be reduced to 86. Approximately 0.6 acres per year of LLW disposal would still be needed at NTS to accommodate this waste. The increase in generation rate over No Action for solid sanitary wastes would decrease from a factor of 21 to a factor of 11; thus, proportionately decreasing the impact to the planned lifetime of the landfill.

Modular High Temperature Gas-Cooled Reactor. Spent nuclear fuel would be generated at the rate of 80 yd^3 per year. This would add 0.24 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The MHTGR would be designed to provide the necessary stabilization and storage of the spent nuclear fuel while awaiting final disposition. The liquid LLW generated from the MHTGR would far exceed the limited existing treatment capability at Pantex. The MHTGR would have to provide a liquid radioactive waste treatment capability that would treat the liquid LLW into a solid form that would meet the waste acceptance criteria of the selected offsite LLW disposal facility. The solid LLW generated from the MHTGR would exceed the Pantex capability (factor of 15 greater) to stage solid LLW prior to shipment to NTS. Expansion of existing facilities or the construction of a new facility would be examined in a site-specific NEPA analysis. Locating the MHTGR at Pantex would require an additional 27 shipments of solid LLW to NTS per year. The additional LLW shipments would require approximately 0.2 acres per year of LLW disposal at NTS. The 60-percent increase in solid mixed LLW could be handled within the existing and planned capability as currently being studied pursuant to complying with the *Federal Facility Compliance Act* of 1992. The approximate tripling of solid hazardous waste volumes due to the MHGTR could also be handled within the existing and planned capability at Pantex. The MHTGR would generate larger quantities (factor of 2 greater) of liquid sanitary wastes than

TABLE 4.5.3.10–3.—*Potential Spent Nuclear Fuel and Waste Management Impacts from Tritium Supply Technologies and Recycling at Pantex Plant*

	Tritium Supply Technologies and Recycling									
	HWR		MHTGR		Large ALWR		Small ALWR		APT	
Category	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact	Change from No Action[a] (percent)	Impact
Spent Nuclear Fuel	New	New storage facility	New	New storage facility	New	New storage facility	New	New storage facility	None	None
Low-Level										
Liquid	+521,000	New treatment facility	+130,000	New treatment facility	+1,240,000	New treatment facility	+196,000	New treatment facility	None	None
Solid	+22,200	New staging facility, 92 LLW shipments	+6,600	New staging facility, 27 LLW shipments	+4,240	New staging facility, 32 LLW shipments	+4,040	New staging facility, 18 LLW shipments	+3,580	New staging facility, 16 LLW shipments
Mixed Low-Level										
Liquid	+1	None	+1	None	+1	None	+1	None	+1	None
Solid	+2,440	Expand treatment and storage	+60	None	+160	None	+160	None	+176	None
Hazardous										
Liquid	None	None	None	None	None	None	None	None	None	None
Solid	+65	None	+160	None	+57	None	+57	None	+6	None
Nonhazardous (Sanitary)										
Liquid	+156	Add or expand treatment facilities	+111	Add or expand treatment facilities	+261	Add or expand treatment facilities	+161	Add or expand treatment facilities	+651	Add or expand treatment facilities
Solid	+2,040	Landfill life reduced or expansion required	+2,020	Landfill life reduced or expansion required	+1,950	Landfill life reduced or expansion required	+1,580	Landfill life reduced or expansion required	+1,180	Landfill life reduced or expansion required
Nonhazardous (Other)										
Liquid	None	None	None	None	None	None	None	None	None	None
Solid	+221	None-Project wastes are recyclable	+220	None-Project wastes are recyclable	+209	None-Project wastes are recyclable	+170	None-Project wastes are recyclable	+110	None-Project wastes are recyclable

[a] This column reflects the percentage change in generation rate for No Action. Percentage change was calculated using waste volumes prior to rounding. Do not use rounded numbers in Table 4.5.3.10–2 to calculate percentage change.

Source: Tables 4.5.3.10–1; 4.5.3.10–2.

is currently projected for Pantex under No Action. Additional treatment facilities or expansion of existing or planned facilities would be analyzed in a site-specific NEPA analysis. The MHTGR would increase by a factor of 21 the quantities of solid sanitary waste for the city of Amarillo landfill as compared to No Action. This would cause an increase in the need for landfill capacity at the city of Amarillo sanitary/industrial landfill.

Siting an MHTGR without tritium recycling facilities at Pantex would not affect the generation of nor change the impacts from spent nuclear fuel and liquid LLW as described above and in table 4.5.3.10–3. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.5.3.10–3. The generation of solid LLW would increase by a factor of 53 over No Action and would still exceed the Pantex capability to stage while awaiting shipment to NTS. However, the total number of additional shipments would be reduced to 22. Approximately 0.15 acres per year of LLW disposal would be needed at NTS to accommodate this waste. The increase in generation rate over No Action for solid sanitary wastes would decrease from a factor of 21 to a factor of 11; thus, proportionately decreasing the impact to planned lifetime of the landfill.

Advanced Light Water Reactor (Large). Spent nuclear fuel would be generated at the rate of 55 yd^3 per year. This would add 105 metric tons of heavy metal per year to the DOE spent nuclear fuel inventory. The ALWR would be designed to provide the necessary stabilization and storage of the spent nuclear fuel for the life of the facility. The liquid LLW generated from the ALWR would far exceed the limited existing treatment capability at Pantex. The Large ALWR would have to provide a liquid radioactive treatment capability. The facility would treat the liquid LLW into a solid form that would meet the waste acceptance criteria of the LLW disposal facility at NTS. The solid LLW generated from the ALWR would also exceed the Pantex capability to stage solid LLW prior to shipment to NTS. Expansion of existing facilities or the construction of a new facility would be examined in a site-specific NEPA analysis. Locating the Large ALWR at Pantex would require an additional 32 shipments of solid LLW to NTS per year. The additional LLW shipments would require approximately 0.2 acres per year of LLW disposal at NTS. The threefold increase in solid mixed LLW for the Large ALWR could be handled within the existing capability for staging since Pantex is currently handling about 50 yd^3 of mixed LLW. As seen in table 4.5.3.10–3, the increase in solid hazardous waste volumes could be handled within the existing and planned capability at Pantex. The capacity of the staging area is approximately 300 yd^3 with hazardous waste continually being shipped offsite. As in other technologies, the Large ALWR would generate larger quantities (factor of 3) of liquid sanitary wastes than currently projected for Pantex under No Action. Additional treatment facilities or expansion of existing or planned facilities would be necessary. The ALWR would increase by a factor of 21 the quantities of solid sanitary waste for the city of Amarillo landfill as compared to No Action. This would cause an increase in the need for landfill capacity at the city of Amarillo sanitary/industrial landfill.

Siting a Large ALWR without tritium recycling facilities at Pantex would not affect the generation of nor change the impacts from spent nuclear fuel and liquid LLW as described above and in table 4.5.3.10–3. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste streams generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.5.3.10–3. The generation of solid LLW would increase by a factor of 29 over No Action and would exceed the Pantex capability to stage while awaiting shipment to NTS. However, the total number of additional shipments would be reduced to 26. Approximately 0.18 acres per year of LLW disposal would be needed at NTS to accommodate this waste. The increase in generation rate over No Action for solid sanitary wastes would decrease from a factor of 21 to a factor of 9; thus, proportionately decreasing the impact to planned lifetime of the landfill.

Advanced Light Water Reactor (Small). Spent nuclear fuel would be generated at the rate of 36 yd^3 per year. This would add 68 metric tons of heavy

metal per year to the DOE spent nuclear fuel inventory. The Small ALWR facility would be designed to provide the necessary stabilization and storage of the spent nuclear fuel for the life of the facility. The liquid LLW generated from the Small ALWR facility would far exceed the limited existing treatment capability at Pantex. The Small ALWR facility would have to provide a liquid radioactive treatment capability to convert the liquid LLW into a solid form that would meet the waste acceptance criteria of the LLW disposal facility at NTS. The solid LLW generated from the ALWR facility would also exceed the Pantex capability to stage solid LLW prior to shipment to NTS. Expansion of existing facilities or the construction of a new facility would be examined in site-specific, tiered NEPA documents. Locating the Small ALWR facility at Pantex would require an additional 18 shipments of solid LLW to NTS per year. This increase in LLW shipments would require approximately 0.1 acres of LLW disposal at NTS. The threefold increase in solid mixed LLW for the Small ALWR could be handled within the existing capability for staging since Pantex is currently handling about 50 yd^3 of mixed LLW. As seen in table 4.5.3.10–3, the slight increase in solid hazardous waste volumes could be handled within the existing and planned capability at Pantex since the staging capacity is almost 300 yd^3. As in the other technologies, the Small ALWR would generate larger quantities (factor of 2) of liquid sanitary wastes than currently projected for Pantex under No Action. Additional treatment facilities or expansion of existing or planned facilities would be necessary. The ALWR would increase the quantities of solid sanitary waste for the city of Amarillo landfill as compared to No Action by a factor of 17. This would cause an increase in the need for landfill capacity at the city of Amarillo sanitary/industrial landfill.

Siting a Small ALWR without tritium recycling facilities at Pantex would not affect the generation of nor change the impacts from spent fuel and liquid LLW as described above and in table 4.5.3.10–3. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.5.3.10–3. The generation of solid LLW would increase by a factor of 27 over No Action and would exceed the Pantex capability to stage while awaiting shipment to NTS. However, the total number of additional shipments would be reduced to 13. Approximately 0.09 acres per year of LLW disposal would be needed at NTS to accommodate this waste. The increase in generation rate over No Action for solid sanitary wastes would decrease from a factor of 17 to a factor of almost 7; thus proportionately decreasing the impact to the planned lifetime of the landfill.

Accelerator Production of Tritium. The APT does not generate spent nuclear fuel. Any liquid LLW can be solidified at the point of generation. The solid LLW generated from the APT would exceed the Pantex capability to stage solid LLW prior to shipment to NTS. Expansion of existing facilities or the construction of a new facility would be examined in a site-specific NEPA analysis. Locating the APT at Pantex would require an additional 16 shipments of solid LLW to NTS per year. The additional LLW shipments would require 0.1 acres per year of LLW disposal at NTS. The increase from 5 yd^3 to 14 yd^3per year of solid mixed LLW would not require an expansion of the capability currently being studied pursuant to complying with the *Federal Facility Compliance Act* of 1992. The slight increase in solid hazardous waste volumes could be handled within the existing and planned capability at Pantex. The APT would increase by approximately a factor of 11 the amounts of liquid sanitary wastes than currently projected for Pantex under No Action. Additional treatment facilities or expansion of existing or planned facilities would be necessary. The APT would increase the quantities of solid sanitary waste for the city of Amarillo landfill as compared to No Action by a factor of 13. This would cause an increase in the need for landfill capacity at the city of Amarillo sanitary/industrial landfill.

Siting an APT without tritium recycling facilities at Pantex would not affect the generation of nor change the impacts from liquid LLW as described above and in table 4.5.3.10–3. Liquid mixed LLW and cooling tower blowdown would no longer be generated. All remaining waste stream generation rates would decrease; however, the impacts from solid mixed LLW, hazardous wastes, liquid sanitary wastes, and other solid nonhazardous wastes would not change from those described above and in table 4.5.3.10–3. The generation of solid LLW would increase by a

factor of 23 over No Action and would still exceed the Pantex capability to stage while awaiting shipment to NTS. However, the total number of additional shipments would be reduced to 10. Approximately 0.07 acres per year of LLW disposal would be needed at NTS to accommodate this waste. The increase in generation rate over No Action for solid sanitary wastes would decrease from a factor of 13 to 3; thus proportionately decreasing the impact to the planned lifetime of the landfill.

Less Than Baseline Operations. In the event of a reduced baseline tritium requirement the waste volumes shown in table 4.5.3.10–2 would not appreciably change as a result of the HWR operating at less power and the MHTGR and ALWR irradiating fewer target rods. In the case of a Phased APT using the helium-3 target, the waste volumes are approximately the same as the Full APT using the helium-3 target.

Multipurpose Reactor

Multipurpose Modular High Temperature Gas-Cooled Reactor. The volume of spent nuclear fuel generated by the six-reactor module multipurpose MHTGR would be approximately double the spent nuclear fuel from the three-reactor module tritium supply MHTGR. Similar to the mixed-oxide fuel assemblies, the plutonium-oxide fuel assemblies would have greater decay heat. Because the increased decay heat reduces storage density in the pool area and increases the fuel pool dwell time before dry storage, the spent nuclear fuel storage requirement would more than double that required for the three-reactor module tritium supply MHTGR. No increases in waste generation rates or characteristics are expected due to the change from uranium-oxide reactor fuel to plutonium-oxide reactor fuel. However, there would be increases in waste generation for all waste categories due to operation of the Pit Disassembly/Conversion Facility to include the introduction of mixed TRU and TRU wastes from both the Pit Disassembly/Conversion Facility and the fabrication of plutonium-oxide fuel. These increases are in addition to those listed in table 4.5.3.10–2 for the tritium supply MHTGR. Table 4.8.3.1–8 provides the quantity of waste effluents from the Pit Disassembly/Conversion Facility.

In addition, approximately 385 yd^3 of mixed TRU and TRU waste would result from the fabrication of plutonium-oxide fuel. The 399 yd^3 of mixed TRU and TRU waste would require transport to a geologic repository (assuming one is available) after they have been processed to meet the WIPP waste acceptance criteria. Since Pantex has a very limited capability to manage TRU and mixed TRU wastes, additional facilities to handle TRU waste would be needed. The transport of the mixed TRU and TRU wastes to WIPP would require 35 truck shipments per year, 18 regular train shipments per year, or six dedicated train shipments per year. One hundred gallons of liquid and 0.2 yd^3 of solid mixed LLW would require treatment in accordance with the Pantex Site Treatment Plan. One additional LLW shipment every two years and approximately 0.003 acres per year of LLW disposal area at NTS would be required to dispose of the 10 yd^3 of solid LLW. Sufficient staging capacity exists to accumulate the 1,000 gallons of liquid and 1 yd^3 of solid hazardous wastes while awaiting shipment to a RCRA-permitted treatment and disposal facility. An additional 87 yd^3 of solid nonhazardous wastes would require disposal in the sanitary landfill. Additional liquid sanitary and industrial wastewater treatment facilities may be required if the Pit Disassembly/Conversion Facility is not collocated with the multipurpose reactor.

Multipurpose Advanced Light Water Reactor. Spent fuel would be generated at the same rate with approximately the same amount of residual heavy metal content as the tritium supply ALWR. The decay heat in the mixed-oxide fuel assemblies could be 10 to 20 percent greater than the heat in spent uranium-oxide fuel assemblies. The increased decay heat load could reduce the fuel assembly storage density in the fuel pool and dry storage casks or increase fuel pool dwell time before dry storage. No increases in waste generation rates or characteristics are expected due to the change from uranium-oxide reactor fuel to mixed-oxide reactor fuel. However, there would be increases in waste generation for all waste categories due to operation of the Pit Disassembly/Conversion/Mixed-Oxide Fuel Fabrication Facility to include the introduction of mixed TRU and TRU wastes. These increases are in addition to those listed in table 4.5.3.10-2 for the Large and Small tritium supply ALWR. As shown in table 4.8.3.1-4, approximately 399 yd^3 of mixed TRU and TRU wastes

would require transport to a geologic repository (assuming one is available) after they have been processed to meet the WIPP waste acceptance criteria.

Since Pantex has a very limited capability to manage TRU and mixed TRU wastes, additional facilities to handle TRU waste would be needed. The transport of the mixed TRU and TRU wastes to WIPP would require 35 truck shipments per year, 18 regular train shipments per year, or six dedicated train shipments per year. Two hundred gallons of liquid and 13 yd^3 of solid mixed LLW would require treatment in accordance with the Pantex Site Treatment Plan. Twenty-five additional LLW shipments per year and approximately 0.16 acres per year of LLW disposal area at NTS would be required to dispose of the 524 yd^3 of solid LLW. Sufficient staging capacity exists to accumulate the 200 gallons of liquid and 13 yd^3 of solid hazardous wastes while awaiting shipment to a RCRA-permitted treatment and disposal facility. An additional 3,920 yd^3 of solid nonhazardous wastes would require disposal in the sanitary landfill. Additional liquid sanitary and industrial wastewater treatment facilities may be required if the Pit Disassembly/Conversion/Mixed Oxide Fuel Fabrication Facility is not collocated with the multipurpose reactor.

Potential Mitigation Measures. Each new tritium supply technology and recycling facility would be designed to process its own waste into a form suitable for storage or disposal and would use proven waste minimization and pollution prevention technologies to the extent possible. Some designs produce waste quantities or waste forms that could undergo additional reductions by utilizing the emerging technologies, thereby further reducing or mitigating impacts. Therefore, the impacts previously discussed could be substantially reduced. Pollution prevention and waste minimization would be considered in determining the final design of any facility constructed as part of the proposed action at Pantex. Pollution prevention and waste minimization would also be analyzed as part of site-specific tiered NEPA documents.

Some of the facilities such as Building 11-15A and Building 11-9 are planned to handle mixed wastes generated from past and current operations and from environmental restoration activities may be able to treat, store, or dispose of Complex wastes (DOE 1993a:5-12). Utilization of these existing facilities or the need for the construction of new facilities, as appropriate at the time, would be addressed in site-specific tiered NEPA documents.

The impact to the city of Amarillo sanitary landfill could be mitigated by considering possible onsite alternatives, financial assistance to the city or other possible offsite landfills. These alternatives would be addressed in a site-specific tiered NEPA document.