Final Environmental Impact Statement Safe Interim Storage Of Hanford Tank Wastes DOE/EIS-0212 VOLUME 1 OF 2 VOLUME 1

FINAL
ENVIRONMENTAL IMPACT STATEMENT

SAFE INTERIM STORAGE OF HANFORD
TANK WASTES

Hanford Site
Richland, Washington

October, 1995

WASHINGTON STATE DEPARTMENT OF ECOLOGY
NUCLEAR WASTE PROGRAM
LACEY, WASHINGTON 98503

U.S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
RICHLAND, WASHINGTON 99352

Department of Energy
Richland, WA 99352

October 1995

Dear Citizen:

This is the Safe Interim Storage of Hanford Tank Wastes Final Environmental Impact Statement. The Department of Energy and the Washington State Department of Ecology have prepared the Final Environmental Impact Statement in accordance with the National Environmental Policy Act and the Washington State Environmental Policy Act.

This Environmental Impact Statement deals with interim actions required prior to making decisions based on the Tank Waste Remediation System Environmental Impact Statement, a separate Environmental Impact Statement which is being prepared to analyze longer term waste management decisions.

This Environmental Impact Statement analyzes five alternatives for maintaining safe storage of high level radioactive wastes currently stored in the older single-shell tanks, the Watchlist Tank 241-SY-101, and future waste volume associated with tank farm and other Hanford facility operations, including alternative methods of transferring this waste across the Hanford Site. The site-specific analyses presented in Volume 1 support the discussion of environmental consequences related to these alternatives. Volume 2 is the Comment Response Document which provides summaries of public comments received on the draft Environmental Impact Statement during and after the 45-day public comment period, and the responses to those comments.

A complete copy of the Final Environmental Impact Statement and reference documents are available in public reading rooms and information repositories. Their addresses are included in the National Environmental Policy Act/State Environmental Policy Act fact sheet in Volume 1. For further information or to request additional copies, contact:

Carolyn Haass　　　　　　　　　Geoff Tallent

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The Department of Energy will issue a Record of Decision no less than 30 days after the Environmental Protection Agency publishes a Notice of Availability in the Federal Register for the Final Environmental Impact Statement. A copy of the Record of Decision can be obtained by contacting the Office of Communications at the phone number listed above.

Sincerely,

Paul F.X. Dunigan, Jr.
NEPA Compliance Officer

COVER SHEET

RESPONSIBLE AGENCIES: Lead Federal Agency: U.S. Department of Energy; Lead State Agency: Washington State Department of Ecology

TITLE: Safe Interim Storage of Hanford Tank Wastes, Final Environmental Impact Statement, Hanford Site, Richland, Washington

CONTACTS: For further information or additional copies of this Final Environmental Impact Statement, contact:

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For general information on the U.S. Department of Energy Environmental Impact Statement process call 1-800-472-2756 or contact:

Carol Borgstrom, Director
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ABSTRACT: This Final Environmental Impact Statement is prepared pursuant to the National Environmental Policy Act and the Washington State Environmental Policy Act. U.S. Department of Energy and Washington State Department of Ecology have identified the need to maintain safe storage of high-level radioactive wastes currently stored in the older single-shell tanks, Watchlist Tank 241-SY-101 (commonly referred to as 101-SY), and future waste volumes associated with Tank Farm and other Hanford Facility operations, including a need to provide a modern, safe, reliable, and regulatory-compliant replacement cross-site transfer capability. The purpose of this action is to prevent uncontrolled releases to the environment by maintaining safe storage of tank wastes. This action would be an interim action pending other actions that could result from the Tank Waste Remediation System Environmental Impact Statement. This Final Environmental Impact Statement analyzes five alternatives for maintaining safe interim storage of Hanford tank wastes.

NEPA/SEPA FACT SHEET

DOCUMENT TITLE AND LOCATION OF PROJECT: Safe Interim Storage of Hanford Tank Wastes, Final Environmental Impact Statement; Hanford Site, Richland, Washington.

ABSTRACT: This Final Environmental Impact Statement has been prepared pursuant to the National Environmental Policy Act and the Washington State Environmental Policy Act. U.S. Department of Energy and Washington State Department of Ecology have identified the need to maintain safe storage of high-level radioactive wastes currently stored in the older single-shell tanks, the Watchlist Tank 101-SY, and future waste volumes associated with tank farm and other Hanford facility operations, including a need to provide a modern, safe, reliable, and regulatory-compliant replacement cross-site transfer capability. The purpose of this action is to prevent uncontrolled releases to the environment by maintaining safe storage of high-level tank wastes.

The following alternatives have been identified for maintaining safe interim storage of Hanford tank wastes during the interim period prior to making and implementing decisions as part of the Tank Waste Remediation System Environmental Impact Statement. A complete description of the alternatives is provided in Section 3. Section 5 provides an assessment of environmental impacts which would result from implementing each alternative.

Preferred Alternative - The preferred alternative consists of construction and operation of a replacement cross-site transfer system, a retrieval and transfer system in Tank 102-SY to remove transuranic sludge and residual supernatant, continued operation of the existing mixer pump in Tank 101-SY to mitigate its flammable gas safety issue, and transfer of salt well liquids from single-shell tanks and facility waste streams from the 200 West Area to available existing double-shell tank space in the 200 East Area. The initial cross site waste transfers would utilize the existing cross-site transfer system. At the time the replacement transfer system becomes operational, waste would be transferred exclusively via the replacement cross-site transfer system.

Truck Transfer Alternative - The truck transfer alternative consists of constructing and operating a high level radioactive waste load facility and a waste unload facility, and using tanker trucks to transfer salt well liquids from the single-shell tanks and facility waste streams from the 200 West Area to available existing double-shell tank space in the 200 East Area. This alternative includes use of the existing roadways utilizing either a modified tanker trailer truck or the LR-56(H) truck. The continued operation of the existing mixer pump in Tank 101-SY would mitigate its flammable gas safety issue.

Rail Transfer Alternative - The rail transfer alternative consists of constructing and operating a high level radioactive waste load facility and a waste unload facility, and using rail tanker cars to transfer salt well liquids from the single-shell tanks and facility waste streams from the 200 West Area to available existing double-shell tank space in the 200 East Area. The rail transfer also includes construction of additional railway segments, operation of a railcar, and continued operation of the existing mixer pump in Tank 101-SY to mitigate its flammable gas safety issue.

New Storage Alternative - The new storage alternative consists of construction and operation of two new double-shell tanks and their associated facilities, the replacement cross-site transfer system, and retrieval and transfer systems for Tanks 102-SY and 101-SY. This alternative includes retrieval and dilution of Tank 101-SY and transfer of the waste to one or both new tanks to mitigate its flammable gas safety issue, removal of sludge and residual supernatant waste from Tank 102-SY, and transfer of salt well liquids from the single-shell tanks and facility waste from the 200 West Area to available existing double shell tank space in the 200 East Area. The existing cross site transfer system would be utilized until the replacement system is operational. The operation of the transfer systems would be similar to the method described in the preferred alternative.

No Action Alternative - The no action alternative consists of continued retrieval of salt well liquids from 200 West Area single-shell tanks and transfer of West Area facility waste streams from the 200 West Area to available existing double-shell tank space in the 200 East Area. The waste streams and salt well liquids would be transferred to the extent possible utilizing the existing cross-site transfer system capability via Tank 102-SY. In addition, operation of the existing mixer pump in Tank 101-SY would continue to mitigate its flammable gas safety issue.

PROPONENT: U.S. Department of Energy

RESPONSIBLE OFFICIALS AND AGENCIES: Lead Federal Agency: John Wagoner of the U.S. Department of Energy; Lead State Agency: Mike Wilson of the Washington State Department of Ecology

CONTACTS: For further information or additional copies of this Final Environmental Impact Statement contact:

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LICENSES (PERMITS) REQUIRED:

The following is a summary of potential permits and approvals required for the actions described within this Environmental Impact Statement.

Environmental Media	Permit/Approval or Requirement	Regulation	Regulatory Agency
Air Emissions	Radiation Air Emissions Program	WAC 246-247	Washington State Department of Health
Air Emissions	National Emissions Standards for Hazardous Air Pollutants	40 CFR 61 Subpart H	Washington State Department of Health
Air Emissions	Notice of Construction New Source Review	WAC 173-400, WAC 173-460,	Ecology Benton County Air Pollution Control Authority
Soil Column Wastewater Disposal	Solid Waste Discharge Permit	WAC 173-216	Ecology
Soil Column Wastewater Disposal	Approval of Engineering Report, Plans and Speci-fications, and Operations and Maintenance Manual	WAC 173-240	Ecology
Domestic Wastewater Disposal	Septic Systems design approval	WAC 246-272	Washington State Department of Health
Dangerous Waste	Dangerous Waste Permit, Resource Conservation and Recovery Act	WAC 173-303 & 40 CFR 264, 265, 270	Ecology
Underground Storage Tanks	Tank Permit	WAC 173-360	Ecology
All Media	Cultural Resource Review Clearance	36 CFR 800	U.S. Department of Energy State Historic Preservation Office
All Media	Endangered Species Approval	50 CFR 402.6	U.S. Fish and Wildlife Service

AUTHORS AND PRINCIPAL CONTRIBUTORS: A listing of authors and principal contributors to this Final Environmental Impact Statement and the subject area of their contributions is in Section 8 of this Final Environmental Impact Statement.

FINAL ENVIRONMENTAL IMPACT STATEMENT DATE OF ISSUE: Anticipated availability of Safe Interim Storage of Hanford Tank Wastes Final Environmental Impact Statement is October 1995.

DATES FOR FINAL ACTIONS: Anticipated availability of the Safe Interim Storage of Hanford Tank Wastes Record of Decision is November 1995. The Record of

Decision will be published in the Federal Register.

RELATED DOCUMENTS: Environmental Impact Statement technical reports, background data, materials incorporated by reference, and other related documents are available either through the contacts listed in the "Contacts" Section, or at:

DOE Freedom of Information
Reading Room
Forrestal Building
1000 Independence Ave. S.W.,
Washington, D.C.

DOE Public Reading Room
Washington State University
Tri-Cities Branch
100 Sprout Road
Richland, WA

and at the following U.S. Department of Energy information repositories:

University of Washington
Suzzallo Library
Government Publication Room
Seattle, WA

Gonzaga University
Foley Center
E. 502 Boone
Spokane, WA

Portland State University
Branford Price Millar Library
SW Harrison and Park
Portland, OR

Copies of the Environmental Impact Statement are available free of charge to the interested public through the contacts listed in the "CONTACTS" Section.

Final Environmental Impact Statement Safe Interim Storage Of Hanford Tank Wastes

VOLUME 1 TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

X	chi, concentration, Ci/m3
X/Q	atmospheric dispersion factor
u	micron; as a unit of measure equivalent to 10-6 meters
ug	microgram
um	micrometer
ACGIH	American Conference of Governmental Industrial Hygienists
AEA	Atomic Energy Act
AIRFA	American Indian Religious Freedom Act
ALARA	as low as reasonably achievable
ARAR	Applicable Relevant and Appropriate Requirement
ARR	Airborne Release Rate
ASIL	acceptable source impact level
Ba	Burbank Sandy Loamy
BARCT	Best Available Radionuclides Control Technology
BDBE	beyond design basis earthquake
BNL	Brookhaven National Laboratory
Bq	becquerel
BSW	bounding slurry waste
BTU	British Thermal Unit
BWIP	Basalt Waste Isolation Project
C	Celsius
CAA	Clean Air Act
CAM	continuous air monitor
CASS	Computer Automated Surveillance System
CBC	Columbia Basin College
CDI	chronic daily intake
CEDE	Committed Effective Dose Equivalent
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	cubic feet per minute
CFR	Code of Federal Regulations
Ci	curie
CLUP	Comprehensive Land Use Plan
cm	centimeter
CO	carbon monoxide
CSZ	Cascadia Subduction Zone
CWA	Clean Water Act
dB	decibel
dB(A)	A-weighted sound level
DBA	design basis accident
DBE	design basis earthquake
DCG	derived concentration guidelines
DCRT	double-contained receiver tank
DN	Dilute Non-Complexed
DNFSB	Defense Nuclear Facility Safety Board
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE-HQ	U.S. Department of Energy, Headquarters
DOE-RL	U.S. Department of Energy, Richland (Washington) Operations
DOH	Washington State Department of Health
DOT	Department of Transportation
DST	double-shell tank
E.O.	Executive Order
EA	Environmental Assessment
Ecology	Washington State Department of Ecology
ECSTS	existing cross-site transfer system
EDNA	environmental designation for noise abatement
EEO	Equal Employment Opportunity
EIS	Environmental Impact Statement
El	Ephrata Sandy Loamy
EMSL	Environmental Molecular Science Laboratory
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ERPG	Emergency Response Planning Guidelines

ESE	east-southeast
F	Fahrenheit
FONSI	Finding of No Significant Impact
FS	Feasibility Study
ft	foot or feet
ft^2	square foot or feet
ft^3/sec	cubic foot or feet per second
FY	fiscal year
g/g	gram per gram
g	gram
g	gravity
gal	gallon
gpd	gallons per day
gpm	gallons per minute
GRE	gas release event
ha	hectare
He	Hezel (Sand)
HEGA	high-efficiency gas adsorption
HEME	high-efficiency mist eliminator
HEMF	high-efficiency metal filter
HEPA	high-efficiency particulate air
HLW	high-level waste
HMS	Hanford Meteorological Station
hp	horsepower
HP	Health Physics
HQ	hazard quotient
hr	hour
HRA	Hanford Remedial Action
HSDP	Hanford Site Development Plan
HSWA	Hazardous and Solid Waste Amendments
HVAC	heating, ventilation, and air-conditioning
HWMA	Hazardous Waste Management Act
Hz	Hertz
ICE	instrumentation, control, and electrical
ICR	incremental cancer risk
in	inch
INEL	Idaho National Engineering Laboratory
ITRS	Initial Tank Retrieval System
kg	kilogram
Kgal	1,000 gallons
km	kilometer
km^2	square kilometers
L	liter
lb	pound
LCF	latent cancer fatality
Leq	equivalent sound level
LFL	lower flammability limit
LIGO	Laser Interferometer Gravitational-Wave Observatory
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LOOP	loss of off-site power
LOS	Level of Service
L/min	liters per minute
m	meter
m^2	square meters
m^3/s	cubic meters per second
M&O	management and operations
MAP	Mitigation Action Plan
MEOSI	maximally exposed off-site individual
mg	milligram
mi	mile
mi^2	square mile
mm	millimeter
MMI	Modified Mercalli Intensity
MOU	Memorandum of Understanding
mph	miles per hour
mrem	millirem
Ms	surface wave magnitude
MSL	mean sea level
MWTF	Multi-Function Waste Tank Facility
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NaOH	sodium hydroxide

NCAW	Neutralized Cladding Acid Waste
nCi	nanocurie
NCRW	Neutralized Cladding Removal Waste
NEPA	National Environmental Policy Act
NESHAPS	National Emissions Standards for Hazardous Air Pollutants
NH3	ammonia
NHPA	National Historic Preservation Act
NO2	nitrogen dioxide
NOA	Notice of Availability
NOC	Notice of Construction
NOI	Notice of Intent
NIOSH	National Institute for Occupational Safety and Health
NOx	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NSF	National Science Foundation
NTF	New Tank Facility
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
OSR	Operational Safety Requirement
OU	operable unit
OWVP	Operational Waste Volume Projection
P.L.	Public Law
pCi	picocurie; as a unit of measure equivalent to 1 x 10-12 curie
PFP	Plutonium Finishing Plant
PGA	peak ground acceleration
PM	particulate matter
PM10	particulate matter less than 10 microns in diameter
PNL	Pacific Northwest Laboratory
ppb	parts per billion
ppm	parts per million
ppmv	parts per million volume
PPSS	past practice sluicing system
PSAR	preliminary safety analysis report
PSD	Prevention of Significant Deterioration
PSE	preliminary safety evaluation
psi	pounds per square inch
PSICSF	pump system installation containment seal fixture
PUREX	Plutonium Uranium Extraction Plant
QA	quality assurance
QC	quality control
RAEP	Radiation Air Emissions Program
RCRA	Resource Conservation and Recovery Act
RCSTS	replacement cross-site transfer system
RCW	Revised Code of Washington
rem	Roentgen equivalent man
RfD	reference dose
RFETS	Rocky Flats Environmental Technology Site
RI	Remedial Investigation
ROD	Record of Decision
Rp	Rupert (Sand)
rpm	revolutions per minute
RWMC	Radioactive Waste Management Complex
SA	Safety Assessment
SAR	safety analysis report
SARA	Superfund Amendments and Reauthorization Act
SARP	Safety Analysis Report for Packaging
scfm	standard cubic feet per minute
SEPA	State Environmental Policy Act
SF	slope factor
SHPO	State Historic Preservation Officer
SIS	Safe Interim Storage
SO2	Sulfur dioxide
SR	State Route
SST	single-shell tank
Supply System	Washington Public Power Supply System
Sv	Sievert
SWDP	Solid Waste Discharge Permit
SWL	salt well liquids
TEDF	Treated Effluent Disposal Facility
TRU	Transuranic
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TSP	total suspended particulate

TSR	Technical Safety Requirement
TWA	time weighted average
TWRS	Tank Waste Remediation System
U.S.	United States
UCRL	University of California Research Lab
USC	United States Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USQ	unreviewed safety question
VOC	volatile organic compound
WAC	Washington Administrative Code
WAFW	West Area facility waste
WDFW	Washington Department of Fish and Wildlife
WHC	Westinghouse Hanford Company
WIPP	Waste Isolation Pilot Plant
WRAP	Waste Receiving and Processing Facility
WVRF	waste volume reduction factor
WSU-TC	Washington State University-Tri-Cities
yd^3	cubic yard
yr	year

ELEMENTS

Actinium	Ac
Aluminum	Al
Americium	Am
Antimony (Stibium)	Sb
Argon	Ar
Arsenic	As
Astatine	At
Barium	Ba
Berkelium	Bk
Beryllium	Be
Bismuth	Bi
Boron	B
Bromine	Br
Cadmium	Cd
Cesium	Cs
Calcium	Ca
Californium	Cf
Carbon	C
Cerium	Ce
Chlorine	Cl
Chromium	Cr
Cobalt	Co
Copper	Cu
Curium	Cm
Dysprosium	Dy
Einsteinium	Es
Erbium	Er
Europium	Eu
Fermium	Fm
Fluorine	F
Francium	Fr
Gadolinium	Gd
Gallium	Ga
Germanium	Ge
Gold	Au
Hafnium	Hf
Helium	He
Holmium	Ho
Hydrogen	H
Indium	In
Iodine	I
Iridium	Ir
Iron	Fe
Krypton	Kr
Lanthanum	La
Lawrencium	Lr
Lead	Pb
Lithium	Li
Lutetium	Lu
Magnesium	Mg
Manganese	Mn
Mendelevium	Md
Mercury	Hg
Molybdenum	Mo
Neodymium	Nd
Neon	Ne
Neptunium	Np
Nickel	Ni
Niobium	Nb

Nitrogen	N
Nobelium	No
Osmium	Os
Oxygen	O
Palladium	Pd
Phosphorus	P
Platinum	Pt
Plutonium	Pu
Polonium	Po
Potassium (Kalium)	K
Praseodymium	Pr
Promethium	Pm
Protactinium	Pa
Radium	Ra
Radon	Rn
Rhenium	Re
Rhodium	Rh
Rubidium	Rb
Ruthenium	Ru
Scandium	Sc
Selenium	Se
Silicon	Si
Silver	Ag
Sodium (Natrium)	Na
Strontium	Sr
Sulfur	S
Tantalum	Ta
Technetium	Tc
Tellurium	Te
Terbium	Tb
Thallium	Tl
Thorium	Th
Thulium	Tm
Tin	Sn
Titanium	Ti
Tungsten (Wolfram)	W
Uranium	U
Vanadium	V
Xenon	Xe
Ytterbium	Yb
Yttrium	Y
Zinc	Zn
Zirconium	Zr

2 PURPOSE AND NEED FOR ACTION

In the Draft SIS EIS, DOE and Ecology identified a purpose and need to resolve near-term tank safety issues associated with hydrogen gas generation in Watchlist tanks while continuing to provide safe storage for other Hanford wastes. These Watchlist tanks were identified pursuant to P.L. 101-150, section 3137 "Safety Measures for Waste Tanks at Hanford Nuclear Reservation" of the National Defense Authorization Act 1991. Since the issuance of the Draft SIS EIS, use of the mixer pump in Tank 101-SY has been successful in mitigating issues associated with hydrogen production, pressure generation, and unacceptable high flammability levels for hydrogen. DOE now believes that through continued use of mixer pumps, waste exhibiting gas release activity may continue to be safely stored in existing tanks and may not need to be removed and diluted prior to final treatment for disposal.

Consistent with the Draft SIS EIS, DOE and Ecology recognize the need to continue to provide safe storage of high-level radioactive tank wastes while supporting tank farm management and operations prior to implementing decisions made in the TWRS EIS. To minimize the risk of managing tank waste, a modern, safe, reliable, and regulatory compliant replacement cross-site transfer capability is needed to move wastes between the 200 West and 200 East Area tank farms in support of the Tri-Party Agreement Milestone M-43-07A. This is especially true in the 200 West Area where there is far less useable DST capacity than there is waste in SSTs. The replacement waste transfer capability would provide the means to move waste to the available DST capacity located in the 200 East Area.

However, the ECSTS has been recently tested for integrity and was found suitable for pumping selected wastes such as supernatant from 102-SY and SWLs. Wastes such as these may be pumped, subject to periodic integrity testing, while compliant transfer capability is under development.

This Final SIS EIS analyzes the following alternatives to support continued safe storage and tank farm waste management activities: preferred alternative; truck transfer alternative; rail transfer alternative; new storage alterative; and no action alternative. Additionally, this EIS will identify those alternatives which have been dismissed based on their inability to resolve safety issues expeditiously within the confines of an interim action.

The alternatives evaluated in this Final SIS EIS would provide DOE the ability to manage Hanford tank waste safely and in compliance with RCRA, 40 CFR 264.193 and Washington State Dangerous Waste Regulations, WAC 173-303-640.

Based on current tank waste management and operation activities, the SIS Final EIS addresses the need to do the following:

- Remove SWLs from older SSTs to reduce the likelihood of liquid waste escaping from the corroded tanks into the environment. Many of these tanks have leaked and new leaks are developing in these tanks at a rate of more than one per year.
- Provide ability to transfer the tank wastes via a compliant system to mitigate any future safety concerns and use current or future tank space allocations.
- Provide adequate tank waste storage capacity for future waste volumes associated with tank farm operations and other Hanford facility operations.
- Mitigate hydrogen generation in Tank 101-SY.

3 DESCRIPTION OF ALTERNATIVES

This section describes the alternatives available to DOE and Ecology to satisfy the following purpose and need statement described in detail in Section 2.

. Remove SWL from older SSTs to reduce the likelihood of liquid waste escaping from the corroded tanks into the environment. Many of these tanks have leaked and new leaks are developing in these tanks at a rate of more than one per year.

. Provide ability to transfer the tank wastes via a compliant system to mitigate any future safety concerns and use current or future tank space allocations.

. Provide adequate tank waste storage capacity for future waste volumes associated with tank farm operations and other Hanford facility operations.

. Mitigate hydrogen generation in Tank 101-SY.

This section also discusses alternatives considered but dismissed and compares alternatives.

Section 3.1 describes the alternatives that have been considered to meet the purpose and need which include:

. Preferred Alternative
. Truck Transfer Alternative
. Rail Transfer Alternative
. New Storage Alternative
. No Action Alternative.

Section 3.2 discusses alternatives considered but dismissed from detailed evaluation in this EIS. Even though these alternatives are not fully evaluated in this EIS, DOE and Ecology are continuing to evaluate these and other alternatives for their ability to meet future waste management needs and to satisfy the purpose and need statement as described in Section 2.

Section 3.3 compares the alternatives described in Section 3.1. This comparison identifies the specific technical actions within each alternative to meet the objectives established in Section 2.

3.1 ALTERNATIVES

This section describes the following alternatives:

. Preferred Alternative
. Truck Transfer Alternative
. Rail Transfer Alternative
. New Storage Alternative
. No Action Alternative.

The facilities described for each of the alternatives are currently in conceptual design except for the RCSTS which has a completed definitive design. The following descriptions have been provided for analytical purposes.

3.1.1 PREFERRED ALTERNATIVE

The preferred alternative proposes the construction and operation of an RCSTS, a retrieval and transfer system in Tank 102-SY, and continued long-term operation of the existing mixer pump in Tank 101-SY. This alternative proposes Tank 102-SY solids and residual supernatant, SWL from SSTs, and WAFWs would be transferred to safe storage in existing DSTs in the 200 East Area. The initial waste retrieval and transfers would use the existing transfer pump in the Tank 102-SY and the ECSTS. At the time the RCSTS becomes operational, waste would be transferred exclusively via the RCSTS. The existing Tank 102-SY solids would be retrieved by either slurry pumping utilizing the ITRS, or hydraulic sluicing based on the past practice sluicing. Refer to Section

1.2.4 for additional information on Tank 102-SY retrieval. The preferred alternative would support the objectives of removing and transferring SWLs to reduce the likelihood of liquid waste escaping into the environment. In addition, the preferred alternative would satisfy the objective to maintain the ability to transfer tank wastes via a compliant system to take advantage of current or future tank space allocations. Implementing the preferred alternative would support transfer of facility waste and provide capability to mitigate any future safety concerns or waste volumes associated with tank farm operations as well as Hanford facility operations. The use of the mixer pump in Tank 101-SY would continue to mitigate the flammable gas safety concerns in this tank, precluding the need for dilution and retrieval of Tank 101-SY.

Sections 3.1.1.1 through 3.1.1.5 describe the construction and operation of the specific actions proposed for the preferred alternative. A general process diagram of the preferred alternative is shown in Figure 3-1.

3.1.1.1 Existing Cross-Site Transfer System

- The ECSTS began operating in 1952 and was used originally to transfer high- and low-level radioactive waste solutions from the 200 East Area to the 200 West Area for recovering uranium metal at U Plant. During its 40 years of service, the system also transferred liquid waste from 200 West to 200 East Areas for evaporative concentration and subsequent storage in the 200 East Area tank farms. The waste streams originated from process points in both areas including B Plant, PFP, PUREX, T Plant, S Plant, and the various tank farms. Earlier in its operating history, four of the six lines are believed to have plugged. The ECSTS was removed from service in the late 1980s. One of the remaining lines was recently tested and was used successfully to transfer supernatant waste from Tank 102-SY to the East Area tank farms. The results of the testing program are discussed in detail in the following operation section.

Description - The ECSTS consists of six 8-centimeter (cm) [(3-inch (in)] diameter stainless steel pipelines within a concrete encasement and a vent station. The encasement consists of a reinforced concrete box [1.5 m (5 ft) wide by 0.6 m (2 ft) high] which provides a 15-cm (6-in) high void space to accommodate the transfer lines. The encasement is buried from 1.5 to 5 m (5 to 15 ft) below grade, depending on location. The pipelines are supported

Figure (Page 3-4)

Figure 3-1. Preferred Alternative Process Diagram

at roughly 5 m (15 ft) intervals and at each of the bends, and anchored approximately every 90 m (300 ft). The lines terminate at two diversion boxes, 241-ER-151 and 241-UX-154 in the 200 East and West Areas, respectively, where they interface with 200 East and West Area transfer piping (Figure 3-2).

The diversion boxes are constructed of reinforced concrete and measure approximately 14-m (45-ft) long, 3-m (10-ft) wide, and 5-m (17-ft) deep. Their function is to re-route waste solutions to other diversion boxes within the tank farms. The vent station, 241-EW-151, is located roughly midway between the 200 East and West Areas and serves as an air exhaust intake point to vent the lines during waste transfer and flushing. The vent station is also made of reinforced concrete, measuring approximately 5 m (17 ft) long, 3 m (10 ft) wide, and 5 m (17 ft) deep. From the vent station, the encasement slopes downwards in both directions and drains liquids back to the diversion boxes. The diversion boxes and the vent station are equipped with leak detection equipment, and the vent station is equipped with a high-efficiency particulate air (HEPA) filter to reduce the chance for airborne releases during pipeline pressure checks. The area surrounding the vent station is monitored for above-normal radiation levels should a leak occur.

Operation - In 1988, DOE-RL performed an audit on the ECSTS to assess its ability to meet projected waste transfer requirements (DOE 1988). Based on this audit, WHC subsequently performed an engineering study on the ECSTS (WHC 1993a). The functional design criteria analysis found the following deficiencies with portions of the ECSTS (WHC 1995a).

- Segments lack secondary containment and leak detection capability as specified by Washington State and Federal regulations.
- Segments constructed of relatively thin-walled pipes have exceeded or are nearing the end of their design life.
- A segment in the 200 West Area provides a transfer function that has no backup, which could lead to long-term system outages should this section fail.

Figure (Page 3-6)
Figure 3-2. ECSTS Flow Schematic

In May of 1995, DOE tested the integrity of one of the transfer lines using pressurized water. The test results showed that the line is intact. In late July and early August of 1995, approximately 1,644,000 L (435,000 gal) of supernatant from Tank 102-SY was transferred through this line to the 200 East Area. Future waste transfers would include SWL from SSTs in the 200 West Area, and other dilute process wastes from the 200 West Area facilities. These wastes would be accumulated in Tank 102-SY, the 200 West Area receiving and staging tank for facility wastes and retrieved SWL from SST. From Tank 102-SY waste would be pumped into the ECSTS for transfer into available DSTs in the 200 East Area.

While the recent pressure test and waste transfer were successful, the lines lack the pressure rating and pumping capabilities for transferring 200 West Area tank wastes containing solids or slurried wastes without the risk of plugging the line. The ECSTS may suffice for transporting SWL and other dilute solutions in the near-term, however, the ECSTS could not transfer slurried wastes such as those present in Tanks 102-SY or 101-SY.

3.1.1.2 Replacement Cross-Site Transfer System

- The proposed RCSTS would consist of two new parallel encased pipelines to connect the 241-SY-A and -B valve boxes in the 200 West Area with the 244-A Lift Station in the 200 East Area. The proposed RCSTS is shown in Figure 3-3. The line would be capable of pumping slurried waste (liquid waste containing some solids) from the SY Tank Farm in the 200 West Area to 200 East Area and liquid waste in either direction. Non-slurry, low activity liquid waste could be transferred from 200 East Area to 200 West Area using the existing 200 East Area Tank Farm transfer pumps.

The RCSTS would be approximately 10 km (6.2 mi) long and consist of one diversion box, one booster pump, a vent station, and all associated instrumentation and electrical connections.

Figure (Page 3-8)
Figure 3-3. RCSTS Flow Schematic

A site selection process was developed for the RCSTS, which considered engineering constraints, potential environmental effects, and agency and stakeholder involvement. Appendix B provides a detailed description of the siting process. As a result of the siting process, an optional route has been evaluated which is a slight modification to the primary RCSTS route. The optional route would follow along an existing roadway adjacent to the 200 West Area, as depicted in Figure 3-4.

Description - The RCSTS lines would consist of two 8-cm (3-in) diameter stainless steel pipes, each encased in a 15-cm (6-in) carbon steel outer pipe to provide secondary containment as required by Federal and state regulations, and DOE design criteria. A cross-section of the RCSTS is shown in Figure 3-5. The lines would be sloped at least 0.25 percent to allow gravity draining and would be buried, bermed, or appropriately shielded for radiation and freeze protection. The pipeline would be designed to prevent corrosion (rust) from the metal pipes contacting the soil. Both pipelines would be insulated with polyurethane foam and covered with a fiberglass jacket. The proposed RCSTS would be designed to perform to the following design parameters (DOE 1993, WHC 1995a):

Specific Gravity	1.0 to 1.5
Viscosity	10.0 to 30.0 centipoise
Solid Content	0.0 to 30.0 vol%
Design Velocity	1.4 to 1.8 m/second (s) (4.5 to 6 ft/s)
Temperature	2y to 93y C (35y to 200y F)
Pressure	400 to 1,200 lbs/square inch (psi)
pH	11.0
Design Life	40 years
Particle Size	0.5 to 4,000 microns (-)

Existing valve pits would connect the RCSTS to existing pipelines to facilitate liquid waste transfer between the 200 West and East Areas. A booster pump would be located in the diversion box and would provide the power to transfer waste slurries at the minimum required velocity to prevent the lines from plugging. A vent station would be located at the high point of the transfer system. Its function would be to introduce air into the lines after a transfer to facilitate draining the primary containment pipes.

Figure (Page 3-10)

Figure 3-4. ECSTS and RCSTS Locations

Figure (Page 3-11)

Figure 3-5. Cross-Section of the RCSTS

Both the diversion box and the vent station would be equipped with stainless steel liners and have provisions for washing down radioactive contamination, collecting accumulated liquids, and routing the liquids back to the tank farms via the RCSTS. The diversion box and the vent station would have connections for attaching portable ventilation systems during maintenance. A concrete cover with access blocks would provide radiation shielding and weather protection from rainwater and snow melt. If required, perimeter fences may be installed to prevent intrusion by unauthorized personnel.

Instrumentation and electrical equipment would be enclosed in a weather shelter located adjacent to the diversion box and vent station. These weather shelters would require heating and cooling capability to protect the equipment from temperature extremes.

Shielding requirements for liquid waste from the SY Tank Farm to the 244-A Lift Station would be based on a "worst case" source term, and assume that the pipelines and valves are full of liquid waste. All process piping would have sufficient earth cover to reduce personnel exposure to as low as reasonably achievable (ALARA), and would not exceed 0.05 mrem/hour (hr) at grade. The diversion box and cover would attenuate radiation levels to 0.05 mrem/hr at the surface.

Construction - The RCSTS would be constructed over a period of approximately 21 months and would require a peak workforce of approximately 80 workers. These workers could be additions to the current Hanford Site workforce. Construction of the RCSTS would consist of site preparation, system construction, and other construction activities.

The RCSTS would include work in the 600, 200 East, and 200 West Areas. Except for the inter-tie points with existing pipe work, the RCSTS would be routed around contaminated soil. The 10-km (6.2-mi) pipe route and the areas for the vent station and the diversion box would be cleared and grubbed. New gravel roads would be constructed to access the diversion boxes and vent station. No demolition or relocation of existing structures would be required. Due to boring methods proposed during construction, no road closures would be expected. Approximately 30 ha (74 acres) of land would be cleared. During the construction period, conditions for blowing dust would be monitored. If winds exceed approximately 24 kilometers per hour (kmph) [(15 mi per hour (mph)], dust control measures would be implemented, such as applying water or a soil fixative. Any construction activities in contaminated areas would be performed by workers with radiation training using established radiation work procedures. Construction procedures in contaminated areas would also include the use of greenhouse covers and continuous air monitoring.

The material excavated for pipeline construction would be stored along the opened excavation and reused to backfill the completed piping and finish grading the disturbed land. The material excavated for constructing the diversion boxes and vent station would be reused to backfill around the completed structure and finish grading the surrounding disturbed areas. Excavation and backfill and grading activities would be performed with self-loading scrapers, bulldozers, backhoes, and road graders. The exact numbers and types of equipment utilized would depend on the construction approach.

New gravel roads would be constructed to access the diversion boxes and the vent station. The area that would be cleared for access roads is included in the total area to be cleared. All areas disturbed during construction would be graded and stabilized with gravel or revegetated.

For pipeline construction and installation, the buried portions of the process lines would be encased in all-welded steel secondary encasement pipes installed on an engineered backfill in the excavation. The completed pipeline would be encased in polyurethane foam and a fiberglass reinforced-plastic jacket to minimize the temperature drop during a process transfer.

The RCSTS piping would be connected to existing radioactively contaminated systems and structures in the 200 East and West Areas by workers with radiation training using established radiation work procedures. These procedures require that exposure to radiation be kept within the operating contractor's guidelines and ALARA. Several small cranes, flat bed trucks, and engine-driven welding machines would be utilized for pipeline construction.

Operation - When waste is to be transferred, a specific procedure would be prepared using the existing general tank farm transfer procedure. The procedure would address the route involved, a material balance, estimated arrival time at the receiver tank, pressure and temperature monitoring, flushing requirements, and chemical and physical composition information.

Depending on the type of waste, the line may be preheated prior to transfer.

Waste transfers would be remotely controlled and monitored from control rooms in the West Area, with additional monitoring capabilities at the diversion box and vent station. An automated shutdown system would be capable of automatically turning off the transfer pumps. Backup electrical power is also available to a backup pump in the event of mechanical or electrical interruption. Signals that would activate the shutdown process include leak detection, existing area radiation detection, high pressure detection between slurry line and isolation valves, high line pressure detection, and shutdown of DST retrieval systems. When a shutdown is activated, the transfer system valves would fail in the "as is" position to allow for drainage and flushing of the system.

Actual waste transfer may be preceded by filling the waste transfer line with heated water. Preheating, if necessary, would be accomplished by introducing progressively higher temperature batches of water into the transfer line in the 200 West Area, followed immediately by the waste stream. Filling/preheating would generate an estimated 45,000 L (12,000 gal) of water per transfer, which would add to the tank farm inventory. The waste would push the preheated water through the line to the 200 East Area.

Following waste transfer, flushing water would be injected into the line to reduce the radioactivity and help minimize corrosion. When all the slurry reaches the 200 East Area, water flow would be halted and the vent line opened. The remaining flush water would be allowed to gravity drain to the tank farms in both areas. A single flush would add an estimated 45,000 L (12,000 gal) of water to the tank farm inventory.

3.1.1.3 Retrieval Systems

- The Tank 102-SY currently contains an estimated 1.3 million to 1.4 million L (325,000 gal) of waste. This waste is comprised of approximately 499,000 L (71,000 gal) of solids and 930,000 L (254,000 gal) of free liquid (WHC 1995b). With implementation of the preferred alternative, as much of the tank waste as practicable would be recovered to allow use of the tank for subsequent receipt of SST waste. This would allow complex SWL to be transferred to Tank 102-SY without the potential for becoming mixed with the noncomplex waste currently in Tank 102-SY. The retrieval of solid waste from Tank 102-SY would be accomplished by construction and installation of either an ITRS or hydraulic sluicing. Both retrieval options are described in this section. As mentioned in Section 1.2.4, this activity is an ongoing tank farm management action previously evaluated under prior EISs and a supplement (DOE 1975, DOE 1980, DOE 1987).

. ITRS - The ITRS proposed for use in Tank 102-SY would use slurry pumping to retrieve solids from the Tank 102-SY. Slurry pumping involves installing and operating two 300-horse power (hp) mixer pumps to break up and suspend solids into a slurry. To help suspend and transfer solids, approximately 530,000 L (140,000 gal) of liquid would be needed. The liquid diluent could include non-complexed SWL to the maximum extent practicable, which would help minimize new waste generation. If the SWL is not sufficient or found to be incompatible, then conditioned caustic solution or dilute waste from other sources would be used.

The transfer of slurry from Tank 102-SY would be accomplished by installing and operating a small transfer pump in a spare tank riser. The transfer pump would also be utilized to introduce diluent in the tank either at the pump suction intake or through pipes attached to the pump column. A conceptual diagram of Tank 102-SY with the ITRS is shown in Figure 3-6. The liquid addition system for Tank 102-SY would include hot water and caustic solution supply, a flush tank and a flush pump for mixing water and caustic solution, a diluent pump, and a booster pump. Instrumentation would be provided in a valve pit downstream of the transfer pump to determine the waste properties such as density, viscosity, flow, temperature, and pressure. Configuration of the pumps, tanks, and instrumentation would be similar to the dilution and retrieval of Tank 101-SY described in Section 3.1.4.2.

Following the retrieval action, the waste would be transferred via the RCSTS for storage in existing DSTs in the 200 East Area.

Construction - The ITRS option would include utilizing two mixer pumps and a transfer pump for slurry pumping of the Tank 102-SY solids. The Tank 102-SY would be provided with in-tank dilution capabilities, which include flushing and caustic addition capabilities. In addition, Tank 102-SY would also be connected to the proposed RCSTS via the SY-A/B valve pits.

Figure (Page 3-16)
Figure 3-6. Conceptual Arrangement of Tank 102-SY Retrieval System

The construction, installation, and modifications of Tank 102-SY would include the following elements:

- Construction and installation of two 300-hp mixer pumps for breaking up and suspending solids
- Construction and installation of a small transfer pump for transferring waste from the tank
- Instrument Control and Electrical (ICE) Building to house electrical and instrumentation equipment and the operator stations
- Operator station would include monitor, alarm, and control retrieval systems for the tank
- Instrumentation to measure the physical characteristics of the waste prior to transfer
- Equipment and containers for removal, cleaning, decontamination, transport, and storage of contaminated components including an existing thermo couple tree and transfer pump
- Utilities for retrieval operations (electrical, water, and telecommunications)
- Site preparation and modifications for the installation of equipment
- Modifications to the central pump pit for the load distribution frame
- Modifications to the cover blocks as required to support the new equipment
- Modifications to the existing valve pits to house a transfer booster pump and flush pump
- Installation of new jumpers as required to support the operation of the transfer pump, dilution system, and flush system
- Installation of a flush tank, an isolation tank, and chemical unloading pad
- Installation of a video monitoring system
- Upgrades to the existing ventilation system, if required
- Piping interface with the cross-site transfer system.

In addition, the retrieval and dilution system would interface with the existing instrumentation to monitor tank waste, shell, and air space temperatures, and waste levels within the Tank 102-SY.

Operation - The Tank 102-SY solids retrieval operation would be a three-step process. First, the tank contents would be mobilized via operation of the two mixer pumps to achieve a measure of waste homogeneity. If the existing supernate is determined inadequate as a dilution media, the tank liquid would be removed prior to mixing. Second, the diluent would be added to the tank, if required, for an in-tank dilution process to achieve approximately 2:1 dilution of the solids in the tank. During diluent additions, the mixer pumps would be operated to disperse the diluent and achieve waste homogeneity. This would prevent formation of a stratified layer on the surface preventing retrieval of sludge from the bottom. Finally, the slurry would be pumped from the tank utilizing the transfer pump for subsequent transfer via RCSTS, and storage into existing DSTs in the 200 East Area.

The following modes of operation would be provided with the retrieval and transfer system.

- Recirculation - Transfer pump circulates waste back into the tank until correct waste properties identified earlier for the transfer of waste via RCSTS are achieved. On-line instrumentation will be monitored during this phase of operation.
- Transfer - Diluted waste would be routed into the cross-site transfer system and transferred to another DST.
- Bypass - If on-line instrumentation detects that waste being

transferred is out of specification, the flow would be diverted from the transfer line to the recirculation loop and back into the tank. Bypass operations would continue until the waste achieves the required specification, via addition of diluent or continued conditioning and mixing.

- Flush - The transfer lines would be preconditioned with diluent prior to starting a transfer and to continue a transfer during Bypass mode. The transfer lines would also be flushed after completing a transfer operation or before shutdown.

. Past Practice - As an option to installing the ITRS, the hydraulic sluicing would use pressurized water and recycled tank liquids sprayed from a nozzle to dissolve, dislodge, and suspend the Tank 102-SY solids into a slurry as depicted in Figure 3-7. Hydraulic sluicing has been performed in the past to recover tank wastes and is assumed to be capable of recovering 99 percent of the Tank 102-SY solids. Currently, an activity is underway to retrieve the contents of Tank 106-C using sluicing techniques. An EA was prepared to analyze potential environmental impacts of the past practice sluicing waste retrieval of Tank 106-C and a FONSI was issued in 1995 (DOE 1995a). Although the Tank 106-C past practice sluicing demonstration project involves an SST, the Tank 102-SY solids retrieval by hydraulic sluicing would be similar in construction and operation.

Figure (Page 3-20)
Figure 3-7. Conceptual sluicing Arrangement for Tank 102-SY

The hydraulic sluicing proposed to be installed in Tank 102-SY would involve construction and installation of two remotely aimed sluicers to ensure full sluicing coverage of the waste. The transfer of slurry from the tank would be accomplished by installation and operation of a small transfer pump in a spare tank riser. The nozzles used for sluicing would be rotated and angled to direct the slurry to the transfer pump for removal from the tank. The liquid addition and transfer system would be similar to the ITRS liquid addition and transfer system described earlier. Following the retrieval action, the waste would be transferred via the RCSTS for storage in existing DSTs in 200 East Area.

With the exception of potential human health effects described in Section 5, detailed evaluation of the hydraulic sluicing alternative has not been presented in this EIS since this option is considered bounded by the construction, installation, and operation of the ITRS. The detailed evaluation of the hydraulic sluicing was presented in the past practice sluicing EA for the Tank 106-C, and is incorporated into this EIS (DOE 1995a). The primary difference between the hydraulic sluicing and ITRS is the construction and installation of the two remotely aimed sluicers in lieu of the two mixer pumps. In addition, the hydraulic sluicing would require large amount of additional liquid for retrieval. The sluicing fluid would have to be recycled via the RCSTS from the 200 East Area, and the ventilation system would have to be upgraded to handle increased aerosols.

3.1.1.4 Mixer Pump

- The mixer pump actively mitigates the flammable gas retention and episodic GRE in Tank 101-SY by periodically mixing the tank waste using a centrally-mounted submersible mixer pump. Mixing maintains the average flammable gas concentration in the tank dome space and risers below 25 percent of the LFL of hydrogen gas in hydrogen/nitrous oxide atmosphere. The alternatives would use the 150-hp mixer pump and other infrastructure currently in place in Tank 101-SY. However, the new storage alternative would use this mixer pump in conjunction with the ITRS for dilution and retrieval of Tank 101-SY as described in Section 3.1.4.2. Two backup mixer pumps are available should the existing mixer pump fail or need replacement.

Environmental effects associated with the installation and operation of mixer pumps have been evaluated in previous EAs and are incorporated into this EIS (DOE 1992a, DOE 1992b, DOE 1994).

Description - The submersible 150-hp mixer pump now operating in Tank 101-SY was originally purchased as a spare mixer pump for the Hanford Grout Program. The original design was modified to place the pump suction at about the 660-cm (260-in) elevation to ensure it remained in liquid and the nozzles were at 71 cm (28 in) above the tank bottom to enhance vertical mixing. Operating at 1,000 revolutions per minute (rpm), the pump injects 8,300 liters per minute (L/min) (2,200 gpm) of waste slurry at 20 m/s (66 ft/s) through two opposed 6.6 cm (2.6 in) diameter nozzles. Though its operating time is limited by motor oil temperature, the pump has performed flawlessly since installation and has proved capable of mixing the waste and keeping it in suspension by operating only a few hours per week.

The orientation of the pump and nozzle axis in the tank is shown by the plan and profile views on Figure 3-8. The pump is mounted just off the tank centerline in riser 12A. The nozzle orientation is referenced to true west as O percent. Since the pump has two opposing nozzles, a O-percent orientation also directs a jet at l80 percent.

Construction - Installation of a new submersible mixer pump, if required, would consist of several steps including installation of the load distribution frame, submerged mixer pump, and modified cover blocks on the pump pit. The existing mixer pump in Tank 101-SY would be replaced with another mixer pump of similar construction, should a need arise.

Specific measures would be taken during removal of the existing mixer pump and installation of a new mixer pump to mitigate the potential for excessive personnel exposures or releases to the environment of radioactive or other hazardous material. These measures incorporate factors related to weather conditions, monitoring requirements, lifting, rigging, and handling. The mixer pump would be removed from the tank using a boom crane. A spray ring in the tank riser would rinse the external surfaces of the pump prior to removal. The mixer pump would be drawn into a large plastic bag as it is removed from the riser. The pump would then be lowered into a shipping container before being transported out of the tank farm for storage before disposal.

Figure (Page 3-23)
Figure 3-8. Plan and Profile View of Tank 101-SY Mixer Pump

Operation - Long-term mixer pump operation in the Tank 101-SY would utilize the successful jet mixing techniques developed during the testing phases to continue to mitigate the tank. The mixer pump is currently operated to prevent the periodic GREs resulting in flammable gas concentrations in excess of 25 percent of the LFL of hydrogen gas in hydrogen/nitrous oxide atmosphere at the tank exhaust and tank dome space. Another operational objective is to keep the tank waste level as low as possible to increase the head space. The operational mode of the mixer pump is discussed and defined in the Mixer Pump Long-Term Operation Plan for Tank 101-SY Mitigation (WHC 1994a).

The data associated with Tank 101-SY are reviewed periodically to determine if there are any undesirable conditions developing that would require changes in the pump operation. Pump operations are programmed to be aborted by immediately turning the pump off if any of the abort criteria listed in the Safety Assessment (SA) are ever exceeded (WHC 1994a).

3.1.1.5 Interim Stabilization

- Previous NEPA documents (DOE 1987, DOE 1994) determined that the only viable alternative for preventing leaks from SSTs which are at the end of or have exceeded their design life is to pump out the interstitial liquid from the solid waste, a process called interim stabilization. (Refer to Section 1.2.3 for a background discussion of the interim stabilization of SSTs).

Sixty-seven of the SSTs (approximately 44 percent) are either suspected or known to have leaked liquid radioactive waste to the ground, and the remaining tanks can be expected to leak at any time in the future. During the last 40 years, the management and handling of the liquid radioactive waste have focused on reducing the volume of liquid in underground tanks. Part of this liquid waste reduction strategy is based upon the pumping of as much drainable liquid as possible from the SSTs to minimize the volume of liquid available to leak into the ground. This process is known as interim stabilization. The Tri-Party Agreement established a requirement for the completion of interim stabilization.

Interim stabilization of SSTs was initiated approximately 20 years ago. A total of 105 of the 149 SSTs (approximately 70 percent) have been interim stabilized to date with work presently in progress to stabilize the remaining SSTs.

Description - Interim stabilization is accomplished by salt well pumping via jet pumps (WHC 1992a). The resultant liquid waste SWL is transferred to double-contained receiver tanks (DCRTs) and accumulated for a period of time (pumping rates are low). From the DCRTs, the waste is transferred to DST for storage or into an evaporator for volume reduction. Tank 102-SY, a DST, has been designated as the 200 West Area receiver tank once the SWL is pumped from the receiver DCRTs in the 200 West Area. Figure 3-9 provides a simplified representation of a typical salt well-DCRT system.

Salt well waste from SST tank farms are accumulated in DCRTs before being pumped to final destinations. DCRT vaults are underground reinforced concrete structures which contain 76,000 L (20,000 gal) receiver tanks.

Future SWL retrievals from SSTs in the 200 West Area would stage SWL waste from DCRT in Tank 102-SY, prior to cross-site transfer to DSTs for storage until final disposal decisions are made. In the near term, cross-site waste transfers would utilize the ECSTS. Future transfers would occur through either the RCSTS, truck or rail options described in this EIS.

3.1.2 TRUCK TRANSFER ALTERNATIVE

The truck transfer alternative proposes constructing and operating a waste load facility in the 200 West Area and a waste unload facility in the 200 East Area, constructing additional roadway segments, operation of a transfer truck and the continued long-term operation of the existing mixer pump in Tank 101-SY. This alternative proposes that SWL from SSTs in the 200 West Area and West area facility wastes would be transferred to safe storage facilities in existing DSTs in the 200 East Area via truck. This alternative would primarily use the existing roadways. Waste would be transferred with either a modified tanker trailer truck or the LR-56(H) truck. Initial waste transfers would use the ECSTS until the time the waste load and unload facilities become operational. At the time the facilities become operational, waste would be transferred exclusively via the truck transfer facilities and transfer vehicle. Implementation of the truck transfer facilities would provide the ability to transfer waste from the 200 West Area via a regulatory compliant transfer system to safe storage facilities in the 200 East Area thereby reducing the likelihood of waste escaping from SSTs. The continued use of the mixer pump in SY-101 would mitigate the flammable gas safety concerns in this tank. Existing DSTs would provide adequate waste storage under this alternative.

Figure (Page 3-26)
Figure 3-9. Typical Salt Well-DCRT System

Sections 3.1.2.1 and 3.1.2.2 describe the specific actions proposed for the truck transfer alternative. Refer to Section 3.1.1.1 for detailed descriptions of the ECSTS, Section 3.1.1.4 for mixer pump operations, and Section 3.1.1.5 for description of SWL interim stabilization. A general process diagram of the truck transfer alternative is shown on Figure 3-10.

3.1.2.1 Truck Transfer Vehicles

Under the truck transport alternative, two vehicle options exist: a specially outfitted tanker trailer, or a French built LR-56(H) Truck certified in Europe for HLW liquid wastes. A description of these vehicles are described in the following paragraphs.

- Tanker Trailer Truck - The tanker trailer truck would consist of a 19,000 L (5,000-gal) DST, approximately 2.4 m (8 ft) in diameter and 5 m (16 ft) long. It would have 5 cm (2 in) of lead shielding, process instrumentation, gauges, rinsing equipment, and a HEPA filtration system. Due to its weight, the tank would require mounting to a specially-built, heavy-duty low-boy, wide-bed trailer (Figure 3-11) (WHC 1994b).

- LR-56(H) Truck - The LR-56(H) truck is a specifically designed vehicle for on-site transfers. Modified for use at the Hanford Site, this vehicle is referred to as the LR-56(H). The LR-56(H) has already been ordered by DOE for other site activities. To meet regulatory requirements, specific to the Hanford Site, the manufacturer is completing the following modifications:

  - A Department of Transportation (DOT) standard compliant trailer (i.e., longer and more axles)
  - Addition of a spray wash/sluicing system
  - Additional tube cavity at the bottom of the cask for neutrondetector element
  - Redundant level monitor
  - Redundant temperature monitor.

Figure (Page 3-28)
Figure 3-10. Truck and Rail Transfer Alternative

Figure (Page 3-29)
Figure 3-11. Illustration of the 19,000-L (5,000-Gal) Tank Mounted on a Heavy-Duty Tanker

The LR-56(H) has the capacity to transport approximately 3,800 L (1,000 gal) of liquid waste. The LR-56(H) is designed with a 5-cm (2-in) thick lead-shielded container, and would be equipped with its own pumps for waste transfer, sampling devices, self-closing valves, monitors, alarms, and 12-millimeter (mm) (0.5 in) protective lead shield at the front of the tank (WHC 1995c). In the unlikely event the truck is overturned, service equipment in the upper section would be protected by retaining containers and safety cradles (Figure 3-12) (WHC 1991a).

Both the tanker trailer and the LR-56(H) truck would use existing Route 3, connecting the 200 West Area to the 200 East Area (Figure 3-13). The distance from the load facility to the unload facility would be approximately 11 km (7 mi) (WHC 1995c). The addition of approximately 1.5 km (0.9 mi) of new road in the 200 East Area would be required to avoid sharp road curves and proximity to existing office trailers (WHC 1995b).

3.1.2.2 Load and Unload Facilities

The proposed truck transfer alternative would consist of a waste load facility located in the 200 West Area and a waste unload facility in the 200 East Area. The load facility would be located in the vicinity of the SY-Tank Farm, and the unload facility would be located in the vicinity of the A Tank Farm. Figure 3-13 identifies potential locations of the load and unload facilities in relation to the existing transportation network (WHC 1994b).

Figure (Page 3-31)
Figure 3-12. LR-56(H) Truck

Figure (Page 3-32)
Figure 3-13. Facility Locations and Routes for Truck and Rail Transport

Figure (Page 3-33)
Figure 3-14. Existing 204-AR Unloading Station

The facilities would be designed to minimize radiation exposure as required by DOE Order 6430.1A, General Design Criteria (DOE 1989). Design of the proposed load and unload facilities is in the conceptual stage. However, based on similar existing on-site facilities shown in Figure 3-14 (i.e., the 240 AR Waste Unloading Facility and 340 Waste Handling Facility), the proposed load and unload facilities would include the following features.

- Concrete walls would provide radiation shielding varying in thickness from approximately 0.6 m (2 ft) at the base to 25 cm (10 in) at the top of the first level. This shielding would reduce the normal dose rate on the outside of the building and to areas of full time occupancy to applicable standards. Both the entrance and exit of the load and unload areas would have hinged steel shielding doors, a vestibule and a secondary set of outer (roll-up) doors to provide a double air barrier to the outside in the event of a spill.
- Separate heating, ventilation, and air-conditioning (HVAC) systems to maintain a negative pressure, radiation detection systems, continuous air monitoring (CAM) units for airborne particulate radionuclides, gamma-monitoring instruments, and heated air supply to protect the liquid lines during winter months (WHC 1991b).
- A vehicle unloading canyon would be designed for remote operation. The floor of the entire unload area would drain into an underground catch tank encased in a lined concrete pit, equipped with level indication, alarm sluicing, and sampling capabilities (WHC 1992b).
- The majority of operations would be remotely performed and monitored from a control room.
- Sludge would be removed from unloaded tanks by sluicing.

In addition to these features the following special features would be required for transporting and handling HLW (WHC 1995c):

- Drive-through loading and unloading shielded cells to avoid backing up into the facility.
- Remote operation and maintenance of transfer pumps and valves by using master/slave manipulators. Remote equipment (bridge mounted electro-mechanical manipulator, crane) in load and unload cells for recovery

from upset conditions.

- Access to the tank vault would be by removable shielding blocks to facilitate remote maintenance with the bridge-mounted, electro-mechanical manipulator in the cell and to enable periodic tank integrity inspections.
- Temporary storage capability of two 94,600-L (25,000-gal) stainless steel tanks.
- Zoning ventilation for truck cell, pump/valve cell, solid waste handling cell.

Figure 3-15 depicts a conceptual load and unload facility.

Construction - The truck transport facilities would be constructed over a period of approximately 1 to 1.5 years and would require a peak construction workforce of approximately 35 workers. These workers could be additions to the current Hanford Site workforce. Construction of the truck transport facilities would consist of site preparation, system construction, and other construction activities.

The truck transport facilities would include work in the 200 East and 200 West Areas. The 0.8-ha (2-acre) area needed for the load and unload facilities would be cleared and grubbed, if required. Based on the location of the proposed load and unload facilities, approximately 1.5 km (0.9 mi) of roadway extensions would be constructed for access. No demolition or relocation of existing structures would be required. During the construction period, conditions for blowing dust would be monitored. If winds exceed approximately 24 kmph (15 mph), dust control measures would be implemented, such as applying water or a soil fixative. Any construction activities in contaminated areas would be performed by workers with radiation training using established radiation work procedures. Standard construction procedures in contaminated areas would also include the use of green house covers and continuous air monitoring.

Figure (Page 3-36)
Figure 3-15. Conceptual Transportation System Transporter Load/Unload Facility

The material excavated for constructing the load and unload facilities, and roadway extensions could be reused to backfill around the completed structure and finish grading the surrounding disturbed areas. Excavation and backfill and grading activities would be performed with self-loading scrapers, bulldozers, backhoes, and road graders. The exact numbers and types of equipment utilized would depend on the construction approach, but would not likely exceed 10 pieces of equipment. All areas disturbed during construction would be graded and stabilized with gravel, suitable road surface, or revegetated.

The load and unload facilities piping would be connected to existing systems and structures in the 200 East and West Areas by workers with radiation training using established radiation work procedures. These procedures require that exposure to radiation be kept within the operating contractor's guidelines ALARA. Small cranes, flat bed trucks, and engine-driven welding machines would be utilized for construction.

Operation - The load facility would receive waste from 200 West Area tanks, and store it in two 94,600-L (25,000-gal) double-contained holding tanks (WHC 1994b). Once the transfer vehicle is in place, transfer from the holding tanks would occur after necessary sampling, and chemical adjustment is completed.

The rate of transfer from storage to the truck would be dependent upon waste characteristics. Due to the radioactivity of the waste, the transfer lines would be connected to the truck remotely, using an overhead crane (WHC 1994b). The fundamental basis to ensure maximum safety in filling operations is transfer under vacuum (WHC 1991a). Displaced air from the truck's container would be vented through the attached HEPA filters before being released to the atmosphere (WHC 1991a).

Once waste transfer from the load facility is complete, the truck would transport the waste container to the unload facility. Inside the unload facility, waste would be transferred into holding tanks. From there, waste would be transferred via new double-contained pipe (WHC 1994b).

After unloading is complete, the transfer lines would be flushed and then disconnected from the truck. The truck would be decontaminated as necessary in the load bay by a spray system (WHC 1994b). A complete truck transfer cycle would take approximately 16 hours (two shifts). A 6-day workweek is anticipated (WHC 1994b, WHC 1995c).

An estimated 1.9 million L (5-million gal) of waste would require cross-site transfer by trucks. Based on LR-56(H) 3,800-L (1,000-gal) trucks, approximately 4,691 trips would be required, which includes 4,222 trips for the SWL and 469 trips for the West Area facility waste. However, if the 19,000 L (5,000 gal) trucks are used, then approximately 938 trips would be required, which includes 844 trips for the SWL and 94 trips for the WAFW. Radioactive waste transfer regulations are discussed in Section 4.6.3.

Approximately 12 workers would be needed to support truck transfer operations. Of these, it is anticipated that a health physics technician would be required to perform radiation surveys of the truck at each facility (WHC 1995c).

3.1.3 RAIL TRANSFER ALTERNATIVE

The rail transfer alternative proposes constructing and operating a waste load facility in the 200 West Area and a waste unload facility in the 200 East Area, constructing additional railway segments, operation of a rail car and the continued long-term operation of the existing mixer pump in Tank 101-SY. This alternative proposes that SWL from SSTs in the 200 West Area and West Area facility wastes would be transferred to safe storage facilities in existing DSTs in the 200 East Area via rail car. This alternative primarily uses the existing railways. Waste would be transferred with a modified rail tanker car. Initial waste transfers would use the ECSTS until the time the waste load and unload facilities become operational. At the time the facilities become operational, waste would be transferred exclusively via the rail transfer facilities and tanker car. Implementation of the rail transfer facilities would provide the ability to transfer waste from the 200 West Area via a regulatory compliant transfer system to existing safe storage facilities in the 200 East Area thereby reducing the likelihood of waste escaping from SSTs. The continued use of the mixer pump in SY-101 would mitigate the flammable gas safety concerns in this tank. Adequate safe storage would be provided by existing DSTs under this alterative.

Sections 3.1.3.1 and 3.1.3.2 describe the specific actions proposed for the rail transfer alternative. Sections 3.1.1.1, 3.1.1.4, and 3.1.1.5 provided a detailed description of the ECSTS, mixer pump operations and interim stabilization. A general process diagram of the rail transfer alternative is shown in Figure 3-10.

3.1.3.1 Rail Transfer Vehicle

The rail tanker car would be a 38,000-L (10,000-gal) capacity, shielded [5 cm (2 in) of lead equivalent] for HLW, DST mounted on a special flat-bed rail car (WHC 1995c). See Figure 3-16 for an illustration of a typical rail tanker car. The maximum load limit for the rail tanker would be 92,500 kilogram (kg) [(204,000 pounds (lbs)]. Depending on the characteristics of the waste, a more limiting volume may be required (WHC 1993b).

The rail tanker car would use the existing railway between 200 West and 200 East. Approximately 490 m (1,600 ft) of additional new rail line would be added to provide access to the proposed load and unload facilities (WHC 1995c). Small roadway extensions may be included to provide access to the facilities. The rail distance from the load facility to the unload facility would be approximately 21 km (13 mi) (WHC 1995c).

3.1.3.2 Load and Unload Facilities

With the exception of the track for the rail car to enter and exit the facility, the proposed rail load and unload facility would have similar features as the truck load and unload facilities described in Section 3.1.2.2.

Construction - The proposed rail transport facilities would be similar in design to the truck transport facilities described in Section 3.1.2.2. The load and unload facilities would be built in the same locations and construction activities would be the same as described in Section 3.1.2.2. The rail transport facilities would be constructed over a period of approximately 1.5 years and would require a peak construction workforce of approximately 35 workers. These workers could be additions to the current Hanford Site workforce. Construction of the rail transport facilities would consist of site preparation, system construction, and other construction activities.

Figure (Page 3-40)
Figure 3-16. Low-Level Rail Tanker Car (Requires Shielding for High-Level)

The load and unload facilities piping would be connected to existing systems and structures in the 200 East and West Areas by workers with radiation training using established radiation work procedures. These procedures require that exposure to radiation be kept within the operating contractor's guidelines ALARA.

Operation - The complete rail transfer cycle (load, transport, unload and return) would take approximately 33 hours (4 shifts and 1 hour overtime) (WHC 1994b). For purposes of this analysis, it is assumed rail transport would occur 16 hours per day (two shifts) in a 6-day work week (WHC 1994b).

The proposed rail transport facilities would operate similar to the truck transport facilities described in Section 3.1.2.2. Based on an estimated 1.9 million L (5-million gal) of waste requiring cross-site transfer by 38,000 L (10,000 gal) rail cars, approximately 470 trips would be required, which includes 423 trips for the SWL and 47 trips for the West Area facility waste. Approximately 12 workers would be needed to support rail transfer operations.

Tank car loading and unloading would be scheduled to minimize outdoor storage of loaded tank cars (WHC 1993b). During transport, spacer cars would be used between the engine and the tank car to provide shielding for the engine crew based on applicable regulations. The train would consist of the locomotive, a minimum of two spacer cars and the liquid waste tank car. Only one HLW tank car would be carried on the train in any given trip. The shipment would move at a speed not to exceed 40 kmph (25 mph) at any time. Speed would not exceed 16 kmph (10 mph) at any paved road crossing or 8 kmph (5 mph) while on a spur line (WHC 1993b).

Once a train arrives at the unload facility, the spacer cars would be stored on a separate spur line, while the tank car would be surveyed and decontaminated, if necessary. Once inside the unload facility, the tank car would be positioned for waste transfer as described in Section 3.1.2.2 (WHC 1986).

3.1.4 NEW STORAGE ALTERNATIVE

The new storage alternative proposes to construct and operate two new DSTs and their associated facilities, the RCSTS to replace the ECSTS, and ITRS for Tank 102-SY and Tank 101-SY. This alternative proposes that the waste in Tank 101-SY would be retrieved and diluted at a ratio of approximately 1:1 (PNL 1995) via an ITRS and transferred to one or both of two new DSTs utilizing the RCSTS. Three location options for the NTF have been identified for this alternative, one in the 200 West Area and two in the 200 East Area. This alternative also proposes that solid and residual supernatant waste from Tank 102-SY, SWL from SSTs in the 200 West Area and 200 West Area facility wastes would be transferred to existing DSTs in the 200 East Area using the same methods described for the preferred alternative as described in Section 3.1.1. Implementation of the RCSTS proposed as part of the new storage alternative would provide the ability to transfer SWL and facility waste from the West area via a regulatory compliant transfer system to existing DSTs in the 200 East Area thereby reducing the likelihood of waste escaping from SSTs. Implementation of the ITRS in Tank 101-SY, RCSTS, and NTF and associated facilities proposed as part of this alternative would provide adequate tank waste storage capacity while mitigating the flammable gas safety concerns in this tank. In addition, this alternative would provide additional storage capacity that could be used for other future waste management needs.

Sections 3.1.4.1 through 3.1.4.2 describe the specific actions proposed for the new storage alternative. Sections 3.1.1.1, 3.1.1.2, and 3.1.1.5 provided detailed descriptions of the ECSTS, RCSTS, and interim stabilization respectively. A general process diagram of the new storage alternative is shown in Figure 3-17.

3.1.4.1 New Tanks Facilities

- As described in Appendix A, existing DST storage capacity is committed in the near term to other waste management activities. If a decision is made to retrieve Tank 101-SY, additional storage capacity would be needed.

Figure (Page 3-43)
Figure 3-17. New Storage Alternative

Description - The NTF would consist of two DSTs and associated facilities. The two DSTs would be located either in the 200 West Area or in one of two locations in the 200 East Area. A site selection process considered engineering constraints, potential environmental effects, and agency/

stakeholder involvement. Appendix B, Site Selection Process, provides a detailed description. The NTF would have its own Support Facility that would house the ventilation systems, tank sampling systems, and a control room. A diesel generator building would house a diesel generator to supply emergency backup electrical power at each area. The tanks would be designed for a 0.35 g ground acceleration initiated by an earthquake. Figures 3-18 and 3-19 show the location options of the proposed NTF in relation to the 200 West and East Areas, respectively. Appendix B describes the site selection criteria used in determining potential NTF sites.

Figure 3-20 provides a plan view of the NTF. Figure 3-21 provides an illustration of the NTF structures. Figure 3-22 illustrates a DST for the NTF. Each DST would consist of two concentric structures. A steel primary tank would be used to contain the radioactive waste materials. Each primary tank would have a diameter of approximately 23 m (75 ft), be capable of storing approximately 4 million L (1 million gal) of waste, and contain mixer pumps and a transfer pump. An outer reinforced concrete confinement structure, designed to sustain all loads and lined with a steel liner, would be used to provide secondary confinement. An annular space would separate the secondary confinement from the primary tank, and this space would contain leak detection instruments to detect leakage from the primary tank. The supporting pad, placed between the bottom of the primary tank and secondary confinement structure, would support the primary tank and be slotted to provide passages for annulus ventilation airflow and facilitate inspection of the tank bottom. Numerous penetrations in the primary tank and the annulus would be provided to support the transferring and mixing of waste and monitoring. The design life of each DST would be 50 years.

Monitoring and sampling of tank operations would include the following:

- In-tank, tank wall, bottom, and concrete temperatures
- Corrosion rates

Figure (Page 3-45)
Figure 3-18. Proposed NTF Location in 200 West Area

Figure (Page 3-46)
Figure 3-19. Proposed NTF Locations in 200 East Area

Figure (Page 3-47)
Figure 3-20. Plan View of the NTF

Figure (Page 3-48)
Figure 3-21. Illustration of NTF

Figure (Page 3-49)
Figure 3-22. Drawing of a NTF DST

- Tank pressure (vacuum)
- Continuous tank monitoring of hydrogen, ammonia, and total hydrocarbons for flammability
- Grab samples of carbon monoxide, hydrogen sulfide, carbon disulfide, acetone, 1-butanol, carbon tetrachloride, benzene, methyl butyl ketone, methyl iso-butyl ketone, tri-butyl phosphate, and normal paraffin hydrocarbons and nitrogen oxides (NOx)
- Stack gas monitoring for total hydrocarbons and alpha, beta, and gamma radiation
- Stack gas sampling for tritium, iodine (129I), and alpha, beta, and gamma radiation
- Annulus and pit leak detection.

The tank ventilation systems would remove heat generated in the tanks. Each tank would have two heat-removal systems: a primary tank ventilation system and an annulus ventilation system, as described in the following paragraphs.

- Primary Tank Ventilation System - The primary tank ventilation system would maintain negative pressure in the tank and exhaust gases from the tank vapor space to the atmosphere after passing them through moisture-removing and filtering equipment. In sequence, the exhaust would pass through a condenser, high-efficiency mist eliminator (HEME) filter, electrical heater, high-efficiency metal filter (HEMF), HEPA filter, high-efficiency gas adsorption (HEGA) filter, and another HEPA filter. The condenser, HEME, and HEMF backflush water would drain back to a primary tank.

. Annulus Ventilation System - The annulus ventilation system would remove heat from the primary tank walls and floor by convection. A CAM would be installed to measure radioactivity in each annulus ventilation exhaust system upstream of the HEPA filters to measure radioactivity.

After filtration and monitoring, both primary and annulus ventilation systems would exhaust through stacks. The primary tank ventilation system would be capable of moving air from a nominal 0.14 cubic meters per second (m3/s) [300 cubic feet per minute (cfm)] up to 0.45 m3/s (960 cfm) of air.

The Support Facility would contain operating galleries from which local control and monitoring of the primary tank ventilation system would be performed. The Support Facilities would also contain one or more rooms for each of the following functions or equipment: liquid and exhaust sampling, control, communications, process cell supply air filter, air compressor, contaminated solid waste, building exhaust, building HVAC supply, normal and backup electrical distribution panels, backup electrical motor control centers, condenser cooling equipment, and process cell exhaust. The HVAC systems for the Support Facilities would maintain differential air pressures within the facilities to minimize the potential for the spread of contamination. Four ventilation zones would be established such that airflow would be directed from areas with the least potential for contamination to areas with the most potential for contamination.

The process pits and their associated ventilation systems would provide secondary confinement of radioactive material and would be ventilated to maintain a slight negative pressure relative to the atmosphere so that airborne contamination remains in the pits.

Separate, dedicated incoming and outgoing 8-cm (3-in) diameter steel waste transfer lines, with associated spare lines, would connect the NTF with existing facilities by the RCSTS. All process lines and drains would be encased in secondary piping to collect and detect leakage from the primary piping. All process lines would be sloped for free draining to prevent fluid accumulation in traps. Encasement piping would drain into the process pit in which it terminates, and process pits would drain into the tank on which they are constructed. All encased process lines would be equipped with a leak detection system. Capability for periodic pressure testing of the primary process piping and encasement would be provided.

Construction - Figure 3-23 shows a typical construction area for the proposed NTF. The NTF would be constructed over a 3-year period and require a peak construction workforce of approximately 150 workers as incremental additions to the Hanford Site workforce. Site preparation would include approximately 10 ha (25 acres) of land, cleared and graded for construction of the two tanks and support facilities either for the 200 East or West Area sites, and an additional 10 ha (25 acres) of land cleared and graded for construction access, laydown, parking, and spoil piles.

Excavation for the waste tanks would be approximately 43 by 79 m (140 by 260 ft) and 18 m (60 ft) deep for either of the tank locations. Spoil material from the excavation would be placed in a spoil pile located at either NTF location. The spoil pile would contain material suitable for structural backfill, which would be reused for backfill around the completed tanks.

Site clearing, grading, and excavation activities would occur at the chosen NTF site for approximately 6 months of which 4 months would involve a two-shift operation. Heavy construction equipment would consist of approximately four to six large self-loading scrapers, four large bulldozers, a road grader, a water truck for dust control, and a fuel truck. Existing natural drainage traverses north for the 200 East Area and west for the 200 West Area. Surface drainage from storm water and snowmelt would evaporate or percolate naturally.

To prevent possible surface run-off flooding, finished grading of both sites would provide both run-on and run-off control for the new facilities. Construction access roads would be 9 m (30 ft) wide and surfaced with crushed gravel.

At either tank location, the finished grade and the area disturbed during construction would be stabilized upon project completion. Spoil pile locations and borrow areas would be stabilized by planting suitable vegetation determined through consultations with appropriate Federal and state agencies and tribes.

Figure (Page 3-53)
Typical Construction Area for NTF

Construction activities would encompass tank erection and erection of the Support Facility Building. Two DSTs would be erected at either the 200 East

Area or 200 West Area. The DSTs would be constructed with a crawler crane located at the bottom of the excavation. DST components would be off-loaded and stored in the construction laydown area and loaded onto trucks with a small crane or cherry picker for transport to the immediate erection area. Tank erection activities would last approximately 3 years.

After erection of the secondary confinement structures, backfill material would be placed around the tanks at the bottom of the dome. Backfill material would be placed with self-loading scrapers, leveled, and compacted, typically in 0.3-m (1-ft) lifts. Approximately two self-loading scrapers, two bulldozers, and two vibratory compactors would be utilized for placing the backfill. Backfilling activities would last approximately 5 weeks.

The Support Facility Building would be two-stories tall, and be built with reinforced concrete. Construction of the Support Facility Building would last approximately 18 months and would overlap tank erection and backfill by approximately 12 months. Construction activities would require at least one crawler or truck crane, a concrete pump, a cherry picker, and several flat bed trucks.

Several additional structures would be located at the NTF. These structures would include exhaust stacks, stack monitoring facilities, diesel generator buildings, and diesel fuel oil tank vaults. These structures would not require significant heavy equipment for construction.

In addition to the buildings and structures, waste transfer piping, process piping, and utilities would be installed and connected to existing sources. Most of the required underground excavation activities would be performed within the cleared portion of each facility, and other excavation would be performed in areas that have been previously developed.

Septic systems would be installed at the NTF, if necessary, to provide service during construction and operation. The septic systems would be sized to accommodate a volume of 12,500 L/day (3,300 gal/day) and accommodate all project construction personnel. Portable facilities would be utilized as required to supplement the septic systems. The NTF system would include a 18,000 L (5,000 gal) septic tank and three 50 percent capacity disposal fields of approximately 116 square meters (m2) [1,250 square feet (ft2)] each. The disposal fields would be located within the cleared and graded areas of the NTF site. A sewage treatment facility has been proposed for the 200 Areas and, if available, may also serve the proposed NTF (DOE 1995b).

After completing construction activities, permanent roadways and parking areas would be paved, and the remainder of the disturbed areas would be stabilized. Approximately 11,300 m2 (122,000 ft2) and 11,400 m2 (123,000 ft2) of land would be covered by new pavement and structures, respectively, at the NTF. The NTF would be finish-graded for drainage away from the pavement and structures.

Operation - Waste transfer operations would be initiated by remotely or manually aligning the valves on the transfer route for transfer to a new tank. A typical transfer to a new 200 East Area tank would involve the valves in the main valve pit, the multi-tank transfer pit, a diversion box, and the transfer pump pit on the tank. Transfers to a new 200 West Area tank would involve valves in its main valve pit, Diversion Box 1, and the transfer pump pit of the tank. The transferring tank and the booster pumps in the RCSTS would provide the necessary force to effect the transfer.

If the new tank storage alternative is selected with new DSTs in the 200 East Area, the RCSTS would be the same but would consist of two diversion boxes and two booster pumps. The second diversion box would be located in 200 East Area and would transfer waste to and from the new DSTs (Figure 3-3). The second booster pump would be located in the second diversion box to facilitate waste transfer from the new DSTs.

Approximately 50 workers would be needed to support NTF operations. These workers would come from the existing Hanford Site workforce.

3.1.4.2 Dilution and Retrieval

- The new storage alternative would mitigate flammable gas release in Tank 101-SY by decreasing the volume of gas-retaining material and reducing or eliminating its ability to retain, and ultimately release, flammable gas. The retention and release behavior of gas is tied closely to the properties of the sludge that forms as the solids settle. Dilution would dissolve a significant fraction of the solids and change the waste properties so that gas can migrate to the surface continuously instead of being held in the sludge.

For dilution to be an effective mitigation, it must eliminate or greatly reduce the ability of settled solids to retain gas and maintain flammable gas concentration below 25 percent of the LFL. Therefore, for dilution to be effective for Tank 101-SY it must be combined with retrieval and transfer of the gas generating waste so that the flammable gas level in the tank is reduced.

Description - The retrieval and dilution of waste from Tank 101-SY would be accomplished by operating the existing 150-hp mixer pump and construction and installation of a retrieval and dilution system provided by the ITRS. The ITRS would support dilution of waste for retrieval and transfer operations and mitigation of flammable gas safety issue in Tank 101-SY.

The retrieval of wastes from Tank 101-SY would be accomplished by installation and operating a small transfer pump in a spare tank riser. The transfer pump would also be utilized to introduce diluent in the tank either at the pump suction intake or through pipes attached to the pump column. The current mixer pump in Tank 101-SY would be used to mix the tank prior to transfer. A conceptual diagram of Tank 101-SY with the ITRS is shown on Figure 3-24. The dilution system for Tank 101-SY would include hot water and caustic solution supply, a flush tank and a flush pump for mixing water and caustic solution, a diluent pump, and a booster pump (Figure 3-25). Instrumentation would be provided in a valve pit downstream of the transfer pump to determine the waste properties such as density, viscosity, flow, temperature, and pressure.

Following retrieval and dilution, the waste would be transferred via the RCSTS to the NTF for storage in either the 200 West Area or 200 East Area. The dilution ratios required for Tank 101-SY mitigation and retrieval and transfer have been evaluated to be approximately 1:1 (i.e., one part of waste combined with an equal part of diluent). The proposed diluent is a two-molar solution of sodium hydroxide (NaOH) (PNL 1994).

Figure (Page 3-57)
Figure 3-24. Probable Tank COnditions at the Beginning of Retrieval Operations

Figure (Page 3-58)
Figure 3-25. Simplified Process Flow Diagram

Construction - The dilution and retrieval activities would include the construction and installation of a transfer pump in Tank 101-SY and in-line dilution capabilities provided by the ITRS. Tank 101-SY would be provided with flushing, caustic addition capabilities, and pipe routings to the tank farms. In addition, this system would be connected to the proposed RCSTS, described in Section 3.1.1.2.

The construction, installation, and modifications to the Tank 101-SY would include the following elements.

- Construction and installation of:
  - a small transfer pump for transferring waste from the tank
  - operator station including monitor, alarm, and control retrieval systems for the tank
  - Instrumentation to measure the physical characteristics of the waste prior to transfer
  - new jumpers, as required, to support the operation of the transfer pump, dilution system, and flush system
  - a flush tank, an isolation tank, and chemical unloading pad
- Utilities for retrieval operations (electrical, water, and telecommunications)
- Modifications to the central pump pit for the load distribution frame, cover blocks as required to support the new equipment, and existing valve pits to house a transfer booster pump, and flush pump
- Upgrades to the existing ventilation system, if required
- Piping interface with the RCSTS.

In addition, the retrieval and dilution system would interface with the existing instrumentation critical to monitor tank waste, shell, and air space temperatures, and waste levels within Tank 101-SY.

Operation - The Tank 101-SY retrieval and dilution operation would be a four-step process. First, the tank contents would be mobilized via operation of the mixer pump to achieve a measure of waste homogeneity. Second, as the tank is nearly full, the first batch of waste retrieved would be diluted in-line with a two-molar NaOH solution to meet a specified waste concentration that complies with the RCSTS requirements. Third, when adequate space is available in the tank, the diluent would be added to the tank for an in-tank dilution process. The diluent would be added to the tank to reach the prescribed waste dilution ratio of 1:1. During diluent additions, the mixer pumps would be operated to disperse the diluent and achieve waste homogeneity. This would prevent formation of a stratified layer on the surface preventing retrieval of sludge from the bottom. Finally, the diluted waste would be retrieved from the tank utilizing the transfer pump for subsequent transfer via the RCSTS, and storage into two new DSTs at the NTF.

The following modes of operation would be utilized during the retrieval and transfer process.

. Recirculation - The transfer pump would circulate waste back into the tank while diluent is added at the pump suction until correct waste properties are achieved for transfer and/or tank space would allow no further addition of diluent. Further dilution of waste could be achieved as part of the transfer process if proper dilution is not achievable within the tank. On-line instrumentation would be monitored during this phase of operation.

. Transfer - Diluted waste would be routed into the RCSTS and transferred to new DSTs, either in 200 East or West Areas.

. Bypass - If on-line instrumentation detects that waste being transferred is out of specification (refer to Section 3.1.1.2), the flow would be diverted from the transfer line to the recirculation loop and back into the tank. Bypass operations would continue until the waste achieves the required specification, via addition of diluent or continued conditioning and mixing.

. Flush - The transfer lines would be preconditioned with diluent prior to starting a transfer and to continue a transfer during Bypass mode. The transfer lines would also be flushed after completing a transfer operation or before shutdown.

3.1.5 NO ACTION ALTERNATIVE

The no action alternative would continue to retrieve both complex and non-complex SWL from SSTs and the WAFW by existing stabilization programs and transfer the waste utilizing the ECSTS via Tank 102-SY as described in Section 3.1.1.1. The no action alternative mitigates the safety issues in Tank 101-SY by the long-term operation of the existing mixer pump or a replacement pump, as described in Section 3.1.1.4 and the ability to provide safe storage conditions in existing DSTs.

Additionally, it is assumed for purposes of this analysis that no retrieval, dilution or transfer of Tank 101-SY wastes or Tank 102-SY solids would occur under the no action alternative and, therefore, construction of a retrieval system for Tank 102-SY or Tank 101-SY, RCSTS, waste load and unload facilities and operation of transfer vehicles, and NTF would not occur. A general process diagram of the no action alternative is shown in Figure 3-26.

3.2 ALTERNATIVES CONSIDERED BUT DISMISSED

Under DOE and CEQ requirements, all alternatives that could satisfy the need for action identified in Section 2, Purpose and Need for Action, must be assessed for reasonableness within the requirements of NEPA. The criteria of reasonableness for this EIS are affected by the following:

. The need to resolve safety issues expeditiously

. The restriction under CEQ regulations which requires that during the NEPA process for an EIS (in this case the TWRS EIS) an agency shall not take any action that would have an adverse effect, or limit the choice of reasonable alternatives. [40 CFR 1506.1(a)]

Figure (Page 3-62)
Figure 3-26. No Action Alternative

. The need to adhere to other regulations and DOE orders. Reasonableness is affected by a noncompliance with regulations or unacceptability based on policy determinations regarding acceptable risk to workers and the public.

Section 3.2.1 identifies those alternatives dismissed based on their inability to resolve safety issues expeditiously within the confines of an interim action. Section 3.2.2 identifies those alternatives that would prejudice TWRS decision-making, and Section 3.2.3 identifies those alternatives that are non-compliant with existing regulations or DOE orders.

3.2.1 RESOLVE FLAMMABLE GAS SAFETY ISSUES EXPEDITIOUSLY

The urgent safety issue which was created by large hydrogen releases in Tank 101-SY, necessitated that DOE and Ecology evaluate only those alternatives which have a proven ability to resolve this safety issue expeditiously, without affecting TWRS disposal decisions. Flammable GREs in Tank 101-SY have resulted in concentrations which exceeded the LFL for hydrogen. Several potential technical options for resolving GREs in Tank 101-SY have been dismissed from detailed evaluation in this EIS because their technical ability to resolve or mitigate the generation of unacceptable levels of flammable gas has not been proven (WHC 1992c).

The 1992 report, Mitigation/Remediation Concepts for Hanford Site Flammable Gas Generating Waste Tanks, (WHC 1992c), developed and evaluated 22 concepts for mitigating and/or remediating the generation, storage, and periodic release of hydrogen gas in Tank 101-SY and 22 other Hanford waste tanks. Mitigation by dilution, heating, mixing, and ultrasonic agitation were reported to be the most promising concepts for additional study (PNL 1994). In addition, other mitigation options such as chemical processing were found to be more complex, costly, and longer to implement than options discussed in this report. Furthermore, other options would only be needed if the four mitigation options discussed in this report could not produce and maintain acceptable results during the interim period prior to disposal decisions (WHC 1992c).

DOE has continued to fund the evaluation of the most promising mitigation concepts of mixing and diluting which are the principal alternatives evaluated in this EIS. Remediation concepts such as chemical processing, have been deferred to the TWRS EIS. A Pacific Northwest Laboratory (PNL) report, Assessment of Alternative Mitigation Concepts for Hanford Flammable Gas Tanks, (PNL 1994) released after the issuance of the SIS Draft EIS, reinforced the technical opinion that mixing and dilution are the most promising technical options for mitigation of the hydrogen gas safety issue. A subsequent evaluation of dilution (PNL 1995) indicated that a likely dilution ratio to successfully mitigate gas release events in Tank 101-SY would be approximately one part diluent to one part waste. Consequently, the DOE and Ecology have considered either use of mixer pumps or dilution as reasonable approaches that could work for mitigation of the Tank 101-SY safety issue

DOE will continue to evaluate promising options and look for other waste management strategies which may provide better, more cost effective solutions to hydrogen gas release events. However, for the interim needs of DOE and Ecology to resolve the specific issues regarding hydrogen generation in Tank 101-SY, these other solutions have been determined to be unreasonable at this time.

3.2.2 TANK WASTE REMEDIATION SYSTEM DECISION-MAKING

Because the TWRS EIS and ROD process will be the decision-making process for final disposal of tank wastes, alternatives which would prejudice TWRS EIS alternatives and options have been dismissed as alternatives for this interim action decision. These technical options include grouting wastes, in-tank chemical processing, and sugar denitrification. These options have the potential to physically or chemically alter the waste to an extent which could affect the viability of technical options being evaluated under the TWRS EIS for final waste disposal. The TWRS EIS will evaluate these options and others for their viability as alternatives for final waste disposal. Under CEQ regulations these options are not reasonable as interim actions to satisfy the purpose and need statement in Section 2 without affecting future decision-making.

Considering the interim time frame for decision-making in this EIS, the following option was dismissed from further evaluation:

Destroy the Complexant in West Area Single-Shell Tanks - The Organic complexant could be destroyed by heat and aggressive oxidation. However, this option was dismissed from consideration as the decision on treatment and disposal of tank wastes is being evaluated in the TWRS EIS. Any action to treat waste would prejudice the actions and decision being based on the TWRS EIS.

3.2.3 NONCOMPLIANT

Alternatives which have the potential to technically provide alternative storage but do not comply with regulations or policies have been evaluated. These include rail car or tanker truck storage, above ground tank storage, and surface impoundments. While no regulations explicitly prohibit storage of the waste in rail cars, tanker trucks, or above ground storage, the following regulations apply:

- DOE Order 6430.1A, General Design Criteria, which includes requirements for confinement of HLW
- WAC-173-303, Section 640, "Dangerous Waste Regulations, Tanks Systems"

Considering the interim time frame for decision-making in this EIS, these options were dismissed from further evaluation because these regulations would make it difficult or impossible to obtain the necessary permits and approvals for such storage.

3.3 COMPARISON OF ALTERNATIVES

The alternatives described in Section 3.1 present DOE and Ecology with full range of actions to be implemented by the ROD which follow this EIS. These alternatives characterize the various actions available to DOE and Ecology to meet the purpose and need statements identified in Section 2 which include:

- Remove SWL from older SSTs to reduce the likelihood of liquid waste escaping from the corroded tanks into the environment, also referred to as interim stabilization.
- Provide ability to transfer the tank wastes via a compliant system to mitigate any future safety concerns and take advantage of current or future tank space allocations.
- Provide adequate tank waste storage capacity for current and future waste volumes associated with tank farm operations as well as other Hanford facility operations.
- Mitigate hydrogen generation in Tank 101-SY.

Table 3-1 presents for each alternative, the actions that would satisfy the objectives of the purpose and need statement. All alternatives would reduce the potential for leaks from SSTs by continuation of the interim stabilization program by which SWL would be retrieved from all remaining SSTs. All alternatives except the no action alternative would provide a modern, safe, and reliable RCSTS that complies with regulations. Only the preferred and new storage alternatives would meet Tri-Party Agreement Milestone M-43-07 which requires the construction and operation of the RCSTS. All alternatives, except the new storage alternative, would manage future waste volumes associated with tank farm operations and other Hanford facility operations within the existing DST tank inventory; however, the ability of the no action alternative to accomplish this objective is uncertain. Safe storage of wastes in Tank 101-SY and mitigation of unacceptable generation of hydrogen would be accomplished by continued operations of the mixer pump currently in Tank 101-SY, except under the new storage alternative, which would retrieve and dilute Tank 101-SY and store the diluted waste in new DSTs.

Table 3-1
Comparison of Alternatives

Alternatives	Purpose and Need: Remove SWL to Reduce SST Leaks (Interim Stabilization)		Provide Compliant Cross-site Waste Transfer Capabilitya	Provide Adequate Waste Storage	Mitigate Hydrogen Generation in Tank 101-SY
	Non-complexed SWL	Complexed SWL			
Preferred	Transfer through	Retrieve Tank	ECSTS/RCSTS	Existing DSTs	Continue

	Tank 102-SY prior to solids retrieval	102-SY solids prior to transfer			Mixer Pump Operations
Truck Transfer	Bypass Tank 102-SY with Truck	Bypass Tank 102-SY with Truck	ECSTS/Truck	Existing DSTs	Continue Mixer Pump Operations
Rail Transfer	Bypass Tank 102-SY with Rail	Bypass Tank 102-SY with Rail	ECSTS/Rail	Existing DSTs	Continue Mixer Pump Operations
New Storage	Transfer through Tank 102-SY prior to solids retrieval	Retrieve Tank 102-SY solids prior to transfer	ECSTS/RCSTS	New DSTs	Retrieve and Dilute
No Action	Transfer through Tank 102-SY without solids retrieval	Transfer through Tank 102-SY without solids retrieval[b]	ECSTS	Existing DSTs	Continue Mixer Pump Operations

[a] Only the preferred and new storage alternatives would meet Tri-Party Agreement Milestone M-43-07 which requires the construction and operation of the RCSTS.

[b] Transferring complexed waste through Tank 102-SY without previously removing sludge in this tank has the potential to create additional TRU waste.

The following actions would be utilized by each alternative to meet the objectives of the purpose and need:

- Remove SWL to reduce SST leaks
- Provide compliant cross-site waste transfer capability
- Provide adequate storage
- Mitigate hydrogen generation in Tank 101-SY.

3.3.1 REMOVE SWL TO REDUCE SST LEAKS

Based on analyses in NEPA documents (DOE 1987, DOE 1994) and safety analysis documents that evaluated alternatives for resolving safety issues resulting from uncontrolled releases from SST leaks, the only acceptable alternative is continuing the interim stabilization program implemented in the 1970s. As described in Section 3.1.1.5, this program retrieves the remaining interstitial liquids from SSTs and pumps the SWL to interim storage in DSTs. DOE, Ecology, and the EPA agreed to this action in the Tri-Party Agreement. Therefore, under all alternatives evaluated in this EIS, continuing the interim stabilization program is the only action considered for resolution of safety issues associated with SST leaks.

Although the environmental impacts of interim stabilization have been evaluated previously, the action is included in this EIS to fully analyze all aspects of Hanford Site waste generation during the interim period, and to analyze the need for cross-site waste transfers. The interim stabilization program for SSTs in the 200 West Area generates SWL waste, which must be transferred to DSTs in the 200 East Area. Limitations on the use of Tank 102-SY for staging complexed wastes, and the ECSTS, as discussed in Sections 1.2.4 and 3.1.1.1, respectively, created the need for DOE and Ecology to evaluate alternatives for cross-site waste transfer.

The preferred and the new storage alternative would utilize the ECSTS for facility wastes and non-complexed SWL until the RCSTS becomes operational. At that time TRU solids from Tank 102-SY would be diluted and retrieved and transferred to DSTs in the 200 East Area. After solids removal, complexed SWLs would be transferred from 200 West Area SSTs through Tank 102-SY and the RCSTS to DSTs in the 200 East Area. The truck and rail transfer alternatives would similarly use the ECSTS until truck or rail facilities were operational to transfer facility wastes and non-complexed SWL. Once operational, the truck and rail transfer alternatives would transfer wastes by truck or rail tanker instead of pipeline. Under the truck and rail transfer alternatives TRU solids from Tank 102-SY would not require dilution and retrieval because complexed waste would not be transferred through Tank 102-SY, instead wastes would be transferred directly from DCRTs to the truck or rail load facility prior to cross-site transfers.

The no action alternative would transfer all facility and SWL wastes through Tank 102-SY and use the ECSTS to transfer wastes to the 200 East Area. The no action would violate the RCSTS Tri-Party Agreement Milestone and DOE administrative requirements for TRU waste segregation.

3.3.2 PROVIDE COMPLIANT CROSS-SITE WASTE TRANSFER CAPABILITY

The ECSTS would continue to be used under all alternatives until a replacement capability becomes operational. Under the preferred alternative and the new storage alternative, the RCSTS would be built to replace the ECSTS. Under the truck and rail transport alternatives, the RCSTS would not be built and cross-site waste transfers would be accomplished by tanker trucks or rail cars. The no action alternative would utilize the ECSTS for all cross-site waste transfers required prior to implementing waste disposal decisions resulting from the TWRS ROD.

3.3.3 PROVIDE ADEQUATE STORAGE

Waste projections in Appendix A demonstrate that the current inventory of DSTs would meet the storage requirements for all current tank waste volumes and future projected wastes with contingency space. All alternatives except the new storage alternative would provide interim storage within existing DSTs. Tank 101-SY retrieved and diluted wastes are not included in the current OWVP. If DOE would to choose dilution to mitigate hydrogen generation in Tank 101-SY, additional storage capacity would be required. The new storage alternative would provide additional DST storage for wastes which are not currently projected to be generated before FY 2003. Such wastes would include diluted Tank 101-SY wastes, or other yet to be identified wastes which could require retrieval and new storage to resolve safety issues prior to the TWRS ROD.

3.3.4 MITIGATE HYDROGEN GENERATION IN TANK 101-SY

Active tank monitoring programs implemented since the issuance of the SIS Draft EIS have identified that only Watchlist Tank 101-SY currently requires action beyond passive storage to maintain safety. As described in Section 1.3.4, based on the results of the ongoing monitoring program, Tank 103-SY was determined to no longer require action beyond continued monitoring.

Safe management of Tank 101-SY requires the prevention of unacceptable GREs. The preferred, truck and rail transfer and no action alternatives would resolve this safety issue through continued operation of a mixer pump which was installed in Tank 101-SY in July 1993. The new storage alternative would retrieve and dilute the waste from Tank 101-SY, transfer the waste through the RCSTS, and store it in new DSTs at a concentration sufficient to prevent GREs.

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4 AFFECTED ENVIRONMENT

Section 4 discusses the environment which is likely to experience impacts from construction, operation, or decontamination and decommissioning of the alternatives identified in Section 3. For baseline purposes, the environment prior to implementing proposed alternatives is considered as the starting point for this environmental impact analysis.

For this EIS, the affected environment is the entire area of the Hanford Site and the area adjacent to it. The Hanford area is located in southeastern Washington State northwest of the confluences of the Snake and Yakima Rivers with the Columbia River. The location of the Hanford Site is shown in Figure 4-1. The site is located within Benton, Grant, Franklin, and Adams Counties. The location of Hanford Site in relation to these counties is shown in Figure 4-2.

Major population centers in close proximity to the Hanford Site are the cities of Richland, Pasco, and Kennewick, commonly referred together as the Tri-Cities. The Tri-Cities are the closest urban areas to the site and home to most of the Hanford Site employees. The cities are serviced by an airport at Pasco, Interstate Highways 82 and 182, and U.S. Highways 12 and 395, several state highways, railroads, and river barges on the Columbia River.

The Hanford Site is about 50 km (30 mi) north to south and 39 km (24 mi) east to west, comprising a site area of about 1,450 km2 (560 mi2). It is a relatively large, undisturbed area of shrub-steppe that contains numerous plant and animal species adapted to the region's semiarid environment. Two small east-west ridges, Gable Butte and Gable Mountain, rise above the plateau of the central part of the Hanford Site as shown in Figure 4-3. The Columbia River flows through the northern part of the site and, turning south, forms part of the eastern boundary of the site. The Yakima River is close to the southern boundary of the site. Although no permanent streams cross the area, there are several ephemeral streams on-site and some persistent springs and creeks which disappear into the ground on the Fitzner Eberhardt Arid Lands Ecology Reserve.

Figure (Page 4-2)
Figure 4-1. Location of Hanford Site

Figure (Page 4-3)
Figure 4-2 Counties Containing and Surrounding the Hanford Site

Figure (Page 4-4)
Figure 4-3. Hanford Site and Environs

The Hanford Site is mostly undeveloped with widely spaced clusters of industrial buildings located along the western shoreline of the Columbia River and at several locations in the interior of the site (Figure 4-1). These clusters are interconnected by roads, railroads, and electrical transmission lines. Undeveloped areas comprise about 94 percent of the total site area. The industrial clusters are heavily developed and land uses consist of industrial uses, waste disposal, and transportation facilities. These clusters are completely contained within the Hanford Site, and are relatively remote from urban areas and residential concentrations. The distance has traditionally served two roles. First, the isolation of the clusters from urban populations and residential areas have facilitated security and protected the off-site public from exposure to radiological or chemical hazards. Second, the isolation has mitigated noise, construction activities, and other actions incompatible with residential land uses.

This section of the EIS on the affected environment is arranged into eight topics discussed in the following sections:

- Section 4.1 Geology, Seismology, and Soils
- Section 4.2 Water Resources and Hydrology
- Section 4.3 Physical Environment
- Section 4.4 Ecology
- Section 4.5 Population and Socioeconomics
- Section 4.6 Transportation
- Section 4.7 Land Use
- Section 4.8 Cultural Resources.

These topics are presented in the same order for the impact analyses presented in Section 5.

4.1 GEOLOGY, SEISMOLOGY, AND SOILS

The geology, seismology, and soils section presents existing information regarding the geological setting for the Hanford Site, the site's seismological characteristics, including earthquake history, and site soil conditions. Section 4.1.1 describes the regional geological resources. Section 4.1.2 describes the seismologic setting for the site and presents the earthquake history and information regarding the ground acceleration which may be experienced during a seismic event. Section 4.1.3 presents existing information regarding the agricultural and engineering properties of the soils at the site.

4.1.1 GEOLOGIC RESOURCES

The following sections discuss the site geology in terms of:

- Topography and Geomorphology
- Stratigraphy and Lithology
- Mineral Resources
- Geologic Processes.

4.1.1.1 Topography and Geomorphology

- The proposed project site is located in a portion of the Pasco Basin, a topographic and structural depression in the southwest corner of the Columbia Basin physiographic subprovince. This subprovince is characterized by generally low-relief hills with incised river drainages.

The Pasco Basin is surrounded by linear ridges formed by folds of basalt bedrock. These ridges are the Saddle Mountains to the north, the Horse Heaven Hills and Rattlesnake Mountain to the south, and Yakima and Umtanum Ridges to the west. The higher ridges of Gable Mountain and Gable Butte, north of the 200 Areas proposed project site, represent the last surface manifestations of the Umtanum Ridge to the west.

In the immediate vicinity of the 200 East and 200 West Areas, the Pasco Basin is an area of generally low to near flat relief ranging from 119 meters (390 ft) at Columbia River level to 229 m (750 ft) above mean sea level (MSL) on the 200 Areas Plateau (DOE 1992). The 200 Areas Plateau is a broad flat alluvial terrace.

4.1.1.2 Stratigraphy and Lithology

- The Columbia Basin subprovince is underlain by the Columbia River Basalt Group that consists of a thick sequence of Miocene basalt flows erupted from approximately 17 to 6 million years ago. The Columbia River Basalt Group within the Pasco Basin is greater than 3 km (1.8 mi) in thickness (DOE 1988). Three main basalt formations are shown in Figure 4-4.

Up to 185 m (607 ft) of late Miocene to Pliocene bedded sedimentary deposits (known as the Ringold Formation) overlay the basalts. The deposits are thickest in the Cold Creek area south of the proposed site and thin to the north against the higher ridges of Gable Mountain (DOE 1992). The Ringold Formation has been subdivided in the Hanford area into relatively continuous gravelly horizons (Unit A and Unit E), and less permeable, finer-grained sedimentary deposits (lower mud). The base of the Ringold Formation is commonly a coarse-grained sequence (Unit A) that is separated from the overlying Unit E gravels by the lower mud unit (DOE 1992).

Above the Ringold Formation in the 200 West Area is a local unit named the Plio-Pleistocene unit by local workers. It is composed of fine sand and silt. This unit is important due to its dense calcium carbonate cement called caliche which tends to inhibit downward percolation of water.

The uppermost important sedimentary units in the Pasco Basin are the flood deposits of the Hanford Formation. These deposits range up to 90 m (300 ft) in thickness.

4.1.1.3 Mineral Resources

- Currently no mineral resources other than crushed rock, sand, and gravel are produced from the Pasco Basin. These represent potential economic resources. Deep natural gas production from anticlines in the basalt has been tested by oil exploration companies without commercial success. With respect to the proposed site, there are no indications that the mineral resource potential is different from the remainder of the basin.

4.1.1.4 Geologic Processes

- Geologic processes which alter topography are landslides, floods, volcanic activity, and liquefaction. Each of these processes as they relate to the Hanford Site are described in the following list.

Figure (Page 4-8)
Figure 4-4. Stratigraphic Units Present in the Pasco Basin

- Landslides - Landslides in the Ringold Formation sediments are common in areas where these sediments have been over-steepened by erosion such as the White Bluffs area along the Columbia River. The likelihood of such over-steepening in the proposed project area is low due to the absence of any actively eroding streams.
- Floods - The nearest potential flooding source to the proposed site is Cold Creek to the southwest. Studies of the probable maximum flood in Cold Creek area show its effect is limited to the southwestern corner of the 200 West Area only (PNL 1994). Natural flooding on the Columbia River would be restricted to the immediate floodplain of the river. Failure of the upstream dams due either to natural causes or sabotage would not likely affect the proposed site (PNL 1994).
- Volcanic Activity - Two types of volcanic activity have affected the Pasco Basin in the past: basaltic flood volcanism and the Cascade style dacitic volcanism to the west. The basaltic volcanism has been quiescent for the past 8 million years and appears unlikely to resume due to changes in the plate tectonic regime of the region. The only effect of increased Cascade volcanism to the site would be from ashfall, such as the ashfall from the 1980 eruption of Mount St. Helens.
- Liquefaction - Liquefaction is not an issue at the proposed site due to the deep water table.

4.1.2 SEISMOLOGY

This section discusses geological characteristics of the Hanford area which would generate ground motion due to seismic events. This section examines the tectonic setting, earthquake history, earthquake ground motion, and geologic hazards.

4.1.2.1 Tectonic Setting

- The characterization of the tectonic setting of the region in which the Hanford Site is located includes the following main tectonic terranes and seismic sources.

- Major Tectonic Terranes - The Pacific Northwest and adjacent continental margin are divided into four major tectonic terranes reflecting the regional tectonic setting of a convergent plate margin. These tectonic terranes are the continental margin, the fore-arc terrane, the volcanic-arc terrane, and the back-arc terrane shown in Figure 4-5. The dynamic interaction between the two major converging plates, Juan de Fuca and the North American, define the characteristic structure and location of these four terranes with respect to plate geometry and configuration. The continental margin is the western-most of the four major tectonic terranes of the North American Plate and marks the sub-oceanic expression of the plate boundary the Cascadia Subduction Zone (CSZ) shown in Figure 4-6.

  The back-arc terrane of Washington occurs east of the Cascade Mountains, and is underlain primarily by Jurassic to early Miocene metamorphic and volcanic rocks which represent the accreted terranes of past collisions and continental deposits eroded from them (Reidel et al. 1989). Overlying a portion of this terrane is the Columbia Basalt Plateau, a region of thick thoelitic basalt lava flows. The Hanford Site and proposed project sites lie within a subprovince of this basalt province known as the Yakima Fold Belt (RHO 1979).

The Yakima Fold Belt is characterized by narrow, linear anticlinal ridges of basalt and broad synclinal basins with an east to east-southeast orientation. The folds have wave lengths of between 5 and 32 km (3 and 20 mi), amplitudes of less than 1 km (0.6 mi) and are commonly steeper on the northern limb (DOE 1992). The faults in the subprovince appear to be associated with the folding and are found on the flanks of the folds. The folds extend eastward up to 113 km (70 mi) from the Cascade Range Province and were growing during the eruption and emplacement of the basalt and probably continue to grow at the present time (DOE 1988). In general, the structures do not affect the sediments that overlie the basalt.

. Seismic Sources - Earthquakes are the result of sudden releases of built-up stress within the tectonic plates that comprise the earth's surface. The stresses accumulate from friction between the plates as they are forced past one another. Movement can occur between plates, as in subduction zones, or within plates.
The following seismic sources in the region could impact the design and performance of any new facilities or waste management systems.

Figure (Page 4-11)
Figure 4-5. Tectonic Terranes and Provinces of the Pacific Northwest

Figure (Page 4-12)
Figure 4-6. Geometry of Tectonic Plates in the Pacific Northwest

- Shallow Structures in the Yakima Fold Belt or Columbia River Basalts - The orientation of the structural fabric of the Yakima Fold Belt suggests an origin by north-south compressional forces that operated from middle Miocene age to present. Compression during the extrusion of the lavas resulted in the folds propagating upwards through succeeding flows, folding the latest flow, and faulting the underlying flows (Reidel et al. 1989). The Hooper and Convey Model (Reidel et al.) suggests that the compression is the result of oblique subduction along the CSZ and back-arc spreading associated with the basin and range crustal extension. The observable evidence suggests that the maximum compressive stress is horizontal and transmits deformation in a brittle manner only in the Columbia River Basalts (Geomatrix 1993). It is believed that underlying pre-basalt rocks deform in a ductile fashion and thus do not generate seismic activity. One of most active areas of shallow earthquake activity is along the Saddle Mountains anticline, north of the Hanford Site (RHO, 1979).

- Deep, Basement Structures - Two geologic models are currently used to explain the tectonic history of the crystalline basement underlying the Columbia Plateau: the failed rift model and the basement block model. Neither of these adequately explains the pattern of seismicity recorded in the region. In response to this discrepancy, the most recent seismic hazard analysis of the Hanford Site (Geomatrix 1993) uses an areal seismic model to assess seismic risk. This model, known as the random basement model, assumes that seismic activity occurs more or less randomly in the crust.

- Cascadia Subduction Zone - The source of seismic activity in the region that could potentially impact the new tanks is the CSZ, which lies off the coast of the Pacific Northwest. Two separate sources of seismic activity exist within this zone: an intraplate source where seismic events occur within the subducted Juan de Fuca oceanic plate, and an interplate source where seismic events occur at the interface of the Juan de Fuca and the North American plates. Of the two, the interplate source has the highest probability of generating earthquakes of a magnitude capable of causing ground motion at the proposed site that could impact the proposed facilities (Geomatrix 1993).

4.1.2.2 Earthquake History

- The Hanford Site lies in an area of relatively low seismic activity. Between 1870 and 1980, only five earthquakes occurred in the Columbia Plateau region that had Modified Mercalli Intensities (MMI) of

VI or greater, and all these events occurred prior to 1937. The largest event was the July 16, 1936 Milton-Freewater, Oregon earthquake when the MMI equalled VII and the surface wave magnitude (Ms) equalled 5.8 (DOE 1988). The location of this earthquake and its association with known geologic structures are uncertain (DOE 1988). Originally, the epicenter of this event was located at 45y50'N and 118y18'W near Milton-Freewater, Oregon. Woodward-Clyde Consultants (WHC 1994) relocated the epicenter approximately 22 minutes latitude further north, which places it about 100 km (62 mi) southeast of the Hanford Site.

Seismicity within the Columbia Plateau can be segregated into three depth zones: 0 to 4 km (0 to 2.5 mi); 4 to 8 km (2.5 to 5 mi); and deeper than 8 km (5 mi). Approximately 70 to 80 percent of this activity occurs in the 0 to 4 km (0 to 2.5 mi) zone, and 90 percent of it occurs in the first two zones (DOE 1988). Most of the earthquakes in the central Columbia Plateau are north or northeast of the Columbia River. Most of the earthquakes in the shallowest zone occur as swarms, which are not associated with mapped faults.

4.1.2.3 Earthquake Ground Motion

- The seismic design of new equipment or facilities under the proposed alternatives or the seismic upgrade of existing facilities would follow applicable DOE guidelines, stipulated in DOE Order 6430.1A and its primary reference Lawrence Livermore National Laboratory/ University of California Research Lab (LLNL/UCRL)-1-5910 (WHC 1994). These documents require that site earthquake ground motions be computed using probabilistic methods. Two site-specific studies of this type have been performed for the Hanford Site (WCC 1989, Geomatrix 1993). The horizontal peak ground accelerations (PGA) and their associated annual probabilities of being exceeded were estimated for several locations within the Hanford Site.

The results for the 200 East and West Areas, where the proposed RCSTS or NTF would be located, are summarized in Table 4-1.

Table 4-1
Peak Ground Acceleration Estimates for 200 East and West Areas

200 Area Location	Reference	Annual Probability of Exceedance			
		2 x 10-3	1 x 10-3	2 x 10-4	1 x 10-4
East	WCC 1989	-	0.07 g	0.18 g	0.25 g
	Geomatrix 1993	0.09 ga	0.13 g	0.28 g	0.37 g
West	WCC 1989	-	0.07 g	0.19 g	0.26 g
	Geomatrix 1993	0.10 g	0.14 g	0.30 g	0.39 g

ag = gravity

Each reference reports similar PGA values for the 200 East and West Areas, but the differences in PGA values reported by both references for a particular annual probability vary between factors of approximately 1.5 to 1.9.

4.1.2.4 Geologic Hazards

- Three major structures of the Yakima Fold Belt are found within the Hanford Site: the Umtanum Ridge-Gable Mountain Structure, the Yakima Ridge Structure, and the Rattlesnake Hills Structure (Figure 4-7). Each is composed of an asymmetrical anticline over-steepened to the north and with associated faults along their flanks. Two types of faults associated with the folds have been identified. Thrust faults occur on the northern, over-steepened limbs of the folds. These faults are sympathetic to the folds with more or less the same strike as the fold axes. Cross faults with a north-northwest trend cut the linear folds into separate segments and show a right lateral strike-slip movement (Reidel et al. 1989). Most known faults within the Hanford area are associated with anticlinal fold axes, are thrust or reverse faults. Normal faults exist, and were probably formed concurrently with the folding. Existing known faults within the Hanford area include wrench (strike-slip) faults as long as 3 km (1.9 mi) on Gable Mountain and the Rattlesnake-Wallula Alignment, which has been interpreted as a right-lateral strike-slip fault. The faults in Central Gable Mountain are considered capable faults by the Nuclear Regulatory Commission (NRC) criteria (10 CFR 100) in that they have slightly displaced the Hanford Formation gravels, but their relatively short lengths give them low seismic potential. No seismicity associated with the Gable Mountain Fault has been observed. The Rattlesnake-Wallula Alignment is interpreted to be capable faults by the NRC (Supply System 1981).

Figure (Page 4-16)
Figure 4-7. Anticlines in Vicinity of Hanford Site

4.1.3 SOILS

The surface and near-surface soil shown in Figure 4-8 in the Hanford 200 East and West Areas, as well as the area of the proposed RCSTS alignment, consists of Rupert Sand (Rp), Burbank Loamy Sand (Ba), and Ephrata Sandy Loam (El). An additional soil unit, Hezel Sand (He), is also present on the western boundary of the 200 West Area. A description of each of these soil types follows (PNL 1994).

- Rupert Sand - This soil type consists of coarse sand and is also known as the Quincy Sand. This soil covers the majority of the 200 West Area and approximately one-half of the 200 East Area.
- Burbank Loamy Sand - This coarse-textured sand covers approximately one-third of the 200 West Area on the northeast and east, a relatively small portion of the 200 East Area, and the majority of the area between the 200 West and East Areas.
- Ephrata Sandy Loam - This medium-textured soil covers the northern portion of the 200 East Area.
- Hezel Sand - This soil is similar to Rp sand and covers a portion of the area on and immediately west of the boundary of the 200 West Area.

There are currently no identified prime or unique farmlands at the Hanford Site because of inadequate precipitation and the absence of irrigation. There are some soil types present that, if properly irrigated, could be designated as prime or unique (Bolick 1994).

Figure (Page 4-18)
Figure 4-8. Soil Map of the hanford Site

4.2 WATER RESOURCES AND HYDROLOGY

The baseline conditions for water resources and hydrology encompass surface water, the vadose zone, and groundwater. Each of these hydrological regimes may be affected by the alternatives and each regime would be affected differently. The baseline environment provides a description of the existing environment, as it has already been affected by actions at the Hanford Site.

4.2.1 SURFACE WATER

The following description of surface water resources concerns surface water occurrence and characteristics, floodplains and runoff, and water quality.

4.2.1.1 Occurrence and Characteristics

- There is one naturally occurring lake on the Hanford Site, Westlake, which is located about 3 km (2 mi) north of the 200 East Area and approximately 8 km (5 mi) northeast of the 200 West Area, as shown in Figure 4-9. The lake is situated in a topographically low-lying area, and is sustained by groundwater inflow resulting from intersection with the groundwater table. Westlake was considered to be an ephemeral lake before operations began at the Hanford Site, with water level fluctuations occurring in response to groundwater level fluctuations. However, due to artificial recharge from waste water disposal at the site, water levels in the lake have become more stable. Two ephemeral creeks, Cold Creek and its tributary Dry Creek, traverse the uplands of the Hanford Site southwest and south of the 200 East and West Areas. The confluence of the two creeks are 5 km (3 mi) southwest of the 200 West Area and 7.2 km (4.5 mi) southwest of the 200 East Area. These creeks drain southeasterly toward the horn of the Yakima River, located south of the Hanford Site.

Surface runoff from the uplands in and west of the Hanford Site is small; in most years, measurable flow occurs only during brief periods and in only two places, upper Cold Creek Valley and in upper Dry Creek Valley. This surface runoff either infiltrates into the valley floor or evaporates. These ephemeral creeks are not sustained by groundwater baseflow during any part of the year, since the depth to groundwater is over 46 m (150 ft) near the intersection of these creeks. The Columbia River is 16 to 24 km (10 to 15 mi) east of and downgradient from the 200 Areas and approximately 11 km (7 mi) toward the north (Figure 4-9). The river forms part of the eastern boundary of the Hanford Site and comprises the base level and receiving water for groundwater and surface water in the region.

Figure (Page 4-20)
Figure 4-9. Surface Water Features of the hanford Site

4.2.1.2 Floodplains and Runoff

- There are no floodplains in the 200 East and West Areas. Floods in Cold and Dry Creeks have occurred historically; however, there have not been any flood events or evidence of flooding in these creeks reaching the 200 East and West Areas before infiltrating into pervious sediments. During periods of unusually rapid snowmelt or heavy rainfall, surface runoff extends beyond Rattlesnake Springs in the upper part of Dry Creek and was believed to be approximately 6 m3/s [200 cubic feet per second (ft3/s)] during a brief period during March 1952 (GSP 1972). However, this runoff quickly infiltrated into the alluvial sediments of Cold Creek Valley.

Natural runoff generated on-site or from off-site upgradient sources is not known to occur in the 200 East and West Areas. Measurable runoff occurs during brief periods in two locations, Cold Creek Valley and Dry Creek Valley west and southwest of the 200 West Area (GSP 1972). The total amount of annual recharge to the unconfined aquifer from these areas is estimated to be 555,000 m3 (450 acre ft) that generally occurs east of the Hanford Site (GSP 1972).

4.2.1.3 Water Quality

- Effluents from 200 Area activities normally contain low levels of radionuclides. These effluents include cooling water, steam condensates, process condensates, and waste water from laboratories and chemical sewers (PNL 1995). Historically, these effluents were released to the ground via multiple discharge points in the 200 Areas. Since June 1995, most of these streams have been diverted to the Treated Effluent Disposal Facility (TEDF) east of the 200 East Area. Here effluents are released to the ground through a permitted discharge point.

Surface water in Westlake reflects water quality in the groundwater which feeds the lake. Identified contaminant plumes in the groundwater intersect the lake (DOE 1992). Water quality in the ephemeral creeks are not known to be affected by site activities. Water quality in the Columbia River has been monitored and published since 1973 (PNL 1993). Low levels of radionuclides have been detected along the Hanford Reach adjacent to the Hanford Site, but are well below concentration guidelines established by the DOE and EPA drinking water standards (PNL 1993). Potential nonradiological contaminants measured in the river were either undetected or at concentrations below drinking water standards.

4.2.2 VADOSE ZONE

The vadose zone extends from the ground surface to the top of the groundwater. Vadose zone characteristics determine the rate, extent, and direction of liquid flow downward from the surface. Vadose zone characteristics discussed in the following sections are infiltration, perched water, and soil moisture.

4.2.2.1 Infiltration

- Recharge to the unconfined aquifer is primarily from artificial sources. Natural recharge occurs chiefly from precipitation since there are no natural surface water bodies in the 200 East and West Areas.

Average annual precipitation in the 200 East and West Areas is approximately 16 cm (6.3 in). Estimates of evapotranspiration from precipitation range from 38 to 99 percent (PNL 1987) and lysimeter data in the 200 East Area indicate that no recharge occurred at a depth of 4.9 m (16 ft) during a 16-year period

(PNL 1990). However, other studies indicated that approximately 19 million L (5 million gal per year) of natural recharge may occur in the 200 East Area (DOE 1992).

The total natural recharge in the 200 West Area is estimated to be approximately 8.3 million L (2.2 million gal) per year (DOE 1993). This is based upon a recharge rate of 0.1 cm (0.04 in) per year through fine-textured soil with deep rooted vegetation, common to the 200 East and West Areas. These natural recharge values in the 200 West Area are approximately equal to volumes disposed of by artificial sources. Currently, the active artificial recharge in, and adjacent to, the 200 Areas is through permitted facilities only, which include the TEDF, several septic tanks, drain fields, and trench drains.

4.2.2.2 Perched Water

- Caliche layers do not occur in the 200 East Area (DOE 1992) and perched groundwater is not expected to occur. Local perched horizons are possible in the silt paleosols within the Hanford Formation (WHC 1992b). Perched water has been reported in the vicinity of B Pond within the lower part of the Hanford Formation. Perched water may occur in the 200 West Area within the vadose zone upon the caliche layer approximately 55 m (180 ft) beneath the site. Measured hydraulic conductivities of this unit range from 9 x 10-4 to 9 x 10-2 m (0.003 to 0.3 ft per day) (DOE 1993).

4.2.2.3 Soil Moisture

- Soils are likely to be close to saturation and would not hold significant amounts of additional liquid in areas continuing to receive artificial recharge, or in areas of past artificial recharge. As a result of artificial recharge, ground-water mounds have developed beneath these areas.

4.2.3 GROUNDWATER

The 200 East and West Areas lie near the middle of the Pasco Structural Basin within the Columbia Plateau. This area is within the Yakima Fold Belt and is located on the southern flank of the Gable Mountain Anticline near the axial trace of the Cold Creek Syncline. Much of the 200 East and West Areas are located upon the 200 Area Plateau.

The following sections characterize ground-water features of the Hanford Site in greater detail.

4.2.3.1 Hydrogeologic Setting

- Groundwater occurs over 91 m (300 ft) in depth at an elevation (above seal level) of 122 m (400 ft) in the vicinity of the 200 East Area (see Figure 4-10). Groundwater occurs approximately 72 m (235 ft) in depth at an elevation of 139 m (455 ft) in the vicinity of the proposed NTF site in the 200 West Area (see Figure 4-11). Figure 4-12 shows the most recent ground-water table contour map for 1992 (DOE 1992) for the Hanford Site. Regionally, the water table occurs near the contact between the Hanford Formation and the underlying Ringold Formation. Across the 200 East and West Areas, the regional ground-water flow is toward the north, east, and southeast. Ground-water discharge occurs locally in Westlake. Regional ground-water discharge occurs along the course of the Columbia River, which is nearly 11 km (7 mi) north of the 200 West Area and approximately 11 km (7 mi) northwest of the 200 East Area.

Figure (Page 4-24)
Figure 4-10. Map of the Vadose Zone in the 200 East Area

Figure (Page 4-25)
Figure 4-11. Map of the Vadose Zone in the 200 West Area

Figure (Page 4-26)
Figure 4-12. Hanford Site Water Table Map

Natural recharge to groundwater beneath the 200 East and West Areas occurs primarily in upland areas west of the Hanford Site, although recharge from direct precipitation has been estimated to be approximately 0.1 cm (0.04 in per year). Historically, artificial recharge contributed an order of magnitude more recharge than natural discharge.

Because natural recharge on the site is low and recharge to the regional aquifer occurs primarily in upland locations at considerable distances from the site, seasonal water table fluctuations are not large. This is evidenced by the similarity in water table contours and elevations observed as part of the routine monitoring.

4.2.3.2 Aquifer Characterization

- Discussion of aquifer characterizations for the 200 East and West Areas follows.

- 200 East Area - Depth to groundwater in the 200 East Area ranges from 97 m (317 ft) in the southeast to 37 m (123 ft) in the vicinity of the 216-B-3C Pond (B Pond mound) located approximately 5 km (3 mi) east of the proposed NTF sites (DOE 1992). Groundwater occurs under unconfined conditions within the Ringold Unit A approximately 96 m (315 ft) in depth near the proposed project site. The saturated section above basalt is approximately 34 m (112 ft) in thickness (WHC 1992b). Erosional windows occur in the basalt north of the 200 East Area that allow communication between the regionally-confined Rattlesnake Ridge interbed below the basalt and the unconfined aquifer of the Hanford Formation.

  The average groundwater gradient across the 200 East Area is 0.001; in the vicinity of the proposed NTF sites, the gradient is virtually flat. An 0.007 gradient is associated with the western slope of the B Pond mound, approximately 5 km (3 mi) east of the proposed NTF sites. Hydraulic conductivities of the unconfined aquifer near the proposed project sites range from 152 to 305 m (500 to 1,000 ft per day) (DOE 1992).

- 200 West Area - Groundwater occurs in the 200 West Area within the Ringold Formation primarily under unconfined conditions, approximately 72 m (235 ft) in depth beneath the proposed project site in the 200 West Area (DOE 1993). The saturated section is approximately 107 m (350 ft) thick above the Elephant Mountain Basalt. This includes approximately 23 m (75 ft) of Unit A Gravels under confined and semi-confined conditions.

  Ground-water flows in the direction of the ground-water hydraulic gradient (see Figure 4-12) toward the north, east, and southeast with an approximate gradient of 0.003 toward the east and southeast (DOE 1994). Hydraulic conductivities measured in the 200 West Area in the Ringold Unit E aquifer range from approximately 1.8 x 10-2 to 61 m (0.06 to 200) ft per day. Hydraulic conductivities range from 0.5 to 1.2 m (1.7 to 4 ft) per day in the semi-confined to confined Ringold Unit A Gravels (DOE 1994).

  Hydraulic conductivities measured in the uppermost part of the Ringold Unit E aquifer in the vicinity of the proposed NTF site range from 0.3 m (1 ft) per day from Well 299-W19-32, to 27 m (90 ft per day) from Well 299-W23-13. Well 299-W19-32 is located approximately 430 m (1,400 ft) to the west of the proposed project site and Well 299-W23-13 is located approximately 610 m (2,000 ft) to the southwest. Transmissivities range from 2 m2 (20 ft2) per day in Well 299-19-32 to 167 m2 (1,800 ft2) per day in Well 299-W23-13 (DOE 1993).

  A discontinuous layer of silt and sand cemented by calcium carbonate (caliche - Plio-Pleistocene Unit) occurs locally nearly 55 m (180 ft) in depth in the 200 West Area. This unit provides for perched water conditions and is approximately 9-m (30-ft) thick in the vicinity of the proposed project site (DOE 1993).

4.2.3.3 Ground-water Flow

- This section examines the physical and chemical characteristics of ground-water flow in the 200 East and West Areas.

- 200 East Area - Groundwater flow beneath the 200 East Area is primarily influenced by changes in lithology as it flows east from the 200 West Area toward the 200 East Area out of the Ringold Unit E gravels. Flow is also influenced by the ground-water mound associated with the B Pond approximately 5 km (3 mi) east of the proposed NTF sites. Ground-water gradients abruptly flatten approximately 0.8 km (0.5 mi) west of the proposed NTF sites (DOE 1992) and abruptly increase near the B Pond mound. Ground-water flow is deflected by the mound north through Gable Gap and toward the southeast.

Ground-water gradients in the vicinity of the proposed tank site flatten toward the north, east, and southeast beyond the 200 West Area (DOE 1993). The hydraulic gradient on the eastern slope of the mound in the vicinity of the proposed project site is approximately 0.003 and ground-water velocity ranges from 0.02 to 1.4 m (0.065 to 4.6 ft per day) (DOE 1993). Downward vertical gradients exist in the vicinity of the proposed NTF site between the unconfined aquifer and the Rattlesnake Ridge Interbed below the Elephant Mountain Basalt. This may provide the potential for ground-water flow into the confined aquifer systems within the basalt section. However, there is no evidence of erosional windows through the basalt near the axis of the Cold Creek Syncline. Basalt in the vicinity of the proposed project site is over 18-m (60-ft) thick (DOE 1993).

. 200 West Area - The proposed NTF site in the 200 West Area is located above a ground-water mound caused by artificial recharge during the operational period of the U Plant Area, especially the 216-U-10 Pond. Ground-water elevations have declined significantly since the 216-U-10 Pond was decommissioned in the fall of 1984. Significant declines of ground-water elevations have been recorded within seven wells in the U Plant Area since 1984. Hydrographs of two wells (299-W19-1 and 299-W19-10) west of the proposed NTF site indicate that ground-water elevations have declined approximately 5 m (15 ft) since the 216-U-10 Pond was decommissioned (DOE 1993). The proposed NTF site is located on the eastern slope of the mound. The regional flow direction, from east to west, has been greatly affected by artificial discharges from waste management units throughout the 200 West Area. The mound seems to have shifted slightly, as it continues to dissipate beneath the 216-U-10 Pond, toward the northeast, in response to past discharges beneath the 216-U-14 Ditch and the 216-Z-20 Crib.

Erosional windows exist through the basalt into the regionally confined Rattlesnake Ridge Interbed north of the 200 East Area in the vicinity of Gable Gap. Aquifer communication exists between the unconfined Hanford Formation and the regionally confined system in this area. Well data indicates that a slight upwardly directed vertical gradient occurs into the unconfined system (DOE 1992); which should minimize the potential of contaminating the regionally-confined system (RHO 1984).

4.2.3.4 Ground-water Contamination

- Ground-water contamination by both radionuclide and nonradionuclide contaminants has been identified on the Hanford Site. Remedial strategies for the site have been developed or are being developed to contain the contaminants to prevent their migration off-site. There has been no identified vertical migration of contaminants to deeper aquifers beneath the site due to intervening low-permeability strata and upward groundwater gradients except where localized erosional windows through basalt provide for aquifer communication. Discussion of ground-water contamination for the 200 East and West Areas follows.

. 200 East Area - Unconfined groundwater beneath the 200 East Area contains 13 different contaminants (DOE 1992) that have been mapped as plumes. These plumes are: arsenic, chromium, cyanide, nitrate, gross alpha, gross beta, tritium, 60cobalt (Co), 90strontium (Sr), 99technecium (Tc), 129iodine (I), 137cesium (Cs), and 239, 240Pu. In general, these plumes are located in the east-southeast and northwest portion of the 200 East Area. Gross alpha and gross beta represent comprehensive measurements of alpha and beta activity, respectively, without differentiating between specific radionuclides.

Low concentrations of tritium and 129I have been reported in confined groundwaters where erosional windows through basalt bedrock, north of the 200 Area, provide communication between the uppermost confined aquifer and the unconfined aquifer (PNL 1992a).

. 200 West Area - Thirteen overlapping contaminant plumes are located within the unconfined gravels of Ringold Unit E: 99Tc, U, nitrate, carbon tetrachloride, chloroform, trichloroethylene, 129I, gross alpha, gross beta, tritium, arsenic, chromium, and fluoride (DOE 1994). The proposed project site is within the boundaries of all except the chromium, chloroform, trichloroethylene, fluoride, and arsenic plumes. Plumes of Tc, U, 129I, gross alpha, and gross beta are associated with the U Plant area.

4.2.3.5 Ground-water Uses

- Groundwater is not normally used in the 200 East and West Areas. Water for drinking and emergency use and facilities process water comes from the Columbia River. Regionally, groundwater is used for irrigation and domestic water supply; however, there are no domestic (potable) or irrigation production wells downgradient of the Hanford Site or the 200 East and West Areas.

On the Hanford Site, water supply wells are located at the Yakima Barricade approximately 13 km (8 mi) west of the 200 East Area, the Fast Flux Test Facility in the 400 Area approximately 16 km (10 mi) southeast, and at the Hanford Safety Patrol training Academy approximately 26 km (16 mi) southeast. Three wells, used for emergency cooling water, are located near B Plant in the 200 East Area.

4.3 PHYSICAL ENVIRONMENT

Aspects of the physical environment described in this section are:

- Meteorology, Climatology, and Air Quality
- Radiation
- Sound Levels and Noise.

4.3.1 METEOROLOGY, CLIMATOLOGY, AND AIR QUALITY

The Hanford Site is located in a semiarid region of southeastern Washington State. The Cascade Range shown in Figure 4-13 greatly influence the climate of the Hanford Site by their rain shadow effect. This range also serves as a source of cold air drainage, which has a considerable effect on the wind regime on the Hanford Site.

Figure (Page 4-32)
Figure 4-13. Mountain Ranges Surrounding the Hanford Site

Climatological data are available for the Hanford Meteorological Station (HMS), which is located between the 200 East and West Areas. Data have been collected at this location since 1945. Temperature and precipitation data are also available from nearby locations for 1912 through 1943. Data from the HMS are representative of the general climatic conditions for the region and describe the specific climate of the 200 Area Plateau. The information used in this section has been excerpted from the most current Hanford Site National Environmental Policy Act Characterization (PNL 1994). Because the data are updated annually, some numbers reported in this Final EIS are different than those in the Draft EIS.

The following sections characterize existing wind, temperature and humidity, precipitation, fog and visibility, severe weather, atmospheric dispersion, and air quality conditions.

4.3.1.1 Wind

- Wind instruments on twenty-four 9.1-m (29.9-ft) towers distributed on and around the Hanford Site provide supplementary data for defining wind patterns. Locations of these towers are shown in Figure 4-14.

Figure 4-15 shows that prevailing wind directions on the 200 Area Plateau are from the northwest in all months of the year. Southwesterly winds are secondary. Summaries of wind direction indicate that winds from the northwest quadrant occur most often during the winter and summer. During the spring and fall, the frequency of southwesterly winds increases with a cor-
responding
decrease in northwest flow. Winds blowing from other directions, such as northeast, display minimal monthly variations.

Monthly average wind speeds are lowest during the winter months, averaging 10 to 11 kmph (6 to 7 mph), and highest during the summer, averaging 14 to 16 kmph (9 to 10 mph). Wind speeds that are well above average are usually associated with southwesterly winds. However, the summertime drainage winds are generally northwesterly and occasionally reach 50 kmph (30 mph). These winds are most prevalent over the northern portion of the Hanford Site.

4.3.1.2 Temperature and Humidity

- Ranges of daily maximum and minimum temperatures vary from normal maxima of 2y Celius (C) [(36y Farenheit (F)] in early January to 35y C (95y F) in late July. There are, on the average,

Figure (Page 4-34)
Figure 4-14. Hanford Site Wind Monitoring Network

Figure (Page 4-35)
Figure 4-15. Wind Directions for the hanford Site, 1979-1988

51 days during the summer months with maximum temperatures greater than or equal to 32y C (90y F) and 12 days with maximum greater than or equal to 38y C (100y F). From mid-November through mid-March, minimum temperatures average less than or equal to 0y C (32y F) with the minimum temperatures in early January averaging -6y C (21y F). The winter months have an average of 3 days with minimum temperatures less than or equal to -18y C (-0.4y F). Only about half the winters experience such temperatures. The record maximum temperature is 45y C (113y F) and the record minimum temperature is -31y C (-24y F).

The annual average relative humidity at the HMS is 54 percent. It is highest during the winter months, averaging about 75 percent, and lowest during the summer, averaging about 35 percent.

4.3.1.3 Precipitation

- Average annual precipitation at the HMS is 16 cm (6.3 in). Most of the precipitation occurs during the winter with more than half of the annual amount occurring in November through February. Days with greater than 1.3 cm (0.5 in) precipitation occur less than 1 percent of the year. Winter monthly average snowfall ranges from 0.8 cm (0.32 in) in March to 14.5 cm (5.7 in) in December. Snowfall accounts for about 38 percent of all precipitation in December through February.

4.3.1.4 Fog and Visibility

- Fog has been recorded during every month of the year at the HMS. Ninety-five percent of the occurrences are in November through February, with less than 1 percent in April through September. The number of days with fog is presented in Table 4-2.

Table 4-2
Number of Days With Fog by Season

Category Total	Winter	Spring	Summer	Autumn	Total
Fog	32	2	y1/2	12	46
Dense fog	17	1	y1/2	6	24

Besides fog, other phenomena restricting visibility to less than or equal to 9.6 km (6 mi) include dust, blowing dust, and smoke from field burning. There are few such days of restricted visibility; an average of 5 days per year have dust or blowing dust and less than one day per year has reduced visibility from smoke.

4.3.1.5 Severe Weather

- High winds are associated with thunderstorms. The average occurrence of thunderstorms is 10 per year. They are most frequent during the summer; however, they have occurred in every month. The average winds during thunderstorms do not come from any specific direction. Estimates of the extreme winds, based on peak gusts observed from 1945 through 1980, are shown in Table 4-3 (PNL 1994).

Table 4-3
Estimates of Extreme Winds at the Hanford Site

Peak Gusts, km/h a

Return Period, yr	15.2 m (50 ft) Above Ground	61 m (200 ft) Above Ground
2	97	109
10	114	129
100	137	151
1,000	159	175

a1 kmph = 0.62 mph

Tornadoes are infrequent and generally small in the northwest portion of the United States. The Hanford Site National Environmental Policy Act (NEPA) Characterization (PNL 1994) lists no violent tornadoes for the region surrounding the Hanford Site. The HMS climatological summary and the National Severe Storms Forecast Center database list 22 separate tornadoes within 161 km (100 mi) of the Hanford Site from 1916 through August 1982 (PNL 1994). Two additional tornadoes have been reported since August 1982. The estimated probability of a tornado striking a point at the Hanford Site is 9.6 x 10-6 per year (PNL 1994).

4.3.1.6 Atmospheric Dispersion

- Atmospheric dispersion is a function of wind speed, duration and direction of wind, atmospheric stability, and mixing depth. Dispersion conditions are generally good if winds are moder- ate to strong, the atmosphere is of neutral or unstable stratification, and there is a deep mixing layer. Good dispersion conditions associated with neutral and unstable stratification exist about 57 percent of the time during the summer. Less favorable dispersion conditions may occur when the wind speed is light and the mixing layer is shallow. These conditions are most common during the winter when moderately to extremely stable stratification exists about 66 percent of the time. Less favorable conditions also occur periodically for surface and low-level releases in all seasons from about sunset to about an hour after sunrise as a result of ground-based temperature inversions and shallow mixing layers. Mixing-layer thicknesses have been estimated at the HMS using remote sensors. These variations in mixing layer are summarized in Table 4-4.

Table 4-4

Frequency of Mixing-Layer Thickness by Season and Time of Day

Mixing Layer, m (ft)	Summer (%) Night	Summer (%) Day	Winter (%) Night	Winter (%) Day
250 (820)	48.5	1.2	65.7	35.0
<250-500 (820-1,641)	37.1	9.0	24.7	39.8
>500 (1,641)	14.4	89.9	9.6	25.2

Occasionally, there are extended periods of poor dispersion conditions associated with stagnant air in stationary high-pressure systems that occur primarily during the winter months. The Hanford Site National Environmental Policy Act (NEPA) Characterization (PNL 1994) estimated that the probability of poor dispersion conditions (inversion periods) extending more than 12 hours varies from a low of about 10 percent in May and June to a high of about 64 percent in September and October.

4.3.1.7 Air Quality

- National Ambient Air Quality Standards (NAAQS) have been set by EPA, as mandated in the 1970 Clean Air Act (CAA). Ambient air is that portion of the atmosphere, external to buildings, to which the general public has access. The standards define levels of air quality that are necessary, with an adequate margin of safety, to protect the public health (primary standards) and the public welfare (secondary standards). Standards exist for sulfur oxides [measured as sulfur dioxide (SO2)], nitrogen dioxide (NO2), carbon monoxide (CO), fine particulates (PM10), lead, and ozone. The standards specify the maximum pollutant concentrations and frequencies of occurrence that are allowed for specific averaging periods from one hour to one year, depending on the pollutant.

For clean areas, the EPA has established the Prevention of Significant

Deterioration (PSD) program to protect existing ambient air quality while allowing a margin for future growth. The Hanford Site operates under a PSD permit issued by the EPA in 1980. The permit provides specific limits for emissions of oxides of nitrogen from the PUREX and U Plants.

State and local governments can impose standards for ambient air quality that are stricter than the national standards. Washington State has established more stringent standards for SO2 and total suspended particulate (TSP). In addition, Washington State has established emission standards for PM10, volatile organic compounds (VOCs), and toxic air pollutants. At the local level, Benton County Clear Air Authority can establish more stringent air standards, but has not done so. Table 4-5 summarizes the relevant air quality standards (Federal and state standards).

Emission inventories for permitted pollution sources in Benton County are routinely compiled by the Benton County Clean Air Authority. Table 4-6 lists the annual emission rates for stationary sources within the Hanford Site that have been reported to Ecology by DOE.

Comparable on-site monitoring data were obtained in 1990 and reported in the Hanford Site National Environmental Policy Act (NEPA) Characterization (PNL 1992b). The only on-site air quality monitoring conducted during this year was for NOx, for which the primary source is the PUREX Plant. At three locations within the Hanford Site, NOx were sampled with a bubbler assembly operated to collect 24-hour integrated samples. The results of the sampling are in Table 4-7. The highest annual average concentration was less than 0.006 ppm, well below the applicable Federal and Washington State annual ambient standard of 0.05 ppm.

On-site monitoring of TSP was discontinued in early 1988 when the Basalt Waste Isolation Project (BWIP), for which those measurements were required, was concluded.

Table 4-5
Ambient Air Quality Standards

Pollutant	Federal Primary	Federal Secondary	Washington State
TSP			
Annual geometric mean	NS	NS	60 -g/m3
24-hr average	NS	NS	150 -g/m3
PM10 (fine particulates)			
Annual arithmetic mean	50 -g/m3	50 -g/m3	50 -g/m3
24-hr average	150 -g/m3	150 -g/m3	150 -g/m3
SO2			
Annual average	0.03 ppm	NS	0.02 ppm
24-hr average	0.14 ppm	NS	0.10 ppm
3-hr average	NS	0.50 ppm	NS
1-hr average	NS	NS	0.40 ppma
CO			
8-hr average	9 ppm	9 ppm	9 ppm
1-hr average	35 ppm	35 ppm	35 ppm
Ozone			
1-hr averageb	0.12 ppm	0.12 ppm	0.12 ppm
NO2			
Annual average	0.05 ppm	0.05 ppm	0.05 ppm
Lead			
Quarterly average	1.5 -g/m3	1.5 -g/m3	1.5 -g/m3

Source: PNL 1994

a0.25 ppm not to be exceeded more than two times in any 7 consecutive days.

bNot to be exceeded more than 1 day per calendar year.

ppm = parts per million
-g/m3 = micrograms per cubic meter (1-g/m3 = 6.2 x 10-11 lb/ft3)
NS = no standard

Table 4-6
Emission Rates for Stationary Emission Sources Within the Hanford Site for 1992

Source	Operation (h/yr)	TSP (t/yr)	PM10 (t/yr)	SO2 (t/yr)	NOx (t/yr)	VOC (t/yr)	CO (t/yr)
300 Area Temp. Boiler	6,384	9	8	110	22	0	2
300 Area Boiler #3	0	0	0	0	0	0	0
300 Area Boiler #4	0	0	0	0	0	0	0
300 Area Boiler #5	0	0	0	0	0	0	0
300 Area Boiler #6	8,760	4	3	48	10	0	1
200 East Boiler	8,760	3	1	200	58	1	49
200 West Boiler	8,760	4	1	260	75	1	62
200 East, 200 West Fugitive Coal	8,760	107	54	0	0	0	0
100-N Boiler	0	0	0	0	0	0	0
100-N Boiler	0	0	0	0	0	0	0
300-Area Incinerator	0	0	0	0	0	0	0
1100-Area Boiler	0	0	0	0	0	0	0
1100-Area Boiler	0	0	0	0	0	0	0
200-E Fugitive Emissions	8,760	1	0	0	0	0	0
200-E Area Backup Boiler	0	0	0	0	0	0	0
Res. Dis. Area Temp. Boiler	8,760	9	8	120	24	0	2

Source: PNL 1994.

h/yr = hour per year
t/yr = tons per year

Table 4-7
Ambient Nitrogen Dioxide Concentrations in the Hanford Environs for 1990

Maximum Locations	Number of 24-hr Samples	Annual Average,a ppmv NO2 (%)	Samples Less Than Detection Limit, (%)b	Maximum 24 hr, ppmv
100-B	236	<0.005 . 6	32.6	0.02-1
200-West	278	<0.005 . 8	29.1	0.034
Army barracks	282	<0.006 . 6	7.8	0.018

Source: PNL 1992b

aAnnual average plus or minus (y) standard errors of the mean. Samples less than detectable daily concentrations were assumed equal to the 24-h detection limit.
bMinimum 24-hr detection limit is 0.003 ppmv.
ppmv = parts per million volume

Off-site monitoring for TSP in the vicinity of the Hanford Site was discontinued in 1991 (PNL 1994). TSP data collected in 1990 at Sunnyside and Wallula were reported in Revision 5 of the Handford Site National Environmental Policy Act (NEPA) Characterization (PNL 1992). The annual geometric means of TSP measurements at Sunnyside and Wallula for 1990 were 71 -g/m3 and 80 -g/m3 (4.4 x 10-9 lb/ft3 and 5.0 x 10-9 lb/ft3), respectively. Both of these values exceeded the Washington State annual standard, 60 -g/m3 (3.72 x 10-9 lb/ft3). The Washington State 24-hour standard, 150 -g/m3 (9.3 x 10-9 lb/ft3), was exceeded six times during the year at Sunnyside and seven times at Wallula.

The only off-site monitoring near the Hanford Site in 1992, for PM10, was conducted by Ecology (PNL 1994). PM10 was monitored at three locations: Columbia Center in Kennewick, Wallula, and the Walla Walla Fire Station (Table 4-8). During 1992, the 24-hour PM10 standard established by the State of Washington, 150 -g/m3, was exceeded twice at the Columbia Center monitoring location; the maximum 24-hour concentration at Columbia Center was 596 -g/m3; the other occurrence >150 -g/m3 was 183 -g/m3. None of the sites exceeded the annual primary standard, 50 -g/m3, during 1992.

Table 4-8
Results of PM10 Monitoring Near the Hanford Site in 1992

Location	Annual Arithmetic Mean (-g/m3)	Max. Concentration (-g/m3)	No. Occurrences >150 -g/m3
Kennewick, Columbia Center	26	596	2
Wallula	35	124	0
Walla Walla Fire Station	28	67	0

Source: PNL 1994

During the past 10 years, CO, SO2 and NO2 have been monitored periodically in communities and commercial areas southeast of the Hanford Site. These ambient urban measurements are typically used to estimate the maximum back-
ground
pollutant concentrations for the Hanford Site because of the lack of specific on-site monitoring.

Particulate concentrations can reach relatively high levels in eastern Washington State because of exceptional natural events (i.e., dust storms, volcanic eruptions, and large brushfires) that occur in the region. Washington State ambient air quality standards have not considered "rural fugitive dust" from exceptional natural events when estimating the maximum background concentrations of particulates in the area east of the Cascade Mountain crest. EPA has in the past exempted the rural fugitive dust component of background concentrations when considering per-
mit applications
and enforcement of air quality standards. However, EPA is now investigating the prospect of designating the Tri-County area (i.e., parts of Benton, Franklin, and Walla Walla counties) as a nonattainment area for fine PM10. Windblown dust has been identified as a particularly large problem in this area. A grant to Washington State University and the Agricultural Research Center has funded a study to ascertain the effects of this dust. Ecology has been working with the EPA and the local Air Quality District to control other sources of PM10, thereby potentially delaying or preventing the need for the nonattainment designation. At this time, a final decision has not been made on this issue.

4.3.2 RADIATION

Many of the activities at the Hanford Site which formerly released radiation to the environment no longer occur, since the Hanford mission has changed from production of Pu for national defense to environmental cleanup of the site. Current levels of radioactivity in environmental media within and in the vicinity of the Hanford site reflect contributions from naturally-occurring radioactivity, fallout from man-made sources (such as past weapons tests, and the Chernobyl accident), and emissions from Hanford Site facilities. Emissions sources are located in the 100, 200, 300, 400, and 600 Areas.

The 200 Areas contain facilities for nuclear fuel chemical separations, processing, waste handling and disposal, and steam and electrical power generation using fossil fuels. All of these facilities are potential sources of emissions. Major potential sources of emissions are the PUREX Plant and 242-A Evaporator in the 200 East Area, and U Plant, the PFP, T Plant, and the 222-S Analytical Laboratory in the 200 West Area. Other sources in both areas include tank farms and underground storage tanks.

The following sections describe the radiation monitoring programs at the Hanford Site and reports the results of current monitoring.

4.3.2.1 Radiation Monitoring Programs

- The following types of monitoring are performed to detect and distinguish the source of radioactivity in the environment (PNL 1995).

- Facility effluent monitoring determines the flow rate of effluents being released and when radioactivity levels might exceed specified threshold levels. This monitoring also determines gross alpha and beta activity and, when appropriate, the specific radionuclides activity. This information can be input to environmental transport models to predict concentrations of radioactive materials in environmental media.

- Near-facility monitoring is conducted in the vicinity of major potential emissions sources such as the PUREX Plant. Air, surface water and seeps, external radiation, soil, and vegetation are included in near-facility monitoring.

- Environmental monitoring is conducted at and beyond the site boundary. Air, surface water, groundwater, external radiation, soil, vegetation, wildlife, and food and farm products are included in off-site environmental monitoring. The monitoring program includes sampling locations that are remote to the Hanford Site that can be used to distinguish between radioactivity from the site and from other sources.

The areas most likely to be affected by the proposed project alternatives are within and around the 200 Areas. The near-facility monitoring program collects environmental samples from the 100, 200, and 300/400 Areas. Table 4-9 lists the sample types monitored and number of samples obtained in the 200 Areas during 1994 (PNL 1995).

Table 4-9
Near-Facility Sampling in 1992

Sample Type	Number of Samples
Air	32
Surface water and seeps	12
External radiation	58
Soil	57
Vegetation	37

90Sr, 137Cs, 239,240Pu, and U were consistently detected in samples collected in the 200 East and West Areas. Concentrations in air samples over the past 5 years show a consistent downward trend due to facility shutdowns, better effluent controls, and improved waste management practices.

Concentrations in surface water, aquatic vegetation, and sediment samples from ditches and ponds were below applicable derived concentration guidelines (DCG) values and in many cases below the limits of detection. Maximum measured values are summarized in Table 4-10.

Table 4-10
Maximum Radionuclide Concentrations for 200 Area Samples in 1994

Parameter	Concentration (pCi/L) Surface Water	Derived Concentration Guide	(pCi/g) Aquatic Vegetation	Sediment
Gross Alpha	3.3	-	-	-
Gross Beta	228	-	-	-
Tritium	1.06x105	2.0x106	-	-
90Sr	12.1	1,000	1.5	4.5
137Cs	192	3,000	2.4	7
239,240Pu	-	-	3.5	2
Ua	-	-	4.5x10-8	7.9y10-7

Source: PNL 1995 and DOE Order 5400.5, Radiation Protection of the Public and the Environment

aUranium concentration units are gram per gram (g/g).
pCi = picocurie

Radionuclide concentrations in soil and vegetation samples from the 200 East and West Areas showed trends similar to those observed for air. Concentrations of 90Sr, 137Cs, and 239,240Pu showed a consistent downward trend but were higher than those measured offsite. Radiological surveys are conducted in areas known or suspected to contain surface or subsurface contamination. Areas exceeding specified levels are posted as contamination areas, underground radioactive material areas, or soil contamination areas - depending upon the character of the contamination. In the 200 East and West Areas during 1994, 2,492 ha (6,157 acres) were posted as the result of surface contamination and 795 ha (1,964 acres) as the result of subsurface contamination. Surface and subsurface contamination areas are much larger than reported in the Draft EIS. This change reflects the inclusion of the tank farms and the use of a global positioning system to enhance accuracy.

Approximately 137 sample locations at and beyond the Hanford Site boundary were monitored during 1994 (PNL 1995). Sample types included air, spring water, Columbia River water and sediments, irrigation water, drinking water, ponds, foodstuffs, wildlife, soils, vegetation, and direct radiation. Results for springs discharging into the Columbia River and river water and sediments indicated contributions of radioactivity originating at the Hanford Site. Results for air and vegetation were generally consistent with natural sources for radioactivity and fallout but suggested a minor contribution from site emissions. For soil and foodstuffs except milk there was no difference between locations upwind and downwind of the site, suggesting no contribution from Hanford facilities. Slightly elevated levels of 129I in milk appear to be due to emissions from the site. Columbia River water and sediment, seeps and springs along the river, and irrigation water drawn from a canal fed by the river continue to show detectable levels of radioactivity that originated from the Hanford Site.

4.3.2.2 Radiation Monitoring Reporting

- Doses to members of the public for emissions from the Hanford Site are evaluated annually in two documents, the Environmental Report and the Radionuclide Air Emissions Report. The Hanford Site Environmental Report for Calendar Year 1994 (PNL 1995) evaluated the dose to the hypothetical maximally exposed off-site individual (MEOSI) and to the general population within 80 km (50 mi) of the site for air and water exposure pathways. This report is prepared to meet DOE reporting requirements and evaluates the contribution of the 100, 200, 300, and 400 Areas to off-site dose using the GENII computer code (PNL 1988a, PNL 1988b, PNL 1988c). The Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 1994 evaluated the dose to the hypothetical MEOSI using the CAP-88 computer program (EPA 1990) and to the general population within 80 km (50 mi) using the GENII computer code. This report is prepared to met EPA reporting requirements under Appendix H, 10 CFR 61.

The doses reported in these two reports for the MEOSI are summarized in Table 4-11. The air emissions and water effluents from the 200 East and West Areas accounted for most of the dose to the public as the result of Hanford operations. These doses are well below the DOE limit of 100 mrem per year for members of the general public. This DOE limit of 100 mrem per year includes all pathways, including direct exposures from DOE activities. These doses are also well below the State of Washington 10 mrem per year standard for air emissions in WAC 246-247. The two reports agree on the dose via the air pathways. The population dose for the 200 East and West Areas was 0.26 person-rem through air pathways and 0.3 person-rem through water pathways, and

Table 4-11
> Dose to Hypothetical MEOSI From Hanford Site Operations During 1994 (mrem)

		Environmental Report		Air Emissions Report
Effluent	Pathway	200 Areas	All Sources	All Sources
Air	External	2.8y10-6	1.3y10-4	-
	Inhalation	6.4x10-4	.01	-
	Foods	0.0015	0.0015	-
	Subt	0.0021	.012	0.005
Water	Recreation	2y10-4	2y10-4	-
	Foods	0.014	0.014	-
	Fish	0.017	0.017	-
	Drinking Water	0.0067	0.0067	-

Subt	0.038	0.039	-
Tota	0.04	0.051	-

Sources: PNL 1995, DOE 1995

0.33 person-rem through air pathways and 0.3 person-rem through water pathways for the entire site (PNL 1995).

4.3.3 SOUND LEVELS AND NOISE

Noise is technically defined as sound waves perceptible to the human ear. The frequency of sound waves is measured in Hertz (Hz), and the pressure that sound waves produce is measured in decibels (dBs). Humans have a perceptible hearing range of 31 to 20,000 Hz. The threshold of audibility ranges from about 60 dBs at a frequency of 31 Hz to less than about one -
dB between 900 and
8,000 Hz. For regulatory purposes, noise levels for perceptible frequencies are weighted to provide an A-weighted sound level [dB(A)] that closely correlates with individual community response to noise. Sound pres-
sure levels
outside the range of human hearing are not considered noise in a regulatory sense, even though wildlife may be able to hear these frequencies.

Noise levels are often reported as the equivalent sound level (Leq). The Leq is expressed in dB(A) over a specified period of time, usually 1 or 24 hours. The Leq expresses time-varying noise levels by integrating noise levels over time and expressing them at a steady-state continuous sound level.

The following sections characterize existing background noise information, environmental noise regulations, and Hanford Site sound levels.

4.3.3.1 Background Noise Information

- Studies at Hanford of the propagation
of noise have been concerned primarily with occupational noise at work sites. Environmental noise levels have not been extensively evaluated because of the remoteness of most Hanford activities and isolation from receptors that are covered by Federal or state statutes. This discussion focuses on the few environmental noise analyses that is available. The majority of available information consists of model predictions, which in many cases have not been verified because the predictions indicated that the potential to violate state or Federal standards is remote or unrealistic.

There are two sources of environmental noise measurements at Hanford. Environmental noise measurements were made in 1981 during site character-ization of the Skagit/Hanford Nuclear Power Plant Site (PNL 1994). The Hanford Site was considered as the site for a geologic waste repository BWIP for spent commercial nuclear fuel and other nuclear HLW. Site characterization studies performed in 1987 included measurement of background environmental noise levels at five locations on the Hanford Site. Additionally, certain activities such as well drilling and sampling can produce noise in the field apart from major permanent facilities.

Noise levels are expressed as Leq for 24 hours (Leq-24). To collect Skagit/Hanford data, preconstruction measurements of environmental noise were taken in June 1981 on the Hanford Site (PNL 1994). Fifteen sites were monitored and noise levels ranged from 30 to 60.5 dB(A). The values for isolated areas ranged from 30 to 38.8 dB(A). Measurements taken around the sites where the Washington Public Power Supply System was constructing nuclear power plants ranged from 50.6 to 64 dB(A). Measurements taken along the Columbia River near the system's intake structures (location # WNP-2) were 47.7 and 52.1 dB(A) compared to more remote river noise levels of 45.9 dB(A) measured about 5 km (3 mi) upstream from the intake structures. Community noise levels in North Richland (300 Area at Horn Rapids Road and the 240 By-Pass Highway) were 60.5 dB(A).

BWIP background noise levels were determined at five sites located within the Hanford Site. Wind was identified as the primary contributor to background noise levels, and winds exceeding 19 kmph (12 mph) significantly affected noise levels. Background noise levels in undeveloped areas at the Hanford Site can best be described as a mean Leq-24 of 24 to 36 dB(A). Periods of high wind, which normally occur in the spring, would elevate background noise levels.

In the interest of protecting Hanford Site workers and complying with

Occupational Safety and Health Administration (OSHA) standards for noise in the workplace, the Hanford Environmental Health Foundation has monitored noise levels resulting from several routine operations performed at the Hanford Site. Occupational sources of noise propagated in the field are summarized in Table 4-12. These levels are reported here because operations such as well sampling are conducted in the field away from established indus- trial areas and may disturb sensitive wildlife.

4.3.3.2 Environmental Noise Regulations

- The Noise Control Act of 1972 and subsequent amendments (Quiet Communities Act of 1978, 42 USC 4901-4918, 40 CFR 201-211) delegate the regulation of environmental noise to the state.

The State of Washington has adopted RCW 70.107, which authorizes Ecology to implement rules consistent with Federal noise control legislation. RCW 70.107 and the implementing regulations embodied in WAC 173-60 through 173-70 defined the regulation of environmental noise levels. Maximum noise levels are defined for the zoning of the area for environmental designation for noise abatement (EDNA). The Hanford Site is classified as a Class C EDNA on the basis of industrial activities. Unoccupied areas are also classified as Class C areas by default because they are neither Class A (residential) nor Class B (commercial). Maximum noise levels are established based on the EDNA classification of the receiving area and the source area.

Table 4-12
Monitored Levels of Noise From Outdoor Activities at the Hanford Site

Activity	Year Measured	Average Noise Level (dB)	Maximum Noise Level (dB)
Water wagon operation	1984	104.5	111.91
Well sampling	1987	74.8	78.2
Truck	1989	78	83
Compressor	1989	88	90
Generator	1989	93	95
Well drilling, Well 32-2	1987	98	102
Well drilling, Well 32-3	1987	105	111
Well drilling, Well 33-29	1987	89	91
Pile driver [diesel 1.5 m (5 ft) from source]	1987	118	119
Tank farm filter building 9 m (30 ft) from source	1976	86	NA

NA = not applicable

4.3.3.3 Hanford Site Sound Levels

- Most industrial facilities on the Hanford Site are located sufficiently far from the site boundary that noise levels at the boundary are not measurable or are barely distinguishable from back- ground noise levels.

4.4 ECOLOGY

The existing ecological resources in the vicinity of the 200 East and West Areas are characterized according to vegetation, wildlife, and threatened or endangered species. Each of these elements is discussed in the following sections.

4.4.1 VEGETATION

The Hanford Site is located in a semiarid region that normally supports sagebrush scrub. The site consists of large areas of undeveloped land, including abandoned agricultural areas, and widely-separated clusters of industrial buildings. The plant and animal species on the Hanford Site are representative of those inhabiting the shrub-steppe (sagebrush-grass) region of the northwestern United States. It is estimated that currently there are approximately 49,000 ha (120,000 acres) of shrub-steppe habitat on the Hanford Site (PNL 1992).

The vegetation along the corridor of the proposed RCSTS pipeline and its optional route segment is primarily a shrub-steppe community dominated by big sagebrush (Artemisia tridentata), referred to as sagebrush in this EIS, as shown in Figure 4-16. The sagebrush, cheatgrass, and Sandberg bluegrass community is the most common in this area. Substantial parts, especially inside the 200 East and West Areas, are previously disturbed and have rabbitbrush- and cheatgrass-dominated vegetation or are barren.

Figure 4-17 shows the distribution of vegetation types on the proposed NTF site in the 200 West Area. Figure 4-18 shows the distribution of vegetation types on the proposed NTF "Site E" option, just west of the 200 East Area. In both of these NTF sites, the open ground is dominated by Sandberg bluegrass (Poa sandbergii), cheatgrass (Bromus tectorum), abundant amounts of draba (Draba verna) and Carey's balsamroot (Balsamorhiza careyana).

Previously disturbed areas are vegetated mainly with non-native invasive plants. However, the dominant shrub is the native grey rabbitbrush which has invaded disturbed areas throughout the area. Newly-proposed NTF "Site D" option, which is within the 200 East Area, is located on Figure 4-19.

4.4.2 WILDLIFE

More than 300 species of insects, 39 species of mammals, and more than 36 common species of birds, and 12 species of reptiles and amphibians, have been identified on the Hanford Site (PNL 1994). All species common to the Hanford Site can be found in the vicinity of the proposed NTF site option areas and proposed RCSTS corridors.

Pocket mice (Perognathus parvus) and jackrabbits (Lepus spp.) are the primary small mammal species observed. Large mammals include deer (Odocoileus spp.) and elk (Cervus elaphus), although the elk occur almost exclusively on the Fitzner Ebherhardt Arid Lands Ecology Reserve located on Rattlesnake Mountain. Coyotes (Canis latrans) and raptors are the primary predators.

Figure (page 4-53)
Figure 4-16. Vegetation map Between 200 East and West Area

Figure (Page 4-54)
Figure 4-17. NTF Site Vegetation - 200 West Area

Figure (Page 4-55)
Figure 4-18. NTF "Site E" Vegetation - West of the 200 East Area

Figure (Page 4-56)
Figure 4-19. NTF Site "D" Vegetation - West of the 200 East Area

The most common snakes are gopher snakes (Pituophis melanoleucus), yellow-bellied racers (Coluber constrictor), and rattlesnakes (Crotalus viridis). Toads and frogs are found along the Columbia River. Grasshoppers and various species of beetles are the most conspicuous insects in the community.

The horned lark (Eremophila alpestris) and western meadowlark (Sturnella neglecta) are the most abundant nesting birds in the shrub-steppe community.

4.4.3 THREATENED OR ENDANGERED SPECIES

The areas potentially affected by the proposed actions and alternatives were examined for threatened or endangered plant and animal species. Discussion of these examinations follows.

4.4.3.1 Threatened or Endangered Plant Species

- The ecological surveys for the area between the 200 East Area and the 200 West Area indicated that there are no Federally-listed threatened or endangered plant species present, as specified by the Endangered Species Act of 1973 as amended (Brandt 1994). The ecological reviews identified the presence of stalked-pod milkvetch (Astragalus sclerocarpus), a Class 3 State of Washington monitor species. This designation indicates it is either more common or less threatened than previously believed and therefore is not a species of concern. This species is common throughout the Hanford Site. Piper's daisy (Erigeron piperianus) is a state-sensitive species and has been found near the 200 East Area.

4.4.3.2 Threatened or Endangered Animal Species

- The loggerhead shrike (Lanius ludovicianus) is classified as a Federal and state candidate species. This designation indicates the species is under review for possible listing as threatened or endangered species. Loggerhead shrikes nest in undisturbed sagebrush and bitterbrush habitats, such as those found at the 200 East and RCSTS areas. The northern sagebrush lizard (aceloporus graciosus), also a Federal candidate species) is also found in the mature sagebrush habitat. The western burrowing owl, another Federal candidate species, was not found in the project impact area.
The Washington Department of Fish and Wildlife (WDFW) has designated shrub-steppe as a Priority Habitat, which is defined as a habitat providing unique or significant value to a wide variety of wildlife and often especially for species of concern. Designating habitat as priority represents a measure to help prevent species from becoming threatened or endangered.

The sage sparrow (Amphispiza belli) is a state candidate species. Habitat requirements for the sage sparrow are sagebrush and chaparral with scattered shrubs. Their breeding range includes central Washington and they have been found to be nesting in moderate numbers in the proposed project areas.

The bald eagle (Haliaeetus leucocephalus), a Federal and state threatened species, is a regular winter resident occurring principally along the Columbia River. The peregrine falcon (Falco peregrinus), a Federal and state endangered species, is a casual migrant visitor to the area but does not nest there. The State of Washington lists the sandhill crane (Grus canadensis) as endangered, and the ferruginous hawk (Buteo regalis), noted for nesting on area power poles, as threatened. There are several species of animals that are under consideration for listing.

Two Ecological Resource Reviews have been completed by PNL (Brandt, 1994). These reviews indicated a nesting presence of the loggerhead shrike, Federal Candidate 2 Species, and the sage sparrow, a state candidate species. The nesting presence would result in a restriction on clearing and grubbing activities during the nesting season (March 1 to July 1). Construction schedules would be adjusted as required to meet this restriction. No other restrictions resulted from the Ecological Resource Review conducted by PNL.

Other than the loggerhead shrike, sagebrush lizard, and sage sparrow which are candidates for listing as endangered or threatened, no animal species registered as threatened or endangered are known to depend on the habitats in the immediate vicinity of the proposed RCSTS site, or its alternate location. However, the ferruginous hawk and other raptors may forage for prey species in some of these habitats.

4.5 POPULATION AND SOCIOECONOMICS

The Hanford Site directly and indirectly influences the socioeconomic characteristics in Benton and Franklin Counties, in the state, and in particular, the Tri-Cities area (see Figure 4-20). The Tri-Cities area consists of Pasco in Franklin County and Richland and Kennewick in Benton County.

Employee residence records as of December 1993 indicate 84 percent of all Hanford site employees reside in Benton County, 7 percent reside in Franklin county, and 80 percent reside in the Tri-Cities. Most of the remaining 9 percent of the Hanford workforce reside in Yakima County, Grant County, Adams County, or Walla Walla County, but do not constitute a large proportion of the workforce in those counties. Consequently, alternatives considered in this EIS are expected to have only a slight impact on the socioeconomic characteristics of other surrounding counties. Although major project activities at the Hanford Site can have socioeconomic impacts in neighboring counties and major cities in the region, Benton and Franklin counties will receive most of the employment effects. The region of socioeconomic influence for actions considered in this EIS is shown in Figure 4-21.

The local area around the Hanford Site and the Tri-Cities in particular is described in detail in the Draft Environmental Impact Statement for the Siting, Construction, and Operation of New Production Reactor Capacity (DOE 1991) and in the Tri-Cities Profile (State of Washington 1992).

These sources provide more information on socioeconomic characteristics. The following sections summarize information from these sources, including:

- Local Economy, Employment, and Income
- Population Characteristics
- Housing
- Local Infrastructure.

Figure (Page 4-60)
Figure 4-20 Urban Areas with Population Greater than 1,000 Persons Within Commuting Range of the Proposed Project Site

Figure (Page 4-61)
Figure 4-21 Socioeconomic Region of Influence for Hanford Site

4.5.1 LOCAL ECONOMY, EMPLOYMENT, AND INCOME

The following economic sectors have been the principal driving forces of the economy in the Tri-Cities since the early 1970s:

- The DOE and its contractors that operate the Hanford Site.
- Washington Public Power Supply System in its construction and operation of nuclear power plants.
- Agriculture, including a substantial food-processing industry. With the exception of a minor amount of agricultural commodities sold to local area consumers, the goods and services produced by these sectors are exported from the Tri-Cities.

In addition to providing employment and payrolls directly, these major sectors of the local economy support many secondary jobs through purchase of equipment, supplies, and services.

Employment by the DOE, DOE contractors, the Washington Public Power Supply System, and Seimens Nuclear Power Corporation, another major employer, provided 17,594 jobs with an annual payroll of $771 million in the second quarter of 1991 (State of Washington 1992). While these jobs reflect approximately 27 percent of the total number of jobs in the communities, the income reflects nearly 42 percent of all payroll dollars. Current reductions in Federal spending are resulting in a decline in direct Hanford Site employment.

Employment by the food processors, farms, and related agricultural services in the Tri-Cities area provided approximately 12,900 jobs, with a total payroll of $160 million in 1990 (State of Washington 1992). The employment by economic sector in the Tri-Cities area for 1991 is shown in Table 4-13. The delineation of Hanford Site employment by city and outlying areas of Benton and Franklin Counties is shown in Table 4-14.

Table 4-13
Industry Employment Distribution in the Tri-Cities Area

Economic Sector	Number of Employees
Mining Construction	3,800
Manufacturing	5,500
Transportation and Public Utilities	2,400
Trade	13,600
Finance, Insurance, and Real Estate	1,800
Services	25,700
Government including DOE and contractors	11,500
Total	64,300

Source: State of Washington 1992

Table 4-14

Hanford Site Employment by City

Location	Percent
Kennewick	30
Pasco	9
Richland	>42
Other Areas in Benton and Franklin	12

Source: Stucky 1994

Studies performed by PNL in 1987 and 1989 suggest that for each Hanford Site job, 1.2 additional indirect jobs are created in Benton and Franklin Counties. Total personal income, per capita income, and median income for the Benton and Franklin counties are presented in Table 4-15.

Total personal income includes all forms of income, such as wages and dividends. Per capita income reflects total personal income divided by the population of the area. Median income reflects the point at which half of the households have an income greater than the median.

Table 4-15
Income in Benton and Franklin Counties

County	Total Personal Income ($ Million)	Per Capita Income ($)	Median Income ($)
Benton	2,097	18,038	35,000
Franklin	607	15,477	27,075

Source: Laamb 1994

Per capita income in 1991 for the cities of Kennewick, Pasco, and Richland is $17,392, according to information supplied by TRIDEC (State of Washington 1992). The average household income in 1992 for the Tri-Cities was $35,792 for Kennewick, $25,364 for Pasco, and $47,691 for Richland (State of Washington, 1992).

4.5.2 POPULATION CHARACTERISTICS

Population growth for the Tri-Cities and Benton and Franklin Counties since 1940 is directly related to activities at the Hanford Site. The local economy is dependent on employment at the Hanford Site. Projections show continued growth for the two counties dependent upon a stable employment base at the Hanford Site. Recent changes in Federal funding and DOE budget cuts are likely to impact projected growth trends. In 1995, the workforce at Hanford Site is expected to be cut by nearly 5,000 jobs.

Executive Order (E.O.) 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" requires Federal agencies to identify and address environmental effects of their projects on minority and low-income populations. The approach in this EIS identifies areas of minority and low-income populations and assesses potential effects from project-related activities in Section 5. The composition and distribution of minority and low-income populations are discussed in Appendix C, "Environmental Justice Evaluation."

4.5.3 HOUSING

Benton and Franklin Counties experienced an increase in housing demand between 1992 and 1993. Home sales in the first half of 1993 were 4.6 percent higher than in the first half of 1992. Housing prices increased by 22 percent between the second quarter of 1992 and the second quarter of 1993 (TRIDEC 1993).

The average price of single-family homes sold in the second quarter of 1993 was $109,000. However, in July, 1993, 38 percent of homes sold for $80,000 or less, indicating an increase in moderately priced single-family homes. Permits for construction of homes grew in Kennewick by 30 percent and in Richland by 50 percent between 1992 and 1993.

Rental properties for the Tri-Cities between June 1992 and June 1993, according to TRIDEC, had a low vacancy rate and high rental rate. Richland's vacancy is the highest at 3 percent during this period.

The high demand for housing units of all kinds was reflected in the census data collected by the State of Washington for 1990 and shown in Table 4-16. However, the demand for housing has been eased by the ongoing reduction in workforce by DOE at the Hanford Site.

Table 4-16
Total Units and Occupancy Rates (1993 Estimates)

	Richland	Pasco	Kennewick	Tri-Cities Average
All Units	14,388	7,846	18,110	13,448
Occupancy Rate (%)	96	92	95	94
Single Units	9,921	3,679	9,824	7,808
Occupancy Rate (%)	98	96	97	97
Multiple Units	3,827	2,982	5,944	4,251
Occupancy Rate (%)	95	91	96	94
Mobile Homes	640	1,239	2,342	1,407
Occupancy Rate (%)	88	86	97	90

Source: PNL 1994, Office of Financial Management 1993.

4.5.4 LOCAL INFRASTRUCTURE

Local infrastructure relevant to the affected environment are characterized in the following sections:

- Local Taxes
- Emergency Services
- Medical Services
- Education.

4.5.4.1 Local Taxes

- The regional tax base has continued to grow with the increase in employment and population. Taxable sales have contributed to the tax base and assessed property values. Between the first quarter of 1992 and the first quarter of 1993, taxable retail sales increased by more than 7 percent in Franklin and Benton Counties combined. Kennewick and Richland both increased taxable retail sales 11 percent in the same reporting period (TRIDEC 1993). Although taxable retail sales increased more between 1991 and 1992 (14.5 percent for the two-county area), the slower growth is probably due to seasonal decline in sales during the first quarter.

4.5.4.2 Emergency Services

- Benton County has 40 commissioned officers and sheriffs, six fire districts, and three hospitals. Franklin County has 18 commissioned officers and one sheriff, four fire districts, and one hospital.

4.5.4.3 Medical Services

- The Tri-Cities area is served by three hospitals: Kadlec Medical Center, Kennewick General Hospital, and Our Lady of Lourdes Health Center. Kadlec Medical Center, located in Richland, has 144 beds and functions at 43.6 percent capacity. Their 5,188 annual admissions represent more than 38 percent of the Tri-Cities market. Non-Medicare/Medicaid patients accounted for 56.4 percent, or 2,926 of their annual admissions. An average stay of 4.4 days per admission was reported for 1991.

Kennewick General Hospital maintains a 45.5 percent occupancy rate in its 70 beds with 4,585 annual admissions. Non-Medicare/Medicaid patients in 1993 represented 52 percent of its total admissions. An average stay of 3.2 days per admission was reported.

Our Lady of Lourdes Health Center, located in Pasco, reported an occupancy rate of 36.5 percent; however, outpatient income serves as a primary source of income for the center. In 1993, Our Lady of Lourdes had 3,803 admissions, of which 52 percent were non-Medicare/Medicaid patients. The institution reported an average admission stay of 6 days.

4.5.4.4 Education

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- Primary and Secondary - Primary and secondary education are served by the Richland, Kennewick, Pasco, and Kiona-Benton School districts. The combined 1993 spring enrollment for all districts was approximately 29,777 students, an increase of 4.6 percent from the 1992 total of 28,397 students. The 1993 total includes approximately 13,001 students from the Kennewick School district, about 8,212 and 7,094 students, respectively, in the Richland and Pasco School districts, and 1,470 from Kiona-Benton. In 1993, all four school districts were operating at or near their capacity.
- Post-Secondary - Post-secondary education in the Tri-Cities area is provided by a junior college, Columbia Basin College (CBC), and the Tri-Cities branch campus of Washington State University (WSU-TC). The WSU-TC offers a variety of upper-division, undergraduate, and graduate degree programs. The 1993 fall enrollment was approximately 6,295 at CBC and 1,117 at WSU-TC. WSU-TC is operating almost at capacity, and plans are underway for an additional building. Many of the programs offered by these two institutions are geared toward the vocational and technical needs of the area. Currently, 26 associate degree programs are available at CBC and 14 graduate programs are available at WSU-TC.

4.6 TRANSPORTATION

This section discusses transportation to the Hanford Site provided by highways, air, water, railroad, and other transportation facilities. However, the most-used mode of transportation is the local highway system. Section 4.6.1 focuses on vehicular traffic and circulation. Barge transport and rail transport are other transportation facilities considered in Section 4.6.2. Section 4.6.3 briefly discusses the regulations and policies governing on-site radioactive waste shipments, and summarizes the safety history for on-site truck and rail transport of radioactive waste.

4.6.1 VEHICULAR TRAFFIC AND CIRCULATION

To evaluate existing conditions, documents and traffic data for national and state roadway systems and the Hanford Site roadways were reviewed. Descriptions of these reviews are presented in the following sections:

- National and State Roadway Systems
- Hanford Site Roadways

4.6.1.1 National and State Roadway Systems

- Regional access to the project site is provided by a number of national and state highway systems shown in Figure 4-22. The major route adjacent to the Hanford Site is Interstate 82, a national highway which links the Cities of Yakima and Richland. Interstate 82 is a four-lane divided highway which provides two lanes of traffic travelling in each direction.

Other regional transportation facilities which provide access to the Hanford Site include State Highways 24 and 240. State Highway 24 is an east-west highway which extends from Yakima to its connection at State Highway 240, and is two lanes wide in the project area. State Highway 240 is a north-south highway which extends from Richland to its connection with State Highways 24 and 243, and also is two lanes wide.

4.6.1.2 Hanford Site Roadways

- Roadways within the Hanford Site which provide local service to the 200 Acres include Route 4 (formerly Route 4-South), Route 10, Route 2-South, Route 11A, Route 5 (formerly Route 4-North and South), and the State Route 240 access road which opened in December 1994.

As identified on Figure 4-23, Route 4 is a principal arterial within the

Hanford Site providing entrances and exits on State Highway 240. It has two travel lanes in either direction south of the Wye Barricade and one lane in either direction north of the Wye Barricade. Route 4 carries most of the traffic from the City of Richland to the 200 East Area. Traffic volumes during shift changes at the Hanford Site create traffic congestion and a safety problem onsite. Traffic flow has improved since the 3.5 km (2.2 mi) State Route 240 access road was opened.

Figure (Page 4-69)
Figure 4-22. Regional Transportation System

Figure (Page 4-70)
Figure 4-23. hanford Site Roadway System

Between its intersection with State Highway 240 and south of the Wye Barricade, Route 4 has an estimated 17,000 vehicles per day (WHC 1992c). Traffic volumes for Route 4 north of the Wye Barricade, between Army Loop Road and Baltimore Avenue, are estimated at 8,000 vehicles per day (WHC 1992c). The number of vehicles per day is expected to decrease as a result of a reduction in the on-site workforce.

According to a recent traffic study, (Trost 1995) the peak hour occurs between 6:15 am and 7:15 am with a traffic volume of approximately 1,700 vehicles. According to on-site employees, based on the average daily traffic on Route 4 between the Wye Barricade and Baltimore Avenue, Route 4 is currently operating at Level of Service (LOS) "D". LOS is a qualitative measure of a roadway's ability to accommodate vehicular traffic. LOSs range from "A" to "F", with "A" presenting excellent (free-flow) conditions and "F" representing extreme congestion. LOS "D" or better is considered satisfactory (Trost 1995).

Based on the high volume of vehicles on Route 4 and the associated passenger car accident risk, a mandate has been implemented to reduce traffic on Route 4 by 1,000 vehicles per day. To meet the requirement, administrative traffic control measures have been instituted, such as providing alternative access routes and ridesharing. Based on recent traffic counts, the mandatory measures have been effective in reducing the amount of time that Route 4 is operating at LOS "D".

Route 10 provides access to State Highway 240 at its southern terminus and Route 4 at its northern terminus. Route 10 is classified as a north-south minor arterial within the Hanford Site, with one travel lane in either direction. Traffic counts for Route 10 taken at its connection with State Highway 240 reveal a daily traffic of approximately 2,200 vehicles. Traffic counts for Route 10 between the Wye Barricade and the 300 Area indicate a traffic volume of approximately 1,700, signifying that a large portion of the traffic on Route 10 is destined for the 300 and 400 Areas. The peak traffic hours for Route 10 are unknown. According to on-site employees and based on the average daily traffic on Route 10 between the Wye Barricade and State Highway 240, Route 10 is currently operating at LOS "B".

Route 2S and Route 11A are classified as minor arterials and provide secondary access to the 200 Areas. Route 2S becomes Route 11A west of Route 2N. Route 2S and Route 11A both provide four travel lanes, two in either direction. Between its intersection with Route 11A and north of the Wye Barricade, Route 2S has an estimated traffic volume of 970 vehicles per day (WHC 1992c). Traffic volumes for Route 11A west of Route 2N are estimated to be approximately 147 vehicles per day (WHC 1992c). According to the Trost study, the peak hour occurs between 6:15 am and 7:15 am, with a traffic volume of approximately 500 vehicles. Route 2S and Route 11A have been the subject of voluntary administrative traffic controls which offer ridership incentives to those who use Route 2S/11A to access the 200 Areas. This control was implemented to reduce traffic volumes on Route 4. According to subsequent traffic counts, traffic has increased on the Route 2S/11A roadway, which suggests that the voluntary traffic controls are reducing traffic volumes on Route 4. According to on-site employees, Route 2S/11A is currently operating at an acceptable LOS.

Route 5 is classified as a collector arterial, providing access to the 100 Area and 200 East Area at its north and south terminals, respectively. The roadway has two travel lanes, one in either direction. Between Route 1 and Route 11A, Route 5 has an average daily traffic volume of approximately 1,000 vehicles. According to on-site employees and based on average daily traffic on Route 5 between Route 1 and Route 11A, Route 5 is currently operating at LOS "A".

Construction of State Route 240 access road was completed in December 1994. This access road connects State Highway 240 to Beloit Avenue in the 200 West Area while implementing a set of administrative traffic control measures to redirect traffic to alternate routes. The access road consists of a two-lane blacktop road capable of handling light traffic at the legal speed limit. The access road is designed to meet the state's roadway standards except for a

9,072-kg (10-ton) weight restriction. The access road and the proposed administrative traffic control measures are reducing Route 4 traffic volume by the approximately 1,000 vehicles per day needed to attain safe traffic circulation (Trost 1994).

Route 3 is a two-lane paved roadway approximately 4.8 km (3 mi) long, connecting the 200 East and West Areas. Route 3 accommodates approximately 1,500 vehicles per day while operating at a LOS "C" or "B" during peak and non-peak hours, respectively.

For alternative access to the Hanford Site, the Ben Franklin line, a public transit line under DOE contract, provides bus service south of the Wye Barricade. This service route connects the Hanford Site with the City of Richland. Park-and-Ride lots are provided in the 1100 Area for employees commuting from the Cities of Kennewick and Pasco.

4.6.2 OTHER TRANSPORTATION FACILITIES

The Hanford Site is located adjacent to the Columbia River. The Port of Benton is the port-of-call for all vessel traffic to the Hanford Site. Port terminals are also provided in the Cities of Kennewick and Pasco. The Port of Benton does not place restrictions on the type of vessels entering the port, although the access to the port is limited by water depths. Vessel traffic at Port Benton is about 15 to 20 vessels per year (Keller 1994).

The railroad system on the Hanford Site consists of approximately 204 km (127 mi) of track. The system begins at the Richland Junction (Columbia Center) where it joins the Union Pacific commercial track and runs to the abandoned Chicago, Milwaukee, St. Paul, and Pacific right of way near the Vernita Bridge located on the north boundary of the Hanford Site. Figure 4-24 illustrates the layout of the Hanford Site rail transportation system.

Approximately 139 km (86 mi) of the rail system are considered "in service" to active facilities across the site. There are roughly 64 km (40 mi) of track that are in standby or out-of-service condition. This track serves areas or facilities having no current rail shipping activity. The standby track receives are not maintained, but could be restored if needed for decontamination and decommissioning, environmental restoration, or future programs that may require rail service. Project funding for restoration of standby track would be the responsibility of the requesting program office.

Figure (Page 4-74)
Figure 4-24. Hanford Site Rail Transportation System

The in-service track accommodates approximately 1,400 movements of 500 commercial rail cars annually to provide essential materials to site-wide facilities. The wide variety of materials transported by rail on the Hanford Site ranges from fuels (such as oil and coal) to hazardous and toxic process chemicals, and includes transport of radioactive materials and equipment. The nature of these materials demands that these shipments be accomplished in a safe manner.

4.6.3 RADIOACTIVE WASTE TRANSPORTATION AT THE HANFORD SITE

This section discusses transport and radioactive waste by truck and by rail.

Regulations for the safe transportation of radioactive materials are designed to protect workers and the general public from the potential consequences of loss or dispersal of radioactive materials during transit as well as from routine (non-accident) radiation doses. These regulations ensure safety by establishing standards for packaging, handling, and routing of shipments (DOE 1987, Appendix L). Off-site shipment of radioactive materials is primarily governed by the DOT and the NRC.

On-site shipment of radioactive and hazardous materials at the Hanford Site is controlled by DOE Orders, DOE-RL documents, and DOE contractor policies developed to ensure compliance with federal agency requirements. The DOE-RL requires that on-site packaging and shipping of hazardous materials be conducted in accordance with DOT regulations. If compliance is not technically or economically practicable, packing and shipping must be accomplished with an equivalent degree of safety. Since the Hanford Site is a controlled environment, the equivalent safety concept allows DOE the flexibility to exercise acceptable technical or economic alternatives for selected on-site transportation activities without compromising safety (WHC 1993a).

4.6.3.1 Radioactive Waste Shipment by Truck

- Radioactive waste shipments occur routinely at the Hanford Site. Truck accident data since 1983 indicates that there have been no accidents involving radioactive waste (Green 1995, WHC 1993b). However, of approximately 42 million km (26 million mi) driven by truck since 1983, there were 114 truck accidents involving other types of cargo (Wilson 1992). Depending on the radioactive waste being transported (i.e. type, quantity, and activity of the material), varying degrees of packaging requirements and administrative controls are placed on the shipment. Examples of administrative controls for truck shipments are:

- Speed restrictions
- Required escorts
- Shipping during off-peak hours
- Restricting/prohibiting shipments during icy conditions.

A detailed discussion of truck packaging, speed limits, and accident probabilities for truck transport is presented in Appendix F.

4.6.3.2 Radioactive Waste Shipment by Rail

- The Hanford Site has transported radioactive waste by rail without incident for many years. Typically, on-site track and equipment are maintained to higher standards than commercial equipment. The assembly of the track is a higher standard than normally used on commercial track of equal class. The result is a more stable track with a lower likelihood of derailments caused by track failure. While train wheels have slipped off the tracks several times, no train has tipped over or been in danger of tipping over.

Site procedures do not allow trains to operate in a conflicting manner on the Hanford Site tracks. Therefore, a collisions between two trains is impossible. Collisions between a train and a road vehicle are highly unlikely because waste is shipped normally during off-peak vehicle usage hours when there is little traffic, and rail crossings along the train route are barricaded.

Factors that promote safe rail transport at the Hanford Site include:

- During normal travel, approaching grade crossings, and on facility rail spurs, speeds are lower than commercial limits for the same class of track.

- Track inspections that occur no more than 8 hours before a radioactive waste shipment

- Assignment of one crew member to watch the cars constantly for abnormalities

- Prohibiting rail shipments during conditions of low visibility such as fog or darkness

- On-site train lengths shorter than commercial trains (seven cars compared to 60 cars) which reduces the amount of rolling mass and subsequently allows the train to stop in a shorter distance.

These factors plus others help ensure safe transport of radioactive materials within the Hanford Boundary. A detailed discussion of rail shipping containers, speed limits, and accident probabilities is in Appendix F.

4.7 LAND USE

This section discusses current and potential future land uses in the vicinity of the Hanford Site. This includes the 200 East and West Areas of the Central Plateau and the area immediately adjacent to the proposed RCSTS.

A discussion of land-use policies and plans that may affect the siting and construction of the proposed project alternatives are presented in Section 4.7.1. Section 4.7.2 discusses land use patterns in the vicinity of the 200 Areas and the portion of the 600 Area between the 200 East and West Areas. Section 4.7.3 discusses the aesthetic and visual resources in the affected environment.

4.7.1 LAND USE POLICIES AND PLANS

The entire Hanford Site is a Federally controlled area and is not subject to state and local land use regulations such as zoning and planning. Consequently, there are no relevant state and local land use plans and policies that apply to this site. However, there are several DOE orders, the Hanford Site Development Plan (HSDP), and the Hanford Future Site Uses Working Group Report that pertain to the proposed project area and are implemented by DOE in land use guidance decisions. These orders are being consolidated in support of the Secretary of Energy's land use initiative, Land and Facility Use Policy (O'Leary 1994). The following orders and documents are in use and will be incorporated into the new Land and Facility Use Policy in the future.

- DOE Order 4320.1B - This order establishes policies and assigns responsibilities for the planning and development of DOE sites. It requires a draft site development plan and outlines the planning process and the elements to be included. The plans are updated annually.

- DOE Order 6430.1A - Division 2 of this order specifies the conditions and requirements to be considered during site selection, including civil engineering factors.

- Hanford Site Development Plan - The HSDP provides an overview of land use, infrastructure, and facility requirements to support DOE programs and an existing and future land use plan for the Hanford Site. It was written and is updated annually in accordance with DOE Order 4320.1B. It states that for planning purposes, the 200 East and West Areas are to be used exclusively for the collection of site waste materials and associated facilities.

  The HSDP contains a master plan which outlines the relationship of the land and infrastructure needed by Hanford Site missions. The master plan includes the following guidelines for land development:

  - Minimize the disturbance of clean land

  - Consolidate support activities to improve productivity and maximize flexibility

  - Develop the site in accordance with applicable environmental, cultural, safety, and health requirements.

- Hanford Future Site Uses Working Group Report (FSUWG 1992) - The Hanford Future Site Uses Working Group was organized by DOE to help make recommendations on required clean-up levels under the Hanford Remedial Action (HRA) EIS. The group consisted of Federal, tribal, state, and local governments with interests in the Hanford Site. The Working Group was charged with identifying and articulating a vision for the future use of the Hanford Site, discussing the implications, and agreeing on clean-up issues. As part of the final report, the Working Group made recommendations for future uses of the 200 Areas.

  The Working Group recommended concentrating waste from the Hanford Site into the 200 Areas and the portion of the 600 Area on the 200 Area Plateau and transporting wastes across the Hanford Site to the 200 Areas. This would help minimize the amount of land devoted to or contaminated by waste management activities. The Working Group further recommended that waste and contaminants within the 200 Areas be treated and managed to prevent off-site migration.

  The Working Group also developed six future use options for the Central Plateau, which includes the 200 Areas. The options include a goal "...that the overall clean-up criteria for the Central Plateau should enable general usage of the land and groundwater for other than waste management activities in the horizon of 100 years from the decommissioning of waste management facilities and closure of waste disposal facilities." The options differentiate between types of waste and different types of waste management or commercial activities. They are further distinguished by three major criteria: type of waste, methods of treatment or disposal, and length of time for storage. The options range from the fulfillment of existing obligations for disposal or storage of Hanford on-site waste to allowing for the addition of the storage, treatment or disposal of off-site DOE and commercial waste.

4.7.2 LAND USE PATTERNS

The 200 East and West Areas, which cover about 26 km2 (10 mi2), are located on the Central Plateau with the 600 Area between and adjacent to them. The 200 East and West Areas are approximately 8 and 14.5 km (5 and 9 mi), respectively, from the Columbia River. For approximately 50 years, these areas were exclusively used for fuel reprocessing, waste processing,

management, and disposal. The present use of the 200 East and West Areas includes the storage of high-level radioactive wastes in underground tanks.

The existing structures at the 200 East Area consist of tank farms, the PUREX Plant, the B Plant, and various buildings shown in Figure 4-25. At the 200 West Area, the existing facilities consist of tank farms, the PFP, T-Plant, and other structures shown in Figure 4-26. The portion of the 600 Area between the 200 East and West Areas is undeveloped open space.

4.7.3 AESTHETICS AND VISUAL RESOURCES

Visual resources reflect the importance to a landscape's aesthetic qualities and its sensitivity to change. To describe the visual resource values associated with the Hanford Site and the 200 East and West Areas, the following factors are considered:

. Landscape character
. Potential viewing areas.

Each factor is discussed in the following sections.

4.7.3.1 Landscape Character

- The Hanford Site is located within the semiarid Pasco Basin of the Columbia Plateau province in southeastern Washington State. The landscape setting within the Hanford Site region is characterized by broad basins and plateaus interspersed with ridges, providing for wide and open vistas throughout much of the area.

Major landscape features include the Columbia River which flows through the northern part of the Hanford Site, and turns south to form part of the eastern boundary of the site. North of the Columbia River, the Saddle Mountains border the northernmost part of the site. The Yakima River is located along a small portion of the southern boundary and joins the Columbia River below the city of Richland, on the Site's southeast border. Rattlesnake Mountain and Cold Creek Valley are dominant features in the southwestern portion of the Site, and the Yakima and the Umtanum ridges form the western boundary. Two small east-west ridges, Gable Butte and Gable Mountain, rise above the plateau

Figure (Page 4-81)
Figure 4-25. 200 East Developed Areas and Existing Structure

Figure (Page 4-82)
Figure 4-26. 200 West Developed Areas and Existing Structures

of the central portion of the Hanford Site (see Figure 4-3). Adjoining lands to the west, north, and east are principally range and agricultural land.

The 200 and 600 Areas in the central portion of the Hanford Site are on a large open plateau which varies in elevation from 190 to 244 m (623 to 800 ft) and is characterized by flat terrain (less than 10 percent slope) with ephemeral drainage patterns. Vegetation types within this area are limited to sagebrush and bluegrass-cheatgrass. Dominant adjacent natural features include Gable Butte and Gable Mountain to the north and Rattlesnake Mountain to the south.

Only about 6 percent of the Hanford Site surface area has been disturbed and used for the production of nuclear materials, waste storage and waste disposal. The remainder of the area is undeveloped, including natural areas and abandoned agricultural lands that remain undisturbed due to restricted public access (PNL 1994). Past activities within the general vicinity of these locations have greatly modified the natural visual character of the landscape, resulting in an industrial setting at both the 200 East and West Areas. The 200 Areas contain numerous and scattered large-, moderate- and small-scale facilities used for waste storage and disposal. This includes an extensive infrastructure network of roads, major electrical transmission lines, railroads, and pipelines.

4.7.3.2 Potential Viewing Areas

- In general, areas with potential views to a project shown in Figure 4-27 include residential areas and communities, major travel routes, and recreation or special areas. The appearance of features seen in the landscape varies with viewing distance and project type. Views are generally divided into four distance zones:

- Foreground; within 1 km (0.5 mi)
- Middleground; from 1 km (0.5 mi) to a range of 5 to 8 km (3 to 5 mi)
- Background; from 5 to 8 km (3 to 5 mi) to 25 km (15 mi)
- Seldom-seen areas; either beyond 25 km (15 mi) or generally unseen due to the topography.

Figure (Page 4-84)
Figure 4-27. Potential Viewing Areas

Due to size of the Hanford Site and lack of public access, views are limited and will be distant and within the context of the existing modified setting in the 200 East and West Areas. There are no foreground views of the project, or nearby residential areas. The Tri-Cities, located southeast of the Hanford Site, constitute the nearest population centers (PNL 1994). The nearest city, Richland, is located approximately 27 km (17 mi) southeast of the 200 East Area.

Views from major travel routes include State Highways 240 and 24. Visibility from this highway ranges from middle to background views of the 200 West Area and background views of the 200 East area. Both areas are also within background view of State Highway 24. Other secondary public access roads with background views include Stevens Road and County Road 4, located approximately 13 km (8 mi) southeast of the 200 East Area.

Potential viewing areas include recreational sites and areas such as the Columbia River, and dispersed recreational use areas along the Wahluke Slope in the northern portion of the Hanford Site. Current recreation use on the river does not allow for overnight camping, and views from the river are restricted due to terrain. This portion of the Columbia River running through the Hanford Site is being considered for resource protection including Wild and Scenic Rivers Act. Dispersed recreational uses along the Wahluke Slope are concentrated primarily in the Wahluke State Wildlife Recreation Area. This area is open to limited day access and would have background views to the 200 East and West Areas from the White Bluffs along the northeastern edge of the Columbia River.

Other potentially key viewing areas include the Fitzner Eberhardt Arid Lands Ecology Reserve, located within the southwestern portion of the Hanford Site. This area is used intermittently for dispersed natural resource investigations, and users would have background views to both 200 East and West Areas.

Residential areas with potential views include West Richland, dispersed residences east of the Columbia River, and the northern portion of Richland. These views will vary from background to seldom-seen.

4.8 CULTURAL RESOURCES

This section discusses the cultural resources at the Hanford Site. Numerous Federal laws and regulations, including the National Historic Preservation Act (NHPA), protect and provide for the management of cultural resources.

The Hanford Site contains a rich diversity of known cultural resources including historic, archaeological, and Native American concerns which are discussed in Section 4.8.1, 4.8.2, and 4.8.3, respectively. These resources are representative of the prehistoric, historic, and modern eras.

As a result of the Hanford Site being closed to the public for over 50 years, cultural resource sites there have been more protected than other sites in the mid-Columbia basin. The restricted access has minimized looting and vandalism of cultural sites. The overall condition, and thus potential significance, of the cultural resources occurring within the Hanford Site is high. Another contributing factor to the quality of the Hanford Site's cultural resources is that other, similar localities along the Columbia River have experienced hydroelectric and agricultural development which usually destroys cultural resources. The Hanford Site has not experienced this type of development.

These conditions have resulted in the Hanford Site containing some of the most important archaeological sites in the region. Many of these sites, either individually or collectively, are listed on the National Register of Historic Places (NRHP). In addition, many other historic structures currently not on the NRHP are potentially eligible to be listed due to their relation to the

Manhattan Project, the Cold War, and other eras of historical importance. In addition to these prehistoric and historic resources, the Hanford Site contains natural resources and sacred sites important to the present cultures of regional Native American tribes.

4.8.1 HISTORICAL RESOURCES

Historic structures occur within both the 200 East and West Areas. No historic structures occur within the affected areas of the proposed project alternatives.

4.8.2 ARCHAEOLOGICAL RESOURCES

The locations of the affected areas of the proposed alternatives have been previously subjected to archaeological reviews by PNL cultural resource staff. These surveys, which include comprehensive literature and records searches as well as field inventories where necessary, have been conducted either for this or other projects on the Hanford Site. The studies conducted to date reveal that many of the areas affected by the proposed project alternatives have been extensively disturbed by previous Hanford Site activities and conclude that no known archaeological resources exist within the project alternative areas. (Crist 1993, Crist 1994, McIntire 1993, Minthorn 1990, Cadoret 1995).

A large area of 530 ha (1,300 acres) has been identified for potential habitat restoration to mitigate habitat loss from the preferred or new storage alternatives. This area has also been surveyed and two potentially significant cultural resource sites have been located within the area (Nickens 1995). Consultation with tribes and the State Historic Preservation Officer (SHPO) is underway to verify the significance of these sites and assure that these sites would not be disturbed during revegetation activities.

4.8.3 NATIVE AMERICAN CONCERNS

Natural features within the Hanford Site outside the 200 East and West Areas are considered sacred by members of the Wanapum People, Yakama Indian Nation, the Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce Tribe. These features include Rattlesnake Mountain, Gable Mountain, Gable Butte, Goose Egg Hill, and many sites along the Columbia River. The tribes have expressed a desire that cleanup be completed so that general use of the land and groundwater within the 200 East and West Areas be available within 100 years of site closure. During consultation with representatives of the Yakama Indian Nation, the tribes expressed their preference that all ground-disturbing activities should be confined to previously disturbed areas.

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5 ENVIRONMENTAL IMPACTS

The implementation of the alternatives described in Section 3 would have impact on the environment. This section analyzes the impacts that each alternative would have on workers, the public, and the environment. The environmental impact analyses focus on the alternatives identified in this EIS and are addressed in the following sections:

- 5.1 Anticipated Impacts of the Preferred Alternative
- 5.2 Anticipated Impacts of the Truck Transfer Alternative
- 5.3 Anticipated Impacts of the Rail Transfer Alternative
- 5.4 Anticipated Impacts of the New Storage Alternative
- 5.5 Anticipated Impacts of the No Action Alternative.

In addition to these subsections, Section 5.6 discusses unavoidable adverse impacts to the environment. Section 5.7 evaluates the relationship between short-term and long-term uses of the affected environment. Section 5.8 discusses the irreversible and irretrievable commitment of resources. Section 5.9 compares and contrasts the environmental impacts of all alternatives.

The environmental impacts of each alternative are identified and evaluated in the following subsections.

- Geology, Seismology, and Soils
- Water Resources and Hydrology
- Physical Environment
- Biological and Ecological Resources
- Population and Socioeconomic
- Transportation
- Land Use
- Cultural Resources
- Anticipated Health Effects Under Normal Conditions
- Health Effects Under Accident Conditions
- Potential Mitigation Measures.

5.1 ANTICIPATED IMPACTS OF THE PREFERRED ALTERNATIVE

The analysis of the environmental impacts of the preferred alternative considers:

- The construction and operation of the RCSTS to replace the ECSTS;
- Retrieval of Tank 102-SY using one of two retrieval systems;
- Use of existing storage capacity in DSTs to manage wastes, and;
- Continued operations of the mixer pump in Tank 101-SY to mitigate hydrogen generation.

The primary components of the RCSTS, the retrieval systems, and mixer pump operations in Tank 101-SY are described in detail in Section 3.1.

5.1.1 GEOLOGY, SEISMOLOGY, AND SOILS

This section discusses the impact the preferred alterative would have on geologic resources, seismology, and soils. Construction under the preferred alternative would modify the existing terrain, restrict access to part of the Hanford Site, and disturb soil resources.

5.1.1.1 Geologic Resources

- The impact to the geologic environment by the facilities proposed by the preferred alternative would be minimal. Restriction of public access to mineral deposits already exists at the Hanford Site. Restriction of resource access for site operations would have minimal impact since sand and gravel resources are readily available at other areas within the Hanford Site.

Adequate soils engineering would be employed during site preparation to preclude any potential for subsidence. Faulting has not been identified in the construction site vicinity. Due to the generally subdued topography of the proposed RCSTS site and pipeline alignment, landslides or slope failure would not present a hazard. The construction and operation of the facilities proposed as part of the preferred alternative would not impact the geology of the site.

5.1.1.2 Seismology

- Seismologic hazards, discussed in Section 4.1.2, would not impact facilities proposed as part of the preferred alternative.

The RCSTS would be designed to resist a variety of loads including dead, live, pressure, thermal, and seismic loads. The seismic loads are those resulting from:

- Passage of seismic waves (i.e., wave-propagation effects)
- Seismic-induced building settlements and seismic anchor movements
- Soil failure due to liquefaction, landslide, etc.
- Transfer of stress between the inner and outer pipelines at their connection points.

The seismic design of the facilities proposed as part of the preferred alternative would be according to the general requirements of DOE Order 6430.1A, its primary reference LLNL/UCRL 15910 and the Brookhaven National Laboratory (BNL) guidelines 52361. The design basis earthquake (DBE) for which items would be designed is specified by DOE as the maximum horizontal ground surface acceleration (WHC 1994a, WHC 1993a, WHC 1993b). The consequences of a seismic rupture of the RCSTS are evaluated in Section 5.1.10. Seismic hazards are not expected to affect continued use of the ECSTS pending completion of the RCSTS, due to the unlikely probability of a seismic accident event rupturing the ECSTS.

5.1.1.3 Soils

- The majority of the 200 East and 200 West Areas and the proposed RCSTS construction sites are covered with sandy soil that supports vegetative cover (sagebrush and various grasses) (PNL 1995). Vegetation protects the soil from wind erosion. The sandy soil would be susceptible to both short-term and long-term wind erosion if it were exposed during clearing for construction. Wind erosion would be prevented through normal dust control procedures throughout construction.

The preferred alternative would include revegetation of the sites to mitigate construction activities from disturbance and removal of native soil and vegetation along the proposed route of the RCSTS. A detailed discussion of planned revegetation activities is provided in Subsection 5.1.4.

Without irrigation, none of the soils affected by the RCSTS could be considered prime or unique farmlands, prime forest lands, or prime pasture lands (Brincken 1994).

5.1.2 WATER RESOURCES AND HYDROLOGY

This section discusses the impact the preferred alternative would have on water resources and hydrology. Potential spills and leaks from the proposed RCSTS or the ECSTS are not expected during normal operations. The potential for accidental releases is discussed in Section 5.1.10. Under normal operating conditions no impacts to water resources are anticipated. Even in the unlikely event of a transfer pipeline break in either the ECSTS or RCSTS, ground-water resources would be protected by the thick vadose zone in this area and the tendency for many radionuclides to be retained in the soils. The enhanced secondary containment provided by the RCSTS provides an added level of protection not present in the ECSTS.

Standard construction procedures for dust suppression using water would not be expected to effect water resources due to the small amount of water that would be used, rapid evaporation, and the thick vadose zone in this area.

5.1.3 PHYSICAL ENVIRONMENT

This section discusses the impact the preferred alternative would have on the physical environment. Impacts of the preferred alternative on the physical environment are examined in terms of the following elements of the environment:

- Air Quality

. Radiation
. Sound Levels and Noise.

5.1.3.1 Air Quality

- Air quality impacts have been considered for construction and routine operations of the preferred alternative. This subsection describes the analytical approach applied to construction emissions and operation emissions.

. Construction Emissions - Construction activities for the Tank 102-SY retrieval system would occur primarily within the tank farm area currently covered with gravel, therefore, potential dust emissions would be limited to RCSTS construction. Particulate emissions, primarily blowing dust, would result from RCSTS project excavation and fill activities. Estimates of the fugitive dust emissions from previous air emission analysis (Rittman 1994) would be applicable to the construction of the RCSTS.

Emissions were estimated using an EPA fugitive dust emission factor of 1.04 x 10-4 g/s/m2 (2.05 x 10-8 lb/s/ft2) assuming a 30-day month. By reclaiming surface soils during RCSTS installation, construction operations would limit the total area of exposed soil surface. For purposes of analysis in this EIS, it is assumed that 2.3 ha (5.7 acres) would be subject to wind erosion at any time during RCSTS construction. The average dust emission rate from this area would be 2.4 g/s (5.1 x 10-3 lb/s).

Air concentrations of fugitive dust downwind of the proposed construction area were computed as an area source using the ISCLT2 program from EPA. Hanford Site wind data collected at the HMS between 1983 and 1991 were used in the modeling. Results are shown in Table 5-1. The wind direction east-southeast (ESE) produced the largest concentrations of fugitive dust. Based on the data in Table 5-1, the Ecology Air Quality Standard of 60 yg/m3 (3.7 x 10-9 lb/ft3) would not be exceeded.

Table 5-1
Fugitive Dust Emissions from RCSTS Construction

	Concentration (yg/m3)bm
300	43.33
400	33.05
500	26.22
700	18.00
1,000	11.39
2,000	4.24
5,000	1.09
10,000	0.39

a1 m = 3.281 ft
byg/m3 = 6.2x10-11 lb/ft3

The construction of the RCSTS or the retrieval system proposed in Tank 102-SY, would not produce fugitive dust concentrations in excess of EPA or Ecology Air Quality Standards. Construction activities would include mitigation activities to control fugitive dust emissions from the construction site, including watering exposed areas and stabilizing spoils piles by use of vegetation or soil fixative.

. Operations Emissions - Airborne emissions from the existing tank farm ventilation operations in the 200 West and East Areas are known to exist. Operations from existing mixer pump or ECSTS activities are not expected to result in on-site or off-site health effects from toxic gas emissions, based on An Environmental Assessment for Proposed Pump Mixing Operations to Mitigate Episodic Gas Releases in Tank 241-101-SY DOE/EA/0803 (DOE 1992a). RCSTS activities would have no routine toxic chemical emissions.

Limited monitoring for on-site airborne concentrations of volatile organic compounds reported in the Hanford Site Environmental Report for Calendar Year 1993 (PNL 1994a) indicate that levels are below Ecology's acceptance source impact levels (ASILs) for benzene and carbon tetrachloride. That report indicated that measured on-site concentrations were close to background levels.

5.1.3.2 Radiation

- Airborne emissions of radioactive materials from normal operation of facilities under the preferred alternative would not result in any measurable increase in radioactivity in off-site air, water, soil, vegetation, and animals. Section 5.1.9 discusses in detail estimated emissions of radioactive materials from normal operations under the preferred alternative.

5.1.3.3 Sound Levels and Noise

- Potential noise impacts from constructing and operating the RCSTS and the retrieval system at the Hanford Site would not be expected to exceed maximum noise limits set by the State of Washington.

The distance between the RCSTS and the retrieval system to the nearest receptor location is significant, creating a large buffer zone for noise abatement and control. Although occasional recreational usage of the Hanford Site occurs along the Columbia River and Route 240, protection of the public from potential noise impacts would be maintained by the distance from the proposed project site to these areas.

During construction, equipment may temporarily increase ambient noise levels at the proposed project site. Noise levels created by construction equipment have been measured and typical data are presented in Figure 5-1. Occupational noise exposure would be monitored within the work areas expected to exhibit noise levels beyond limits set by OSHA and threshold limit values established by the American Conference of Governmental Industrial Hygienists (ACGIH). A hearing conservation program including the use of OSHA-approved hearing protection would be implemented to protect workers during these operations, as necessary.

5.1.4 BIOLOGICAL AND ECOLOGICAL RESOURCES

The construction of the preferred alternative would require removal of vegetation, destruction of habitat, and the generation of dust and noise. Although these actions would be temporary, they may have both short-term and long-term effects upon site vegetation and wildlife.

Figure (Page 5-8)
Figure 5-1. Construction Equipment Noise Ranges

The following subsections examine the potential effects of the preferred alternative:

- Vegetation
- Wildlife
- Threatened or Endangered Species.

5.1.4.1 Vegetation

- Construction of the preferred alternative would remove vegetation from the RCSTS route and associated facility maintenance areas. In addition, construction staging, laydown, and spoils stockpiling areas would require the removal of vegetation and would disturb soil, but these areas would be revegetated by seeding with native species after construction is complete. The areas disturbed during construction of the RCSTS would be similarly revegetated after construction, except for the areas requiring access for monitoring and maintenance. If decommissioning at the end of the useful life of the RCSTS requires removal of the pipeline, the corridor would be disturbed again. All these disturbed land areas would have long-term changes in vegetation cover.

Land surfaces disturbed by construction and left to revegetate without intervention would become quickly dominated by Russian thistle and cheatgrass, ubiquitous non-native annual plants highly adapted to the arid conditions of south-central Washington. If native perennial species were not killed by the surface disturbance they would probably resprout and remain a presence. If they were killed by the surface disturbance, they would be slow to reestablish from seed because of competition from the cheatgrass. Among native shrubs, grey rabbitbrush would be best able to establish after disturbance. Rabbitbrush/cheatgrass plant communities are common in previously disturbed sites.

The RCSTS construction on the proposed route would disturb a corridor with a width of 30 m (100 ft) and a length of about 10 km (32,000 ft), resulting in approximately 30 ha (74 acres) of disturbed land. About 9 ha (23 acres) of the corridor would be mature sagebrush/cheatgrass habitat. The remaining 21 ha (51 acres) would be disturbed areas occupied by grey rabbitbrush/cheatgrass habitat or barren areas, including roads (see Figure 4-16). Much of the proposed RCSTS route follows an existing dirt road about 4.6 m (15 ft) wide, so in these areas the width of clearing of the sagebrush habitat is calculated as 26 m (85 ft) rather than 30 m (100 ft).

An optional route segment from the fence at the eastern edge of the 200 West Area to the vent station about midway along the proposed RCSTS was evaluated to determine if it would offer a significantly lower impact on mature sagebrush habitat (see Figure 4-16). This optional route was selected for evaluation because it could use the approximately 10 m (30-ft) wide access road along the north side of the ECSTS to reduce the width of the construction corridor. This optional route, however, is about 305 m (1,000 ft) longer than the proposed route. The effect of the proposed RCSTS on mature sagebrush habitat by using this optional segment would be a reduction of approximately 0.6 ha (1.6 acres) of mature habitat loss compared with the proposed route. Changing to this optional segment would have significant cost implications.

An alternate eastern segment from the vent station to the 200 East Area paralleling the ECSTS was also evaluated. Because of the distribution of mature sagebrush patches, disturbed areas, and contaminated areas that must be avoided, using this alternate segment would increase the loss of mature habitat by 2.1 ha (5.3 acres) over the proposed route.

The 9 ha (23 acres) of sagebrush/cheatgrass habitat would experience long-term effects. Part of this area could be revegetated by seeding with native species after construction, but an estimated one-quarter of the width of the corridor would be subject to future disturbance for access and maintenance. The soil disturbance from construction activities would result in compaction, mixing of soil horizons, and wind erosion, conditions which favor species that thrive on disturbed soil. Sagebrush communities are expected to require decades to become established and reach maturity. Seeding for revegetation of the impacted grey rabbitbrush habitats may also include sagebrush seed to encourage more complete development of shrub steppe vegetation with the highest value for wildlife species of concern. Areas of the corridor that are currently barren and not subject to ongoing disturbance would be similarly revegegated once construction of the facilities and pipeline is complete.

Mitigation besides revegetation of the areas temporarily disturbed by the construction would be required. If the assumption is made that it would not be possible to restore within a reasonable time the sagebrush/cheatgrass habitat on the area that would be temporarily disturbed, then a full 9 ha (23 acres) would need mitigation.

The mature sagebrush habitat would be replaced at a ratio of 3:1 for this project. Sites would be selected that fit into a site-wide program if one is developed later. If the worst-case mitigation debt of 9 ha (23 acres) of sagebrush habitat is assumed, then a 3:1 ratio equals 28 ha (69 acres) of compensation. Figure 5-2 shows the proposed area for such compensation to occur. It has over 530 ha (1,300 acres) available for potential habitat restoration. The site-disturbing activities that might be associated with restoration of sagebrush habitat would be minimized, and the impacts on the restoration sites would be minor and localized. Specific plots of adequate acreage will be selected and evaluated for cultural resources and ecological baseline information as part of the MAP.

Since there would be no ground disturbance to the ECSTS, no habitat impact would occur from its use during the time the RCSTS is constructed.

5.1.4.2 Wildlife

- Clearing vegetation in the vicinity of the RCSTS pipeline corridor to construct the facilities and pipeline would result in a loss of habitat in that vicinity for some of the wildlife species on the Hanford Site. The anticipated clearing schedule would avoid the bird nesting season. Construction-related impacts would most likely affect:

- The loggerhead shrike and sage sparrow (discussed in section 5.1.4.3)
- Nesting song birds (such as horned lark and western meadowlark)
- Small mammals
- Reptiles, including the sagebrush lizard.

Small mammals, reptiles, and crawling insects that require shade from vegetation would be subjected to habitat fragmentation (i.e., creation of relatively large habitat discontinuities where shrub cover is removed) if the area is not revegetated.

Figure (page 5-12)
Figure 5-2. Composition Area for Lost Sagebrush Habitat

Revegetating would minimize the operational impacts. Habitat restoration, a means of mitigation, would change grass-dominated habitat to sagebrush habitat and would favor some species to the detriment of others (for example, favor shrikes over horned larks). Overall, the effect of converting grass-dominated habitat to sagebrush-dominated habitat would be minor because the grass-dominated habitats are abundant and tend to support few sensitive species. In addition, wildlife diversity would be expected to increase as a result.

Construction noise would temporarily displace some species. Some roadkills would be expected for small mammals and reptiles that remain in the vicinity as heavy equipment moves across the Hanford Site. The operation of the RCSTS would not have any impact on wildlife populations.

5.1.4.3 Threatened or Endangered Species

- No threatened or endangered plant species occur at either the 200 East or West Areas or along the RCSTS corridor. The stalked-pod milkvetch, a State of Washington monitor species, has been found at several locations along the RCSTS corridor in both disturbed and undisturbed sagebrush habitats and may be affected. It may be interspersed in the proposed construction areas including potential mitigation sites. Even though some specimens of this species would be lost, the overall Hanford Site population would not be affected.

The loggerhead shrike, a Federal and state candidate species, the sagebrush lizard, a Federal candidate species, and the sage sparrow, a state candidate species, require mature sagebrush/cheatgrass habitat. The loss of 9 ha (23 acres) out of about 93,000 ha (230,000 acres) on the Hanford Site of mature sagebrush/cheatgrass would be a direct loss of habitat for these species and other species that use the site. During spring 1995 surveys, 11 shrike nests were found along the RCSTS corridor. Three sage sparrows were found along the RCSTS corridor. These species would not be nesting on the potential mitigation sites and would not be affected by the mitigation activity.

The preferred alternative would include establishing compensatory habitat restoration sites to mitigate the disturbance of native soil and removal of vegetation in the construction area. The potential options for habitat restoration sites are discussed in Appendix D.

5.1.5 POPULATION AND SOCIOECONOMIC IMPACTS

This section examines the impact the preferred alternative would have on population and socioeconomics in the region of influence. For purposes of this analysis, the socioeconomic region of influence was defined as those counties in the State of Washington where Hanford employees reside. The analysis includes impacts to the local economy, income, population, housing, and local infrastructure, and an evaluation of environmental justice.

5.1.5.1 Local Economy and Employment

- The preferred alternative would require 20 workers from Hanford's existing workforce for the anticipated 4-month construction period for either retrieval system proposed for Tank 102-SY. An additional 80 workers would be required for a duration of 21 months for the construction of the RCSTS. Twenty of these workers would come from the existing workforce and the remaining 60 would be new hires. The operations workforce of five would come from existing personnel. This information is summarized in Table 5-2.

Table 5-2
Effects of the Preferred Alternative on Employment

Supporting Actions	Construction			Operations		
	No.	Existing/	Duration	No.	Existing/	Duration

	Jobs	New Hires	(mos)	Jobs	New Hires	(yrs)	Assumptions
Retrieval Retrieval System for Tank 102-SY	20	20/0	4	4	4/0	Approx. 2	of Tank 102-SY only
RCSTS	80	20/60	21	5	5/0	30	TWRS activities complete in 30 years

For every job created at the Hanford Site, 1.2 jobs are created locally, for every new hire from outside the region of influence, 1.3 persons would move into the local region. The total employment multiplier is 2.2 and population growth is 2.2 x 1.3, or 2.86. These multipliers are based on the socioeconomic input/output analysis performed by PNL in 1987 and 1989 (DOE 1991). All operations personnel would come from the existing workforce. For 60 temporary construction jobs (i.e., new hires) created at the Hanford Site under the preferred alternative, 132 new jobs would be created locally. Some of these jobs may be filled from the workers in the community available as a result of DOE cutbacks expected in 1995. New hires moving into the region of influence are not expected to increase population above 1995 peak levels and would, therefore, not have significant socioeconomic impacts.

5.1.5.2 Income

- Construction of the preferred alternative would generate construction income for the region of influence. It is expected this income would impact beyond Benton and Franklin Counties, although a majority of the income would flow into these two counties over a period of 2 years. Construction costs associated with services, goods, and materials would constitute the majority of the income generated to Benton and Franklin Counties. Potential fabrication of project components outside the local area could reduce beneficial income impacts to the local area.

5.1.5.3 Population

- As discussed in Section 5.1.5.1, the population growth multiplier has been determined to be 2.86. Therefore, assuming all 60 new hires move into the community from outside the region of influence, a population increase of 172 persons could occur. However, the actual increase is expected to be less since jobs may be filled by the available workforce resulting from general DOE cutbacks at the Hanford Site. The actual number depends on the availability of qualified workers for the new construction jobs. The maximum increase is less than 5 percent of the expected DOE cutbacks, and therefore, problems typically associated with sudden population growth are not anticipated.

5.1.5.4 Housing

- The preferred alternative would not have a significant impact on the housing market within the region of influence. The demand for single-family units and rental units as well as other modes of housing is expected to decline as a result of the DOE cutbacks. Housing for new hires is expected to be readily available as previous Hanford Site employees leave the region of influence to pursue employment elsewhere. No housing shortage or price increase is anticipated to result from this alternative.

5.1.5.5 Local Infrastructure

- Due to a relatively small amount of temporary employment, and therefore population growth, provided by this alternative, the demand for public education, police and fire protection, and medical service is not expected to increase above 1995 peak levels. In light of the DOE cutbacks, overburdening of these community services would not result from the preferred alternative.

5.1.5.6 Environmental Justice

- As discussed above, the primary socioeconomic impact of the preferred alternative would be from temporary construction workers hired for the project duration. However, this impact would be offset by DOE workforce reductions. In addition, as demonstrated in Section 5.1.10, no health effects to any off-site population are anticipated. Therefore, no disproportionate impacts to low-income or minority populations would occur as a result of this alternative. Appendix C provides a more detailed discussion of environmental justice issues.

5.1.6 TRANSPORTATION

The following sections summarize the impacts to the Hanford Site transportation system for the preferred alternative.

5.1.6.1 Vehicular Traffic and Circulation

- Construction of the RCSTS and the retrieval system would occur between the 200 East and West Areas as described in Section 3.3.5.2. Construction vehicles transporting heavy equipment, material, and workers would enter the 200 Areas via State Highways 24 and 240, the new 240 State Route Access Road, and Route 3. The construction phase for the RCSTS would be expected to last approximately 21 months. During the construction phase, the expected volume of construction related vehicles at any one time would vary. As a worst-case condition, a daily maximum of 80 construction personnel would utilize the Hanford Site roadways during construction of the RCSTS. Based on a vehicle occupancy rate of 1.35 passengers per vehicle, the incremental increase in traffic volume would be approximately 60 daily trips. Because the amount of construction-generated vehicles would be relatively small compared to the daily traffic on these roadways (see Section 4.6) and because the affected roadways are currently operating at acceptable LOS, adverse traffic impacts are not expected during construction.

Roadways which could be used as alternate routes to the 200 East and West Areas include Route 10, Route 2 South/Route 11A, and Route 5. Adverse impacts to these roadways are not expected to occur as a result of the proposed alternative. These roadways are currently operating at acceptable LOS and would be able to accommodate the comparatively minor volumes of construction related vehicles without deteriorating existing traffic conditions.

Since the RCSTS would be located underground and operated remotely with existing Hanford Site workforce (Trost, Epperson 1995), no increase in vehicular traffic would be expected to occur from its operation. Similarly, the proposed retrieval system in Tank 102-SY would also be operated by a small, existing workforce. No new personnel or facilities are required to operate the existing mixer pump, therefore, no impacts to on-site traffic conditions would be associated with this component of the preferred alternative. No adverse impacts to roadways are anticipated due to the operation of the preferred alternative.

5.1.6.2 Other Transportation Facilities

- Bus line service and capacity would not be adversely impacted by the preferred alternative. Based on the available capacity of all roadways serving the 200 East and West Areas, it is expected that the majority of construction personnel would travel to the job site via their personal vehicles or carpool. The bus service to the 200 Areas which was previously available has been reduced. If this service were restored or a private bus service replaced it, a significant increase in bus service usage would not be expected as part of the preferred alternative.

It is expected that vessel traffic on the Columbia River would not be significantly affected by the construction of the RCSTS and retrieval system. A small increase in vessel traffic may occur during the construction of the RCSTS to transport construction material and equipment, but this would be temporary. The increase in vessel traffic is not expected to increase vessel traffic congestion or affect the safe transit of other commercial or recreation vessels either at the Port of Benton or on the Columbia River.

During construction of the RCSTS and retrieval system, prefabricated materials may be transported to the 200 Areas via the existing on-site rail system.

Rail service to the 200 East and West Areas is currently provided by spur lines located approximately 0.4 km (0.25 mi) away. Because rail usage to the 200 East and West Areas is very infrequent, transporting construction materials via rail would not cause rail traffic congestion. Rail transport of construction materials would result in minimal delays to vehicles using site roadways.

5.1.7 LAND USE

The preferred alternative would not alter the current or foreseeable future land use patterns or aesthetic and visual resources of the 200 East and West and 600 Areas. Each of these topics are discussed in the following subsections.

5.1.7.1 Land-Use Patterns

- The preferred alternative would be located in the 200 East and West Areas and the portion of the 600 Area located between the 200 East and West Areas. This portion of the Hanford Central Plateau has been used exclusively for fuel reprocessing, waste processing, and management for approximately the last 50 years. These areas contain underground storage tanks, ECSTS, and other waste-handling facilities.

While the preferred alternative would require the commitment of approximately 30 ha (74 acres) of land for the RCSTS, this facility would be consistent with the overall site cleanup mission which is expected to last for several decades. In addition, no other appropriate land uses would be precluded because the site of the proposed action is dedicated to waste storage and handling during the site cleanup mission. Decommissioning of the facilities would also be compatible with existing land use.

The preferred alternative would be consistent with The Future for Hanford: Uses and Cleanup Final Report: dated December 1992 (FSUWG 1992). The Hanford Future Site Uses Working Group, the author of this report, was established through DOE as a part of the scoping of the HRA EIS. This scoping effort enabled participants to articulate their visions of possible future site uses for the Hanford Site. The group divided the Hanford Site into six geographical areas. The Central Plateau, where the 200 East and West and 600 Areas are located, is one of the six areas. The Working Group report recognized the Central Plateau's historic and present use and recommended that waste management activities be concentrated in that area during the site cleanup mission.

5.1.7.2 Aesthetic and Visual Resources

- The potential visual impact of a proposed project is the degree to which visual quality would be altered and the affect of the alteration on viewers. The RCSTS connecting the 200 East Area and the 200 West Area would be underground and, therefore, present no visual impact to off-site viewers after the completion of construction.

5.1.8 CULTURAL RESOURCES

As discussed in Subsection 4.8, field surveys conducted over the 200 East and West Areas and the 600 Area between those two areas, in the vicinity of the proposed RCSTS corridor and its optional route segment, have not identified archeological or historical sites of significance. In addition, no archeological or religious sites of Native American concern have been identified in the proposed project area. As a consequence, construction of the preferred alternative would not adversely affect cultural resources.

Cultural resource reviews have been performed for the area identified for revegetation. Two potential sites were located within the 530 ha (1,300 acre) area identified for habitat restoration. Cultural sites located in this large area would be avoided during mitigation activities by excluding workers from the vicinity of these sites. Detailed avoidance measures for known sites will be specified in the MAP. In the event a potential resource is discovered during construction of the RCSTS or during habitat restoration, work would immediately cease and a qualified archaeologist and the affected tribes would be contacted to determine whether the material is of archaeological interest or cultural significance. If cultural materials are located, procedures outlined in the NHPA and the Hanford Cultural Resources Management Plan would be followed. Prior to any site disturbance a detailed MAP will formalize field procedures which would be utilized to prevent impacts to cultural resources should they be encountered.

5.1.9 ANTICIPATED HEALTH EFFECTS UNDER NORMAL CONDITIONS

This section discusses the potential cause and magnitude of health effects that are anticipated to occur under normal conditions as a result of implementation of the preferred alternative. These health effects could result from direct exposure to ionizing radiation or inhalation of toxic and radioactive materials. The various types of health effects that can occur and the relationship between exposure and health effects is discussed in Appendix E. This section evaluates health effects in terms of latent cancer fatalities (LCFs) for radiation exposures and in terms of incremental cancer risk and systemic toxic effects for chemical exposures. The preferred alternative is described in Section 3.1.1 and briefly summarized here.

The preferred alternative consists of continued operation of the 150-hp mixer pump in Tank 101-SY, continued pumping of SST SWLs in the 200 West Area, continued storage of WAFW, retrieval of sludge from Tank 102-SY, and construction of the RCSTS. The sludge in Tank 102-SY would be retrieved at a minimum dilution ratio of 2:1 (diluent:sludge) using either the ITRS or past practice sluicing system (PPSS) and transferred to the 200 East Area. Retrieval would occur prior to the cross-site transfer of complexed SWLs to avoid mixing with the 269,000 L (71,000 gal) of sludge in Tank 102-SY. The sludge is classified as TRU waste and could be dissolved if mixed with complexed waste. TRU waste is waste other than HLW that contains more than 100 nanocuries (nCi)/g of alpha-emitting TRU nuclides with half-lives greater than 20 years. The reliability of the ECSTS is questionable and its solids handling capability presently unknown. It is assumed that the ECSTS would be used for cross-site transfers of liquid waste until either no usable lines remain or the RCSTS becomes operational.

Activities considered as normal conditions under the preferred alternative would include:

. Facility Construction
. Facility Operation
. Facility Decontamination and Decommissioning.

Each of these activities is discussed relative to health effects in the following subsections.

5.1.9.1 Facility Construction

- Construction activities under the preferred alternative would include:

. RCSTS Construction
. Retrieval System Construction.

The retrieval system would be either an ITRS or a PPSS.

Potential exposures of workers and members of the general public to direct radiation, radioactive materials, and chemicals during construction activities are discussed below:

. RCSTS Construction - Construction of the RCSTS would involve excavation and other earth-moving activities along the 10 km (6.2 mi) route and work in and around contaminated areas such as existing piping, valve pits, and diversion boxes. Workers would be exposed to direct radiation during construction activities in or around existing piping, process pits, and diversion boxes. The total estimated dose from direct radiation during construction work in these contaminated areas is 26.3 person-rem (Light 1994) and, based on an occupational risk factor of 4 x 10-4 LCFs per person-rem, would be expected to result in 0.01 LCFs. The estimated dose assumes that existing contamination levels within process pits and diversion boxes would be reduced by partial decontamination prior to beginning construction in these areas. Exposure to direct radiation during construction activities would also be reduced by applying the ALARA principle in planning work tasks and implementing procedures specific to the task and conditions encountered.

  Exposures to airborne radioactive material and chemicals would also be possible during construction activities in contaminated areas. Inhalation exposures could occur during excavations and grinding or cutting of contaminated pipelines and concrete. Release of airborne contaminants to the environment would be controlled using temporary enclosures or, for large outdoor areas, using wetting or soil fixatives. Other measures to control inhalation exposures would include decontaminating work areas, using protective equipment, and implementing procedures specific to the work.

- Retrieval System Construction - Construction of either an ITRS or PPSS for Tank 102-SY would be expected to result in exposure of workers to direct radiation and to airborne radioactive materials and chemicals. Estimates of these exposures are not available for Tank 102-SY but can be inferred from estimates for ITRS construction for other tanks in the SY Tank Farm.

  ITRS construction activities would include erection of an ICE building, construction of new and modification of existing pump and valve pits, and construction of tank mixing, transfer, and cooling systems (WHC 1994b). Estimated exposure for Tank 101-SY ranges from 170 person-rem to 380 person-rem depending on whether the existing mitigation mixer pump is used for retrieval operations or is replaced with a more powerful mixer pump (personal communication Van Beek 1995). Estimated exposure for Tank 103-SY, including mixer pump installation, is 400 person-rem (personal communication Van Beek 1995). 137Cs is the predominant gamma-emitting radionuclide in wastes in the SY Tank Farm and, since the 137Cs inventory is approximately 40 times higher in Tank 103-SY than Tank 102-SY (WHC 1993c), it is considered unlikely that dose during ITRS construction for Tank 102-SY would exceed 400 person-rem. Based on a risk factor of 1 x 10-4 LCFs per person-rem, adverse health effects are not expected as the result from exposure to direct radiation during ITRS construction for Tank 102-SY.

  Construction of a PPSS for Tank 102-SY would also require installation of equipment inside the tank and modifications in existing contaminated process pits and would be expected to result in direct radiation exposures similar to those for construction of the ITRS.

  Exposures to airborne radioactive material and chemicals would also be possible during in-tank installation of ITRS components and other construction activities. Release of airborne contaminants to the environment would be controlled using temporary enclosures or, for large outdoor areas, using wetting or soil fixatives. Other measures to control inhalation exposures would include decontaminating work areas, using protecting equipment, and implementing procedures specific to the work.

5.1.9.2 Facility Operations

- Facility operations under the preferred alternative would include operation of the Tank 101-SY 150 hp mixer pump, retrieval of Tank 102-SY, SWL pumping activities, and cross-site transfer operations via the transfer pump in Tank 102-SY and both the ECSTS and RCSTS. These activities involve sampling and monitoring waste and ventilation systems, inspection and surveillance, and maintenance of equipment and facilities. Workers and members of the general public could be exposed to the following emissions during these activities:

- Direct Radiation
- Airborne Emissions of Radioactive Material
- Airborne Emissions of Chemicals.

Estimated doses and resultant health effects for each of these exposures are discussed in the following list.

- Direct Radiation - Workers performing routine operations, maintenance, and surveillance would be exposed to direct radiation during mixer pump operations, SWL pumping, and associated cross-site transfers. Workers could also be exposed to direct radiation during Tank 102-SY retrieval operations. Many of these activities are similar to those now being performed by tank farm workers

  Worker exposure records prior to construction of DSTs indicate that tank farm workers had received an average annual dose of 630 mrem from direct radiation exposure (DOE 1980). The DSTs are now the main focus of tank farm operations and include many design features such as improved shielding and remotely-operated and remotely-monitored systems. An examination of more recent radiation exposure records of tank farm workers indicates that the average annual individual dose has dropped to 14 mrem (DOE 1992b). Activities performed by these workers include SWL pumping and inter-farm waste transfer.

  Additional activities performed by tank farm workers under the preferred alternative would include cross-site waste transfers and Tank 102-SY sludge retrieval operations. Since the wastes involved are similar to those currently being handled and the additional activities involve systems reflecting the continuing improvement in radiation protection design, an annual individual dose of 14 mrem is considered representative of the dose that would be received by workers involved in the preferred alternative. Based on this dose and an occupational risk factor of 4 x 10-4 LCFs per person-rem, workers involved in operations under the preferred alternative are not expected to incur any adverse health effects as the result of exposure to direct radiation.

- Airborne Emissions of Radioactive Material - Workers and members of the general public could be exposed to airborne emissions of radionuclides from SSTs awaiting retrieval, or during SWL pumping, or from the SY Tank Farm during operation of the Tank 101-SY mitigation mixer pump, retrieval of Tank 102-SY, and cross-site transfer operations. Emissions from the SSTs, SWL pumping, and operation of the Tank 101-SY mitigation mixer pump are expected to be the same as those for the same activities under the no action alternative. These emissions are discussed in Section 5.5.9 and are not expected to result in any adverse health effects.

  Source terms for airborne emissions of radionuclides during DST retrieval operations were considered by Ligotke, et al (PNL 1994b). The report estimated that the dry aerosol source term would be one to two orders of magnitude greater during sluicing operations than during operation of two 300-hp mixer pumps. The report also concluded that existing DST ventilation systems could control airborne emissions during mixer pump operations provided that the ability of each ventilation system to control moisture to prevent plugging and failure of HEPA filters was evaluated and modified as necessary. Methods of controlling ventilation system moisture include chiller/condensers, HEME, and heaters that could be incorporated in the ventilation system for either method as needed to control emissions during the few weeks that the retrieval system would operate.

  Based on these considerations, airborne emissions of radionuclides under the preferred alternative are expected to be essentially the same as those under current conditions. In 1993, airborne emissions from stacks in tanks farms accounted for 1 percent (1.3 x 10-5 mrem) of total dose to the maximally exposed individual from all stack emissions in the 200 East Area and 0.003 percent (3.1 x 10-8 mrem) of the total dose to the maximally exposed individual from all stack emissions in the 200 West Area. The population dose from all airborne emissions from the 200 Areas in 1993 was 0.17 person-rem. These doses are considered to be representative of those that would be received by the maximally exposed off-site individual and the off-site population from airborne emissions under the preferred alternative. Based on a non-occupational risk factor of 5 x 10-4 LCFs per person-rem, no adverse health effects are expected to be incurred in the off-site population as the result of implementation of the preferred alternative.

- Airborne Emissions of Chemicals - Workers and members of the general public could be exposed to airborne emissions of chemicals from SSTs awaiting retrieval, or during SWL pumping, or from the SY Tank Farm during operation of the Tank 101-SY mitigation mixer pump, retrieval of Tank 102-SY, and cross-site waste transfer operations.

  A FONSI has been issued for operation of the Tank 101-SY mitigation mixer pump based on an EA (DOE 1992b) that assumed operating conditions that would produce chemical emissions greater than those produced by mixer pump operation under the preferred alternative. The report evaluating source terms for dry aerosols during retrieval operations (PNL 1994b) did not estimate source terms for non-condensible vapors. Heat generated by mixing or sluicing operations during retrieval could cause an increase in the source term of volatile organics. Emissions of volatile organics could be controlled by including charcoal filters in the ventilation system.

  Airborne emissions from other activities are expected to be comparable to emissions for normal operations in recent years. Monitoring data on emissions of airborne chemicals from tank farm vents and stacks is limited. Considerably more data are available from personal monitors worn by workers during routine tank farm operations (Hewitt 1995). Data for the S, SX, and SY Tank Farms in the 200 West Area has shown that airborne concentrations of toxic chemicals including volatile organics are consistently only a few percent of 8-hour time weighted average (TWA) concentrations. Detailed discussion of these emissions is provided in Section 5.5.9.2 and Appendix E. Atmospheric dispersion would reduce these concentrations at the site boundary. In cases where the expected ambient concentrations are not well-known, workers are required to wear appropriate respirators or use supplied air systems. On the basis of these considerations, no adverse health effects are anticipated to result from airborne emissions of chemicals under the preferred alternative.

5.1.9.3 Facility Decontamination and Decommissioning

- The RCSTS that would be constructed under the preferred alternative would require decontamination and decommissioning. Decontamination and decommissioning of other facilities such as the existing DSTs and SSTs and the ECSTS are to be addressed in detail in a separate future EIS. The generic impacts of decontamination and decommissioning of TWRS facilities will be included in the TWRS EIS.

The design of the RCSTS incorporates the following features that would simplify decontamination of the RCSTS and reduce the amount of material requiring disposal as radioactive waste:

- Use of modular, separable components to isolate and minimize contamination
- Use of washable or strippable coatings to minimize contamination
- Minimization of the lengths of pipeline and duct runs that would be subject to contamination.

These features would help minimize worker exposure and the potential for health effects by reducing the amount of time workers would be handling contaminated material and equipment.

5.1.10 HEALTH EFFECTS UNDER ACCIDENT CONDITIONS

This section discusses the human health effects that could occur as the result of potential accidents during the implementation of the preferred alternative. Initiating events, frequencies of occurrence, and quantities of respirable hazardous materials released during a range of potential accidents are discussed in detail in Appendix F. No construction accident fatalities are anticipated for this alternative based on the death rate of 31 per 100,000 workers (National Safety Council 1994). The types of health effects that can occur and the relationship between exposure and health effects are discussed in Appendix E. This section evaluates health effects in terms of LCFs for radiation exposures. Health effects for exposures to chemicals during accidents that involve exposure to both radioactive materials and toxic chemicals are not specifically evaluated. A previous analysis (WHC 1994c) concluded that radiological releases are limiting in these cases provided the release duration is at least 2 minutes and 40 seconds. The minimum duration of combined radiological and chemical releases evaluated under the preferred alternative is 2 hours. The effects of a "flash" release of toxic gases during ITRS operations are discussed in Section 5.1.10.3 as an illustration of potential health effects when tank waste levels are reduced over a relatively short period of time.

Safety analyses performed during the facility design process describe accidents as "anticipated," "unlikely," "extremely unlikely," or "incredible." These terms describe the likelihood of an accident occurring during the lifetime of the facility and each term corresponds to a range of annual accident frequencies. These frequencies are used in conjunction with risk acceptance guidelines to determine whether design changes are needed to mitigate the consequences of particular accidents (WHC 1988). For EAs and EISs, accidents are described as "reasonably foreseeable" or "not reasonably foreseeable." As indicated in Table 5-3, these terms also correspond to ranges of accident probabilities. Safety analysis and NEPA documents also describe accidents as being within or beyond the design basis. Design basis accidents (DBAs) are accidents that are considered credible enough to be used to establish design and performance requirements for systems, structures, and components important to safety. Design basis accidents generally have

Table 5-3
Accident Frequency Descriptions and Categories

Description	Annual Frequency (yr-1)	Category
Anticipated - May occur more than once during the lifetime of the facility	1	

		Reasonably Foreseeable
	10-1	
	10-2	
Unlikely - May occur at some time during the lifetime of the facility	10-3	
	10-4	
Extremely Unlikely - Probably will not occur during the lifetime of the facility	10-5	
	10-6	
Incredible - Not credible during the lifetime of the facility	10-7	
	< 10-7	Not Reasonably Foreseeable

frequency of 10-6 per year or greater. Design modifications are not generally made to mitigate "incredible" accidents although incredible accidents with catastrophic consequences may be included in NEPA documents.

The accidents considered in Appendix F include scenarios both within and beyond the design bases of the systems, structures, and components comprising the preferred alternative. Based on frequencies of occurrence and quantities of hazardous materials released, a subset of these accidents was selected for evaluation of reasonably foreseeable health effects.

The actions proposed under the preferred alternative involve use of the following systems:

- Existing Cross-Site Transfer System
- Replacement Cross-Site Transfer System
- Waste Retrieval Systems.

The types and quantities of waste that would be managed under the preferred alternative are summarized in Table 5-4. Detailed characterizations of the wastes listed in Table 5-4 are provided in Appendix E.

Table 5-4
Volumes of Tank Waste Transferred from the 200 West Area under the Preferred Alternative

Waste Type[a]	Volume (kgal)[b]	Systems Used
SWL		
Complexed	575	RCSTS
Uncharacterized	1,221	
Non-Complexed	2,426	ECSTS RCSTS
Salt Well Total	4,222	
WAFW	469	ECSTS RCSTS
Tank 102-SY Slurry	325	ITRS or PPSS RCSTS
Grand Total	5,016	

Source: Salt Well Volumes (WHC 1995a)
Salt Well Pumping Schedule (WHC 1994b)
Tank 102-SY Slurry (WHC 1995c)

[a] Tanks BX-111, T-111, and C-106 are excluded.
[b] 1 kgal = 3,780 L

5.1.10.1 Existing Cross-Site Transfer System

- Transfer pipe breaks and spray releases could occur during operation of the ECSTS under the preferred alternative and result in release of tank waste to the soil column and to the atmosphere. The consequences of these accidents are identical to those discussed in Section 5.5.10 for the no action alternative; however, the probability is less that these accidents would occur under the preferred alternative. Under the preferred alternative, the ECSTS would be used for transfers of non-complexed SWL and only until the ECSTS fails or the RCSTS is available.

5.1.10.2 Replacement Cross-Site Transfer System

- Transfer pipe breaks and spray releases could occur in the RCSTS during implementation of the preferred alternative. Their frequency of occurrence would be less than for similar events in the ECSTS because the improved design of the RCSTS would tend to reduce the occurrence of most initiating events and the higher pumping rate would reduce the period of time required to transfer a given volume of waste. As with the ECSTS, both transfer piping breaks and spray releases are evaluated. Additional information is provided in Appendix F, Section F.3.2.1 for transfer pipeline breaks and Section F.3.2.2 for spray releases.

. Transfer Pipe Breaks - Two types of transfer piping breaks are evaluated for the RCSTS. The mitigated case assumes the material balance calculations result in detection of the leak within 2 hours and the unmitigated case assumes that the leak is undetected for 8 hours.

A recent assessment of RCSTS pipeline break accidents (WHC 1995d) considered excavations and beyond design basis earthquakes as initiating events for transfer pipe breaks. Based on a usage factor of 30 percent for the RCSTS, the annual frequency of an unmitigated excavation-initiated pipe break was found to be an incredible but reasonably foreseeable event while the earthquake-initiated accident was not reasonably foreseeable. At a pumping rate of 140 gallons per minute (gpm), the RCSTS would only need to operate for approximately 5 days per year to transfer all of the wastes shown in Table 5-4. Based on the corresponding usage factor over the five-year interim period, the probability of an unmitigated RCSTS pipe break is incredible (1.7 x 10-7) for an excavation-initiated event and not reasonably foreseeable (1.2 x 10-8) for the seismic-initiated event.

The total probability of an unmitigated RCSTS pipe break due to both initiating events during the interim action is incredible (1.8 x 10-7). The consequences of the accident depend on the type of waste being pumped at the time and the probability that a given waste would be involved depends on the volume of the waste. Consequences and probabilities for each type of waste under the preferred alternative are shown in Table 5-5. For reference, consequences are included for the hypothetical bounding slurry waste (BSW). Radionuclide concentrations for these wastes are discussed in Appendix E, Section E.4.1. The unmitigated RCSTS transfer pipe break accident would be incredible during transfer of SWL and not reasonably foreseeable during transfer of Tank 102-SY slurry and WAFW. Based on a risk factor of 4 x 10-4 LCF/person-rem for workers and 5 x 10-4 LCF/person-rem for the general public, no health effects would be expected for accidents involving

Table 5-5
Estimated Health Effects from a RCSTS Unmitigated Transfer Pipe Break under the Preferred Alternative

Release Location	244-A Lift Station (200 East Area)		
Waste	SWL	102-SY/WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Incredible	Not Reasonably Foreseeable	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.068	3.0	11
ICR	3 x 10-5	0.001	4 x 10-3
Receptor	Uninvolved Workers		
Individual Dose (rem)	1.0	43	160
ICR	4 x 10-4	0.02	0.06
Collective Dose (person-rem)	27	1200	4,300
LCF	0.01	0.5	2
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	0.0021	0.088	0.33
ICR	1 x 10-6	4 x 10-5	2 x 10-4
Collective Dose (person-rem)	31	1,300	5,000
LCF	0.02	0.7	2
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.0025	0.11	0.40
ICR	1 x 10-6	5 x 10-5	2 x 10-4

either waste. If the accident involved the hypothetical BSW, no adverse health effects would be expected for the maximally exposed involved and uninvolved workers but 2 LCFs would be expected in both the uninvolved worker population and the general public.

The probabilities of mitigated RCSTS transfer pipe breaks under the preferred alternative are extremely unlikely (3.2 x 10-6) for the excavation accident, and incredible (2.3 x 10-7) for the seismic accident. Differences between the mitigated and unmitigated accident scenarios are discussed in Appendix F, Section F.3.2.1. The consequences and probabilities associated with each type waste under the preferred alternative are shown in Table 5-6. No adverse health effects would be anticipated for any waste including BSW.

Table 5-6
Estimated Health Effects from a RCSTS Mitigated Transfer Pipe Break under the Preferred Alternative

Release Location	244-A Lift Station (200 East Area)		
Waste	SWL	102-SY/WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Extremely Unlikely	Incredible	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.024	1.0	3.8
ICR	9 x 10-6	4 x 10-4	0.001
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.34	15	55
ICR	1 x 10-4	0.006	0.02
Collective Dose (person-rem)	9.4	400	1,500
LCF	0.004	0.2	0.6
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	7.1 x 10-4	0.031	0.11
ICR	4 x 10-7	2 x 10-5	6 x 10-5
Collective Dose (person-rem)	11	460	1,700
LCF	0.005	0.2	0.9
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	8.7 x 10-4	0.038	0.14
ICR	4 x 10-7	2 x 10-5	7 x 10-5

. Pressurized Spray Releases - Pressurized spray releases are potentially catastrophic accidents that could occur in RCSTS diversion boxes. Under the preferred alternative, there would be only one RCSTS diversion box constructed, Diversion Box 1 in the 200 West Area. The RCSTS preliminary safety analysis report (PSAR) identifies the need to mitigate the consequences of a pressurized spray release from a diversion box but does not estimate an accident frequency. Because of the severity of the unmitigated accident consequences, an accident event sequence was developed and used to estimate accident probability (see Appendix F, Section F.3.2.2). This analysis reflects the unique design features of the RCSTS diversion boxes which allow access for most maintenance and inspection tasks without creating a direct path to the atmosphere. Based on this analysis, a probability of 1.8 x 10-10 was estimated for RCSTS unmitigated spray release during the interim period. Thus this accident is not reasonably foreseeable and not considered further in this EIS.

The mitigated spray release scenario assumes that the spray released from a failed valve is confined within the diversion box and that only vapor produced by the spray escapes through small spaces around penetrations (WHC 1995e). A mitigated RCSTS spray release is an anticipated event under the preferred alternative but is not expected to result in any adverse health effects, even based on BSW. Accident probabilities and consequences for each waste type are shown in Table 5-7.

Table 5-7
Estimated Health Effects from a RCSTS Mitigated Spray Release under the Preferred Alternative

Release Location	Diversion Box 1 (200 West Area)		
Waste	SWL	102-SY/WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Anticipated	Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	5.5 x 10-5	0.0024	0.0087
ICR	< 10-7	9 x 10-7	3 x 10-6

Receptor	Uninvolved Workers		
Individual Dose (rem)	0.0029	0.12	0.45
ICR	1 x 10-6	5 x 10-5	2 x 10-4
Collective Dose (person-rem)	0.014	0.58	2.1
LCF	5 x 10-6	2 x 10-4	9 x 10-4
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	2.5 x 10-6	1.1 x 10-4	3.9 x 10-4
ICR	< 10-7	< 10-7	2 x 10-7
Collective Dose (person-rem)	0.051	2.2	8.1
LCF	3 x 10-5	0.001	0.004
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	9.3 x 10-6	4.0 x 10-4	0.0015
ICR	< 10-7	2 x 10-7	7 x 10-7

5.1.10.3 Waste Retrieval Systems

- This section evaluates selected accidents that could occur during retrieval of the sludge from Tank 102-SY with either the ITRS or the PPSS. No safety documentation currently exists for the application of either system to Tank 102-SY. However, a safety assessment for use of the ITRS on Tanks 101-SY and 103-SY (WHC 1995f) is under review and has been used as the basis for evaluating ITRS accidents under the preferred alternative. An EA has been prepared for retrieval of Tank C-106 using the PPSS (DOE 1995) and a FONSI has been issued. The preliminary safety evaluation that supports the EA (WHC 1994d) has been used as the basis for evaluating PPSS accidents under the preferred alternative.

The consequences and probabilities of pipe breaks and spray releases are evaluated for both systems. A minimum dilution ratio of 2:1 (diluent:sludge) is anticipated to ensure pumpability of the retrieved material. For purposes of evaluation, it is assumed that the entire 961,000 L (254,000 gal) of supernatant now in Tank 102-SY is used to dilute the 269,000 L (71,000 gal) of sludge.

. Initial Tank Retrieval System - The accident scenarios for the ITRS (WHC 1995f) and for the RCSTS (WHC 1995e) were developed by WHC and share many similarities for pipe leaks and sprays.

The frequency of an unmitigated ITRS pipe break is based on event trees developed by Lindberg (WHC 1995d) for pipe breaks in the RCSTS initiated by excavations and beyond design basis earthquakes. For this EIS, an operational failure was added and the total probability of an unmitigated RCSTS pipe break estimated as extremely unlikely. As discussed in Section 5.1.10.2, this probability is dominated by operational failure of the 6.5 mi RCSTS pipeline. Based on the much shorter length of pipe in the ITRS and shorter usage time, the ITRS unmitigated pipe break is considered to be incredible during retrieval of Tank 102-SY. Based on analogy to the RCSTS, the mitigated ITRS pipe break is considered to be unlikely. The consequences of these accidents are shown in Table 5-8. Based on risk factors of 4 x 10-4 for workers and 5 x 10-4 for the general public, no adverse health effects would be expected for a mitigated or unmitigated pipe break accident during ITRS retrieval of Tank 102-SY. If the accident involved hypothetical BSW,

Table 5-8
Estimated Health Effects from ITRS Pipe Breaks under the Preferred Alternative

Release Location	SY Tank Farm			
Mitigation	Unmitigated		Mitigated	
Waste	102-SY	BSW	102-SY	BSW
Dilution (diluent:waste)	0:1	0:1	0:1	0:1
Probability	Incredible	Not Applicable	Unlikely	Not Applicable
Receptor	Involved Workers			
Individual Dose (rem)	2.6	19	0.64	4.8
ICR	0.001	0.008	3 x 10-4	0.002
Receptor	Uninvolved Workers			
Individual Dose (rem)	37	280	9.4	69
ICR	0.01	0.1	0.004	

				0.03
Collective Dose (person-rem)	250	1,800	62	460
LCF	0.1	0.7	0.02	0.2
Receptor	General Public - Existing Boundary			
Individual Dose (rem)	0.045	0.33	0.011	0.083
ICR	2 x 10-5	2 x 10-4	6 x 10-6	4 x 10-5
Collective Dose (person-rem)	980	7,200	250	1,800
LCF	0.5	4	0.1	0.9
Receptor	General Public - Potential Boundary			
Individual Dose (rem)	0.14	1.0	0.034	0.25
ICR	7 x 10-5	5 x 10-4	2 x 10-5	1 x 10-4

LCF would be expected for an unmitigated pipe break and may occur for the mitigated case.

Pressurized spray leaks could occur within pump and valve pits used during ITRS operations and would produce severe consequences if the spray is not confined within the pit. The design of ITRS pits is more similar to that of older pits and diversion boxes than to that of the RCSTS. In light of pit design and the relatively small volume of Tank 102-SY slurry, the probability of an unmitigated ITRS spray release is estimated to range from extremely unlikely to incredible and that of the mitigated spray release is estimated to range from anticipated to unlikely. Accident consequences, assuming a 60-second exposure for the involved worker and 8-hour exposure for other individuals and populations, are shown in Table 5-9. For the unmitigated spray release, deaths from acute radiation exposure would be expected among uninvolved workers and 700 LCFs would be expected in the general population. Health effects would be approximately seven times greater if the accident involved BSW.

Table 5-9
Estimated Health Effects from ITRS Spray Releases under the Preferred Alternative

Release Location	SY Tank Farm			
Mitigation	Unmitigated		Mitigated	
Waste	102-SY	BSW	102-SY	BSW
Dilution (diluent:waste)	0:1	0:1	0:1	0:1
Probability	Extremely Unlikely to Incredible	Not Applicable	Anticipated to Unlikely	Not Applicable
Receptor	Involved Workers			
Individual Dose (rem)	1,400	11,000	1 x 10-4	7.7 x 10-4
ICR	0.6	4	< 10-7	3 x 10-7
Receptor	Uninvolved Workers			
Individual Dose (rem)	74,000	5.5 x 105	0.0054	0.040
ICR	30	200	2 x 10-6	2 x 10-5
Collective Dose (person-rem)	4.3 x 105	3.2 x 106	0.031	0.23
LCF	200	1,000	1 x 10-5	9 x 10-5
Receptor	General Public - Existing Boundary			
Individual Dose (rem)	68	500	4.9 x 10-6	3.7 x 10-5
ICR	0.03	0.3	< 10-7	< 10-7
Collective Dose (person-rem)	1.3 x 106	9.8 x 106	0.096	0.71
LCF	700	5,000	5 x 10-5	4 x 10-4
Receptor	General Public - Potential Boundary			

Individual Dose (rem)	220	1,600	1.6 x 10-5	1.2 x 10-4
ICR	0.1	0.8	< 10-7	< 10-7

The 8-hour exposure time assumed for uninvolved workers and the general population is very conservative; however, LCFs would still be expected in the general population if the unmitigated release lasted only 30 minutes. As shown in Table 5-9 for the mitigated ITRS spray release, ensuring that the spray is confined within the pit virtually eliminates the possibility of adverse health effects.

The ITRS safety analysis also evaluated a release of toxic gases from the ventilation system as the level of waste in the tank was reduced during a waste transfer (WHC 1995f). Although evaluated as an anticipated accident, this type of release would be expected to occur whenever the waste level in a tank containing dissolved gasses is significantly reduced. A process simulator was used to estimate the concentration of ammonia and nitrogen oxide at the ventilation system exhaust for a range of ventilation rates at a drawn down rate of 93 cm (37 in) of waste per day. These concentrations were compared to the toxic chemical risk guidelines developed by Davis (WHC 1994c). These guidelines establish a correspondence between the frequency of a release and airborne concentrations of toxic chemicals. For an anticipated release, onsite concentrations should not exceed ERPG-1. ERPG-1 is defined by the American Industrial Hygiene Association as "The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor." Using a sum-of-the-fractions method, the concentrations of ammonia and nitrogen oxide were approximately 5 percent of ERPG-1.

- Past Practice Sluicing System - Accident scenarios developed for the PPSS (WHC 1994d) involve the same general types of accidents, pipe breaks and spray releases, as those evaluated for the ITRS but use somewhat different assumptions and parameter values in estimating release durations and accident frequencies. These differences appear to be due to the application of an older set of assumptions rather than to any fundamental differences in the systems, equipment, and components. To standardize the basis for comparison with other systems, the PPSS accident scenarios have been modified to reflect the assumptions used in safety assessments for the RCSTS and ITRS. The details of these changes are discussed in Appendix F, Section F.1.3.4. The principal changes are elimination of reliance on the seismic shutoff switch to terminate pipe leaks and elimination of the assumption of three independent operator errors to cause loss of confinement for spray leaks. Release rates per unit time have not been altered.

The preliminary safety evaluation (PSE) for the Tank 106-C PPSS (WHC 1994d) evaluated pipe breaks caused by operational failures and by earthquakes. That system includes approximately 600 m (2,000 ft) of piping and was assumed to operate 8,770 hr/yr. The length of piping that would be used in a PPSS for Tank 102-SY is unknown but would be expected to be similar to that for the ITRS if Tank 102-SY supernatant is used as the sluicing fluid. It is also anticipated that retrieval operations using the PPSS would require approximately the same length of time as the ITRS. Accordingly, the probability of an unmitigated PPSS pipe break is considered to be incredible and that for a mitigated PPSS pipe break is considered to be unlikely. Consequences shown in Table 5-10 assume an 8-hour leak for the unmitigated accident and a 2-hour leak for the mitigated accident. Under these assumptions, no adverse health effects would be expected among workers but 2 LCFs would be expected in the general population as the result of a PPSS unmitigated pipe break under the preferred alternative based on Tank 102-SY waste. If the accident involved BSW, the maximally exposed uninvolved worker would have a 1 in 10 chance of developing a fatal cancer (0.1 ICR) and 6 LCFs would be expected in the general population. No adverse health effects would be expected for the mitigated accident with Tank 102-SY waste and the consequences of the mitigated accident with BSW would be similar to those for the unmitigated accident with Tank 102-SY waste.

Pressurized spray leaks could occur within pump and valve pits used during PPSS operations and produce severe consequences if the spray is not confined within the pit. For this evaluation, the probability of unmitigated and mitigated PPSS spray leaks is assumed to be the same as for the ITRS. The unmitigated spray release is considered to be extremely unlikely to incredible and the mitigated spray release to be anticipated to unlikely. As shown in Table 5-11, the PPSS unmitigated

Table 5-10
Estimated Health Effects from PPSS Pipe Breaks under the Preferred Alternative

Release Location	SY Tank Farm			
Mitigation	Unmitigated		Mitigated	
Waste	102-SY	BSW	102-SY	BSW
Dilution (diluent:waste)	0:1	1:1	0:1	1:1
Probability	Incredible	Not Applicable	Unlikely	Not Applicable
Receptor	Involved Workers			
Individual Dose (rem)	6.4	24	1.6	5.9
ICR	0.003	0.009	6 x 10-4	0.002
Receptor	Uninvolved Workers			
Individual Dose (rem)	93	340	23	86
ICR	0.04	0.1	0.009	0.03
Collective Dose (person-rem)	610	2,300	150	570
LCF	0.2	0.9	0.06	0.2
Receptor	General Public - Existing Boundary			
Individual Dose (rem)	0.17	0.61	0.042	0.15
ICR	8 x 10-5	3 x 10-4	2 x 10-5	8 x 10-5
Collective Dose (person-rem)	3,500	13,000	880	3,300
LCF	2	6	0.4	2
Receptor	General Public - Potential Boundary			
Individual Dose (rem)	0.52	1.9	0.13	0.48
ICR	3 x 10-4	0.001	7 x 10-5	2 x 10-4

Table 5-11
Estimated Health Effects from PPSS Spray Releases under the Preferred Alternative

Release Location	SY Tank Farm			
Mitigation	Unmitigated		Mitigated	
Waste	102-SY	BSW	102-SY	BSW
Dilution (diluent:waste)	0:1	0:1	0:1	0:1
Probability	Extremely Unlikely to Incredible	Not Applicable	Anticipated to Unlikely	Not Applicable
Receptor	Involved Workers			
Individual Dose (rem)	1,000	3,800	1.4 x 10-5	5.1 x 10-5
ICR	0.4	2	< 10-7	< 10-7
Receptor	Uninvolved Workers			
Individual Dose (rem)	54,000	2.0 x 105	7.2 x 10-4	0.0027
ICR	20	80	3 x 10-7	1 x 10-6
Collective Dose (person-rem)	3.1 x 105	1.2 x 106	0.0041	0.015
LCF	100	500	2 x 10-6	6 x 10-6
Receptor	General Public - Existing Boundary			
Individual Dose (rem)	50	180	6.5 x 10-7	2.4 x 10-6
ICR	0.02	0.09	< 10-7	< 10-7

Collective Dose (person-rem)	9.7 x 105	3.6 x 106	0.013	0.047
LCF	500	2,000	6 x 10-6	2 x 10-5
Receptor	General Public - Potential Boundary			
Individual Dose (rem)	160	600	2.1 x 10-6	7.8 x 10-6
ICR	0.08	0.3	< 10-7	< 10-7

spray leak would be expected to cause adverse health effects. Based on 8-hour exposures, death of the maximally exposed uninvolved worker, 100 LCFs in the maximally exposed uninvolved worker population, and 500 LCFs in the general population would be anticipated. No adverse health effects would be expected for the mitigated PPSS spray release.

Consequences based on the BSW would be approximately five time greater for the mitigated and unmitigated accidents. In view of the stage of design of retrieval systems for Tank 102-SY, these health effects are not considered to be significantly different from those for the ITRS.

5.1.11 POTENTIAL MITIGATION MEASURES

This section discusses the potential mitigation measures for the preferred alternative.

Fugitive dust emissions during construction would be mitigated by watering of exposed areas and stabilizing spoils piles by use of vegetation or soil fixative.

The preferred alternative would include the establishment of revegetation sites to mitigate the removal of native soil and vegetation in the areas of the construction activities. The potential options for habitat restorations are discussed in Subsection 5.1.4 and Appendix D.

5.2 ANTICIPATED IMPACTS OF THE TRUCK TRANSFER ALTERNATIVE

The analysis of the environmental impacts of the truck transfer alternative considers:

- The construction and operation of new load and unload facilities;
- Additional roadway segments;
- Operation of a transfer vehicle, and;
- Continued operation of the mixer pump in Tank 101-SY to mitigate hydrogen generation.

The primary components that would make up the truck transfer alternative are described in detail in Section 3.1.2.

5.2.1 GEOLOGY, SEISMOLOGY, AND SOILS

Minimal impacts on geological resources or soils would be expected from the truck transfer alternative. Because the majority of roadways, facilities proposed for the alternative already exist, and since the load and unload facilities would be located on relatively subdued topographical surfaces, a minimal amount of site modification would be required. This would slightly modify the existing terrain, restrict access to part of the Hanford Site, and insignificantly disturb soil resources.

5.2.1.1 Geologic Resources

- The impact to the geologic environment from the truck transfer alternative would be minimal. Restriction of public access to mineral deposits already exists at the Hanford Site. Restriction of resource access for Hanford Site operations would have minimal impact since sand and gravel resources are readily available at other areas within the Hanford Site.

Adequate soils engineering would be employed during site preparation to preclude any potential for subsidence. Faulting, as described in Section 4.1.1, has not been identified in the Hanford Site vicinity. Due to the generally subdued topography of the proposed site, landslides or slope failure would not present a hazard. The construction and operation of the facilities proposed for the truck transfer alternative would not impact the geology of the Hanford Site.

5.2.1.2 Seismology

- Seismic hazards discussed in Section 4.1.2 would not impact the facilities proposed as part of the truck transfer alternative.

The proposed loading and unloading facilities would be designed to resist a variety of loads including dead, live, pressure, thermal, and seismic loads. The seismic loads are those resulting from:

- Passage of seismic waves (i.e., wave-propagation effects)
- Seismic-induced building settlements and seismic anchor movements
- Soil failure due to liquefaction, landslide, etc., if applicable
- Transfer of stress between the inner and outer pipelines at their connection points.

The seismic design of the facilities proposed in the truck transfer alternative would be according to the general requirements of DOE Order 6430.1A, its primary reference LLNL/UCRL-15910 and BNL 52361. The DBE for which items would be designed is specified by DOE as the maximum horizontal ground surface acceleration (WHC 1994a, WHC 1993a, WHC 1993b). Seismic hazards are not expected to affect continued use of the ECSTS until the truck transfer facilities are built due to the amount of waste to be transferred and the unlikely probability of an accident event rupturing the ECSTS.

5.2.1.3 Soils

- The majority of the 200 East and West Areas and the potential construction sites for the load and unload facilities and roadway segments are covered with sandy soil that supports vegetative cover (sagebrush and various grasses) (PNL 1995). Vegetation protects the soil from wind erosion. The sandy soil would be susceptible to both short-term and long-term wind erosion if it were exposed during clearing for construction. Wind erosion would be prevented through normal dust control procedures throughout construction. Without irrigation, none of the soils affected by the truck transfer alternative are prime or unique farmlands, prime forest lands, or prime pasture lands (Brincken 1994).

5.2.2 WATER RESOURCES AND HYDROLOGY

Potential spills and leaks from the facilities proposed as part of the truck transfer alternative are not expected during normal operations. The potential for accidental releases associated with the truck transfer alternative is dealt with in Section 5.2.10. Under normal operating conditions no impacts to water resources are anticipated. Even in the unlikely event of a spill to the ground, ground-water resources would be protected by the thick vadose zone in this area and the tendency for many radionuclides to be retained in the soils. Design features incorporating double containment of the transfer vessels and spill handling capabilities at load and unload facilities would provide an added level of protection for ground-water resources.

5.2.3 PHYSICAL ENVIRONMENT

Impacts of the truck transfer alternative on the physical environment are examined in terms of the following elements of the environment:

- Air Quality
- Radiation
- Sound Levels and Noise.

5.2.3.1 Air Quality

- Air quality impacts have been considered for construction and routine operations of the truck transfer alternative. This subsection describes the analytical approach applied to construction and operational emissions.

- Construction Emissions - Airborne particulate emissions from construction of load and unload facilities and additional roadway segments were estimated using emission factors identified in Section 5.1.3.1. The total area of disturbance for the truck transfer facilities is estimated to be approximately 2 ha (5 acres). The average dust emission rate would be 2.2 g/s (4.9 x 10-3 lb/s). Based on the size of the construction areas and the duration of ground disturbance activities, construction-related emissions from the truck transfer alternative would not exceed the applicable air quality standards described in Section 4.

  Construction measures to control fugitive dust emissions would include water application to unstable soils or soil fixative application, as necessary.

- Operations Emissions - Routine operations of the truck transfer alternative are assumed to produce negligible or very minor chemical emissions, mainly from tanker air displacement during filling. No exceedances of Ecology ASILs are assumed for this alternative, as the load and unload facilities would employ HEPA filters for filtration of ventilating air which would control particulate matter at a high removal efficiency. Due to the number of daily truck transfer trips, the amount of time the vehicle engines would be operating and the short duration it would take to transfer the waste from West to East Areas, vehicle emissions are not expected to exceed ASILs.

5.2.3.2 Radiation

- Airborne emissions of radioactive materials from normal operation of facilities proposed as part of the truck transfer alternative would not result in any measurable increase in radioactivity in off-site air, water, soil, vegetation, and animals. Section 5.2.9 assesses the impacts from emissions of radioactive materials under the truck transfer alternative.

5.2.3.3 Sound Levels and Noise

- Potential noise impacts from construction and operation of the truck transport facilities would not be expected to exceed maximum noise levels set by the State of Washington. Due to the distance of potential receptors, duration of noise-generating activities and existing ambient noise levels at the Hanford Site, no noise impacts are expected as part of the truck transfer alternative. If necessary, a hearing conservation program including the use of OSHA-approved hearing protection would be implemented for workers during operations.

5.2.4 BIOLOGICAL AND ECOLOGICAL RESOURCES

The impacts of the truck transfer alternative on biological and ecological resources would be minimal because little or no habitat would be disrupted. The only new construction would be the load and unload facilities and a small roadway segment, and they would be in previously disturbed areas. Therefore, no mature sagebrush habitat would be affected. Due to location of the proposed truck transport facilities and the lack of significant habitat disturbance, adverse impacts to wildlife species and threatened or endangered species are not expected. An increase in road kills would not be expected from the additional activities through the area since the truck transfers would be infrequent and be moving very slowly.

5.2.5 POPULATION AND SOCIOECONOMIC IMPACTS

This section examines the impact the truck transfer alternative would have on population and socioeconomics in the region of influence. The analysis includes impacts to the local economy, income, population, housing, and local infrastructure, and an evaluation of environmental justice.

5.2.5.1 Local Economy and Employment

- As shown on Table 5-12, the truck transfer alternative would require an initial construction workforce of 35 workers for the truck transport facility for a duration of 1.5 years. Ten would come from the existing workforce and 25 would be new hires for the anticipated 18-month construction period. Operation of the transport facilities would require 12 persons from existing Hanford Site personnel.

Table 5-12
Effects of Truck Transfer Supporting Actions on Employment

Supporting Actions	Construction No. Jobs	Construction Existing/ New Hires	Construction Duration (mos)	Operations No. Jobs	Operations Existing/ New Hires	Operations Duration (yrs)	Assumptions
Truck Transport Facilities (load and unload/ roadway)	35	10/25	18	12	12/0	30	TWRS activities complete in 30 years

Source: (WHC 1995g)

For every job created at the Hanford Site, 1.2 jobs are created locally. For every new hire from outside the region of influence, 1.3 persons would move into the local region. The total employment multiplier is 2.2 and population growth is 2.2 x 1.3, or 2.86. These multipliers are based on the socioeconomic input/output analysis performed by PNL in 1987 and 1989 (DOE 1991). All operations personnel would come from the existing workforce. For 25 temporary construction jobs created under the truck transfer alternative, 55 new jobs would be created locally. Some of these jobs may be filled from the workers available in the community as a result of 1995 DOE cutbacks expected in 1995. New hires moving into the region of influence are not expected to increase population above 1995 peak levels and would therefore not have significant socioeconomic impacts.

5.2.5.2 Income

- Construction for the truck transfer alternative would generate construction income for the region of influence. It is expected this income would impact beyond Benton and Franklin Counties, although a majority of the income would flow into these two counties over a period of one and one-half years. Construction costs associated with services, goods, and materials would constitute the majority of the income generated to Benton and Franklin Counties. Potential fabrication of project components outside the location could reduce income impacts to the local area.

5.2.5.3 Population

- As discussed in Section 5.2.5.1, the population growth multiplier has been determined to be 2.86. Therefore, assuming all 25 new hires move into the community from outside the region of influence, a population increase of 72 could occur. However, the actual increase is expected to be less since jobs may be filled by the available workforce resulting from general DOE cutbacks at the Hanford Site. The actual number depends on the availability of qualified workers for the new construction jobs. The maximum increase is less than 2 percent of the expected DOE cutbacks, and therefore problems typically associated with sudden population growth are not anticipated.

5.2.5.4 Housing

- The truck transfer alternative would not have a significant impact on the housing market. The demand for single-family units and rental units as well as other modes of housing is expected to decline as a result of the DOE cutbacks at the Hanford Site. Housing for new hires is expected to be readily available as former Hanford Site employees leave the region of influence to pursue employment elsewhere. No housing shortage or price increase is anticipated to result from this alternative.

5.2.5.5 Local Infrastructure

- Due to the relatively small amount of temporary employment (and therefore, population growth) provided by this alternative, the demand for public education, police and fire protection, and medical services is not expected to increase above 1995 peak levels. In light of DOE cutbacks, overburdening of these community services would not result from this alternative.

5.2.5.6 Environmental Justice

- The primary socioeconomic impact of the truck transfer alternative would be from temporary construction workers hired for the project duration. However, this impact would be offset by DOE workforce reductions. In addition, no health effects to any off-site population are anticipated. Therefore, no disproportionate impacts to low-income or minority populations would occur as a result of this alternative. See Appendix C for a more detailed discussion of environmental justice issues.

5.2.6 TRANSPORTATION

The following subsections summarize the impacts to the Hanford Site transportation system for the truck transfer alternative relevant to vehicular and other transportation facilities.

5.2.6.1 Vehicular Traffic and Circulation

- Construction vehicles transporting heavy equipment and workers during construction of the truck transfer facilities would utilize the same roadways described in Section 5.1.6.1. Construction of truck transfer facilities is expected to last approximately 1.5 years. The volume of construction vehicles during this time would vary. As a worst-case condition, construction of the truck transfer facilities would require up to 35 additional construction personnel. Based on vehicle occupancy rates, an estimated 26 additional vehicle trips would be generated. Because the amount of construction generated vehicles would be a relatively small incremental increase in vehicle traffic compared to the existing daily traffic on affected roadways and because the affected roadways are currently operating at acceptable service levels, construction generated traffic from the truck transfer alternative is not expected to adversely affect any roadway.

As described in Section 3.1.2.1, the truck transfer alternative provides for either the LR-56(H) or the modified tanker truck to transport waste cross-site. The principal road that would accommodate transport of waste via truck is Route 3, the road that directly connects the 200 East and West Areas. Route 3 currently handles approximately 1,500 vehicles per day and operates at a "C" LOS during peak hours. Waste transfer of diluted HLW utilizing either the LR-56(H) or the tanker truck is not expected to have significant impacts to on-site traffic circulation.

The truck transfer alternative proposes waste transfer of SWL from SSTs and WAFW, utilizing either the LR-56(H) or the modified tanker truck. The volume of SWL from SSTs and West Area facility waste to be transferred on an annual basis would be approximately 5 million L (267,000 gal). Assuming an average volume of waste distribution transfer from SSTs and West Area facilities, approximately three daily waste transfer trips would be generated using the LR-56(H). Using the same assumptions, approximately one daily waste transfer trip would be generated using the modified tanker truck. While the estimated transfer trips could be accommodated by the affected roadways for either waste transfer vehicle, potential traffic circulation impacts could occur from the required administrative controls discussed in Section 4.6.1 (i.e., road barricades, speed limitations, escorts, etc). Significant adverse traffic circulation impacts would not be expected with SWL or WAFW transfer using either the LR-56(H) or the modified tanker truck based on:

- The number of transfer trips generated
- Shipping during off-peak hours
- Providing prior notice to on-site operations.

5.2.6.2 Other Transportation Facilities

- Bus line service, vessel traffic, and rail service would not be adversely impacted by the truck transfer alternative. Based on the available capacity of all transportation routes affected by the truck transfer alternative and the expected infrequent use of these transport modes, adverse impacts to these other transportation facilities from the truck transfer alternative are not expected.

5.2.7 LAND USE

The truck transfer alternative would not alter the current or foreseeable future land use patterns or aesthetic and visual resources of the 200 East and West and 600 Areas. Each of these topics are discussed in the following subsections.

5.2.7.1 Land Use Patterns

- The truck transfer alternative would require the commitment of approximately 0.8 ha (2 acres) of land for the load and unload facilities and 1.48 km (.92 mi) of new roadway. The area affected by the truck transfer alternative is currently used and designated for waste storage and handling. The truck transfer alternative would be consistent with all applicable land use guidance documents, as discussed in Sections 5.1 and 5.2. In addition, no other appropriate land uses would be precluded with implementation of this alternative.

5.2.7.2 Aesthetic and Visual Resources

- The load and unload facilities proposed as part of the truck transfer alternative are anticipated to be one-story, rectangular structures. Due to the relatively small size of the load and unload facilities in relation to existing on-site structures, the existing industrialized character of the 200 East and West Areas, and the distance between potential viewers and the proposed truck transfer facilities, there would be no visual impact to off-site viewers with implementation of the truck transfer alternative.

5.2.8 CULTURAL RESOURCES

As discussed in Subsection 4.8, field surveys conducted over the 200 East and West Areas have not identified archeological or historical sites of significance. In addition, no archeological or religious sites of Native American concern have been identified in the proposed project area. As a consequence, construction of the truck transfer alternative would not adversely affect cultural resources.

5.2.9 ANTICIPATED HEALTH EFFECTS UNDER NORMAL CONDITIONS

This section discusses the potential cause and magnitude of health effects that are anticipated to occur under normal conditions as the result of implementation of the truck transfer alternative. These health effects could result from direct exposure to ionizing radiation or inhalation of toxic and radioactive materials. The various types of health effects that could occur and the relationship between exposure and health effects are discussed in Appendix E. This section evaluates health effects in terms of LCFs for radiation exposures and in terms of ICR and systemic toxic effects for chemical exposures. The truck transfer alternative is described in Section 3.1.2 and briefly summarized here.

The truck transfer alternative consists of continued operation of the mixer pump in Tank 101-SY, continued pumping of SST SWLs in the 200 West Area, continued storage of WAFW, use of tanker trailer trucks for cross-site transfer of wastes to the 200 East Area, and construction of two new HLW load and unload facilities to support loading and unloading of the tanker trailer trucks with HLW and high-activity wastes. It is assumed that the ECSTS would be used for cross-site transfer of non-complexed liquids until either no usable lines remain or tanker trailer trucks are available for this purpose. Complexed SWLs would be transferred to the 200 East Area using tanker trailer trucks to avoid mixing with the TRU sludge in Tank 102-SY, the staging tank for the ECSTS in the 200 West Area.

Two tanker trailer truck transfer options are considered. The first is a slightly modified version of the LR-56(H) cask used in France for transport of HLW. The 3,800-L (1,000-gal) capacity double containment cask is mounted on a truck trailer car and has 5-cm (2-in) lead-equivalent shielding. The second is a 19,000-L (5,000-gal) double-shell steel tank with 5-cm (2-in) lead-equivalent shielding. The tank would be mounted on a truck trailer. Several other DOE sites use similar tanks for waste transport, but no other DOE site is known to transport HLW in 19,000-L (5,000-gal) tanks (WHC 1993d).

Activities considered as normal conditions under the truck transfer alternative would include:

. Facility Construction
. Facility Operation
. Facility Decontamination and Decommissioning.

Each of these activities relevant to health effects is discussed in the following subsections.

5.2.9.1 Facility Construction

- Two new HLW load and unload facilities would be constructed under the truck transfer alternative. These facilities would be capable of handling HLW and other high-activity wastes.

Design documents required by DOE Order 4700.1 have not been prepared for the HLW load and unload facilities; however, aspects of facility design have been discussed by Howden (WHC 1993d). One facility is assumed to be located in the vicinity of the A Tank Farm in the 200 East Area and one in the vicinity of the SY Tank Farm in the 200 West Area (WHC 1995h). Construction could involve excavation and other earth-moving activities in contaminated soils and construction in the vicinity of contaminated existing process pits and piping. These activities could result in exposure to direct radiation and airborne contaminants and one similar to those during construction of the RCSTS. The RCSTS construction dose of 26.3 person/rem (Light 1994) is considered to bound radiation exposures to workers during construction of the HLW load and unload facilities. Release of airborne contaminants to the atmosphere would be controlled by using temporary enclosures or, for large outdoor areas, soil fixatives. Other measures to control exposures would include decontamination of work areas, use of protective equipment, and implementation of work procedures specific to the work. No exposure of the off-site public would be anticipated during construction of the load and unload facilities.

5.2.9.2 Facility Operations

- Facility operations under the truck transfer alternative would include operation of the Tank 101-SY mixer pump, continued pumping of the SST SWLs in the 200 West Area, continued storage of WAFW, and transfer of waste to the 200 East Area using both the ECSTS and tanker trailer trucks. These activities involve sampling and monitoring of waste and ventilation systems, inspection and surveillance, and maintenance of equipment and facilities.

Workers and members of the general public could be exposed to the following emissions during these activities:

. Direct Radiation
. Airborne Emissions of Radioactive Materials
. Airborne Emissions of Chemicals.

Estimated doses and resultant health effects for each of these exposures are discussed in the following list.

. Direct Radiation - Workers performing routine operations, maintenance, and surveillance would be exposed to direct radiation during mixer pump operations, SWL pumping, tanker trailer truck loading and unloading, and associated cross-site transfers. Many of these activities are similar to those now being performed by tank farm workers.

Worker exposure records prior to construction of DSTs indicate that tank farm workers had received an average annual dose of 630 mrem from direct radiation exposure (DOE 1980). The DSTs are now the main focus of tank farm operations and include many design features such as improved shielding and remotely-operated and remotely-monitored systems. An examination of more recent radiation exposure records of tank farm workers indicates that the average annual individual dose has dropped to 14 mrem (DOE 1992b). Activities performed by these workers include SWL pumping and inter-farm waste transfer.

The design of the HLW load and unload facility would incorporate features to reduce radiation exposures to operations personnel. These features would include use of modular separable components to isolate and minimize contamination; use of washable or strippable coatings to simplify decontamination; use of remote manipulators for operations and maintenance; and minimization of the surface area that would be subject to contamination.

Radiation and contamination surveys would be required before the tanker trailer truck leaves the load facility and as it arrives at the unload facility. Workers performing these surveys would be exposed to direct radiation. A recent evaluation (WHC 1995h) estimated a dose of 1.6 person-rem/trip. This estimate assumed two Health Physics (HP) technicians spent 8 hours each per trip in a 100 mrem/hr field and is considered to be extremely conservative. Exposure times of 20 minutes for each technician to take smears and exposure rate measurements is considered more reasonable and would result in a dose of 0.07 person-rem per trip. Due to differences in capacity and geometry, exposure rates may be different for the LR-56(H) and the 19,000 L (5,000 gal) tanker trailer truck. In the absence of a design for the latter, a dose of 0.07 person-rem trip is considered reasonable for both.

The total dose to HP technicians during vehicle surveys under the truck transfer alternative would depend on the volumes and types of waste transferred. Dose associated with the transfer of each type of waste is shown in Table 5-13. If the ECSTS remained serviceable during the interim period, only complexed SWL would require transport by tanker trailer truck and the cumulative dose to the technicians would be 38 person-rem for transfer of known complexed SWL using the LR-56(H) and 8 person-rem using the 19,000 L (5,000 gal) tanker. If all SWL and WAFW

Table 5-13
Estimated Worker Exposure during Vehicle Surveys under the Truck Transfer Alternative

Waste Type		LR-56(H)		19,000-L (5,000-gal) Tanker	
		Trips	Person-Rem	Trips	Person-Rem
SWL					
Complexed		575	38	115	8
Uncharacterized		1,221	81	244	16
Non-Complexed		2,426	162	485	32
	Sub-Total	4,222	281	844	56
WAFW		469	31	94	6
	Total	4,691	312	938	62

from the 200 West Area were transported, cumulative dose would increase to 312 person-rem for the LR-56(H) and 62 person-rem for the 5,000 gal tanker. Based on an occupational risk factor 4 x 10-4 LCFs per person-rem, 0.1 LCFs would be expected for transfer of all of these liquids using the LR-56(H) and 0.02 LCFs would be expected if the 19,000-L (5,000-gal) tanker trailer truck were used. In either case adverse health effects would be unlikely. Estimates of the potential dose to the driver of the truck are not available. Informal calculations were performed for this EIS based on the mean of all liquids inventory in the SST, estimated by Hey and Savino (WHC 1994e). The calculations indicate that dose rates of approximately 20 mrem/hr can be expected at the driver position for the LR-56(H). This exposure rate combined with an assumed average speed of 24 kmph (15 mph) over the 10 km (6.5 mi) distance yields an unacceptably high dose to drivers under the truck transfer alternative. A formal shielding analysis is necessary and restrictions on the quantities of radioactive materials transport may be necessary to ensure that radiation exposure during transport is consistent with ALARA principles.

Exposures to workers operating and maintaining the HLW load and unload facilities would be reduced by the following design features:

- Use of modular, separable components to isolate and minimize contamination
- Use of washable or strippable coatings to simplify decontamination
- Use of remote manipulators for operations and maintenance functions
- Minimization of the surface area that would be subject to contamination.

. Airborne Emissions of Radioactive Materials - Workers and members of the general public could be exposed to airborne emissions of radioactive materials as the result of implementation of the truck transfer alternative. Emissions from continued operation of the Tank 101-SY mixer pump and from salt well pumping activities would be expected to be the same as for the no action alternative and are discussed in Section 5.5.9. Other emissions could occur during loading and unloading of the tankers, an activity that would replace transfer of the SWLs to Tank 102-SY under the no action alternative.

Estimates of emissions from the HLW load and unload facilities are not available; however, emissions are monitored at the ventilation system stack at the existing 204-AR Waste Unloading Facility. The 204-AR facility is located in the 200 East Area and is the most modern of the load and unload facilities at the site. It is designed for unloading of low-level waste (LLW) from 76,000 L (20,000 gal) rail cars. Air from the unloading area and the catch tank is passed through two HEPA filters and is exhausted from a single stack equipped with a CAM used for monitoring radiation. Emissions from this stack were below the limit of detection in 1992 (DOE 1992c) and 1993 (DOE 1994a). The total dose to the maximum individual from all stack emissions in the 200 West Area during 1993 was 0.0012 mrem (DOE 1994a). On this basis, no adverse health effects are anticipated as the result of airborne emissions of radionuclides under the truck transfer alternative.

. Airborne Emissions of Chemicals - Workers and members of the general public could be exposed to airborne emissions of chemicals as the result of implementation of the truck transfer alternative. Emissions from continued operation of the Tank 101-SY mixer pump and from SWL pumping would be expected to be the same as for the no action alternative. Other emissions of chemicals could occur during loading and unloading of the tankers, an activity that would replace transfer of SWL to Tank 102-SY under the no action alternative.

It is anticipated that workers would not be present in the bay while waste is being transferred to or from the tanker trailer and that air from the bay and vent lines would pass through HEPA filters prior to discharge. Workers in the vicinity of the discharge could be exposed to VOCs that were not released during SWL pumping. The magnitude of this exposure is expected to be similar to that from transfer of SWLs and West Area Facility Waste to Tank 102-SY under the no action case. Thus operation of the load and unload facilities under the truck transfer alternative is not expected to result in any increase in health effects due to emissions for toxic chemicals.

5.2.9.3 Facility Decontamination and Decommissioning

- The load and unload facilities that would be constructed in the 200 East and West Areas under the truck transfer alternative would require decontamination and decommissioning. Decontamination and decommissioning of facilities such as the existing DSTs and SSTs and the ECSTS considered in this EIS and of TWRS facilities are to be addressed in detail in a separate, future EIS.

The design of these new facilities incorporates features that would simplify their decontamination and reduce the amount of material that requires disposal as radioactive waste. These features include use of modular, separable components to isolate and minimize contamination; use of washable or strippable coatings to minimize contamination; and minimization of the lengths of pipe and duct runs that would be subject to contamination.

5.2.10 HEALTH EFFECTS UNDER ACCIDENT CONDITIONS

This section discusses the human health effects that could occur as the result of potential accidents during the implementation of the truck transfer alternative. Initiating events, frequencies of occurrence, and quantities of respirable hazardous materials released during a range of potential accidents are discussed in detail in Appendix F. No construction accident fatalities are anticipated for this alternative based on the death rate of 31 per 100,000 workers (National Safety Council 1994). The types of health effects that can occur and the relationship between exposure and health effects are discussed in Appendix E. This section evaluates health effects in terms of LCFs for radiation exposures. Health effects for exposures to chemicals during accidents that involve exposure to both radioactive and toxic materials are not specifically evaluated. A previous analysis (WHC 1994c) concluded that radiological releases are limiting in these cases provided the release duration is at least 2 minutes and 40 seconds. The minimum release duration of combined radiological and chemical releases evaluated under the truck transfer alternative is 30 minutes.

The accidents considered in Appendix F include scenarios both within and beyond the design bases of the options and facilities comprising the truck transfer alternative. Terms used to categorize accidents and the corresponding frequency ranges are summarized in Table 5-3. Based on frequencies of occurrence and quantities of hazardous materials released, a subset of these accidents was selected for evaluation of reasonably foreseeable health effects.

The actions proposed under the truck transfer alternative involve the use of the following systems:

- Existing Cross-Site Transfer System
- Truck Tanker Trailers
- Load/Unload Facilities.

The types and quantities of waste that would be handled by each system are summarized in Table 5-14. Detailed characterizations of the wastes listed in Table 5-14 are provided in Appendix E. Accidents that could occur in each of

Table 5-14
Volumes of Tank Waste Transferred from the 200 West Area under the Truck Transfer Alternative

Waste Type[b]	Volume (kgal) [a]	Systems Used
SWL		
Complexed	575	Truck Load/Unload
Uncharacterized	1,221	
Non-Complexed	2,426	ECSTS, Truck Load/Unload
Salt Well Total	4,222	
WAFW	469	ECSTS, Truck Load/Unload
Grand Total	4,691	

Source: Salt Well Volumes (WHC 1995a)
Salt Well Pumping Schedule (WHC 1994b)

[a] 1 kgal = 3,780 L
[b] Tanks BX-111, T-111, and C-106 are excluded.

these systems are discussed in the following sections. To bound the probability of accidents under the truck transfer alternative, it is assumed that all wastes shown in Table 5-14 are handled using truck tanker trailers and the new load/unload facilities.

5.2.10.1 Existing Cross-Site Transfer System

- Transfer pipe breaks and spray releases could occur during operation of the ECSTS under the truck transfer alternative and result in release of tank waste to the soil column and to the atmosphere. The consequences of these accidents are identical to those discussed in Section 5.5.10 for the no action alternative; however, the probability is less that these accidents would occur under the truck transfer alternative. Under the truck transfer alternative, the ECSTS would be used for transfers of non-complexed salt well liquids and only until the ECSTS fails or the truck tanker trailers and supporting load/unload facilities are available.

5.2.10.2 Truck Tanker Trailer

- Two types of tanker trailer trucks are considered for use under the truck transfer alternative. The LR-56(H) is a French-designed vehicle with a nominal capacity of 3,800 L (1,000 gal). The design includes a 1.3-cm (0.5-in) stainless steel tank with a 1.3-cm (0.5-in) stainless steel secondary containment, 5-cm (2-in) lead equivalent shielding, and impact limiters. The second type is a 19,000-L (5,000-gal) tanker trailer truck that is not yet designed. It is assumed to have design features similar to the LR-56(H).

These vehicles would transport SWL and WAFW between new HLW load and unload facilities in the 200 West and East Areas. The new HLW load and unload facilities are assumed to be located in the vicinity of the SY Tank Farm in the 200 West Area and the A Tank Farm in the 200 East Area. Roads would be constructed to connect these facilities with the existing road network (see Figure 3-18). The total road distance between the load and unload facilities would be 10 km (6.5 mi) (WHC 1995h). Accidents involving the load/unload facilities are considered in Section 5.2.10.3. This section evaluates accidents that could occur while the vehicles are enroute.

The original LR-56 has a French Type B(U) certification. Type B packages are designed to withstand punctures, severe impacts, and sustained fires. Unilateral Type B certifications [Type B(U)] are not valid outside the certifying country. The LR-56(H) is a slightly modified version for use at Hanford. It may be difficult to design a 19,000-L (5,000-gal) bulk liquid container to meet Type B specifications. There are no plans to obtain United States Type B certifications for either tanker trailer truck for use at the Hanford Site. As a result, the containment capabilities of these two tankers are assumed to be typical of packages used to transport much lower quantities and concentrations of radioactive material. Release of liquid waste is assumed to occur in accidents involving collisions with subsequent uncontrolled fires and rollovers (WHC 1993d).

The use of Hanford Site data to develop accident frequencies for the truck transfer alternative is discussed in Section F.4.1.3 of Appendix F. The probability of an accident that would release the entire contents of the tanker during the interim period is extremely unlikely: 3.2 x 10-5 for the LR-56(H) and 6.4 x 10-6 for the 19,000-L (5,000-gal) tanker.

Health effects from the loss of 100 percent of the tank contents are shown in Table 5-15 for the LR-56(H) and in Table 5-16 for the 19,000-L (5,000-gal) tanker trailer truck. No adverse health effects would be expected for either size tank, even if the accident involved BSW. Dose and health effects for these accidents are directly proportional to tank capacity and that probability is inversely proportional. As a result risk, as measured by the product of consequence and probability, is the same for the two truck options.

5.2.10.3 Load and Unload Facility

- Accidents could also occur during loading and unloading operations. Although the load and unload facilities have not been designed, spray leaks and spills during loading and seismically-induced breaches of the transport container would be similar to those postulated for the existing 204-AR LLW unloading facility (WHC 1991a).

The leak scenario assumes that a large fraction (0.1 percent) of the waste spilled becomes airborne and, for this reason, is considered to bound spray release scenarios. In the absence of specific design information, this type of release is considered to be anticipated to unlikely. As indicated in Table 5-17, no adverse health effects would be expected as the result of spills during loading and unloading of tankers with SWL, WAFW, or BSW.

The seismically-induced breach scenario also assumed that 0.1 percent of the spilled waste, in this case the entire contents of the transport vehicle, would become airborne. The probability of this accident scenario occurring during the implementation of the truck transfer alternative is unlikely or 1.5 x 10-3 for the LR-56(H) and 3.0 x 10-4 for the 19,000-L (5,000-gal) tank. Estimated doses and health effects for facilities in the 200 West and 200 East Areas are shown in Tables 5-18 and 5-19, respectively. No adverse health effects would be expected for SWL, or WAFW for the LR56(H) tanker truck. A 1:1 dilution of BSW was used for comparison with SWL and WAFW which have low solids contents. This scenario is similar to, but more conservative than that considered for in-transit tank breaches (Tables 5-15 and 5-16) in that it assumes a greater respirable fraction released and a longer on-site exposure time. If the accident should involve BSW, adverse health effects would be expected in the maximum uninvolved worker population and the general population. No adverse health effects would be expected for SWL from the 19,000 L (5,000-gal) truck tanker, however, adverse health effect could occur among the general public from the WAFW.

Table 5-15
Estimated Health Effects from In-Transit Breach of a LR-56(H) Tanker under the Truck Transfer Alternative

Release Location	200 West Area		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Unlikely	Extremely Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	8.8 x 10-4	0.038	0.14
ICR	4 x 10-7	2 x 10-5	6 x 10-5
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.013	0.55	2.0
ICR	5 x 10-6	2 x 10-4	8 x 10-4
Collective Dose (person-rem)	0.085	3.6	13
LCF	3 x 10-5	0.001	0.005
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	1.9 x 10-5	8.3 x 10-4	0.0031
ICR	< 10-7	4 x 10-7	2 x 10-6
Collective Dose (person-rem)	0.40	17	64
LCF	2 x 10-4	0.009	0.03
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	6.1 x 10-5	0.0026	0.0096
ICR	< 10-7	1 x 10-6	5 x 10-6
Release Location	200 East Area		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Unlikely	Extremely Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	8.8 x 10-4	0.038	0.14
ICR	4 x 10-7	2 x 10-5	6 x 10-5
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.013	0.55	2.0
ICR	5 x 10-6	2 x 10-4	8 x 10-4
Collective Dose (person-rem)	0.35	15	56
LCF	1 x 10-4	0.006	0.02
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	2.7 x 10-5	0.0011	0.0042
ICR	< 10-7	6 x 10-7	2 x 10-6
Collective Dose (person-rem)	0.40	17	64
LCF	2 x 10-4	0.009	0.03
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	3.3 x 10-5	0.0014	0.0052
ICR	< 10-7	7 x 10-7	3 x 10-6

Table 5-16
Estimated Health Effects from In-Transit Breach of a 19,000-L (5,000-Gal) Tanker under the Truck Transfer Alternative

Release Location	200 West Area		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Extremely Unlikely	Extremely Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.0044	0.19	0.7
ICR	2 x 10-6	8 x 10-5	3 x 10-4
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.064	2.8	10
ICR	3 x 10-5	0.001	0.004
Collective Dose (person-rem)	0.42	18	67
LCF	2 x 10-4	0.007	0.03
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	9.6 x 10-5	0.0041	0.015
ICR	< 10-7	2 x 10-6	8 x 10-6
Collective Dose (person-rem)	2.0	86	320
LCF	0.001	0.04	0.2
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	3.0 x 10-4	0.013	0.048
ICR	2 x 10-7	7 x 10-6	2 x 10-5
Release Location	200 East Area		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1

Probability	Extremely Unlikely	Extremely Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.0044	0.19	0.7
ICR	2 x 10-6	8 x 10-5	3 x 10-4
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.064	2.8	10
ICR	3 x 10-5	0.003	0.004
Collective Dose (person-rem)	1.8	75	280
LCF	7 x 10-4	0.03	0.1
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	1.3 x 10-4	0.0057	0.021
ICR	< 10-7	3 x 10-6	1 x 10-5
Collective Dose (person-rem)	2.0	86	320
LCF	0.001	0.04	0.2
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	1.6 x 10-4	0.007	0.026
ICR	< 10-7	4 x 10-6	1 x 10-5

Table 5-17
Estimated Health Effects from a HLW Spill in the Load and Unload Facilities under the Truck Transfer Alternative

Release Location	200 West Area		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Anticipated to Unlikely		Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	6.6 x 10-4	0.029	0.11
ICR	3 x 10-7	1 x 10-5	4 x 10-5
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.0035	0.15	0.55
ICR	1 x 10-6	6 x 10-5	2 x 10-4
Collective Dose (person-rem)	0.024	1.0	3.8
LCF	1 x 10-5	4 x 10-4	0.002
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	4.5 x 10-6	1.9 x 10-4	7.2 x 10-4
ICR	< 10-7	1 x 10-7	4 x 10-7
Collective Dose (person-rem)	0.10	4.4	16
LCF	5 x 10-5	0.002	0.008
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	1.4 x 10-5	5.9 x 10-4	0.0022
ICR	< 10-7	3 x 10-7	1 x 10-6
Release Location	200 East Area		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Anticipated to Unlikely		Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	6.6 x 10-4	0.029	0.11
ICR	3 x 10-7	1 x 10-5	4 x 10-5
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.0035	0.15	0.055
ICR	1 x 10-6	6 x 10-5	2 x 10-4
Collective Dose (person-rem)	0.096	4.1	15
LCF	4 x 10-5	0.002	0.006
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	6.2 x 10-6	2.6 x 10-4	9.8 x 10-4
ICR	< 10-7	1 x 10-7	5 x 10-7
Collective Dose (person-rem)	0.10	4.4	16
LCF	5 x 10-5	0.002	0.008
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	7.5 x 10-6	3.2 x 10-4	0.0012
ICR	< 10-7	2 x 10-7	6 x 10-7

Table 5-18
Estimated Health Effects from Seismic Breach of LR-56(H) at the Load and Unload Facilities under the Truck Transfer Alternative

Release Location	200 West Area (SY Tank Farm)		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Unlikely	Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.019	0.79	2.9
ICR	7 x 10-6	3 x 10-4	0.001
Receptor	Uninvolved Workers		

Individual Dose (rem)	0.96	41	150
ICR	4 x 10-4	0.02	0.06
Collective Dose (person-rem)	5.5	240	880
LCF	0.002	0.1	0.4
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	8.7 x 10-4	0.037	0.14
ICR	4 x 10-7	2 x 10-5	7 x 10-5
Collective Dose (person-rem)	16	680	2,500
LCF	0.008	0.3	1
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.0029	0.13	0.47
ICR	1 x 10-6	6 x 10-5	2 x 10-4
Release Location	200 East Area (A Tank Farm)		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Unlikely	Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.019	0.79	2.9
ICR	7 x 10-6	3 x 10-4	0.001
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.96	41	150
ICR	4 x 10-4	0.02	0.06
Collective Dose (person-rem)	25	1,100	4,000
LCF	0.01	0.4	2
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	0.0012	0.053	0.20
ICR	6 x 10-7	3 x 10-5	1 x 10-4
Collective Dose (person-rem)	16	680	2,500
LCF	0.008	0.3	1
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.0015	0.066	0.24
ICR	8 x 10-7	3 x 10-5	1 x 10-4

Table 5-19
Estimated Health Effects from Seismic Breach of 19,000-L (5,000-Gal) Tanker at the Load and Unload Facilities under the Truck Transfer Alternative

Release Location	200 West Area (SY Tank Farm)		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Unlikely	Extremely Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.092	4.0	15
ICR	4 x 10-5	0.002	0.006
Receptor	Uninvolved Workers		
Individual Dose (rem)	4.8	210	760
ICR	0.002	0.08	0.3
Collective Dose (person-rem)	28	1,200	4,400
LCF	0.01	0.5	2
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	0.0044	0.19	0.69
ICR	2 x 10-6	9 x 10-5	3 x 10-4
Collective Dose (person-rem)	78	3,400	12,000
LCF	0.04	2	6
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.015	0.63	2.3
ICR	7 x 10-6	3 x 10-4	0.001
Release Location	200 East Area (SY Tank Farm)		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Unlikely	Extremely Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.092	4.0	15
ICR	4 x 10-5	0.002	0.006
Receptor	Uninvolved Workers		
Individual Dose (rem)	4.8	210	760
ICR	0.002	0.08	0.3
Collective Dose (person-rem)	130	5,400	20,000
LCF	0.05	2	8
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	0.0062	0.27	0.98
ICR	3 x 10-6	1 x 10-4	5 x 10-4
Collective Dose (person-rem)	78	3,400	12,000
LCF	0.04	2	6
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.0077	0.33	1.2

ICR	4 x 10-6	2 x 10-4	6 x 10-4

5.2.11 POTENTIAL MITIGATION MEASURES

Minimal land disturbance in the truck transfer alternative results in a limited need for mitigation. Watering and soil stabilization to control fugitive dust emissions during construction will be performed. Post-construction planting of disturbed areas which are not required as part of the new facilities would also be performed to help control erosion.

5.3 ANTICIPATED IMPACTS OF THE RAIL TRANSFER ALTERNATIVE

The analysis of the environmental impacts of the rail transfer alternative considers:

. The construction and operation of new load and unload facilities;

. Additional railway segments;

. Operating rail transfer vehicles; and

. Continued operation of the mixer pump in Tank 101-SY to mitigate hydrogen generation.

The primary components of the rail transfer alternative are described in Section 3.1.3.

5.3.1 GEOLOGY, SEISMOLOGY, AND SOILS

The rail transfer alternative would not have significant impacts on geological resources or soils. A minimum amount of site modifications would be required since the majority of the railways affected by the rail transfer already exist and a relatively small amount of soil disturbance would be required with construction of the load and unload facilities. This would slightly modify the existing terrain, restrict access to part of the Hanford Site, and insignificantly disturb soil resources.

5.3.1.1 Geologic Resources

- The impact to the geologic environment of the rail transfer alternative would be minimal. Restriction of public access to mineral deposits already exists at the Hanford Site. Restriction of resource access for site operations would have minimal impact since sand and gravel resources are readily available at other areas within the Hanford Site.

Adequate soils engineering would be employed during site preparation to preclude any potential for subsidence. Faulting, as described in Section 4.1.1, has not been identified in the site vicinity. Due to the generally subdued topography of the proposed site, landslides or slope failure would not present a hazard. The construction and operation of the facilities proposed for the rail transfer alternative would not impact the geology of the Hanford Site.

5.3.1.2 Seismology

- Seismic hazards discussed in Section 4.1.2, would not impact the facilities proposed as part of the rail transfer alternative. The proposed load and unload facilities and the new rail segments would be designed to resist a variety of loads including dead, live, pressure, thermal, and seismic loads. The seismic loads are those resulting from:

. Passage of seismic waves (i.e., wave-propagation effects)

. Seismic-induced building settlements and seismic anchor movements

. Soil failure due to liquefaction, landslide, etc., if applicable

. Transfer of stress between the inner and outer pipelines at their connection points.

The seismic design of the facilities proposed as part of the rail transfer alternative would be according to the general requirements of DOE Order 6430.1A, its primary reference LLNL/UCRL-15910 and Guidelines BNL 52361. The DBE for which items would be designed is specified by DOE as the maximum horizontal ground surface acceleration (WHC 1994a, WHC 1993a, WHC 1993b). Seismic hazards are not expected to affect continued use of the ECSTS until the rail transfer facilities are built due to the amount of waste to be transferred and the unlikely probability of an accident event rupturing the ECSTS.

5.3.1.3 Soils

- The majority of the 200 East and West Areas and the potential construction sites for the load and unload facilities and railway segments are covered with sandy soil that supports vegetative cover (sagebrush and various grasses) (PNL 1995). Vegetation protects the soil from wind erosion. The sandy soil would be susceptible to both short-term and long-term wind erosion if it were exposed during clearing for construction. Wind erosion would be minimized through normal dust control procedures throughout construction.

Without irrigation, none of the soils affected by the rail transfer alternative are prime or unique farmlands, prime forest lands, or prime pasture lands (Brincken 1994).

5.3.2 WATER RESOURCES AND HYDROLOGY

This section discusses the impacts the new storage alternative would have on water resources and hydrology.

Potential spills and leaks from the facilities proposed as part of the rail transfer alternative are not expected during normal operations. The potential for accidental releases associated with the rail transfer is dealt with in Section 5.2.10. Under normal operating conditions no impacts to water resources are anticipated. Even in the unlikely event of a spill to the ground, ground-water resources would be protected by the thick vadose zone in this area and the tendency for many radionuclides to be retained in the soils. Design features incorporating double containment and spill handling capabilities at the load and unload facilities would provide an added level of protection for ground-water resources.

5.3.3 PHYSICAL ENVIRONMENT

Impacts of the rail transfer alternative on the physical environment are examined in terms of the following elements of the environment:

- Air Quality
- Radiation
- Sound Levels and Noise.

5.3.3.1 Air Quality

- Air Quality impacts have been considered for construction and routine operations of the rail transfer alternative. This section describes the analytical approach applied to construction and operational emissions.

- Construction Emissions - Airborne emissions from construction of load and unload facilities and additional railway segments were estimated using emission factors identified in Section 5.1.3.1. The total area of disturbance for the truck transfer facilities is estimated to be approximately 2 ha (5 acres). The average dust emission rate would be 2.2 g/s (45 x 10-3 lb/s). Based on the size of the construction areas and the duration of ground disturbance activities, construction-related emissions from the truck transfer alternative would not exceed the applicable Air Quality Standards described in Section 4.

  Construction measures to control fugitive dust emissions would include water application to unstable soils or soil fixative application, as necessary.

- Operations Emissions - Routine operations of the rail transfer alternative are projected to produce minimal chemical emissions, mainly from tanker air displacement during filling and diesel locomotive use.

No exceedances of Ecology ASILs are assumed for this alternative, as the load and unload facilities will employ HEPA filters for filtration of ventilating air which would control particulate matter at a high removal efficiency.

5.3.3.2 Radiation

- Airborne emissions of radioactive materials from normal operation of facilities proposed as part of the rail transfer alternative would not result in any measurable radiation increase in off-site air, water, soil, vegetation, and animals. Section 5.3.9 assesses the impact from emissions of radioactive material under the rail transfer alternative.

5.3.3.3 Sound Levels and Noise

- Potential noise impacts from construction and operation of the rail transport facilities would not be expected to exceed maximum noise levels set by the State of Washington. Due to the distance of potential receptors, infrequent use of rail facilities, duration of noise-generating activities while rail facilities are in use and existing ambient noise levels at the Hanford Site, no noise impacts are expected as part of the rail transfer alternative. If necessary, a hearing conservation program including the use of OSHA-approved hearing protection would be implemented for workers during operations.

5.3.4 BIOLOGICAL AND ECOLOGICAL RESOURCES

The impacts of the rail transfer alternative on biological and ecological resources would be minimal because very little habitat would be disrupted. The only new construction would be the load and unload facilities and a small railway segment, and they would be in previously disturbed areas. Therefore, little or no mature sagebrush habitat would be affected. An increase in road kills would not be expected from the additional activities through the area, since the rail transport vehicles would be moving very slowly and not pose much threat to most wildlife species.

5.3.5 POPULATION AND SOCIOECONOMIC IMPACTS

This section examines the impact the rail transfer alternative would have on population and socioeconomics in the region of influence. The analysis includes impacts to the local economy, income, population, housing, and local infrastructure, and an evaluation of environmental justice.

5.3.5.1 Local Economy and Employment

- The rail transfer alternative would require an initial construction workforce of 35 workers for the rail transport facility for a duration of 1.5 years. Ten would come from the existing workforce and 25 would be new hires. Operation of the transport facility would require 12 persons from existing Hanford Site personnel (see Table 5-20).

Table 5-20
Effects of Rail Transfer Supporting Actions on Employment

Supporting Actions	Construction			Operations			Assumptions
	No. Jobs	Existing/ New Hires	Duration (mos)	No. Jobs	Existing/ New Hires	Duration (yrs)	
Rail Transport TWRS Facilities activities (load and unload	35	10/25	18	12	Existing	30	complete in 30 years

rail spur)

Source: (WHC 1995g)

For every job created at the Hanford Site, 1.2 jobs are created locally. For every new hire from outside the region of influence, 1.3 persons would move into the local region. The total employment multiplier is 2.2 and population growth is 2.2 x 1.3, or 2.86. These multipliers are based on the socioeconomic input/output analysis performed by PNL in 1987 and 1989 (DOE 1991). All operations personnel would come from the existing workforce. For 25 temporary construction jobs created under the rail transfer alternative, 55 new jobs would be created locally. Some of these jobs may be filled from the workers available in the community as a result of DOE cutbacks expected in 1995. New hires moving into the region of influence are not expected to increase population above 1995 peak levels and would not have significant socioeconomic impacts.

5.3.5.2 Income

- Construction for the rail transfer alternative would generate construction income for the region of influence. It is expected this income would impact beyond Benton and Franklin Counties, although a majority of the income would flow into these two counties over a period of one and one-half years. Construction costs associated with services, goods, and materials would constitute the majority of the income generated to Benton and Franklin Counties. Potential fabrication of project components outside the local area could reduce income impacts to the local area.

5.3.5.3 Population

- As discussed in Section 5.3.5.1, the population growth multiplier has been determined to be 2.86. Therefore, assuming all 25 new hires move into the community from outside the region of influence, a population increase of 72 could occur. However, the actual increase is expected to be less since jobs may be filled by the available workforce resulting from general DOE cutbacks at the Hanford Site. The actual number depends on the availability of qualified workers for the new construction jobs. The maximum increase is less than 2 percent of the expected DOE cutbacks, and therefore problems typically associated with sudden population growth are not anticipated.

5.3.5.4 Housing

- The rail transfer alternative would not have a significant impact on the housing market. The demand for single-family units and rental units as well as other modes of housing is expected to decline as a result of the DOE cutbacks at the Hanford Site. Housing for new hires is expected to be readily available as former Hanford Site employees leave the region of influence to pursue employment elsewhere. No housing shortage or price increase is anticipated to result from this alternative.

5.3.5.5 Local Infrastructure

- Due to the relatively small amount of temporary employment, and therefore, population growth, provided by this alternative, the demand for public education, police and fire protection, and medical services are not expected to increase above 1995 peak levels. In light of DOE cutbacks, overburdening of these community services would not result from this alternative.

5.3.5.6 Environmental Justice

- As discussed above, the primary socioeconomic impact of the rail transfer alternative would be from temporary construction workers hired for the project duration. However, this impact would be offset by DOE workforce reductions. In addition, no health effects to any off-site population are anticipated. Therefore, no disproportionate impacts to low-income or minority populations would occur as a result of this alternative. See Appendix C for a more detailed discussion of environmental justice issues.

5.3.6 TRANSPORTATION

Vehicular Traffic and Circulation - Potential transportation impacts from the rail transport alternative would result from construction of the new rail transfer facilities and rail car operations. Potential transportation impacts from construction of rail transfer facilities would be essentially identical to those discussed in Section 5.2.6.1. The following discussion summarizes potential impacts from waste transfer activities during rail car operations.

The rail car that would be used to transport waste has a 38,000-L (10,000-gal) capacity. If all SWL and WAFW were transferred by rail car, approximately 470 train trips would be required to transfer all the waste. Assuming an average volume of waste transfer from SSTs and West Area facilities, approximately two daily waste transfer trips would be generated using the rail car. Current rail usage to the 200 East and West Areas is infrequent. The 15.6-km (9.7-mi) railway distance between the 200 East and West Areas would not experience any rail traffic congestion problems, nor would there be any adverse impacts to the rest of the Hanford Site railway from HLW transfer via rail car. With respect to potential circulation effects from road closures during rail car operations, significant impacts would not be expected due to shipping restrictions to off-peak hours, early notification, and the short duration of road closures.

5.3.7 LAND USE

The rail transfer alternative would not alter the current or foreseeable future land use patterns or aesthetic and visual resources of the 200 East and West and 600 Areas. Each of these topics are discussed in the following sections.

5.3.7.1 Land Use Patterns

- The rail transfer alternative would require the commitment of approximately 0.8 ha (2 acres) of land for the load and unload facilities and 490 m (1,600 ft) of new railway. The area affected by the rail transfer alternative is currently used and designated for waste storage and handling. The rail transfer alternative would be consistent with all applicable land use guidance documents, reports, and DOE orders. In addition, no other appropriate land uses would be precluded with implementation of this alternative.

5.3.7.2 Aesthetic and Visual Resources

- The load and unload facilities proposed as part of the rail transfer alternative are anticipated to be one-story, rectangular structures. Due to the relatively small size of the load and unload facilities in relation to existing on-site structures, the existing industrialized character of the 200 East and West Areas, and the distance between potential viewers and the proposed rail transfer facilities, there would be no visual impact to off-site viewers with implementation of the rail transfer alternative.

5.3.8 CULTURAL RESOURCES

As discussed in Section 4.8, field surveys conducted over the 200 East and West Areas have not identified archeological or historical sites of significance. In addition, no archeological or religious sites of Native American concern have been identified in the proposed project area. As a consequence, construction of the rail transfer alternative would not adversely affect cultural resources.

5.3.9 ANTICIPATED HEALTH EFFECTS UNDER NORMAL CONDITIONS

This section discusses the potential cause and magnitude of health effects that are anticipated to occur under normal conditions as the result of implementation of the rail transfer alternative. These health effects could result from direct exposure to ionizing radiation or inhalation of toxic and radioactive materials. The various types of health effects that could occur and the relationship between exposure and health effects are discussed in

Appendix E. This section evaluates health effects in terms of LCFs for radiation exposures and in terms of incremental cancer risk and systemic toxic effects for chemical exposures. The rail transfer alternative is described in Section 3.1.3 and briefly summarized here.

Under the rail transfer alternative, a shielded rail tanker car would be used to transfer wastes to the 200 East Area. Two high-activity, HLW load and unload facilities, would be constructed to support use of the rail car. One facility is assumed to be in the vicinity of the SY Tank Farm in the 200 West Area and the other in the vicinity of the A Tank Farm in the 200 East Area. Operation of the mixer pump in Tank 101-SY, SST SWL pumping, and storage of WAFW would all continue. It is assumed that the ECSTS would continue to be used for cross-site transfer of non-complexed liquid wastes until either no usable lines remain or rails cars are available for this purpose. Complexed SWLs would be transferred to the 200 East Area using the rail tanker car to avoid mixing with the TRU sludge in Tank 102-SY, the staging tank for the ECSTS in the 200 West Area.

The 38,000-L (10,000-gal) rail tanker car for HLW has not been designed although a 76,000-L (20,000-gal) rail car is used for transfer of LLW at the Hanford Site. Several other DOE sites use similar 19,000-L (5,000-gal) tanks for waste transport but no other DOE site is known to transport HLW in 19,000-L (5,000-gal) or larger tanks (WHC 1993d). The 38,000-L (10,000-gal) rail tanker car is assumed to be of double-shell stainless steel construction with 5-cm (2-in) lead-equivalent shielding (WHC 1993d, WHC 1995h).

Activities considered as normal conditions under the rail transfer alternative would include:

- Facility Construction
- Facility Operation
- Facility Decontamination and Decommissioning.

Each of these activities relevant to health effects is discussed in the following sections.

5.3.9.1 Facility Construction

- Facility construction activities and associated health effects under the rail transfer alternative are identical to those for the truck transfer alternative discussed in Section 5.2.9.1

5.3.9.2 Facility Operation

- Workers and members of the general public could be exposed to direct radiation and airborne radiological and chemical emissions during normal operations under the rail transfer alternative. These exposures include:

- Direct Radiation
- Airborne Emissions of Radioactive Materials
- Airborne Emissions of Chemicals.

Estimated doses and resultant health effects for each of these exposures are discussed in the following list.

- Direct Radiation - Workers performing routine operations, maintenance, and surveillance would be exposed to direct radiation during jet mixer pump operations, salt well pumping, rail tanker loading and unloading, and associated cross-site transfers. Activities associated with the mixer pump, SWL pumping, and inter-farm transfers would be essentially the same as are now being performed by tank farm workers. Tank workers receive an average annual dose of 14 mrem (DOE 1992b).

  As discussed in Section 5.2.9 for the truck transfer alternative, radiation and contamination surveys would be performed on departing and arriving tankers. The larger capacity rail tanker cars would require fewer trips to transport the waste than either tank trailer truck option. Exposure rates on the exterior of the rail tanker would not be expected to be significantly greater due to self-shielding by the waste and approximately the same length of time is assumed to be required to conduct each survey. Therefore, the dose of 0.07 person-rem per trip estimated for tank trailer trucks is also considered reasonable for surveys of the rail tanker cars.

  The dose received by health physics technicians performing these surveys would depend on the extent to which the ECSTS could be used, as indicated in Table 5-21. If only known complexed SWL were transported using rail tanker cars, the total dose would be 4 person-rem. If all the SWL and WAFW were transported using rail tanker cars, the total dose would be 31 person-rem. Based on an occupational risk factor of 4 x 10-4 LCF/person-rem, 0.01 LCFs would be expected for transfer of all these wastes.

No significant direct radiation exposure is anticipated to the train crew. Site requirements specify that at least one spacer car be placed immediately before and after the car containing HLW (WHC 1993e). These spacer cars are expected to reduce radiation exposures to negligible levels at normally occupied positions in the train.

Exposures to workers operating and maintaining the HLW load and unload facilities under the rail transfer alternative are expected to be

Table 5-21
Estimated Worker Exposure during Vehicle Surveys under the Rail Transfer Alternative

Waste Type	Trips		Person-Rem
SWL			
Complexed	58		4
Uncharacterized	122		8
Non-Complexed	243		16
	423	Subtotal	28
WAFW	47		3
	470	Total	31

identical to those discussed in Section 5.2.9.2 for the truck transfer alternative.

. Airborne Emissions of Radioactive Materials - Airborne emissions under the rail transfer alternative are expected to be identical to those discussed in Section 5.2.9.2 for the truck transfer alternative.

. Airborne Emissions of Chemicals - Airborne emissions of chemicals under the rail transfer alternative are expected to be identical to those discussed in Section 5.2.9.2 for the truck transfer alternative.

5.3.9.3 Facility Decontamination and Decommissioning

- The load and unload facilities that would be constructed in the 200 East and West Areas under the rail transfer alternative would require decontamination and decommissioning. Decontamination and decommissioning of facilities such as the existing DSTs and SSTs and the ECSTS considered in this EIS and of TWRS facilities are to be addressed in detail in a separate, future EIS.

The design of these new facilities incorporates features that would simplify their decontamination and reduce the amount of material requiring disposal as radioactive waste. These features include use of modular, separable components to isolate and minimize contamination; use of washable or strippable coatings to minimize contamination; and minimization of the lengths of pipe and duct runs that would be subject to contamination.

5.3.10 HEALTH EFFECTS UNDER ACCIDENT CONDITIONS

This section discusses the human health effects that could occur as the result of potential accidents during the implementation of the rail transfer alternative. Initiating events, frequencies of occurrence, and quantities of respirable hazardous materials released during a range of potential accidents are discussed in detail in Appendix F. No construction accident fatalities are anticipated for this alternative based on the death rate of 31 per 100,000 workers (National Safety Council 1994). The types of health effects that can occur and the relationship between exposure and health effects are discussed in Appendix E. This section evaluates health effects in terms of LCFs for radiation exposures. Health effects for exposures to chemicals during accidents that involve exposure to both radioactive and toxic materials are not specifically evaluated. A previous analysis (WHC 1994c) concluded that radiological releases are limiting in these cases provided the release duration is at least 2 minutes and 40 seconds. The minimum release duration of combined radiological and chemical releases evaluated under the truck transfer alternative is 30 minutes.

The accidents considered in Appendix F include scenarios both within and beyond the design bases of the options and facilities comprising the rail transfer alternative. Terms used to categorize accidents and the corresponding frequency ranges are summarized in Table 5-3. Based on frequencies of occurrence and quantities of hazardous materials released, a subset of these accidents was selected for evaluation of reasonably foreseeable health effects.

The actions proposed under the rail transfer alternative involve the use of the following systems:

- Existing Cross-Site Transfer System
- Rail Tanker Cars
- Load/Unload Facilities.

The types and quantities of waste that would be handled by each system are summarized in Table 5-22. Detailed characterizations of the wastes listed in Table 5-22 are provided in Appendix E. Accidents that could occur in each of

Table 5-22
Volumes of Tank Waste Transferred from the 200 West Area under the Rail Transfer Alternative

Waste Type[b]	Volume (kgal)[a]	Systems Used
SWL		
Complexed	575	Rail
Uncharacterized	1,221	Load/Unload
Non-Complexed	2,426	ECSTS Rail Load/Unload
Salt Well Total	4,222	
WAFW	469	ECSTS Rail Load/Unload
Grand Total	4,691	

Source: Salt Well Volumes (WHC 1995a)
Salt Well Pumping Schedule (WHC 1994b)

[a] 1 kgal = 3,780 L
[b] Tanks BX-111, T-111, and C-106 are excluded.

these systems are discussed in the following sections. To bound the probability of accidents under the rail transfer alternative, it is assumed that all wastes shown in Table 5-22 are handled using rail tank cars and the new load/unload facilities.

5.3.10.1 Existing Cross-Site Transfer System

- Transfer pipe breaks and spray releases could occur during operation of the ECSTS under the truck transfer alternative and result in release of tank waste to the soil column and to the atmosphere. The consequences of these accidents are identical to those discussed in Section 5.5.10 for the no action alternative; however, the probability is less that these accidents would occur under the rail transfer alternative. Under the rail transfer alternative, the ECSTS would be used for transfers of non-complexed SWL and only until the ECSTS fails or the rail tank cars and supporting load/unload facilities are available.

5.3.10.2 Rail Tanker Car

- The rail tanker car for HLW transport at the Hanford Site has not been designed. It is assumed that the design would include a 1.3-cm (0.5-in) stainless steel tank with a 1.3-cm (0.5-in) stainless steel secondary containment, 5-cm (2-in) lead equivalent shielding, and impact limiters. The tank would have a nominal capacity of 38,000 L (10,000 gal) and would be mounted on a flat car. It is considered impractical to design a bulk liquid container of this size to meet Type B requirements. The rail tanker cars would be used to transport SWL and WAFW between new HLW load and unload facilities in the 200 West and East Areas. The new HLW load and unload facilities are assumed to be located in the vicinity of the SY Tank Farm in the 200 West Area and the A Tank Farm in the 200 East Area. Rail spurs would be constructed to connect these facilities with the existing rail network (see Figure 3-13). The total rail distance between the load and unload facilities would be 15.5 km (9.7 mi) (WHC 1995h). Derailments are considered the only reasonably foreseeable accident during transport that would result in release of any radioactive material. As part of the accident assessment for this EIS, fractional release frequencies for rail accidents were developed for the tank cars currently used for liquid LLW transport at the Hanford Site (WHC 1993e) (see Table F-10). It was estimated that the frequency of release of any material during a derailment is 1.5 x 10-8/km (2.4 x 10-8/mi) and the frequency of releasing 90 to 100 percent of the contents is 3.7 x 10-9/km (5.9 x 10-9/mi). The probability of a derailment accident releasing the entire contents of the rail car is extremely unlikely (2.7 x 10-5) during SST interim stabilization activities under the rail transfer alternative. This is equivalent to a frequency of 5.7 x 10-8 per trip. Health effects of the loss of 100 percent of the tank contents during transit are shown in Table 5-23. No adverse health effects would be expected for in- transit accidents involving SWL, WAFW, or BSW. Although doses for this accident under the rail transfer alternative are higher than for the truck transfer alternative, doses for both alternatives are so low that they would be indistinguishable on the basis of observable health effects.

Table 5-23
Estimated Health Effects from In-Transit Breach of a 38,000-L (10,000-Gal) Rail Tanker under the Rail Transfer Alternative

Release Location	200 West		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Extremely Unlikely	Extremely Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.0089	0.38	1.4
ICR	4 x 10-6	2 x 10-4	6 x 10-4
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.13	5.6	21
ICR	5 x 10-5	0.002	0.008
Collective Dose (person-rem)	0.85	37	140
LCF	3 x 10-4	0.01	0.05
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	1.9 x 10-4	0.0083	0.031
ICR	1 x 10-7	4 x 10-6	2 x 10-5
Collective Dose (person-rem)	4.1	170	640
LCF	0.002	0.09	0.3
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	6.1 x 10-4	0.026	0.097
ICR	3 x 10-7	1 x 10-5	5 x 10-5
Release Location	200 East		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Extremely Unlikely	Extremely Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.0089	0.38	1.4
ICR	4 x 10-6	2 x 10-4	6 x 10-4
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.13	5.6	21
ICR	5 x 10-5	0.002	0.008
Collective Dose (person-rem)	3.5	150	560
LCF	0.001	0.06	0.2
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	2.7 x 10-4	0.012	0.042
ICR	1 x 10-7	6 x 10-6	2 x 10-5
Collective Dose (person-rem)	4.1	170	640
LCF	0.002	0.09	0.3
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	3.2 x 10-4	0.014	0.052
ICR	2 x 10-7	7 x 10-6	3 x 10-5

5.3.10.3 Load and Unload Facility

- Accidents could also occur during loading and unloading operations. As discussed in Section 5.2.10.3, the leak scenario developed for the 204-AR LLW loading facility (WHC 1991a) is considered to bound the quantity of respirable material released and the frequency of occurrence of leaks and sprays at the HLW load and unload facilities. Health effects would be identical to those shown in Table 5-17 since the quantity of material released in this scenario depends on the filling rate and not the capacity of the transport vehicle. No adverse health effects would be expected for accidents involving SWL, WAFW, or BSW. A 1:1 dilution of BSW was used for comparison with SWL and WAFW which have low solids content. In the absence of specific design information, a leak during loading is considered to be anticipated to unlikely.

Doses and health effects for a seismically-induced breach of a 38,000-L (10,000-gal) rail tanker car are shown in Table 5-24. The probability of this accident scenario would be unlikely (1.5 x 10-4) and is dominated by accidents involving SWL. No adverse health effects would be expected for accidents involving SWL but could occur in the maximally exposed uninvolved worker population and in the general population for accidents involving WAFW or BSW. The volume of WAFW is relatively small and the probability of a seismically-induced breach of a rail tanker loaded with WAFW is extremely unlikely.

5.3.11 POTENTIAL MITIGATION MEASURES

This section discusses the potential mitigation measures for the rail transfer alternative relative to fugitive dust emissions. Fugitive dust emissions during construction of the facilities proposed as part of this alternative would be mitigated by watering of exposed areas and stabilizing spoils piles by use of vegetation or soil fixative.

Table 5-24
Estimated Health Effects from Seismic Breach of 38,000-L (10,000-Gal) Rail Tanker at the Load and Unload Facilities under the Rail Transfer Alternative

Release Location	200 West Area (SY Tank Farm)		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Unlikely	Extremely Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.18	7.9	29
ICR	7 x 10-5	0.003	0.01
Receptor	Uninvolved Workers		
Individual Dose (rem)	9.6	410	1,500
ICR	0.004	0.2	0.6
Collective Dose (person-rem)	55	2,400	9,000
LCF	0.02	0.9	4
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	0.0087	0.37	1.4
ICR	4 x 10-6	2 x 10-4	7 x 10-4
Collective Dose (person-rem)	160	6,800	25,000
LCF	0.08	3	10
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.029	1.3	5.0
ICR	1 x 10-5	6 x 10-4	0.002
Release Location	200 East Area (A Tank Farm)		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Unlikely	Extremely Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.18	7.9	29
ICR	7 x 10-5	0.003	0.01
Receptor	Uninvolved Workers		
Individual Dose (rem)	9.6	410	1,500
ICR	0.004	0.2	0.6
Collective Dose (person-rem)	250	11,000	40,000
LCF	0.01	4	20
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	0.012	0.53	2.0
ICR	6 x 10-6	3 x 10-4	0.001
Collective Dose (person-rem)	160	6,800	25,000
LCF	0.08	3	10
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.015	0.66	2.4
ICR	8 x 10-6	3 x 10-4	0.001

5.4 ANTICIPATED IMPACTS OF THE NEW STORAGE ALTERNATIVE

The analysis of the environmental impacts of the new storage alternative considers:

- Construction and operation of the NTF which consists of two new DSTs and associated facilities;

- RCSTS to replace the ECSTS;
- ITRS in Tank 101-SY, and;
- Retrieval system proposed in Tank 102-SY.

The facilities proposed as part of the new storage alternative are described in detail in Section 3.4.

5.4.1 GEOLOGY, SEISMOLOGY, AND SOILS

Construction of the new storage alternative would modify the existing terrain, restrict access to part of the Hanford Site, and disturb soil resources. This section discusses the influence that the new storage alternative would have on geologic resources, seismology, and soils.

5.4.1.1 Geologic Resources

- The impact to the geologic environment by the facilities proposed by the new storage alternative would be minimal. Restriction of public access to mineral deposits already exists at the Hanford Site. Restriction of resource access for Hanford Site operations would have minimal impact since sand and gravel resources are readily available at other areas within the Hanford Site.

Adequate soils engineering would be employed during site preparation to preclude any potential for subsidence. Faulting, as described in Section 4.1.1, has not been identified in the construction site vicinity. Due to the generally subdued topography of the proposed site and pipeline alignment, landslides or slope failure would not present a hazard. The construction and operation of the facilities proposed as part of the new storage alternative would not impact the geology of the Hanford Site.

5.4.1.2 Seismology

- Seismic hazards, discussed in Section 4.1.2 would not impact facilities proposed as part of this alternative. The NTF, RCSTS, associated facilities, and retrieval systems would be designed to resist a variety of loads including dead, live, pressure, thermal, and seismic loads. The seismic loads are those resulting from:

- Passage of seismic waves (i.e., wave-propagation effects)
- Seismic-induced building settlements and seismic anchor movements
- Soil failure due to liquefaction, landslide, etc., if applicable
- Transfer of stress between the inner and outer pipelines at their connection points.

The seismic design of the facilities proposed as part of the new storage alternative would be according to the general requirements of DOE Order 6430.1A, its primary reference LLNL/UCRL-15910 and Guidelines BNL 52361. The DBE for which items would be designed is specified by DOE as the maximum horizontal ground surface acceleration (WHC 1994a, WHC 1993a, WHC 1993b). Seismic hazards are not expected to affect continued use of the ECSTS until the RCSTS is built due to the amount of waste to be transferred and the probability of an accident event rupturing the ECSTS. Impacts to the ITRS or a retrieval system in Tank 102-SY are not expected since it would be seismically designed as part of the DST.

5.4.1.3 Soils

- The majority of the 200 East and West Areas and the construction sites for the proposed NTF and RCSTS are covered with sandy soil that supports vegetative cover (sagebrush and various grasses) (PNL 1995). Vegetation protects the soil from wind erosion. The sandy soil would be susceptible to both short-term and long-term wind erosion if it were exposed during clearing for construction. Wind erosion would be prevented through normal dust control procedures throughout construction.

The new storage alternative would include revegetation of the NTF sites to mitigate construction activities, (disturbance and removal of native soil and vegetation) and along the proposed route of the RCSTS. A detailed discussion of planned revegetation activities is provided in Section 5.1.4.

Without irrigation, none of the soils affected by the NTF and RCSTS are prime or unique farmlands, prime forest lands, or prime pasture lands (Brincken 1994).

5.4.2 WATER RESOURCES AND HYDROLOGY

This section discusses the impacts the new storage alternative would have on water resources and hydrology. Potential spills and leaks from the ECSTS or the proposed RCSTS, Tank 101-SY, Tank 102-SY retrieval system ITRS, or NTF are not expected during normal operations. No leaks have been recorded from the 28 DSTs installed in the 200 East and West Areas, supporting the supposition that the new DSTs would not leak during normal operations and that potential for impacts to water resources from the new storage alternative would be remote.

The potential for accidental releases is discussed in Section 5.2.10. Under normal operating conditions no impacts to water resources are anticipated. Even in the unlikely event of accidental release from any element of this alternative, ground-water resources would be protected by the thick vadose zone in this area and the tendency for many radionuclides to be retained in the soils. Secondary containment is provided by both the RCSTS and NTF providing an added level of protection for ground-water resources.

5.4.3 PHYSICAL ENVIRONMENT

Impacts of the new storage alternative on the physical environment are examined in terms of the following elements of the environment:

. Air Quality
. Radiation
. Sound Levels and Noise.

5.4.3.1 Air Quality

- Air quality impacts have been considered for construction and routine operations of the new storage alternative. This section describes the analytical approach applied to construction emissions and operational emissions.

. Construction Emissions - Construction activities for Tank 101-SY and Tank 102-SY retrieval systems would primarily occur within the tank farm area currently covered with gravel, therefore, potential dust emissions would be limited to RCSTS and NTF construction. Airborne emissions from construction of the NTF option sites and RCSTS were estimated using an EPA fugitive dust emission factor of 1.04 x 10-4 g/s/m2 (2.05 x 10-8 lb/s/ft2) assuming a 30-day month. The area of the RCSTS would be approximately 2.3 ha (5.7 acres). Thus, the average dust emission rate from this site would be 2.4 g/s (5.1 x 10-3 lb/s). The area for any of the NTF option sites would be approximately 5 ha (12 acres). Thus, the average dust emission rate from this site would be 5.2 g/s (0.01 lb/s). Airborne emissions from construction of the retrieval systems are not expected.

Air concentrations downwind of the RCSTS and downwind of the proposed NTF were computed using the ISCLT2 program from EPA. The wind direction ESE produced the largest concentrations of fugitive dust. Results of fugitive dust modeling for the RCSTS and the NTF are shown in Table 5-25.

Distance in Table 5-25 is measured from the center of the construction area. As the distance from the construction area increases, the average dust loading would decrease. At large distances, the area source appears no different than a point source. During NTF construction, the Ecology Air Quality Standard of 60 -g/m3 (3.7 x 10-9 lb/ft3) would be exceeded within 500 m (1,640 ft) from the area source.

Table 5-25
Air Concentrations from RCSTS and NTF Construction Dust Emissions

Concentration Concentration

Distance (m)a	(-g/m3)b RCSTS Source	(-g/m3)b NTF Source
300	43.33	76.57
400	33.05	60.38
500	26.22	47.95
700	18.00	32.36
1,000	11.39	21.26
2,000	4.24	8.27
5,000	1.09	2.16
10,000	0.39	0.78

a1 m = 3.281 ft
b-g/m3 = 6.2x10-11 lb/ft3

Receptors located more than 500 m (1,640 ft) downwind would not, on average, be exposed to fugitive dust concentrations which exceed applicable air quality standards. The construction of the RCSTS and NTF would not produce fugitive dust concentrations in excess of EPA Air Quality Standards beyond the Hanford Site boundary.

Because of distance and scheduling, it is expected that fugitive dust emissions from the new storage alternative would not cause an exceedance of particulate matter (PM) or PM10 ambient air quality standards. Construction activities would include activities to control fugitive dust emissions from the construction site, including watering exposed areas and stabilizing spoil piles by use of vegetation or soil fixative.

. Operations Emissions - Potential environmental impacts of airborne emissions of toxic contaminants and particulate matter from the NTF ventilation systems were conservatively estimated using the EPA dispersion model ISCST2. Methods for estimating and data are discussed in Appendix E. These estimates assumed that emissions for two storage tanks originate from an NTF in the 200 East Area (Site E) or the 200 West Area. Site E results would be representative of results from optional Site D in the 200 East Area.

The maximum 24-hour and annual ground level concentrations for the estimated emissions from two new DSTs are shown for expected air contaminants in Table 5-26. The table also shows the Ecology ASILs for each contaminant. As shown in Table 5-26, no exceedances are predicted. Operations from the ECSTS, RCSTS, or the retrieval systems are not expected to result in on-site or off-site effects based on their enclosed design.

5.4.3.2 Radiation

- Airborne emissions of radioactive materials from normal operation of facilities under the new storage alternative would not result in any measurable increase of radioactivity in off-site air, water, soil, vegetation, and animals. Emissions from all 177 existing tanks are already a minor contributor to overall site emissions (DOE 1992c). Although emissions from two DSTs under the new storage alternative would be added to he overall emissions, ventilation systems on these two DSTs would be expected to be at least as effective as those on existing tanks in reducing emissions. Section 5.2.9 assesses the impacts from emissions of radioactive materials under the new storage alternative.

5.4.3.3 Sound Levels and Noise

- Potential noise impacts from constructing and operating the new storage alternative, NTF, retrieval systems, and RCSTS at the Hanford Site would not be expected to exceed maximum noise levels set by the State of Washington.

The distance between the NTF, RCSTS, and the retrieval systems to the nearest receptor location is significant, creating a large buffer zone for noise abatement and control. Although occasional recreational usage of the Hanford Site occurs along the Columbia River and State Highway 240, the public would be protected from potential noise impacts by the distance from the proposed project site to these areas.

Table 5-26
Maximum 24-Hour and Annual Ground Level Concentrations for Emissions from Two DSTs

Contaminants	Extreme Case, 2 Tank Emissions (g/s)	24-Hour Concentration (-g/m3) Distance From Source, On-site 400m	24-Hour Concentration (-g/m3) Distance From Source, Off-site 12,978m	WAC 173-460-150 24-Hr ASIL (-g/m3)	Annual Concentration (-g/m3) Distance From Source, On-site 200m	Annual Concentration (-g/m3) Distance From Source, Off-site 10,771m	ASILs Annual ASIL (-g/m3)
Acetone	2.3x10-3	4.1x10-2	1.0x10-2	5.9x103	1.3x10-2	3.4x10-3	NA
Benzene	5.7x10-6	1.0x10-4	2.5x10-5	NA	3.2x10-5	8.3x10-6	1.2x10-1
1-Butanol	1.4x10-2	2.5x10-1	6.2x10-2	5.0x102	7.9x10-2	2.0x10-2	NA
Carbon Tetrachloride	4.3x10-8	7.6x10-7	1.9x10-7	NA	2.4x10-7	6.3x10-8	6.7x10-2
2-Hexanone	1.7x10-4	3.0x10-3	7.5x10-4	6.7x101	9.7x10-4	2.5x10-4	NA
4-Methyl-2-Pentanone (MIBK)	1.2x10-2	2.1x10-1	5.3x10-2	6.8x101	6.8x10-2	1.8x10-2	NA
Normal Paraffin Hydrocarbon (Kerosene)	1.7x10-2	3.0x10-1	7.5x10-2	NA	9.7x10-2	2.5x10-2	NA
Tributyl Phosphate	4.1x10-10	7.2x10-9	1.8x10-9	7.3	2.3x10-9	6.0x10-10	NA
Ammonia	4.9x10-6	8.7x10-5	2.2x10-5	1.0x102	2.8x10-5	7.2x10-6	NA
Silver (Ag)	2.8x10-15	4.9x10-14	1.2x10-14	3.0x10-2	1.6x10-14	4.1x10-15	NA
Arsenic (As)	1.8x10-13	3.2x10-12	8.0x10-13	2.3x10-2	1.0x10-12	2.6x10-13	NA
Barium (Ba)	9.1x10-16	1.6x10-14	4.0x10-15	1.7	5.2x10-15	1.3x10-15	NA
Calcium (Ca)	6.1x10-15	1.1x10-13	2.7x10-14	1.7x101	3.5x10-14	8.9x10-15	NA
Copper (Cu)	1.4x10-15	2.5x10-14	6.2x10-15	3.3	7.9x10-15	2.0x10-15	NA
Magnesium (Mg)	1.2x10-15	2.1x10-14	5.3x10-15	3.3x10-1	6.8x10-15	1.8x10-15	NA
Sodium (Na)	3.3x10-11	5.8x10-10	1.5x10-10	6.7	1.9x10-10	4.8x10-11	NA
Lead (Pb)	4.1x10-15	7.2x10-14	1.8x10-14	5.0x10-1	2.3x10-14	6.0x10-15	NA
Antimony (Sb)	5.6x10-15	9.9x10-14	2.5x10-14	1.7	3.2x10-14	8.2x10-15	NA
Selinium (Se)	3.6x10-15	6.4x10-14	1.6x10-14	6.7x10-1	2.0x10-14	5.3x10-15	NA
Aluminum Oxide (A1O2)	1.2x10-11	2.1x10-10	5.3x10-11	6.7	6.8x10-11	1.8x10-11	NA
Hydroxide (OH-)	5.1x10-12	9.0x10-11	2.3x10-11	NA	2.9x10-11	7.5x10-12	NA
Fluoride (F-)	9.8x10-13	1.7x10-11	4.3x10-12	5.3	5.6x10-13	1.4x10-12	NA
Iron Hydroxide (III) Fe(OH)3	1.7x10-12	3.0x10-11	7.5x10-12	3.3	9.6x10-12	2.5x10-12	NA
Chromium (III) Hydroxide (Cr(OH)3)	4.6x10-13	8.1x10-12	2.0x10-12	1.7	2.6x10-12	6.7x10-13	NA

NA = Not applicable

During construction, equipment may temporarily increase ambient noise levels at the proposed project site. Noise levels created by construction equipment have been measured and typical data are presented in Figure 5-1. Occupational noise exposure would be monitored within the work areas expected to exhibit noise levels beyond limits set by OSHA and threshold limit values established by the ACGIH. A hearing conservation program including the use of OSHA-approved hearing protection would be implemented to protect workers during these operations, if necessary.

5.4.4 BIOLOGICAL AND ECOLOGICAL RESOURCES

The construction of the new storage alternative would require removal of vegetation, destruction of habitat, and the generation of dust and noise for construction of two new tanks at either the 200 West Area or at one of two sites at the 200 East Area in addition to the RCSTS. Although construction activities would be temporary, they may have both short-term and long-term effects upon site vegetation and wildlife. The following sections examine the potential effects of the new storage alternative upon:

- Vegetation
- Wildlife
- Threatened or Endangered Species.

5.4.4.1 Vegetation

- Construction of the new storage alternative would remove vegetation from the tank sites and associated facility maintenance areas. In addition, construction staging, laydown, and spoils stockpiling areas would require the removal of vegetation and would disturb soil, but these areas would be revegetated by seeding with native species after construction is completed. The areas disturbed for construction of the RCSTS would be similarly revegetated after construction, except for the parts requiring access for monitoring and maintenance. If decommissioning of the facilities requires their removal at the end of their useful life, the site would be disturbed again at that time. All these disturbed land areas would have long-term changes in vegetation cover.

The RCSTS construction disturbance effects would be similar to the effects as described in Section 5.1.4. The vegetation at the three NTF optional sites is dominated by mature sagebrush. At any of the three sites, about 20 ha (50 acres) would be affected by construction activity. About two-thirds of that area would be needed for the tanks and support facilities and the remainder would be revegetated following construction.

Altogether, the disturbance from the RCSTS and NTF totals about 30 ha (73 acres) of big sagebrush/cheatgrass habitat, which would experience long-term effects. About one-third of this area probably could be revegetated after construction, but some of that would be subject to future disturbance because of its proximity to actively-used areas and for future decommissioning. The soil disturbance from construction activities would result in compaction, mixing of soil horizons, and wind erosion, conditions which favor species that thrive on disturbed soil. These conditions would make establishment of native-plant dominated communities more difficult. Big sagebrush communities are expected to require decades to become established and reach maturity. However, some key habitat components for wildlife could be obtained quickly by transplanting mature sagebrush. Seeding for revegetation of the impacted grey rabbitbrush habitats may also include sagebrush seed to encourage more complete development of shrub steppe vegetation with the highest value for wildlife species of concern. Areas that are currently barren would be similarly planted once construction of the facilities and pipeline is complete.

Mitigation besides revegetation of the acreage temporarily disturbed by the construction would be required. If the assumption is made that it would not be possible to restore within a reasonable time the sagebrush/cheatgrass habitat on the area that would be temporarily disturbed, then a full 30 ha (73 acres) would need mitigation. However, different parts of the construction area would receive different kinds of disturbance, and it may be more realistic to assume that some of the area would be restored to sagebrush cover.

The mature sagebrush habitat would be replaced at a ratio of 3:1. Sites would be selected that have a high likelihood of acceptance into a site-wide program if one is developed later. If the worst-case mitigation debt of 30 ha (73 acres) of sagebrush habitat is assumed, then a 3:1 ratio equals 89 ha (219 acres) of compensation area. If one assumes that one-third of the 30 ha (73 acres) of other habitats can be restored to sagebrush habitat, then about 59 ha (146 acres) would be needed in candidate restoration areas. Figure 5-2 shows the proposed area for restoration to occur. It has over 530 ha (1,300 acres) available for potential habitat restoration/enhancement. The site-disturbing activities that might be associated with restoration of sagebrush habitat would be minimized, and the impacts on the restoration sites would be minor and localized. Specific plots with adequate acreage will be selected and evaluated for cultural resources and ecological baseline information as part of the MAP.

5.4.4.2 Wildlife

- Clearing vegetation in the vicinity of the NTF option areas and the RCSTS pipeline corridor to construct the facilities and pipeline would result in a loss of habitat in that vicinity for some of the wildlife species on the Hanford Site. The anticipated clearing schedule would avoid the bird nesting season. Construction-related impacts would most likely affect the loggerhead shrike and sage sparrow (discussed in section 5.1.4.3), as well as nesting song birds (such as horned lark and western meadowlark), ground birds, small mammals, and reptiles, including the sagebrush lizard. Small mammals, reptiles, and crawling insects that require shade from vegetation would be subjected to habitat fragmentation (i.e., creation of relatively large habitat discontinuities where shrub cover is removed) if the area is not revegetated. Revegetating would minimize the operational impacts. Habitat restoration, a means that may be used for mitigation, would change grass-dominated habitat to sagebrush habitat and would favor some species to the detriment of others (for example, favor shrikes over horned larks). Overall, this effect would be minor because the grass-dominated habitats are abundant and tend to support few sensitive species. In addition, wildlife diversity would be expected to increase as a result.

Construction noise would temporarily displace some species. Roadkills would be expected for small mammals and reptiles that remain in the vicinity as heavy equipment moves across the sites. The operation of the facility would not have any significant impact on wildlife populations.

5.4.4.3 Threatened or Endangered Species

- No threatened or endangered plant species occur at either the 200 East or West areas or along the RCSTS corridor. The stalked-pod milkvetch, a State of Washington monitor species, has been found at several locations along the RCSTS corridor in both disturbed and undisturbed sagebrush habitats and may be affected. It may be interspersed in the proposed construction areas including potential mitigation sites. Even though some specimens of this species would be lost, the overall Hanford Site population would not be affected. Piper's daisy, a state-listed sensitive species, has been found in the gravel pit near the 200 East Area site and might occur in a portion of the expected site disturbance areas. It is unlikely that any disturbance of this species would affect the overall site-wide population of the species.

The loggerhead shrike, a Federal and state candidate species, the sagebrush lizard, a Federal candidate species, and the sage sparrow, a state candidate species, require mature sagebrush habitat. The loss of 30 ha (73 acres) out of about 93,000 ha (230,000 acres) on the Hanford Site of sagebrush/cheatgrass would be a direct loss of habitat for these species and other species that use sagebrush habitat. During spring 1995 surveys, 11 shrike nests were found along the RCSTS corridor, all of which would be affected by construction. Two loggerhead shrike nests were found on the alternate Tank Site D inside the 200 East Area. One sage sparrow was found on alternate Tank Site E outside the 200 East Area, while two were found on the 200 West Area tank site. All of these animals would be displaced if tanks are constructed at that site. These species would not be nesting on the potential mitigation sites and would not be affected by the mitigation activity.

5.4.5 POPULATION AND SOCIOECONOMIC IMPACTS

This section examines the impacts the new storage alternative would have on population and socioeconomics in the region of influence. The analysis includes impacts to the local economy, income, population, housing, and local infrastructure, and an evaluation of environmental justice.

5.4.5.1 Local Economy and Employment

- The new storage alternative would require an initial construction workforce of 20 workers for a duration of 8 months for the installation of the ITRS in Tank 101-SY and retrieval system in Tank 102-SY (4 months for each tank). Eighty workers would be required for a duration of 21 months for the construction of the RCSTS, 20 of whom would come from the existing workforce. In addition, 150 workers would be required for the construction of the NTF, expected to take 3 years. Twenty-five of the NTF construction workers would come from the existing site workforce, while the remaining 125 would be new hires. The workforce required to operate the ITRS in Tank 101-SY, retrieval system in Tank 102-SY, RCSTS, and NTF would total 59, all of whom would come from the existing workforce. These workforce figures are summarized in Table 5-27.

Table 5-27
Effects of New Storage Alternative on Employment

Construction	Operations

Supporting Actions	Duration (yrs)	Assumptions	No. Jobs	Existing/ New Hires	Duration (mos)	Assumptions	No. Jobs	Existing/ New Hires
ITRS/ Retrieval System (101/102)	Approx. 2	Tanks 101-SY and 102-SY would be retrieved sequentially	20	20/0	8	Retrieval Systems built independently	4	4/0
NTF (E/W option)	30	TWRS activities complete in 30 years	150	25/125	36	_	50/0	50/0
RCSTS	30	TWRS activities complete in 30 years	80	20/60	21	_	5	5/0

Source: (WHC 1995g)

For every job created at the Hanford Site, 1.2 jobs are created locally. For every new hire from outside the region of influence, 1.3 persons would move into the local region. The total employment multiplier is 2.2 and population growth is 2.2 x 1.3, or 2.86. These multipliers are based on the socioeconomic input/output analysis performed by Pacific Northwest Laboratories (PNL) in 1987 and 1989 (DOE 1991). All operations personnel would come from the existing workforce. For 185 temporary construction jobs (i.e., new hires) created at the Hanford Site under the new storage alternative, 407 new jobs would be created locally. Some of these jobs may be filled from the workers available in the community as a result of DOE cutbacks expected in 1995. New hires moving into the region of influence are not expected to increase population above 1995 peak levels and would not have significant socioeconomic impacts.

5.4.5.2 Income

- Construction for the new storage alternative would generate construction income for the region of influence. It is expected this income would impact beyond Benton and Franklin Counties, although a majority of the income would flow into these two counties over a period of 2 years. Construction costs associated with services, goods, and materials would constitute the majority of the income generated to the region of influence. Potential fabrication of project components outside the local area could reduce the beneficial income impacts to the local area.

5.4.5.3 Population

- As discussed in Section 5.4.5.1, the population growth multiplier has been determined to be 2.86. Therefore, assuming all 185 new hires move into the community from outside the region of influence, a population increase of 529 could occur. However, the actual increase is expected to be less since jobs may be filled by the available workforce resulting from general DOE cutbacks at the Hanford Site. The actual population increase depends on the availability of qualified workers for the new construction jobs. The maximum increase is approximately 10 percent of the expected DOE cutbacks, and therefore, problems typically associated with sudden population growth are not anticipated.

5.4.5.4 Housing

- The new storage alternative would not have a significant impact on the housing market in the region of influence. The demand for single-family units and rental units as well as other modes of housing is expected to decline as a result of the DOE cutbacks at the Hanford Site. Housing for new hires is expected to be readily available as former Hanford Site employees leave the region of influence to pursue employment elsewhere. No housing shortage or price increase is anticipated to result from this alternative.

5.4.5.5 Local Infrastructure

- Due to the relatively small amount of temporary employment, and therefore, population growth, the demand for public education, police and fire protection, and medical service is not expected to increase above 1995 peak levels. In light of DOE cutbacks, overburdening of these community services would not result from this alternative.

5.4.5.6 Environmental Justice

- As discussed above, the primary socioeconomic impact of the new storage alternative would be from temporary construction workers hired for the project duration. However, this impact would be offset by DOE workforce reductions. In addition, no health effects to any off-site population are anticipated. Therefore, no disproportionate impacts to low-income or minority populations would occur as a result of this alternative. Appendix C provides a more detailed discussion of environmental justice issues.

5.4.6 TRANSPORTATION

The following sections summarize the impacts to the Hanford Site transportation system for the new storage alternative.

5.4.6.1 Vehicular Traffic and Circulation

- Potential transportation impacts from this alternative would result from both NTF, retrieval system, and RCSTS construction. While traffic impacts for constructing the RCSTS portion of this alternative would be identical to the additional 60 daily trips described in Section 5.1.6.1, there would be additional construction traffic associated with the NTF. As a worst case condition, construction of the NTF and retrieval system would simultaneously require up to 170 construction personnel. Based on vehicle occupancy rates, an estimated 126 additional vehicle trips would be generated. Construction of the NTF is estimated to take 3 years. Because the amount of construction-generated vehicles would be relatively small compared to the daily traffic on these roadways and because the affected roadways are currently operating at acceptable service levels, the incremental increase in traffic from the new storage alternative is not expected to adversely affect roadway service levels.

Since the RCSTS would be located underground and operated remotely with existing Hanford Site workforce (Trost, Epperson 1995), no increase in vehicular traffic is expected to occur from its operation. Similarly, the estimated 54-person operational workforce for the NTF and retrieval systems would come from the existing Hanford Site workforce (Trost, Epperson 1995) resulting in no increase in vehicular traffic. No significant impacts to roadways are anticipated due to the operation of the new storage alternative.

5.4.6.2 Other Transportation Facilities

- As described in Section 5.1.6.2, bus line service, vessel traffic, and rail service would not be adversely affected by the new storage alternative. Based on the available capacity of all transportation routes affected by the new storage alternative and the expected infrequent use of these transport modes, adverse impacts to these other transportation facilities are not expected.

5.4.7 LAND USE

The new storage alternative would not alter the current or foreseeable future land use patterns or aesthetic and visual resources of the 200 East and West and 600 Areas. Each of these topics are discussed in the following sections.

5.4.7.1 Land Use Patterns

- The new storage alternative would require the commitment of approximately 50 ha (124 acres) of land for the RCSTS and NTF. The area affected by the new storage alternative is currently used and designated for waste storage and handling during the site cleanup mission. The new storage alternative would be consistent with The Future for Hanford: Uses and Cleanup (FSUWG 1992).

5.4.7.2 Aesthetic and Visual Resources

- To determine the impacts to aesthetic and visual resources, a visual assessment was conducted, which focused on the potential visibility of the new storage alternative from local roads, population centers, and dispersed recreation use areas. Visual impact assessment is based on the visual character of the NTF and the degree of potential visibility to viewers in context with the local setting to determine the degree of visual contrast or change resulting from the new storage alternative.

Night lighting is common throughout the 200 West and East Areas; therefore, it is assumed that additional lighting at the NTF would not be seen as a significant change to night visibility. The assessment of the technical options for the new storage alternative focuses on the apparent size and shape of the facilities in relationship to existing structures. The proposed facilities would not have reflective surfaces; therefore, glare from the proposed NTF would not be an issue.

The most significant visual features of the NTF would be the support facility building and stack. The support facility would be a two-story, 12,000-m2 (125,000-ft2) building. The stack on a site would be approximately 45-m (150-ft) tall.

The NTF would not have prominent visual features as seen from public viewing areas because of the distance from viewers which is no closer than approximately 4 km (2.5 mi) and the developed conditions near both site locations (see Figure 5-3). Of the two project areas, the proximity of the 200 West Area NTF location to State Highway 240 would make it more discernable to the public. Visual impacts, if any, associated with the RCSTS pipeline would be short-term and primarily concerned with increased visibility of airborne dust during the construction period.

The existing character of the 200 East and West Areas is industrialized and the addition of the NTF at either location would blend in with prior development. This would result in an overall visual change that would not be readily apparent, due to viewing distances and the lack of visual contrast with the immediate surroundings.

5.4.8 CULTURAL RESOURCES

As discussed in Section 4.8, field surveys conducted over the 200 East and West Areas, particularly in the vicinity of the optional sites for the NTF, and the RCSTS corridor and its optional route segments, have not identified archeological or historical sites of significance. In addition, no archeological or religious sites of Native American concern have been identified in the the proposed project area. As a consequence, construction of the new storage alternative would not adversely affect cultural resources.

Cultural resource reviews have been performed for the areas identified for revegetation. Two potential sites were located within the 530 ha (1,300 acre) area identified for habitat restoration. Cultural sites located in this large area would be avoided during mitigation activities by excluding workers from the vicinity of these sites. Detailed avoidance measures for known sites will be specified in the MAP. In the event a potential resource is discovered during construction, work would immediately cease and a qualified archaeologist and the affected tribes would be contacted to determine whether the material is of archaeological interest or cultural significance. If cultural materials are located, procedures outlined in the NHPA and the Hanford Cultural Resources Management Plan would be followed. Prior to any site disturbance, a detailed MAP will formalize field procedures which would be utilized to prevent impacts to cultural resources should they be encountered.

Figure (Page 5-100)
Figure 5-3. Project Visibility Analysis

5.4.9 ANTICIPATED HEALTH EFFECTS UNDER NORMAL CONDITIONS

This section discusses the potential cause and magnitude of health effects that are anticipated to occur under normal conditions as the result of implementation of the new storage alternative. These health effects could result from direct exposure to ionizing radiation or inhalation of toxic and radioactive materials. The various types of health effects that could occur and the relationship between exposure and health effects are discussed in Appendix E. This section evaluates health effects in terms of LCFs for radiation exposures and in terms of ICR and systemic toxic effects for chemical exposures. The new storage alternative is described in Section 3.1.4 and briefly summarized here.

The new storage alternative consists of continued pumping of SST SWLs in the 200 West Area, construction of the NTF, construction of ITRS for Tank 101-SY, construction of a retrieval system for Tank 102-SY, construction of the RCSTS, retrieval and 1:1 dilution (diluent:waste) of the contents of Tank 101-SY, and retrieval and 2:1 dilution of the sludge in Tank 102-SY. The NTF would be used to store the diluted contents of Tank 101-SY and would be constructed either in the 200 West Area or at one of two sites in the 200 East Area. If the NTF is constructed in the 200 East Area, a diversion box would be added to the RCSTS to connect the NTF. The sludge in Tank 102-SY would be retrieved using either the ITRS or PPSS.

The ECSTS would be used for transfer of non-complexed SWL and West Area facility waste until no usable lines remain or the RCSTS becomes operational. The RCSTS would be used for transfer of the retrieved and diluted sludge from Tank 102-SY and complexed SWL. If the NTF is constructed in the 200 East Area, the RCSTS would also be used to transfer the retrieved and diluted contents of Tank 101-SY.

Activities considered as normal conditions under the new storage alternative would include:

- Facility Construction
- Facility Operation
- Facility Decontamination and Decommissioning.

Each of these activities is discussed relative to health effects in the following sections.

5.4.9.1 Facility Construction

- Construction activities under the dilution alternative would include:

- NTF Construction
- Retrieval System Construction
- RCSTS Construction.

Potential exposures of workers and members of the general public to direct radiation, radioactive materials, and chemicals during construction activities are discussed in the following list.

- NTF Construction - No exposures to radioactive materials, direct radiation, or chemicals are anticipated during construction of the NTF. Dust emissions would result from excavation, temporary spoil storage, backfilling, and finish grading associated with the NTF in either the 200 East or West Areas, but would be reduced by wetting of disturbed areas. Areas of surface and subsurface contamination are known to exist within the 200 East and West Areas (WHC 1991b, PNL 1994a). Areas within and around existing process pits and diversion boxes are also contaminated. However, since all NTF construction and piping tie-ins would be in uncontaminated areas in the 200 West and East Area sites, no exposures are anticipated.

- Retrieval System Construction - Construction of the ITRS for Tank 101-SY and construction of either an ITRS or PPSS for Tank 102-SY would be expected to result in exposure of workers to direct radiation and to airborne radioactive materials and chemicals.

Construction of one or more ITRSs in the SY Tank Farm would include erection of an ICE building, construction of new pump and valve pits, modification of existing pump and valve pits, and construction of tank mixing, transfer, and cooling systems (WHC 1994b). Some construction activities would be performed in contaminated areas. The potential for such exposures would be greatest during installation of equipment and instruments in and around the tanks and their process pits. Exposures could also occur during excavation, grading, and construction in potentially contaminated areas within the SY Tank Farm.

The Tank 101-SY ITRS would use the mitigation 150-hp mixer pump currently installed in Tank 101-SY to mix waste for retrieval operations. The estimated dose to workers from direct radiation during construction of this ITRS is 170 person-rem (personal communication Van Beek 1995). If it became necessary to remove the mitigation mixer pump and install more powerful mixers pumps for retrieval of 101-SY, dose would increase to 380 person-rem.

Construction dose estimates are not available for either an ITRS or PPSS for Tank 102-SY; however, the estimated dose to construct an ITRS that includes new mixer pumps for Tank 103-SY is 400 person-rem (personal communication Van Beek 1995). Cesium, 137Cs, is the predominant gamma-emitting nuclide in both Tanks 103-SY and 102-SY, and since Tank 103-SY inventory of 137Cs is 40 times greater than Tank 102-SY, it is unlikely that dose during construction of an ITRS for Tank 102-SY would exceed 400 person-rem. An EA has been prepared and a FONSI has been issued for the PPSS for Tank 106-C (DOE 1995). Preparation of this tank for sluicing requires installation and modification of equipment inside the tank and in contaminated pits and, in this respect, is similar to the ITRS. Although the EA does not provide a specific estimate of construction dose, Tank 106-C is a high-heat Watchlist tank containing HLW and construction doses are expected to be similar to or greater than those for construction of a similar system for Tank 102-SY.

Based on this approach, retrieval system construction dose would be expected to range from 170 person-rem for the planned ITRS for Tank 101-SY to 780 person-rem for retrieval of both Tanks 101-SY and 102-SY. Based on an occupational risk factor of 4 x 10-4 LCF/person-rem, from 0.07 to 0.3 LCFs would be expected among construction workers. Radiation exposure during construction activities would be reduced by decontamination of work areas, applying the ALARA principle in planning work tasks, and implementing procedures specific to the task and conditions encountered. Exposure to airborne contaminants would be further reduced by using protective equipment, fixatives, and temporary enclosures.

. RCSTS Construction - Construction of the RCSTS would involve excavation and other earth-moving activities along the 10-km (6.2-mi) route and work in and around contaminated areas such as existing piping, valve pits, and diversion boxes. These activities and the resultant exposures would be identical to those discussed in Section 5.1.9 for the preferred alternative.

The total estimated dose from direct radiation during construction work in these contaminated areas is 26.3 person-rem (Light 1994) and, based on an occupational risk factor of 4 x 10-4 LCFs per person-rem, would be expected to result in 0.01 LCFs. Exposure to direct radiation during construction activities would be reduced by decontamination of work areas, applying the ALARA principle in planning work tasks, and implementing procedures specific to the task and conditions encountered.

Exposures to airborne radioactive material and chemicals would also be possible during construction activities in contaminated areas. Inhalation exposures could occur during excavations and grinding or cutting of contaminated pipelines and concrete. Release of airborne contaminants to the environment would be controlled using temporary enclosures or, for large outdoor areas, using wetting or soil fixatives. Other measures to control inhalation exposures would include decontamination of work areas, use of protective equipment, and implementation of procedures specific to the work.

5.4.9.2 Facility Operation

- Workers and members of the general public could be exposed to direct radiation and airborne radiological and chemical emissions during normal operations involving the SY Tank Farm, SWL pumping activities, operation of the retrieval systems, and cross-site waste transfer operations via both the ECSTS and RCSTS.

Workers and members of the general public could be exposed to the following emissions during these activities:

- Direct Radiation
- Airborne Emissions of Radioactive Materials
- Airborne Emissions of Chemicals.

Estimated doses and resultant health effects for each of these exposures are discussed in the following list.

- Direct Radiation - Workers performing routine operations, maintenance, and surveillance would be exposed to direct radiation during mixer pump operations, SWL pumping, waste retrieval operations, and associated cross-site waste transfers. With the exception of retrieval and possible cross-site transfer of Tank 101-SY in the place of continued operation of the mitigation mixer pump, these activities are identical to those discussed in Section 5.1.9 for the preferred alternative. Many of these activities are similar to those now being performed by tank farm workers.

  Each of the new systems operated under the new storage alternative incorporate many design features to minimize radiation exposure. These features include use of modular, separable components to isolate and minimize contamination; use of washable or strippable coatings to minimize contamination; and minimization of the lengths of pipeline and duct runs that would be subject to contamination. The retrieval systems, ITRS or PPSS, would operate for approximately two weeks per tank.

  Based on these considerations, the annual individual dose of 14 mrem currently received by tank farm workers (Light 1994) is considered representative of the dose that would be received by workers involved in the new storage alternative. Based on an occupational risk factor of 4 x 10-4 LCFs per person-rem, workers involved in operations under the new storage alternative are not expected to incur any adverse health effects as the result of exposure to direct radiation.

- Airborne Emissions of Radioactive Materials - Workers and members of the general public could be exposed to airborne emissions of radioactive materials as the result of implementation of the new storage alternative. These emissions would be identical to those under the preferred alternative, except that emissions from Tank 101-SY with its mitigation mixer pump would be replaced by emissions from the brief operation of the ITRS and subsequent emissions from the NTF.

  Retrieval of Tank 101-SY would make use of the existing mitigation mixer pump. Operation of the mixer pumps in Tanks 102-SY and 101-SY would generate heat within the waste and could cause increased releases of airborne radioactive material from the SY Tank Farm ventilation system for the period of mixer pump use due to increased volatilization and evaporation of the waste. Therefore, the ITRS design includes a cooling system to control temperature during operation of the mixer pumps.

  Airborne emissions of radionuclides would occur from the NTF following retrieval and dilution of Tank 101-SY. The primary ventilation system for the NTF would consist of a condenser, HEME, heater, HEMF, and two-stage HEPA filter with a high-efficiency gas absorption (HEGA) between the HEPA stages (DOE 1994b). Treated air would be discharged from a 46-m (150-ft) tall, 1.8-m (6-ft) diameter stack. Doses for a nominal and extreme case were evaluated in National Emission Standards for Hazardous Air Pollutants Application for Approval to Construct Multi-Function Waste Tank Facility (DOE 1994b) for a four-tank NTF in the 200 East Area and a two-tank NTF in the 200 West Area. The nominal case assumes a heat load of 32,000 watts [110,000 British Thermal Unit (BTU)/hr] for both tanks. The extreme case assumes a heat load of 205,000 watts (700,000 BTU/hr) for one tank and 32,000 watts (110,000 BTU/hr) for the other tanks. Radionuclide emissions for the nominal and extreme cases are shown in Table 5-28 for a two-tank NTF located in either the 200 East or 200 West Area.

Table 5-28
Radionuclide Emissions from the NTF

Emissions (Ci/yr)

Radionuclide

	Nominal Case a	Extreme Case b
3H	7.13 x 10-1	1.77 x 100
90Sr	7.93 x 10-8	5.96 x 10-7
90Y	7.77 x 10-8	5.83 x 10-7
106Ru	NA	2.48 x 10-6
106Rh	NA	2.46 x 10-6
113Sn	NA	4.45 x 10-6
125Sb	NA	2.21 x 10-5
129I	3.54 x 10-5	7.17 x 10-5
137Cs	2.27 x 10-9	1.51 x 10-8
137mBa	2.18 x 10-9	1.41 x 10-8
239Pu	1.92 x 10-11	3.70 x 10-11

Source: (DOE 1994b)

aNominal case assumes two tanks at 32,000 watts (110,000 BTU/hr) and a discharge of 0.5 m3/s [1,000 standard cubic feet per minute (scfm)].
bExtreme case assumes one tank at 32,000 watts (110,000 BTU/hr), one tank at 205,000 watts (700,000 BTU/hr), and a discharge of 0.5 m3/s (1,000 scfm).

The CAP88-PC computer program (DOE 1992d) was used to estimate inhalation doses to the maximally exposed on-site and off-site individuals and to the off-site population based on the NTF emissions shown in Table 5-28. The results are shown in Table 5-29 based on the current site boundary. Based on these extremely low doses, no adverse health effects would be expected to result from operation of the NTF.

. Airborne Emissions of Chemicals - Workers and members of the general public could be exposed to airborne emissions of chemicals as the result of emissions of chemical under the new storage alternative. These emissions would be identical to those under the preferred alternative, except that emissions from Tank 101-SY with its mitigation mixer pump would be replaced by emissions from the brief operation of the ITRS and subsequent emissions from the NTF.

Table 5-29
Estimated Annual Inhalation Dose from Airborne Emissions from the NTF

	200 East Area		200 West Area	
	Nominal	Extreme	Nominal	Extreme
Maximally Exposed On-site Individual (mrem)	2.5 x 10-5	6.1 x 10-5	2.5 x 10-5	6.1 x 10-5
Maximally Exposed Off-site Individual (mrem)	1.6 x 10-5	3.5 x 10-5	1.3 x 10-5	2.7 x 10-5
Off-site Population (person-rem)	8.5 x 10-4	1.9 x 10-3	8.5 x 10-4	1.9 x 10-3

The existing Tank 101-SY mitigation mixer pump would be used for retrieval operations. Operation of the ITRS mixer pump would generate heat within the waste and could cause increased releases of airborne chemicals from the SY Tank Farm ventilation system for the period of mixer pump use due to increased volatilization and evaporation of the waste. The ITRS design includes a cooling system to control temperature during operation of the mixer pumps. If necessary, HEGA filters may be added to the ventilation system to provide additional control of VOCs.

Chemical emissions from the NTF have been estimated for nominal and extreme cases (WHC 1994f). The nominal case assumes a heat load of 32,000 watts (110,000 BTU/hr) for both tanks. The extreme case assumes a heat load of 205,000 watts (700,000 BTU/hr) for one tank and 32,000 watts (110,000 BTU/hr) for the other tank. Chemical emission estimates from two tanks for the nominal and extreme cases are shown in Table 5-30. Airborne concentrations of these chemicals at points within and along the Hanford Site boundary are shown in Table 5-26.

Table 5-30
Chemical Emissions from the NTF

Chemical	Emissions (g/s)	
	Nominal Case a	Extreme Case b

Acetone	2.2 x 10-3	2.3 x 10-3
Benzene	NA	5.7 x 10-6
1-Butanol	1.4 x 10-2	1.4 x 10-2
Carbon Tetrachloride	NA	4.3 x 10-8
2-Hexanone	5.8 x 10-5	1.7 x 10-4
4-Methyl-2-Pentanone	4.1 x 10-3	1.2 x 10-2
Kerosene	1.4 x 10-10	1.7 x 10-2
Tributyl Phosphate	1.4 x 10-10	4.1 x 10-10
Ammonia	3.4 x 10-6	4.9 x 10-6
Ag	2.8 x 10-15	2.8 x 10-15
As	1.8 x 10-13	1.8 x 10-13
Ba	9.1 x 10-16	9.1 x 10-16
Ca	6.1 x 10-15	6.1 x 10-15
Cu	1.4 x 10-15	1.4 x 10-15
Mg	1.2 x 10-15	1.2 x 10-15
Na	3.3 x 10-11	3.3 x 10-11
Pb	4.1 x 10-15	4.1 x 10-15
Sb	5.6 x 10-15	5.6 x 10-15
Se	3.6 x 10-15	3.6 x 10-15
AlO2	1.2 x 10-11	1.2 x 10-11
OH-	5.1 x 10-12	5.1 x 10-12
F-	9.8 x 10-13	9.8 x 10-13
Fe(OH)3	1.7 x 10-12	1.7 x 10-12
Cr(OH)3	4.6 x 10-13	4.6 x 10-13

Source: (WHC 1994f)

aNominal case assumes two tanks at 32,000 watts (110,000 BTU/hr) and a discharge of 0.5 m3/s (1,000 scfm).

bExtreme case assumes one tank at 32,000 watts (110,000 BTU/hr), one tank at 205,000 watts (700,000 BTU/hr), and a discharge of 0.5 m3/s (1,000 scfm).

NA = Not Applicable

Three of these chemicals are Class A toxins under Washington Administration Code (WAC) 173-460-150: benzene, arsenic, and lead. The anticipated airborne concentrations of these chemicals would be orders of magnitude below applicable ASILs and no observable increase in cancer fatalities would be expected. A number of chemicals in the NTF emissions are Class B toxins and have the potential to cause adverse but noncarcinogenic health effects. The 24-hour ASILs for these compounds are set at levels at which no health effects would be expected based on occupational exposures. As seen in Table 5-26, airborne concentrations of these chemicals are all far below these threshold levels. This finding is consistent with the data from personal monitors worn by workers performing tasks in the SY Tank Farm.

5.4.9.3 Facility Decontamination and Decommissioning

- The ITRS, NTF, and RCSTS are new facilities that would be constructed and would require decontamination and decommissioning. Decontamination and decommissioning of other facilities such as the existing DSTs, SSTs, and the ECSTS is not considered in this EIS. Decontamination and decommissioning of TWRS facilities would be addressed in detail in a future EIS.

The design of these new facilities incorporates the following features that would simplify their decontamination and reduce the amount of material required disposal as radioactive waste:

- Use of modular, separable components to isolate and minimize contamination
- Use of washable or strippable coatings to minimize contamination
- Minimization of the lengths of pipeline and duct runs that would be subject to contamination.

5.4.10 HEALTH EFFECTS UNDER ACCIDENT CONDITIONS

This section discusses the human health effects that could occur as the result of potential accidents during the implementation of the new storage alternative. Initiating events, frequencies of occurrence, and quantities of respirable hazardous materials released during a range of potential accidents are discussed in detail in Appendix F. The types of health effects that can occur and the relationship between exposure and health effects are discussed in Appendix E. This section evaluates health effects in terms of LCFs for radiation exposures. Health effects for exposures to chemicals during accidents that involve exposure to both radioactive and toxic materials are not specifically evaluated. A previous analysis (WHC 1994c) concluded that radiological releases are limiting in these cases provided the release duration is more than 2 minutes and 40 seconds. The minimum release duration of combined radiological and chemical releases evaluated under the new storage alternative is 2 hours.

The accidents considered in Appendix F include scenarios both within and beyond the design bases of the facilities comprising the new storage alternative. Terms used to categorize accidents and the corresponding frequency ranges are summarized in Table 5-3. Based on frequencies of occurrence and quantities of hazardous materials released, a subset of these accidents was selected for evaluation of reasonably foreseeable health effects.

The actions proposed under the new storage alternative involve the use of the following systems:

- Existing Cross-Site Transfer System
- New Tanks Facility
- Replacement Cross-Site Transfer System
- Initial Tank Retrieval System
- Past-Practices Sluicing System.

The types and quantities of waste that would be handled by each system are summarized in Table 5-31. Detailed characterizations of the wastes listed in Table 5-31 are provided in Appendix E. Accidents that could occur in each of these systems are discussed in the following sections. To bound the probability of accidents under the new storage alternative, it is assumed that all wastes shown in Table 5-31 requiring cross-site transfer are transferred using the RCSTS.

Table 5-31
Volumes of Tank Waste Transferred Under the New Storage Alternative

Waste Type[a]	NTF in 200 West		NTF in 200 East	
	Volume (kgal)[b]	Systems Used	Volume (kgal)[b]	Systems Used
Salt Well Liquid				
Complexed	575	RCSTS	575	RCSTS
Uncharacterized	1,221		1,221	
Non-Complexed	2,426	ECSTS RCSTS	2,426	ECSTS RCSTS
Salt Well Total	4,222		4,222	
West Area Facility Waste	469	ECSTS RCSTS	469	ECSTS RCSTS
101-SY Slurry (1:1)	2,198	ITRS NTF	2,198	ITRS NTF RCSTS
102-SY Slurry (0:1)	325	ITRS or PPSS RCSTS	325	ITRS or PPSS RCSTS
Grand Total	7,214		7,214	

Source: Salt Well Volumes (WHC 1995a)
Salt Well Pumping Schedule (WHC 1994b)
102-SY Slurry (WHC 1995c)

[a]Tanks BX-111, T-111, and C-106 are excluded.
[b]1 kgal = 3,780 L

5.4.10.1 Existing Cross-Site Transfer System

- Transfer pipe breaks and spray releases could occur during operation of the ECSTS under the new storage alternative and result in release of tank waste to the soil column and to the atmosphere. The ability of the ECSTS to handle slurry waste is currently unknown and, as indicated in Table 5-31, it is assumed that only non-complexed SWL and WAFW could be transferred using the ECSTS. These transfers would be made until the ECSTS fails or the RCSTS is available.

5.4.10.2 New Tanks Facility

- The NTF would be constructed either at a site in the southeast area of the 200 West Area (Figure 3-18) or at "Site E" or "Site D" in the 200 East Area (Figure 3-19). A relatively large number of accident scenarios have been evaluated for the NTF (WHC 1994a, WHC 1994g), and are summarized in Appendix F, Section F.1.3. Based on the frequency of occurrence and the quantities of respirable materials released (see Table F-3), the following accident scenarios were selected to represent the range of adverse health effects that could be associated with the NTF:

- Pressurized Spray Leaks
- Beyond Design Basis Tank Leak

During the interim period, the NTF would contain the diluted contents of Tank 101-SY. A dilution ratio of 1:1 (diluent:waste) is assumed. To bound health effects associated with potential future use of the NTF, accident consequences are also evaluated using BSW at a 1:1 dilution.

- Pressurized Spray Leaks - Pressurized spray leaks could occur in NTF transfer pits and valve pits. As with most spray leaks involving tank waste, consequences can be severe if the spray is not confined within the pit. Spray leaks could also occur in NTF transfer piping outside of pits. The unmitigated case considered here has the most severe consequences of a group of unmitigated spray leaks involving both pits and transfer piping (WHC 1994a, WHC 1994g). This accident involves a spray release from a defective leak detection riser flange on a transfer pipeline. A sequence of seven events must occur to pressurize the flange and the flange must be defective for the release to occur. The probability that this would occur is estimated to range from extremely unlikely to not reasonably foreseeable. The basis for this large range of probabilities is discussed in Appendix F, Section F.1.3.2.

  The health effects that could result from an unmitigated pressured spray release in the NTF are shown in Table 5-32. As indicated by the results for 101-SY diluted waste, no adverse health effects would be expected should this accident occur during the interim period. These health effects are based on a risk factor of 4 x 10-4 LCF/person-rem for workers and 5 x 10-4 LCF/person-rem for the general population. No maximally exposed individual would experience more than a 3 in 100 chance of developing a fatal cancer as the result of the accident (0.03 ICR) and no more than 0.6 LCFs would be expected in a maximally exposed population. If the accident involved BSW, 300 LCFs would be expected in

Table 5-32
Estimated Health Effects from a NTF Unmitigated Spray Releases under the New Storage Alternative

Release Location	NTF 200 West	200 East "E"	200 East "D"
Waste	101-SY	101-SY	101-SY
Dilution (diluent:waste)	1:1	1:1	1:1
Probability	Incredible to Not Reasonable Foreseeable		
Receptor	Involved Workers		
Individual Dose (rem)	1.3	1.3	1.3
ICR	5 x 10-4	5 x 10-4	5 x 10-4
Receptor	Uninvolved Workers		
Individual Dose (rem)	69	69	69
ICR	0.03	0.03	0.03
Collective Dose (person-rem)	320	660	930
LCF	0.1	0.3	0.4
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	0.06	0.074	0.078
ICR	3 x 10-5	4 x 10-5	4 x 10-5
Collective Dose (person-rem)	1,200	1,200	1,200
LCF	0.6	0.6	0.6
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.22	0.091	0.095
ICR	1 x 10-4	5 x 10-5	5 x 10-5
Release Location	200 West	200 East "E"	200 East "D"
Waste	BSW	BSW	BSW
Dilution (diluent:waste)	1:1	1:1	1:1
Probability	Not Applicable		
Receptor	Involved Workers		
Individual Dose (rem)	730	730	730
ICR	0.3	0.3	0.3
Receptor	Uninvolved Workers		
Individual Dose (rem)	38,000	38,000	38,000

ICR	20	20	20
Collective Dose (person-rem)	1.8 x 105	3.7 x 105	5.1 x 105
LCF	70	100	200
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	33	41	43
ICR	0.02	0.02	0.02
Collective Dose (person-rem)	6.8 x 105	6.8 x 105	6.8 x 105
LCF	300	300	300
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	120	50	52
ICR	0.06	0.02	0.03

the general population and acute radiation effects, possibly including death, would be expected for workers. This spray release would not be possible if leak detection risers were eliminated (WHC 1995e).

Spray leaks inside NTF process and valve pits would be anticipated to unlikely events but their consequences are readily mitigated by ensuring that cover blocks are in place. The probability that such a spray leak would result in the release of waste to the atmosphere is unlikely to extremely unlikely for the NTF. As indicated in Table 5-33, no adverse health effects would be expected for a mitigated NTF spray release for either Tank 101-SY waste or BSW at a 1:1 dilution.

- Beyond Design Basis Tank Leak - The beyond design basis tank leak accident scenario is initiated by an earthquake and uses very conservative assumptions regarding the amount of waste in the below-ground tank that would reach the surface. The probability of this accident ranges from extremely unlikely to not reasonably foreseeable (WHC 1994g). No adverse health effects would be expected based on the diluted Tank 101-SY waste inventory as shown on Table 5-34. Adverse health effects may occur in the case of the diluted BSW. With BSW, the maximally exposed uninvolved worker would incur an ICR of 0.1 (1 chance in 10) and a single LCF would be expected among the maximum uninvolved worker population. Up to 4 LCFs could occur in the maximally exposed off-site population.

5.4.10.3 Replacement Cross-Site Transfer System

- Transfer pipe breaks and spray leaks could occur during the operation of the RCSTS under the new storage alternative. In cases where the same wastes would be transferred, accident probabilities and health effects are the same as those for the preferred alternative.

If the NTF is constructed in the 200 West Area under the new storage alternative, then only one RCSTS diversion box would be constructed and the diluted contents of Tank 101-SY would not be transferred. Accordingly, accident probabilities and health effects would be identical to those for the preferred alternative (see Section 5.1.10.2 and Tables 5-5 through 5-11).

Table 5-33
Estimated Health Effects from a NTF Mitigated Spray Releases under the New Storage Alternative

Release Location	200 West	200 East "E"	200 East "D"
Waste	101-SY	101-SY	101-SY
Dilution (diluent:waste)	1:1	1:1	1:1
Probability	Unlikely to Extremely Unlikely		
Receptor	Involved Workers		
Individual Dose (rem)	1.6 x 10-6	1.6 x 10-6	1.6 x 10-6
ICR	< 10-7	< 10-7	< 10-7
Receptor	Uninvolved Workers		
Individual Dose (rem)	3.3 x 10-4	3.3 x 10-4	3.3 x 10-4
ICR	1 x 10-7	1 x 10-7	1 x 10-7
Collective Dose (person-rem)	0.0016	0.0032	0.0045
LCF	6 X 10-7	1 x 10-6	2 x 10-6
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	5.7 x 10-7	7.2 x 10-7	7.6 x 10-7
ICR	< 10-7	< 10-7	< 10-7
Collective Dose (person-rem)	0.011	0.011	0.011
LCF	5 X 10-6	5 X 10-6	5 X 10-6
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	2.3 x 10-6	8.8 x 10-7	9.3 x 10-7
ICR	< 10-7	< 10-7	< 10-7
Release Location	200 West	200 East "E"	200 East "D"

Waste	BSW	BSW	BSW
Dilution (diluent:waste)	1:1	1:1	1:1
Probability	Not Applicable		
Receptor	Involved Workers		
Individual Dose (rem)	9.0 x 10-4	9.0 x 10-4	9.0 x 10-4
ICR	4 x 10-7	4 x 10-7	4 x 10-7
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.18	0.18	0.18
ICR	7 x 10-5	7 x 10-5	7 x 10-5
Collective Dose (person-rem)	0.87	1.8	2.5
LCF	3 x 10-4	7 x 10-4	0.001
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	3.2 x 10-4	3.9 x 10-4	4.2 x 10-4
ICR	2 x 10-7	2 x 10-7	2 x 10-7
Collective Dose (person-rem)	6.0	6.0	6.0
LCF	0.003	0.003	0.003
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.0013	4.9 x 10-4	5.1 x 10-4
ICR	6 x 10-7	2 x 10-7	3 x 10-7

Table 5-34
Estimated Health Effects from a NTF Beyond Design Basis Tank Leak under the New Storage Alternative

Release Location	200 West	200 East "E"	200 East "D"
Waste	101-SY	101-SY	101-SY
Dilution (diluent:waste)	1:1	1:1	1:1
Probability	Extremely Unlikely to Not Reasonably Foreseeable		
Receptor	Involved Workers		
Individual Dose (rem)	0.030	0.030	0.030
ICR	1 x 10-5	1 x 10-5	1 x 10-5
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.43	0.43	0.43
ICR	2 x 10-4	2 x 10-4	2 x 10-4
Collective Dose (person-rem)	2.4	4.5	6.5
LCF	9 X 10-4	0.002	0.003
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	6.1 x 10-4	7.5 x 10-4	7.9 x 10-4
ICR	3 x 10-7	4 x 10-7	4 x 10-7
Collective Dose (person-rem)	14	14	14
LCF	0.007	0.007	0.007
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.0022	9.2 x 10-4	9.6 x 10-4
ICR	1 X 10-6	5 x 10-7	5 x 10-7
Release Location	200 West	200 East "E"	200 East "D"
Waste	BSW	BSW	BSW
Dilution (diluent:waste)	1:1	1:1	1:1
Probability	Not Applicable		
Receptor	Involved Workers		
Individual Dose (rem)	16	16	16
ICR	0.007	0.007	0.007
Receptor	Uninvolved Workers		
Individual Dose (rem)	240	240	240
ICR	0.1	0.1	0.1
Collective Dose (person-rem)	1,300	2,500	3,600
LCF	0.5	1	1
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	0.34	0.41	0.43
ICR	2 x 10-4	2 x 10-4	2 x 10-4
Collective Dose (person-rem)	7,400	7,400	7,400
LCF	4	4	4
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	1.2	0.51	0.53
ICR	6 x 10-4	3 x 10-4	3 x 10-4

If the NTF is constructed in the 200 East Area under the new storage alternative, a second RCSTS diversion box would be constructed to service the NTF and the diluted contents of Tank 101-SY would be transferred using the RCSTS. The addition of diluted contents of Tank 101-SY to the wastes transferred using the RCSTS would result in a slight increase in the probability of releases from RCSTS transfer pipe breaks under the new storage alternative. The addition of this waste and of a second RCSTS diversion box would slightly more than double the total probability of an RCSTS spray release but only slightly increase the probability at a given diversion box.

In terms of the accident frequency description and categories summarized in Table 5-3, the probabilities of RCSTS accidents would be the same whether the NTF is constructed in the 200 East or 200 West Areas.

- Transfer Pipe Breaks - Transfer pipe break accident scenarios for the new storage alternative are identical to those for the preferred alternative. The maximum leak volume released to the environment under both alternatives would occur when the break is at the 244-A Lift Station in the 200 East Area. The break could be initiated by an excavation or a beyond design basis earthquake. The total probability that an unmitigated RCSTS pipe leak would occur under the new storage alternative is incredible: 1.8 x 10-7 if the NTF is in the 200 West Area and 2.6 x 10-7 if the NTF is in the 200 East Area.

  Accident probabilities and health effects for each type of waste are shown in Table 5-35. Based on risk factors of 4 x 10-4 LCF/person-rem for workers and 5 x 10-4 LCF/person-rem for the general public, no adverse health effects would be expected. If the accident involved BSW, no adverse health effects would be expected for the maximally exposed involved and uninvolved workers but 2 LCFs would be expected in both the maximally exposed uninvolved worker population and maximally exposed general population.

Table 5-35
Estimated Health Effects from a RCSTS Unmitigated Transfer Pipe Break under the New Storage Alternative

Release Location	244-A Lift Station (200 East Area)			
Waste	101-SY	SWL	102-SY/ WAFW	BSW
Dilution (diluent:waste)	1:1	0:1	0:1	1:1
Probability	Not Reasonably Foreseeable	Incredible	Not Reasonably Foreseeable	Not Applicable
Receptor	Involved Workers			
Individual Dose (rem)	0.020	0.068	3.0	11
ICR	8 x 10-6	3 x 10-5	0.001	4 x 10-3
Receptor	Uninvolved Workers			
Individual Dose (rem)	0.29	1.0	43	160
ICR	1 x 10-4	4 x 10-4	0.02	0.06
Collective Dose (person-rem)	7.8	27	1200	4,300
LCF	0.003	0.01	0.5	2
Receptor	General Public - Existing Boundary			
Individual Dose (rem)	5.9 x 10-4	0.0021	0.088	0.33
ICR	3 x 10-7	1 x 10-6	4 x 10-5	2 x 10-4
Collective Dose (person-rem)	9.0	31	1,300	5,000
LCF	0.004	0.02	0.7	2
Receptor	General Public - Potential Boundary			
Individual Dose (rem)	7.3 x 10-4	0.0025	0.11	0.40
ICR	4 x 10-7	1 x 10-6	5 x 10-5	2 x 10-4

- Pressurized Spray Leaks - Pressurized spray leak accident scenarios for the new storage alternative are identical to those for the preferred alternative. As discussed in Section 5.1.10.2, an unmitigated RCSTS spray is not reasonably foreseeable during the interim period.

  The probability of a mitigated RCSTS spray release is anticipated: 2.5 x 10-2 if the NTF is in the 200 West Area and 6.1 x 10-2 if the NTF is in the 200 East Area. The latter probability includes accidents at both Diversion Box 1 and Diversion Box 2.

  The probability of mitigated RCSTS transfer pipe leaks under the new storage alternative is extremely unlikely: 3.5 x 10-6 if the NTF is in the 200 West Area and 5.0 x 10-6 if the NTF is in the 200 East Area. Accident probabilities and health effects for each type of waste are shown in Table 5-36. No adverse health effects would be expected for any interim waste or for BSW.

Table 5-36
Estimated Health Effects from a RCSTS Mitigated Transfer Pipe Break under the New Storage Alternative

Release Location	244-A Lift Station (200 East Area)			
Waste	101-SY	SWL	102-SY/ WAFW	BSW
Dilution (diluent:waste)	1:1	0:1	0:1	1:1
Probability	Extremely Unlikely	Extremely Unlikely	Incredible	Not Applicable
Receptor	Involved Workers			

Individual Dose (rem)	0.0068	0.024	1.0	3.8
ICR	3 x 10-6	9 x 10-6	4 x 10-4	0.001
Receptor	Uninvolved Workers			
Individual Dose (rem)	0.099	0.34	15	55
ICR	4 x 10-5	1 x 10-4	0.006	0.02
Collective Dose (person-rem)	2.7	9.4	400	1,500
LCF	0.001	0.004	0.2	0.6
Receptor	General Public - Existing Boundary			
Individual Dose (rem)	2.1 x 10-	7.1 x 10-4	0.031	0.11
ICR	4	4 x 10-7	2 x 10-5	6 x 10-5
	1 x 10-7			
Collective Dose (person-rem)	3.1	11	460	1,700
LCF	0.002	0.005	0.2	0.9
Receptor	General Public - Potential Boundary			
Individual Dose (rem)	2.5 x 10-	8.7 x 10-4	0.038	0.14
ICR	4	4 x 10-7	2 x 10-5	7 x 10-5
	1 x 10-7			

Accident probabilities and health effects for mitigated RCSTS spray releases from Diversion Box 1 and Diversion Box 2 are shown in Table 5-37 for each type waste. Based on risk factors of 4 x 10-4 LCF/person-rem for workers and 5 x 10-4 LCF/person-rem for the general public, no adverse health effects would be expected for any interim waste or BSW for mitigated RCSTS spray releases from either diversion box.

Table 5-37
Estimated Health Effects from a RCSTS Mitigated Spray Release under the New Storage Alternative

Release Location	Diversion Box 1 (200 West Area)			
Waste	101-SY	SWL	102-SY/WAFW	BSW
Dilution (diluent:waste)	1:1	0:1	0:1	1:1
Probability	Anticipated	Anticipated	Unlikely	Not Applicable
Receptor		Involved Workers		
Individual Dose (rem)	1.5 x 10-5	5.5 x 10-5	0.0024	0.0087
ICR	< 10-7	< 10-7	9 x 10-7	3 x 10-6
Receptor		Uninvolved Workers		
Individual Dose (rem)	8.2 x 10-4	0.0029	0.12	0.45
ICR	3 x 10-7	1 x 10-6	5 x 10-5	2 x 10-4
Collective Dose (person-rem)	0.0039	0.014	0.58	2.1
LCF	2 x 10-6	5 x 10-6	2 x 10-4	9 x 10-4
Receptor		General Public - Existing Boundary		
Individual Dose (rem)	7.1 x 10-7	2.5 x 10-6	1.1 x 10-4	3.9 x 10-4
ICR	< 10-7	< 10-7	< 10-7	2 x 10-7
Collective Dose (person-rem)	0.015	0.051	2.2	8.1
LCF	7 x 10-6	3 x 10-5	0.001	0.004
Receptor		General Public - Potential Boundary		
Individual Dose (rem)	2.7 x 10-6	9.3 x 10-6	4.0 x 10-4	0.0015
ICR	< 10-7	< 10-7	2 x 10-7	7 x 10-7
Release Location		Diversion Box 2 (200 East Area)		
Waste	101-SY	SWL	102-SY/WAFW	BSW
Dilution (diluent:waste)	1:1	0:1	0:1	1:1
Probability	Anticipated	Anticipated	Unlikely	Not Applicable
Receptor		Involved Workers		
Individual Dose (rem)	1.6 x 10-5	5.5 x 10-5	0.0024	0.0087
ICR	< 10-7	< 10-7	9 x 10-7	3 x 10-6
Receptor		Uninvolved Workers		
Individual Dose (rem)	8.2 x 10-4	0.0029	0.12	0.45
ICR	3 x 10-7	1 x 10-6	5 x 10-5	2 x 10-4
Collective Dose (person-rem)	0.011	0.039	1.7	6.2
LCF	4 x 10-6	2 x 10-5	7 x 10-4	0.002
Receptor		General Public - Existing Boundary		
Individual Dose (rem)	9.4 x 10-7	3.3 x 10-6	1.4 x 10-4	5.2 x 10-4
ICR	< 10-7	< 10-7	< 10-7	3 x 10-7
Collective Dose (person-rem)	0.015	0.051	2.2	8.1
LCF	7 x 10-6	3 x 10-5	0.001	0.004
Receptor		General Public - Potential Boundary		
Individual Dose (rem)	1.1 x 10-6	4.0 x 10-6	1.7 x 10-4	6.3 x 10-4
ICR	< 10-7	< 10-7	< 10-7	3 x 10-7

5.4.10.4 Initial Tank Retrieval System

- Transfer pipe breaks and spray leaks could occur during the operation of the ITRS under the new storage alternative. The ITRS would be used to retrieve and dilute the contents of Tank 101-SY and may also be used to retrieve and dilute the sludge in Tank 102-SY. A 1:1 dilution (diluent:waste) is anticipated for Tank 101-SY where mitigation of episodic gas releases is an issue. A minimum dilution of 2:1 (diluent:sludge) is required for Tank 102-SY sludge. Since the ITRS is designed to provide in-line dilution, undiluted waste would be present in the system during the earlier stages of retrieval. To bound health effects, accident consequences are based on radionuclide concentrations in undiluted waste.

The ITRS accident scenarios under the new storage alternative are identical to those discussed in Section 5.1.10.3 for the preferred alternative. ITRS accident probabilities are expected to be approximately the same for retrieval of Tanks 101-SY and 102-SY. Health effects for unmitigated and mitigated ITRS transfer pipe leaks are shown in Table 5-38 and 5-39 respectively. Health effects for retrieval of Tank 102-SY and BSW are identical to those for the preferred alternative. Health effects for ITRS transfer pipe leaks during retrieval of Tank 101-SY are only a few percent of those for retrieval of Tank 102-SY.

Health effects for unmitigated and mitigated ITRS spray releases are shown in Tables 5-40 and 5-41, respectively. Adverse health effects would be expected for unmitigated ITRS spray releases during retrieval of both Tanks 102-SY and 101-SY as well as during retrieval of BSW. Unmitigated spray releases during retrieval of Tank 102-SY would be expected to cause deaths among exposed workers due to acute radiation effects. In addition, 200 LCFs would be expected in the maximally exposed worker population and 700 LCFs expected in the maximally exposed off-site population. Health effects for accidents involving Tank 101-SY slurry would be a few percent of those involving Tank 102-SY slurry; however, latent cancer fatalities would still be expected in uninvolved worker and off-site populations. Health effects of unmitigated ITRS spray releases involving BSW would be approximately ten times greater than those for 102-SY slurry. The probability of an ITRS unmitigated spray release is considered to be extremely unlikely to incredible. No adverse health effects would be expected for a mitigated ITRS spray release.

Table 5-38
Estimated Health Effects from ITRS Unmitigated Pipe Breaks under the New Storage Alternative

Release Location	SY Tank Farm		
Waste	101-SY	102-SY	BSW
Dilution (diluent:waste)	0:1	0:1	0:1
Probability	Incredible	Incredible	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.034	2.6	19
ICR	1 x 10-5	0.001	0.008
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.50	37	280
ICR	2 x 10-4	0.01	0.1
Collective Dose (person-rem)	3.3	250	1,800
LCF	0.001	0.1	0.7
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	6.0 x 10-4	0.045	0.33
ICR	3 x 10-7	2 x 10-5	2 x 10-4
Collective Dose (person-rem)	13	980	7,200
LCF	0.007	0.5	4
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.0018	0.14	1.0
ICR	9 x 10-7	7 x 10-5	5 x 10-4

Table 5-39
Estimated Health Effects from ITRS Mitigated Pipe Breaks under the New Storage Alternative

Release Location	SY Tank Farm		
Waste	101-SY	102-SY	BSW
Dilution (diluent:waste)	0:1	0:1	0:1
Probability	Anticipated	Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.0086	0.63	4.8
ICR	3 x 10-6	3 x 10-4	0.002
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.13	9.4	69
ICR	5 x 10-5	0.004	0.03
Collective Dose (person-rem)	0.83	62	460
LCF	3 x 10-4	0.02	0.2

Receptor	General Public - Existing Boundary		
Individual Dose (rem)	1.5 x 10-4	0.011	0.083
ICR	< 10-7	6 x 10-6	4 x 10-5
Collective Dose (person-rem)	3.3	250	1,800
LCF	0.002	0.1	0.9
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	4.6 x 10-4	0.034	0.25
ICR	2 x 10-7	2 x 10-5	1 x 10-4

Table 5-40
Estimated Health Effects from an ITRS Unmitigated Spray Release under the New Storage Alternative

Release Location	SY Tank Farm		
Waste	101-SY	102-SY	BSW
Dilution (diluent:waste)	0:1	0:1	0:1
Probability	Extremely Unlikely to Incredible		Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	19	1,400	11,000
ICR	0.008	0.6	4
Receptor	Uninvolved Workers		
Individual Dose (rem)	1,000	74,000	5.5 x 105
ICR	0.4	30	200
Collective Dose (person-rem)	5,700	4.3 x 105	3.2 x 106
LCF	2	200	1,000
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	0.91	68	500
ICR	5 x 10-4	0.03	0.3
Collective Dose (person-rem)	18,000	1.3 x 106	9.8 x 106
LCF	9	700	5,000
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	3.0	220	1,600
ICR	0.001	0.1	0.8

Table 5-41
Estimated Health Effects from an ITRS Mitigated Spray Release under the New Storage Alternative

Release Location	SY Tank Farm		
Waste	101-SY	102-SY	BSW
Dilution (diluent:waste)	0:1	0:1	0:1
Probability	Anticipated to Unlikely		Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	1.4 x 10-6	1 x 10-4	7.7 x 10-4
ICR	< 10-7	< 10-7	3 x 10-7
Receptor	Uninvolved Workers		
Individual Dose (rem)	7.2 x 10-5	0.0054	0.040
ICR	< 10-7	2 x 10-6	2 x 10-5
Collective Dose (person-rem)	4.2 x 10-4	0.031	0.23
LCF	2 x 10-7	1 x 10-5	9 x 10-5
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	6.6 x 10-8	4.9 x 10-6	3.7 x 10-5
ICR	< 10-7	< 10-7	< 10-7
Collective Dose (person-rem)	0.0013	0.096	0.71
LCF	6 x 10-7	5 x 10-5	4 x 10-4
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	2.2 x 10-7	1.6 x 10-5	1.2 x 10-4
ICR	< 10-7	< 10-7	< 10-7

5.4.10.5 Past-Practices Sluicing System

- The PPSS could be used instead of the ITRS for retrieval of Tank 102-SY. Accident scenarios, probabilities, and health effects for the transfer pipe breaks and spray leaks that could occur during retrieval would be identical to those for this activity under the preferred alternative (see Section 5.1.10.3 and Tables 5-10 and 5-11).

5.4.11 POTENTIAL MITIGATION MEASURES

This section discusses the potential mitigation measures for the new storage alternative relevant to fugitive dust and removal of vegetation.

Fugitive dust emissions during construction would be mitigated by watering of exposed areas and stabilizing spoils piles by use of vegetation or soil fixative.

Construction of the new storage alternative would remove vegetation from the tank sites and associated facility maintenance areas. In addition, construction staging, laydown, and spoils stockpiling areas would require the removal of vegetation and would disturb soil, but these areas would be available for revegetation after completion of construction. The areas disturbed for construction of the RCSTS would be revegetated after construction, except for the parts requiring access for monitoring and maintenance. All these land areas would have long-term changes in vegetation cover. See Appendix D for details of the revegetation and mitigation plan.

5.5 ANTICIPATED IMPACTS OF THE NO ACTION ALTERNATIVE

The no action alternative consists of continued interim stabilization of SSTs by salt well pumping. SWL in SSTs in the 200 West Area, residual free liquid supernatant from Tank 102-SY and WAFW would be transferred to the 200 East Area through the ECSTS. Flammable gas mitigation for Tank 101-SY would be accomplished by continued operation of the mitigation mixer pump. No waste would be transferred from Tank 101-SY.

5.5.1 GEOLOGY, SEISMOLOGY, AND SOILS

No impact on geological resources or soils would be expected from the no action alternative. Because the facilities already exist, there would be no need for site modification.

5.5.2 WATER RESOURCES AND HYDROLOGY

No new contaminants are expected to be released to the surface or groundwaters by the no action alternative. The potential for accidental releases is discussed in Section 5.5.10. Even in the unlikely event of a transfer line break in the ECSTS, groundwater resources would be protected by the thick vadoze zone in this area and the tendency for many radionuclides to be retained in the soils. Present waste streams discussed in Section 4.2 which influence the surface and ground-water regimes would remain unchanged. No new impacts would result.

5.5.3 PHYSICAL ENVIRONMENT

The impacts from operations of SSTs and Tank 101-SY have been evaluated in terms of the following elements of the environment:

- Air Quality
- Radiation
- Sound Levels and Noise.

5.5.3.1 Air Quality

- Emissions from Tank 101-SY are released from stack 296-P-23. Emissions from Tank 102-SY are also included in this stack. This stack and 127 other emission sources, inclusive of the subject SSTs, are registered with the Washington Department of Health. The monitoring program for stack 296-P-23 is compliant with the requirements of 40 CFR 61, National Emission Standards for Hazardous Air Pollutants, and records the radionuclide emissions as total alpha and total beta and would be less than 0.1 mrem/yr to the maximally exposed individual if all control devices were removed. As described in Section 5.5.9, chemical emissions from normal operations of SSTs do not exceed regulatory standards. Public exposures resulting from these releases are below all applicable limits (DOE 1992c). A discussion of releases from Tank 101-SY under the no action alternative is provided under Section 5.5.9.

5.5.3.2 Radiation

- Airborne emissions of radioactive materials from normal operation of facilities proposed under the no action alternative would not result in any measurable increase in radioactivity in off-site environmental media. Environmental media include air, water, soil, vegetation, and animals. Emissions from all 177 existing tanks are already a minor contribution to overall site emissions (DOE 1992c) and levels of radioactivity in the Hanford Site environs has decreased since production activities ceased (PNL 1993).

5.5.3.3 Sound Levels and Noise

- No change in existing sound levels and noise would result from the no action alternative.

5.5.4 BIOLOGICAL AND ECOLOGICAL RESOURCES

The no action alternative would not involve new construction or modification of the environment. Hence, there would be no new biological or ecological impacts.

5.5.5 POPULATION AND SOCIOECONOMIC IMPACTS

No additional workers would be required to implement the no action alternative. Since all workers required to continue existing operations are already employed at the Hanford Site and incorporated into the local and regional economy, there would be no incremental increase in regional employment, income, or population growth as a result.

5.5.6 TRANSPORTATION

The no action alternative would not result in any adverse impacts to the existing Hanford Site road and railway transportation systems. Since no new construction or operational personnel would be required to operate the existing mixer pump and ECSTS, no additional construction or operational vehicles would be generated.

5.5.7 LAND USE

Under the no action alternative there would be no changes in land use in the 200 East and West Areas. These areas would continue to be used for waste management activities and facilities. As a result, the no action alternative would be compatible with existing and planned land uses.

There would be no visual impacts with the no action alternative. All existing buildings and facilities are part of the existing environment and the visual landscape.

5.5.8 CULTURAL RESOURCES

Cultural resources would be unaffected by the no action alternative.

5.5.9 ANTICIPATED HEALTH EFFECTS UNDER NORMAL CONDITIONS

This section discusses the potential cause and magnitude of health effects that are anticipated to occur under normal conditions as the result of implementation of the no action alternative. These health effects may be the result of direct exposure to ionizing radiation or inhalation of toxic and radioactive materials. The various types of health effects that could occur and the relationship between exposure and health effects are discussed in Appendix E. This section evaluates health effects in terms of LCFs for radiation exposures and in terms of ICR and systemic toxic effects for chemical exposures. The no action alternative is described in Section 3.1.5 and briefly summarized here.

The no action alternative consists of the continued operation of the Tank 101-SY mixer pump, continued pumping of SWL in the 200 West Area, and continued management of WAFW. The ECSTS would be used for cross-site transfer of these wastes to the 200 East Area. This would require mixing of the TRU sludge in Tank 102-SY with complexed SWL and could result in the dissolution of the sludge. The impacts of the dissolution of this sludge have not been determined beyond the fact that creation of additional TRU waste in the tank farms would be inconsistent with DOE Order 5820.2A which provides for minimizing the production of TRU waste. The ECSTS is near the end of its design life. Of the six pipelines in the ECSTS, only one is currently usable. One line remains to be pressure tested. The remaining four lines are believed to be plugged. Considering its age and condition, the failure of the ECSTS prior the end of the interim period is a distinct possibility.

Activities considered as normal conditions under the no action alternative would include:

- Facility Construction
- Facility Operations
- Facility Decontamination and Decommissioning.

Each of these activities relevant to health effects is discussed in the following sections.

5.5.9.1 Facility Construction

- There would be no construction activity under the no action alternative.

5.5.9.2 Facility Operations

- Facility operations under the no action alternative would include operation of the Tank 101-SY jet mixer pump, salt well pumping activities, and cross-site transfer operations via the ECSTS. These activities involve sampling and monitoring of waste and ventilation systems, inspection and surveillance, and maintenance of equipment and facilities.

Workers and members of the general public could be exposed to the following emissions during these activities:

- Direct Radiation
- Airborne Emissions of Radioactive Material
- Airborne Emissions of Chemicals.

Estimated doses and resultant health effects for each of these exposures are discussed in the following list.

- Direct Radiation - Workers performing routine operations, maintenance, and surveillance would be exposed to direct radiation during mixer pump operations, SWL pumping, and associated cross-site waste transfers. These activities are essentially the same as those now performed by tank farm workers.

  Worker exposure records prior to construction of DSTs indicate that tank farm workers had received an average annual dose of 630 mrem from direct radiation exposure (DOE 1980). The DSTs are now the main focus of tank farm operations and include many design features such as improved shielding and remotely-operated and remotely-monitored systems. An examination of more recent radiation exposure records of tank farm workers indicates that the average annual individual dose has dropped to 14 mrem (DOE 1992b). Activities performed by these workers include SWL pumping and inter-farm transfers.

  Use of the ECSTS is not reflected in the more recent exposure records and may result in a small increase in tank farm worker exposure. The system is near the end of its design life and is expected to require frequent inspection and maintenance. These activities would require increased entry to contaminated areas. Considering the very low existing exposure levels, no adverse health effects would be expected from direct radiation exposure under the no action alternative.

- Airborne Emissions of Radioactive Material - Workers and members of the general public could be exposed to airborne emissions from SSTs awaiting final disposition during SWL pumping, or from the SY Tank Farm.

  Airborne emissions of radioactive materials from the Hanford Site are reported annually in several documents. Emissions from facilities managed by WHC are reported in Environmental Releases for Calendar Year 1993 (WHC 1994h). These data along with data on emissions from facilities at the Pacific Northwest Laboratory managed by Battelle Memorial Institute are reported in Radionuclide Air Emission Report for the Hanford Site, Calendar Year 1993 (DOE 1994a). This report also uses meteorological data for the year being reported and the CAP-88PC computer program (DOE 1992d) to estimate annual dose to the maximally exposed individual. The Hanford Site Environmental Report for Calendar Year 1993 (PNL 1994a) uses the same emission and meteorological data together with the GENII computer program (PNL 1988a, PNL 1988b, PNL 1988c) to estimate annual dose to off-site individuals and the off-site population.

Airborne emissions of radionuclides from the 200 East and West Areas during 1993 are discussed in Section 4.3.2. Annual doses estimated from these releases are summarized and compared to annual doses for all airborne releases in Table 5-42.

Table 5-42
Estimated Annual Doses (mrem) for 1993 Airborne Emissions from the 200 Areas

Pathway	GENII a		CAP-88PC b		
	200 Areas	All Areas	200 East	200 West	All Areas
Externalc	2 x 10-6	3 x 10-4	NR	NR	NR
Inhalation	0.001	0.01	NR	NR	NR
Foodsd	6 x 10-4	8 x 10-4	NR	NR	NR
Total	0.0016	0.011	0.0012	0.0012	0.0063

aSource: PNL 1994a
bSource: DOE 1994a
cIncludes immersion and ground-deposited radionuclides.
dIndicates consumption of foodstuff contaminated by deposition of airborne radionuclides.
NR = Not reported.

The CAP-88PC and GENII programs considered similar exposure pathways (inhalation, immersion, direct radiation, ingestion of contaminated foods) but use somewhat different parameter values, particularly for biotic transfer and uptake and are therefore not expected to yield identical results.

Airborne emissions from most tanks are filtered and discharged through stacks equipped with flow monitors and samplers. A single stack may serve a group of tanks or an entire tank farm. All Hanford Site stacks emitting radionuclides are classified as major or minor stacks depending on whether annual dose to the nearest residence would exceed 0.1 mrem if stack effluents were released without any treatment. The stacks serving some or all of the tanks in the AP, AY, AZ, C, AW, and AN tank farms in the 200 East Area and in the SY and SX Tank Farms in the 200 West Area are classified as major stacks (DOE 1994a). The remaining tanks and tank farms either do not vent through stacks or are classified as minor stacks. In 1993, emissions from major stacks in tanks farms accounted for 1 percent (1.3 x 10-5 mrem) of total dose from all stack emissions in the 200 East Area and 0.003 percent (3.1 x 10-8 mrem) of the total dose from all stack emissions in the 200 West Area. The population dose from all airborne emissions from the 200 Areas in 1993 was 0.17 person-rem. These doses are considered to be representative of those that would be associated with airborne emissions under the no action alternative. Based on a nonoccupational risk factor of 5 x 10-4 LCFs per person-rem, no adverse health effects are expected to occur in the off-site population as the result of implementation of the no action alternative.

. Airborne Emissions of Chemicals - Workers and members of the general public could be exposed to airborne chemicals during SST salt well pumping, management of West Area facility wastes, routine operations in the SY Tank Farm including mitigation mixer pump operation.

Historically, airborne concentrations of chemicals were not routinely monitored; however, an extensive monitoring program was initiated in 1992. In the first year of the program area monitoring was initiated in the vicinity of SST tank farms. Only 78 of 2,956 measurements showed organic vapors in excess of 2.0 ppm. In 1993 personal monitoring of workers performing tasks in the tank farms was added and in 1994 monitoring of selected sources such as tank vents was initiated. The results of personal monitoring of workers in the S, SX, SY tank farms are summarized in Table 5-43, and compared to regulatory limits established by the OSHA. The S and SX tank farms are of interest since they still contain SWL. The SY Tank Farm is of interest since SWL and other wastes are stored and staged in Tank 102-SY prior to cross-site transfers. No monitored levels exceeded the OSHA limits and most are an order of magnitude less. Based on these data, neither site workers nor the public are at any risk from chemical emissions from these tanks farms.

Table 5-43
Airborne Concentrations of Toxic Chemicals
in the Vicinity of the S, SX, and SY Tank Farms

Chemical	OSHA[a] 8-Hr TWA (ppm)	Concentration Range
Ammonia	50	0.09 - 0.20 ppm
Hydrogen Cyanide	10	< 0.03 ppm
Pentane	600	0.08 - 16 ppb
Acetone	1,000	19 - 34 ppb
Carbon Disulfide	4	16 - 52 ppb
Hexane	50	0.12 - 0.6 ppb
Methyl Ethyl Ketone (2-Butanone)	200	0.12 - 0.30 ppb
2-Methyl Hexane	N/A	0.48 - 5.9 ppb
1,1,1-Trichloroethane	350[b]	0.07 - 2.4 ppb
3-Methyl Hexane	N/A	0.71 - 9.7 ppb
Carbon Tetrachloride	2	0.04 - 0.26 ppb
Benzene	1	0.11 - 9.2 ppb
Heptane	400	0.26 - 14.8 ppb
Butanol	50[c]	7.2 ppb
Methylcyclohexane	500	0.10 - 12.9 ppb
Toluene	100	0.10 - 23.9 ppb
Ethylbenzene	100	0.02 - 5.1 ppb
p-Xylene	100	0.10 - 18.8 ppb
o-Xylene	100	0.10 - 7.1 ppb

Source: Toxnet 1995

[a] OSHA regulatory limits for acceptable worker exposure, average over 8 hours.
[b] National Institute for Occupational Safety and Health (NIOSH) recommended 8-hr average exposure limit.
[c] NIOSH recommended ceiling, limit not to be exceeded.
N/A = Not Available.

5.5.9.3 Facility Decontamination and Decommissioning

- No new facilities would be constructed under the no action alternative. The decontamination and decommissioning of other facilities such as the existing DSTs and SSTs and the ECSTS considered in this EIS and of TWRS facilities are to be addressed in detail in a separate, future EIS.

5.5.10 HEALTH EFFECTS UNDER ACCIDENT CONDITIONS

This section discusses the human health effects that could occur as the result of potential accidents during the implementation of the no action alternative. Initiating events, frequencies of occurrence, and quantities of respirable hazardous materials released during a range of potential accidents are discussed in detail in Appendix F. The types of health effects that can occur and the relationship between exposure and health effects are discussed in Appendix E. This section evaluates health effects in terms of LCFs for radiation exposures. Health effects for exposures to chemicals during accidents that involve exposure to both radioactive and toxic materials are not specifically evaluated. A previous analysis (WHC 1994c) concluded that radiological releases are limiting in these cases provided the release duration is at least 2 minutes and 40 seconds. The minimum release duration of combined radiological and chemical releases evaluated under the no action alternative is 2 hours.

The accidents considered in Appendix F include scenarios both within and beyond the design bases of the options and facilities comprising the no action alternative. Terms used to categorize accidents and the corresponding frequency ranges are summarized in Table 5-3. Based on frequencies of occurrence and quantities of hazardous materials released, a subset of these accidents was selected for evaluation of reasonably foreseeable health effects.

Under the no action alternative the ECSTS would be used for interim transfer of waste from the 200 West Area to the 200 East Area. The types and quantities of waste that would be handled by the ECSTS are summarized in Table 5-44. Detailed characterizations of the wastes listed in Table 5-44 are provided in Appendix E. Accidents that could occur in the ECSTS are discussed in the following section. To bound the probability of accidents under the no action alternative, it is assumed that all wastes shown in Table 5-44 are handled using the ECSTS. As a consequence of this assumption, complexed SWL would be mixed with the TRU sludge in Tank 102-SY. This could result in

Table 5-44
Volumes of Tank Waste Transferred from the 200 West Area under the No Action Alternative

Waste Typea	Volume (kgal) b	Systems Used
SWL		
Complexed	575	ECSTS
Uncharacterized	1,221	
Non-Complexed	2,426	ECSTS
Salt Well Total	4,222	
WAFW	469	ECSTS
Grand Total	4,691	

Source: Salt Well Volumes (WHC 1995a)
Salt Well Pumping Schedule (WHC 1994b)
102-SY Supernatant (WHC 1995c)

a1 kgal = 3,780 L
bTanks BX-111, T-111, and 106-C are excluded.

dissolution the sludge and an increase in the volume of TRU waste. Estimates of the quantities of TRU nuclides that could dissolve are not available; however, the radiological characteristics of WAFW are assumed in this EIS to be the same as those of Tank 102-SY slurry. Since this slurry would contain all of the TRU in Tank 102-SY, health effects for this waste should bound those that could result from transfer of complexed SWL containing dissolved TRU from Tank 102-SY.

Existing Cross-Site Transfer System - Transfer pipe breaks and pressurized spray leaks could occur during operation of the ECSTS under the no action alternative. Some of these events could result in releases to the soil column or to the atmosphere while others would be largely confined within the ECSTS encasement or diversion boxes (WHC 1989). These accidents are discussed in detail in Appendix F, Section F.3.1. This section discusses health effects of the more significant of these accidents and also addresses operational failures of the ECSTS.

- Transfer Pipe Leaks - Transfer pipe breaks in the ECSTS could be caused by excavations, earthquakes, or operational failures of welds or pipes. Breaks caused by excavations or earthquakes could rupture both the pipeline and its encasement and result in the result of waste to the soil column and atmosphere.

  An earthquake producing horizontal ground motion in excess of 0.05 g would be expected to rupture both the ECSTS transfer lines and their concrete encasement (WHC 1989) and is considered to be an unmitigated accident. A mitigated case has not been analyzed. The frequency of a 0.05 g earthquake is estimated to be 6.7 x 10-3 /yr (Personal communication, Farnsworth 1995). At 190 L/min (50 gpm), a total of about 10 weeks would be required to transfer all the wastes shown in Table 5-44. Taking into account failure to perform manual shutoff and to perform material balance, the probability of a seismic rupture of the ECSTS during this time is extremely unlikely (3.0 x 10-6). Applying the event tree for the RCSTS excavation pipe break discussed in Section 5.1.10.2 to the ECSTS under the no action alternative yields a probability of incredible (4.5 x 10-7) for the leak. The total probability of an unmitigated ECSTS transfer pipe leak under the no action alternative is extremely unlikely (3.4 x 10-6).

The consequences of the unmitigated ECSTS transfer pipe leak are shown in Table 5-45. Based on a risk factor of 4 x 10-4 LCF/person-rem for workers and 5 x 10-4 LCF/person-rem for the general public, no adverse health effects would be expected for accidents involving SWL, WAFW, or BSW. A 1:1 dilution is assumed for BSW to better reflect the low solids content of the wastes that would actually be transferred. The ability of the ECSTS to transport slurries is currently unknown.

Table 5-45
Estimated Health Effects from an ECSTS Unmitigated Transfer Pipe Break under the No Action Alternative

Release Location	Diversion Box 241-UX-151 (200 West Area)		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Unlikely	Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.019	0.80	3.0
ICR	7 x 10-6	3 x 10-4	0.001
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.27	12	43
ICR	1 x 10-4	0.005	0.02
Collective Dose (person-rem)	1.8	76	280
LCF	7 x 10-4	0.03	0.1
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	4.1 x 10-4	0.017	0.064
ICR	2 x 10-7	9 x 10-6	3 x 10-5
Collective Dose (person-rem)	8.5	360	1,400
LCF	0.004	0.2	0.7
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.0013	0.055	0.20
ICR	6 x 10-7	3 x 10-5	1 x 10-4
Release Location	Diversion Box 241-ER-151 (200 East Area)		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Unlikely	Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.019	0.80	3.0
ICR	7 x 10-6	3 x 10-4	0.001
Receptor	Uninvolved Workers		
Individual Dose (rem)	0.27	12	43
ICR	1 x 10-4	0.005	0.02
Collective Dose (person-rem)	4.1	180	650
LCF	0.002	0.07	0.3
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	5.0 x 10-4	0.021	0.079
ICR	2 x 10-7	1 x 10-5	4 x 10-5
Collective Dose (person-rem)	8.5	360	1,300
LCF	0.004	0.2	0.7
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	6.0 x 10-4	0.026	0.096
ICR	3 x 10-7	1 x 10-5	5 x 10-5

Operational pipe breaks in the ECSTS are not expected to result in loss of secondary containment. If it is assumed for purposes of analysis that the concrete encasement is currently intact, no release of waste to the soil column or atmosphere would occur; however, thousands of gallons of waste could be pumped into the encasement. Given the age and perceived unreliability of the system, such an event could lead to a decision to discontinue use of the ECSTS. The ECSTS SAR (WHC 1989) considered these types of leaks but did not estimate their frequency. Based on a failure rate of 1 x 10-10/hr-ft for stainless steel pipe and applying an error factor of 30 to account for the aged condition of the ECSTS (WHC 1995i) yields a failure frequency of 0.49/yr for a single 5.6 km (3.5-mi) length of ECSTS pipe. The probability of a failure during the 10 weeks (0.178 yr) needed to transfer liquids under the no action alternative is 8.7 x 10-2. The corresponding probability for a 10-km (6.5-mi) length of RCSTS pipeline transferring the same volume is 1.8 x 10-3.

- Pressurized Spray Leaks - Spray leaks inside older diversion boxes, valve pits, and pump pits are not uncommon events at the Hanford Site and can have severe consequences if the spray is not confined within the pit.

The probability of an unmitigated (unconfined) spray release from the ECSTS diversion boxes during ECSTS usage under the no action alternative is extremely unlikely with an estimated probability of 4.0 x 10-6. As shown in Table 5-46, adverse health effects would be expected among the nominally exposed uninvolved worker population (2 LCFs) and the maximally exposed off-site population (7 LCFs) for accidents involving WAFW. The probability of the accident while transferring WAFW is incredible (4 x 10-7). Health effects of the same accident involving BSW would be approximately four times higher. No adverse health effects would be expected for ECSTS unmitigated spray releases involving SWL. If the spray leak is mitigated by cover blocks being in place, the probability of a spray release is anticipated (3.6 x 10-2); however, a much smaller quantity of waste would be released. As indicated in Table 5-47, doses to maximally exposed individuals and populations would be very low and no observable health effects would be expected.

Table 5-46
Estimated Health Effects from an ECSTS Unmitigated Spray Release under the No Action Alternative

Release Location	Diversion Box 241-UX-151 (200 West Area)		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Extremely Unlikely	Incredible	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.19	8.1	30
ICR	8 x 10-5	0.003	0.01
Receptor	Uninvolved Workers		
Individual Dose (rem)	9.9	420	1,600
ICR	0.004	0.2	0.6
Collective Dose (person-rem)	57	2,400	9,000
LCF	0.02	1	4
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	0.018	0.77	2.8
ICR	9 x 10-6	4 x 10-4	0.001
Collective Dose (person-rem)	320	14,000	5.1 x 104
LCF	0.2	7	30
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.060	2.6	9.6
ICR	3 x 10-5	0.001	0.005
Release Location	Diversion Box 241-ER-151 (200 East Area)		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Extremely Unlikely	Incredible	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	0.19	8.1	30
ICR	8 x 10-5	0.003	0.01
Receptor	Uninvolved Workers		
Individual Dose (rem)	9.9	420	1,600
ICR	0.004	0.2	0.6
Collective Dose (person-rem)	130	5,800	2.1 x 104
LCF	0.05	2	9
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	0.023	0.97	3.6
ICR	1 x 10-5	5 x 10-4	0.002
Collective Dose (person-rem)	320	14,000	5.1 x 104
LCF	0.2	7	30
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	0.028	1.2	4.4
ICR	1 x 10-5	6 x 10-4	0.002

Table 5-47
Estimated Health Effects from an ECSTS Mitigated Spray Release under the No Action Alternative

Release Location	Diversion Box 241-UX-151 (200 West Area)		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Anticipated	Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	2.2 x 10-7	9.5 x 10-6	3.5 x 10-5
ICR	< 10-7	< 10-7	< 10-7
Receptor	Uninvolved Workers		
Individual Dose (rem)	1.2 x 10-5	5.0 x 10-4	0.0018
ICR	< 10-7	2 x 10-7	7 x 10-7
Collective Dose (person-rem)	6.6 x 10-5	0.0029	0.011
LCF	< 10-7	1 x 10-6	4 x 10-6
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	2.1 x 10-8	9.0 x 10-7	3.3 x 10-6
ICR	< 10-7	< 10-7	< 10-7
Collective Dose (person-rem)	3.8 x 10-4	0.016	0.060
LCF	2 x 10-7	8 x 10-6	3 x 10-5
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	7.0 x 10-8	3.0 x 10-6	1.1 x 10-5
ICR	< 10-7	< 10-7	< 10-7
Release Location	Diversion Box 241-ER-151 (200 East Area)		
Waste	SWL	WAFW	BSW
Dilution (diluent:waste)	0:1	0:1	1:1
Probability	Anticipated	Unlikely	Not Applicable
Receptor	Involved Workers		
Individual Dose (rem)	2.2 x 10-7	9.5 x 10-6	3.5 x 10-5
ICR	< 10-7	< 10-7	< 10-7
Receptor	Uninvolved Workers		
Individual Dose (rem)	1.2 x 10-5	5.0 x 10-4	0.0018
ICR	< 10-7	2 x 10-7	1 x 10-7
Collective Dose (person-rem)	1.6 x 10-4	0.0067	0.025
LCF	< 10-7	3 x 10-6	1 x 10-5
Receptor	General Public - Existing Boundary		
Individual Dose (rem)	2.6 x 10-8	1.1 x 10-6	4.2 x 10-6
ICR	< 10-7	< 10-7	< 10-7
Collective Dose (person-rem)	3.8 x 10-4	0.016	0.060
LCF	2 x 10-7	8 x 10-6	3 x 10-5
Receptor	General Public - Potential Boundary		
Individual Dose (rem)	3.2 x 10-8	1.4 x 10-6	5.1 x 10-6
ICR	< 10-7	< 10-7	< 10-7

5.6 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

The construction and operation of any of the alternatives except the no action alternative, could result in adverse impacts to the environment. While all the alternatives evaluated in this EIS were formulated with engineering controls and mitigative features to minimize impacts, some impacts would still be unavoidable. This section identifies only adverse impacts that mitigation could not reduce to minimal levels or avoid altogether and includes land use and air quality.

Construction of the RCSTS under the preferred and new storage alternatives would commit approximately 30 ha (74 acres) of land to pipeline installation. Approximately 9 ha (23 acres) of the corridor would be sagebrush, cheatgrass habitat which would experience long-term effects. Part of this area would be revegetated following construction, but an estimated 25 percent would be continuously disturbed for access and maintenance. The sagebrush communities are expected to require decades to become established and reach maturity. While mitigation measures would be established for revegetation in other parts of the 200 Area Plateau, the immediate corridor would suffer adverse impacts. As discussed in Section 5.1.4.3, the loggerhead shrike, the sagebrush lizard, and the sage sparrow all require sagebrush habitat. While construction activities would disrupt big sagebrush habitat in localized areas, compensatory habitat restoration sites would be established as discussed in Appendix D.

Construction of the NTF under the new storage alternative would require 20 ha (50 acres) of land in addition to that committed for the RCSTS. The NTF sites consist of sagebrush habitat at all three optional locations. After tank construction, approximately one-third of this area probably could be revegetated, but some of this area would likely be disturbed because of its close proximity to actively used areas. Because all of the proposed NTF sites would disturb 50 additional acres of sagebrush habitat, habitat restoration would also be increased as discussed in Appendix D.

As discussed in Chapter 5, fugitive dust emissions would be expected from proposed construction activities for the preferred, new storage, truck transfer, and rail transfer alternatives. Construction activities would include mitigation measures such as watering exposed areas, stabilizing spoil piles with soil fixatives or vegetation. Although there would be dust emissions, these measures are expected to keep dust concentrations below regulatory standards.

5.7 RELATIONSHIP BETWEEN SHORT-TERM USE AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY OF THE ENVIRONMENT

In accordance with NEPA and CEQ guidelines, this section discusses the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

The Federal government acquired the Hanford Site in 1943 for activities in support of World War II and continued these activities for national defense during the Cold War of the 1950s and thereafter. The storage of the waste associated with these activities is a necessary component of these activities.

Due to the actions discussed within this EIS, more acres of land would be committed to waste management for some alternatives (the number of acres varies according to the alternative selected). However, all of this land would be in the "Waste Management" zone of the "Exclusive Waste Management Use Area" identified in the report of the Hanford Future Site Uses Working Group (see Figure 6-2) (FSUWG 1992).

Although there would be an initial loss of mature sagebrush habitat for some alternatives (the number of acres lost varies according to the alternative selected), this vegetation would be replaced at a ratio of 3:1 - some revegetation would be on the construction site and most on a compensation site (see Figure 5-2).

The current Hanford Site mission is to clean up the site, provide scientific and technological excellence to meet global needs, and partner in the economic diversification of the region. Future plans for this portion of the Hanford Site call for its continued use as an area dedicated primarily to waste management activities over the next three decades.

Return of the Hanford Site to agricultural or other nonindustrial use may be precluded by the presence of the existing structures, roads, utilities, and the existing soil contamination problems. Because of the potential for, or perception of, contamination, use of the land for agriculture might not be appropriate. The 200 East and West Areas, as well as much of the surrounding area, may be suitable for industrial use.

The Hanford Site has a low biological productivity (i.e., biomass production is low compared to habitats with more moisture) as discussed in Section 4. The land occupied under any of the alternatives combined with that already developed would still occupy less than 6 percent of the total Hanford Site and would not affect the biological productivity of the balance of the Hanford Site. No agriculture is practiced on the Hanford Site because of its restricted access status and availability of other land better suited for growing crops and grazing livestock.

Other uses, such as for wildlife refuges, might be appropriate after decommissioning is completed. Environmental remediation activities are currently underway and are scheduled to continue over the next three decades. Cleanup of the Hanford Site increases the options for future use of the property.

5.8 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The irreversible and irretrievable commitment of natural and manmade resources from constructing and operating the proposed action alternatives would involve materials that could not be recovered or recycled, or that would be consumed or reduced to unrecoverable forms. Some of these commitments would be irretrievable because of the nature of the commitment (e.g., concrete and capital costs) or the cost of reclamation (e.g., contaminated materials).

Construction and operation of the proposed alternatives would consume irretrievable amounts of electricity, fuel, concrete, steel and other metals, plastics, lumber, sand, gravel, water, and miscellaneous chemicals. The land and associated habitat required for constructing the RCSTS, NTF, and load and unload facilities would constitute at a minimum an interim commitment of land for waste management. Future use of these tracts of land, while beyond the scope of this EIS, could include restoring these areas for unrestricted use.

The irreversible and irretrievable commitment of resources for the preferred alternative would include materials, land use, and capital costs. Approximately 826,000 kg (911 tons) of steel would be required for the RCSTS under the preferred and new storage alternatives. As stated in Section 5.1.4.2 approximately 30 ha (74 acres) would be required for constructing the RCSTS.

For the new storage alternative approximately 2,450 m3 (3,200 yds3) of concrete and 1.03 million kg (1,139 tons) of steel would be needed for the tanks. This would be an incremental addition to the materials required for the RCSTS. The NTF would require an additional 20 ha (50 acres) of land.

The truck transfer alternative would require the construction of a load and unload facility and the procurement of transport vehicles. The rail alternative would require construction of a load and unload facility, and the procurement of rail cars. The land required for the load and unload facilities for either the truck or rail load and unload facilities is estimated to be 1.6 ha (4 acres).

The alternatives proposed in this EIS are not considered resource intensive and the resources required are not considered rare or unique. Furthermore committing any of these resources would not cause a negative impact on the availability of these resources.

5.9 COMPARATIVE ANALYSIS OF ALTERNATIVES

To assist in decision-making, this section compares the potential impacts of the alternatives. This section summarizes the detailed impact analyses described for each alternative in Sections 5.1 through 5.5.

As described in Section 3, each alternative consists of actions that would be employed to address the purpose and need for:

- Removing SWL from older SSTs to reduce the likelihood of liquid waste escaping into the environment
- Providing the ability to transfer tank waste via a compliant system between the 200 West and 200 East Areas
- Providing adequate tank waste storage capacity for current and future waste volumes
- Mitigating hydrogen gas generation in Tank 101-SY

Table 5-48 summarizes the actions which would be implemented by each alternative to meet the purpose and need statement. Actions common to more than one alternative include continued use of two existing systems, ECSTS and the mixer pump in Tank 101-SY, and construction and operation of two new systems, RCSTS, and a retrieval system in Tank 102-SY. The actions which are common among alternatives are listed in Table 5-49. Some of the actions are common to more than one alternative as shown in Table 5-49.

The environmental impacts that would result from the implementation of each alternative are compared in Table 5-50. Generally, with the exception of impacts associated with land disturbance, there would be no substantial differences in mitigated environmental impacts among the alternatives.

Comparison of impacts among alternatives is provided in Section 5.9.1. Comparison of the consequences of potential accidents among the alternatives is provided in Section 5.9.2.

5.9.1 COMPARATIVE IMPACTS AMONG ALTERNATIVES

This section compares the environmental impacts among the alternatives using the environmental topics discussed in Section 4.

Table 5-48
Comparison of Alternatives
Purpose and Need

Alternatives	Remove SWL to Reduce SST Leaks (Interim Stabilization)	Provide Compliant Cross-site Waste Transfer	Provide Adequate Waste	Mitigate Hydrogen Generation in Tank

	Non-complexed SWL	Complexed SWL	Capability[a]	Storage	101-SY
Preferred	Transfer through Tank 102-SY prior to solids retrieval	Retrieve Tank 102-SY solids prior to transfer	ECSTS/RCSTS	Existing DSTs	Continue Mixer Pump Operations
Truck Transfer	Bypass Tank 102-SY with Truck	Bypass Tank 102-SY with Truck	ECSTS/Truck	Existing DSTs	Continue Mixer Pump Operations
Rail Transfer	Bypass Tank 102-SY with Rail	Bypass Tank 102-SY with Rail	ECSTS/Rail	Existing DSTs	Continue Mixer Pump Operations
New Storage	Transfer through Tank 102-SY prior to solids retrieval	Retrieve Tank 102-SY solids prior to transfer	ECSTS/RCSTS	New DSTs	Retrieve and Dilute
No Action	Transfer through Tank 102-SY without solids retrieval	Transfer through Tank 102-SY without solids retrieval	ECSTS[b]	Existing DSTs	Continue Mixer Pump Operations

[a]Only the preferred and new storage alternatives would meet Tri-Party Agreement Milestone M-43-07 which requires the construction and operation of the RCSTS.

[b]The ECSTS would not be compliant with applicable requirements.

Table 5-49
Summary of Actions by Alternative

Action	Alternatives: Preferred	Truck Transfer	Rail Transfer	New Storage	No Action
Construct and operate RCSTS	X			X	
Operate ECSTS	X[a]	X[a]	X[a]	X[a]	X
Retrieve solids from Tank 102-SY	X			X	
Continue Tank 101-SY mixer pump operations	X	X	X		X
Retrieve and dilute Tank 101-SY				X	
Provide storage in existing tanks	X	X	X		X
Construct NTF				X	

[a]ECSTS used until replacement transfer capability operational

Table 5-50
Comparison of Potential Impacts

Potential Impact Area	Alternatives: Preferred	Truck Transfer	Rail Transfer	New Storage	No Action
GEOLOGY	This alternative would cause no impacts.	This alternative would cause no impacts.	This alternative would cause no impacts.	This alternative would cause no impacts.	This alternative would cause no impacts.
SOILS	This alternative would disturb 30 ha for the RCSTS.	This alternative would disturb 2 ha for new load and unload facilities and new road spurs.	This alternative would disturb 2 ha for new load and unload facilities and new rail spurs.	This alternative would disturb 30 ha for the RCSTS and 20 ha for the NTF.	This alternative would disturb no new area.
SEISMOLOGY	RCSTS design would incorporate current performance requirements	Load and unload facility designs would incorporate current performance	Load and unload facility designs would incorporate current	ITRS and RCSTS design would incorporate current	This alternative would continue to use tanks and

performance performance requirements of ECSTS constructed to past
of 0.20 gravity for requirements of 0.20
requirements of 0.20 gravity 0.20 gravity for Safety performance requirements.
Safety Class 1 gravity for Safety Class 1 for
Safety Class 1 Class 1. NTF would be
equipment. equipment.
equipment. designed for 0.35 gravity. Tank 101-SY mixer pump

operations would continue
This alternative would This alternative would This
alternative would This alternative would to use tanks constructed
continue to use tanks continue to use ECSTS continue
to use ECSTS continue to use ECSTS to past performance
and ECSTS constructed to constructed to past
constructed to past constructed to past requirements (0.2 to 0.25
past performance performance requirements
performance requirements performance requirements gravity).
requirements until until load and unload until
load and unload until RCSTS replaces ECSTS.
RCSTS replaces ECSTS. facilities are
facilities are operational.
operational.
Tank 101-SY mixer pump
Tank 101-SY mixer pump Tank
101-SY mixer pump operations would continue to
operations would Tank 101-SY mixer pump
operations would continue to use tanks constructed to
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constructed to past to use tanks constructed past
performance requirements (0.2 to 0.25
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gravity).
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alternative has no This alternative has no This alternative has no
RESOURCES AND discharge of effluents. discharge of effluents. discharge
of effluents. discharge of effluents. discharge of effluents.
HYDROLOGY
PHYSICAL ENVIRONMENT
Construction RCSTS would generate Load and unload facility Load and
unload facility RCSTS and NTF would generate This alternative would
dust; however, construction would
construction would generate dust; however, mitigation is have no construction
mitigation is feasible. generate dust; however, dust;
however, mitigation is feasible. activities; therefore, no
mitigation is feasible. feasible.
construction impacts would
Release of contaminated
Release of contaminated soil occur.
soil would be Release of contaminated Release
of contaminated soil would be controlled.
controlled. soil would be controlled. would be
controlled.
Normal Normal emissions would Normal emissions would not Normal
emissions would not Normal emissions would not Normal emissions would not
Emissions not exceed worker or exceed worker or public exceed
worker or public exceed worker or public exceed worker or public
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exposure limits. limits.
Sound Levels This alternative would This alternative would This
alternative would cause This alternative would cause This alternative would
and Noise cause no impacts. cause no impacts. no
impacts. no impacts. cause no impacts.
BIOLOGICAL AND This alternative would This alternative would This
alternative would This alternative would This alternative would
ECOLOGICAL remove 9 ha of Priority remove no Priority Habitat remove no
Priority Habitat remove 9 ha of Priority disturb no Priority
RESOURCES Habitat for proposed for load and unload for load
and unload Habitat for proposed RCSTS Habitat.
RCSTS location and 8.5 facilities, or roadways.
facilities or railways. location and 8.5 ha for
ha for optional RCSTS
optional RCSTS location.
location.

This alternative would

remove 20 ha of Priority

Habitat for NTF.

POPULATION AND SOCIOECONOMICS
Construction RCSTS and Tank 102-SY Load and unload facility Load and
unload facility new RCSTS, NTF, Tank 101-SY This alternative would
Retrieval System new new hire construction hire
construction workforce ITRS, and Tank 102-SY cause no net change.
hire construction workforce of 25 would of 25
would cause no Retrieval System new hire
workforce of 60 would cause no impacts. impacts.
construction workforce of
cause no impacts.
185 would cause no impacts.

Operations Operational workers Operational workers would
Operational workers would Operational workers would Operational workers would
would come from existing come from existing Hanford come from
existing Hanford come from existing Hanford come from existing Hanford
Hanford labor pool. This labor pool. This labor
pool. This labor pool. This labor pool. This
alternative would alternative would provide
alternative would provide no alternative would provide no alternative would provide
provide no net change. no net change. net
change. net change. no net change.

TRANSPORTATION
Construction RCSTS construction work Load and unload facility Load and
unload facility RCSTS construction work No additional traffic
force would not construction work force
construction work force force would not impacts would occur.
significantly add to would not significantly would not
significantly add significantly add to traffic
traffic congestion. add to traffic congestion. to
traffic congestion. congestion.

NTF construction could add

to congestion, but

mitigation would be

accomplished through

scheduling or ride pools.

Operations This alternative would Intersite truck transfers Intersite
rail transfers This alternative would have This alternative would
have no impacts. would impact routine would
impact routine no impacts. have no impacts.
traffic. traffic.

LAND USE
Construction This alternative would This alternative would This
alternative would This alternative would This alternative would
commit 30 ha to waste commit no additional land commit no
additional land commit 30 ha to waste commit no additional land
management for the outside of the 200 East outside
of the 200 East and management for the RCSTS and to waste management.
RCSTS. and West Areas to waste West
Areas to waste 20 ha for the NTF.
management.
management.

Operations This alternative would This alternative would This
alternative would This alternative would This alternative would
conduct operational conduct operational conduct
operational conduct operational conduct operational
activities consistent activities consistent with
activities consistent with activities consistent with activities consistent with
with past, current, and past, current, and future past,
current, and future past, current, and future past, current, and future
future uses. uses. uses.
uses. uses.

CULTURAL This alternative would This alternative would This
alternative would cause This alternative would cause This alternative would
RESOURCES cause no impacts to cause no impacts to known no
impacts to known no impacts to known cause no impacts to known
known resources. resources.
resources. resources. resources.

HEALTH EFFECTS UNDER NORMAL CONDITIONS
Construction This alternative would Load and unload facilities Load and
unload facilities NTF would be located in This alternative would
result in worker would be located in would be
located in uncontaminated areas. require no new

exposure from: uncontaminated areas.
uncontaminated areas. construction.

This alternative would
. RCSTS construction of Connections to existing
Connections to existing result in worker exposure
26.3 person-rem, or lines and facilities would lines
and facilities would from:
0.01 LCF. yield worker doses similar yield
worker doses similar

to RCSTS of 26.3 person- to RCSTS
of 26.3 person-rem, . RCSTS construction of
. Tank 102-SY Retrieval rem, or 0.01 LCF. or 0.01
LCF. 26.3 person-rem, or 0.01
System of 400 person-
LCF
rem or 0.16 LCF.

. Tank 102-SY Retrieval

System of 400 person-rem

or 0.16 LCF.

. Tank 101-SY ITRS

construction of 170

person-rem, or 0.07 LCF.
Operations This alternative would This alternative would not This
alternative would not This alternative would not This alternative would not
not change average tank change average tank farm change
average tank farm change average tank farm change average tank farm
farm worker exposure of worker exposure of 14 worker
exposure of 14 worker exposure of 14 worker exposure of 14
14 mrem/yr, 6 x 10-6 mrem/yr, 6 x 10-6 LCFs. mrem/yr,
6 x 10-6 LCFs. mrem/yr, 6 x 10-6 LCFs. mrem/yr, 6 x 10-6 LCFs.
LCFs.
Load and unload facility Load and
unload facility

operations would add:
operations would add 35

person-
rem, 0.01 LCF.

. 344 person-rem for the
LR-56(H) truck, 0.14 Rail
operator exposure would

LCF not
exceed allowable dose

limits.
. 69 person-rem for 5,000
gal truck, 0.03 LCF

Truck driver exposure
would exceed allowable
dose limits without design
changes or administrative
controls.

1 ha = 2.47 acres

5.9.1.1 Geology, Seismology and Soils

- There are no significant geological resources beneath the Hanford Site nor prime or unique soils at the surface. Therefore, no alternative would significantly impact valuable geological or soil resources.

Under each alternative, except the no action alternative, new facilities would be designed to currently required seismic standards. The new tanks which would be constructed under the new storage alternative would be designed to meet seismic criteria for new DSTs which require the ability to withstand a ground acceleration of 0.35 gravity. Non-storage facilities such as the ITRS, RCSTS, and load and unload facilities would be constructed to a 0.20 g requirement. Seismic design criteria applied to the construction of existing DSTs and SSTs, and the ECSTS were less stringent than those for new DSTs. Tank 101-SY was designed to withstand a ground acceleration from 0.2 to 0.25 g. Construction of new tanks, pipelines, and facilities under the preferred, new storage, truck transfer, and rail transfer alternatives would result in a negligible change in seismic risk relative to the no action alternative.

5.9.1.2 Water Resources and Hydrology

- There would be no operational discharges of liquid effluents under any alternative. All alternatives would reduce risk to vadose zone contamination or ground-water contamination from SST leaks through continuation of the interim stabilization program. All alternatives except the no action alternative would further reduce risks by replacing the ECSTS which is over 40 years old and consists of single-wall pipe in a concrete encasement. The preferred and new storage alternatives would replace the ECSTS with the RCSTS. The truck transfer and rail transfer alternatives would use surface vehicles instead of subsurface piping.

5.9.1.3 Physical Environment

- All alternatives except the no action would involve new construction with the potential for dust emissions which would be controlled by wetting or use of other soil fixatives. Because all alternative would involve only the handling of existing waste and not the processing or generation of new wastes, emission rates would generally remain the same as existing conditions which are compliant with applicable requirements. Under the new storage alternative which would construct the NTF, some reduction in emissions from Tank 101-SY wastes would result from dilution and due to the incorporation of advanced control technologies into NTF design.

Construction of facilities under any alternative would not result in noise impacts offsite due to the distance to the site boundary. Protective equipment would be issued as necessary to on-site individuals to minimize the noise impact to workers.

5.9.1.4 Biological and Ecological Resources

- Construction activities under the preferred and new storage alternatives would result in loss of Priority Habitat for candidate endangered species. The preferred alternative would remove 9 ha (23 acres) and the new storage alternative would remove 30 ha (73 acres).

Loss of habitat would be mitigated by reestablishment of habitat elsewhere on the Hanford Site, to minimize the long-term impacts. The truck transfer, rail transfer, and no action alternatives would not remove Priority Habitat.

5.9.1.5 Population and Socioeconomic Impacts

- Worker requirements for construction under all alternatives would not be significant and would come partially from existing workers. The operations workforce for all alternatives would be drawn from the existing Hanford Site labor pool and result in no net socioeconomic changes. No low-income or minority populations would be adversely affected by any alternative.

5.9.1.6 Transportation

- New construction workers under the preferred, new storage, truck transfer, and rail transfer alternatives could increase traffic congestion. This congestion would be minor and could be mitigated by scheduling, car pools or roadway upgrades. Operational workers for all alternatives would be included in existing traffic loads.

The truck transfer and rail transfer alternatives would have the potential to temporarily affect routine on-site traffic in the 200 East and West Areas as traffic could be restricted during waste transfers. Truck transfers using the LR56(H) could result in traffic disruptions several times per day. The 19,000 L (5,000-gal) truck or rail car would likely disrupt traffic only once per day. The preferred, new storage, and no action alternatives using the RCSTS and, or the ECSTS for cross-site transfers would not have this potential for traffic impacts.

5.9.1.7 Land Use

- The preferred alternative would commit 30 ha (74 acres) of additional land to waste management and the new storage alternative would commit 50 ha (124 acres). This land would be committed for at least 30 years, assuming the TWRS EIS remediation completion estimate of 2028. The truck transfer, rail transfer, and no action alternatives would commit no new land to waste management.

5.9.1.8 Cultural Resources

- There would be no impact on known cultural resources within the areas used for any alternative. Areas proposed for revegetation to restore lost habitat would be surveyed prior to use to establish plans for avoidance of identified resources.

5.9.1.9 Anticipated Health Effects

- Contaminated materials could be encountered during construction of the RCSTS and the Tank 102-SY retrieval system under the preferred and new storage alternatives. However, worker dose would be maintained within site standards and there would be no off-site public exposure. These effects would not occur for the truck transfer, rail transfer, and no action alternatives. No health effects are anticipated during construction of the NTF under the new storage alternative since the NTF would be located on an uncontaminated area.

There would be only minor differences among the alternatives in radiological health effects for workers and the general public for normal operations. With the exception of drivers of the truck transports, no alternative would cause workers or the public to be exposed to unacceptable levels of radiological or toxic constituents as a result of normal operations. The transport driver under the truck alternative would receive an unacceptable exposure without further modification in the truck design or the application of other administrative controls.

5.9.2 ACCIDENT COMPARISON

Potential accidents and their consequences have been summarized by alternative in Table 5-51.

Table 5-51
Comparison of Health Effects from Accidentsa Analyzed for Each Alternative

Latent Cancer Fatalities

Maximum
Potential
Accidents Uninvolved Maximum Off-site
Alternative System and Probabilities
Waste Worker Population Population
Preferred ECSTS Unmitigated
transfer pipe break SWL 0.002 0.004
Truck Transfer "Unlikely"
WAFW 0.07 0.2
Rail Transfer
New Storage
No Action
Unmitigated spray
release SWL 0.05 0.2
"Extremely
Unlikely" WAFW 2 7
Mitigated spray
releaseb SWL < 10-7 2 x 10-7
"Anticipated"
WAFW 3 x 10-6 8 x 10-6
Preferred RCSTS Unmitigated pipe
break SWL 0.01 0.02
"Incredible"
102-SY/WAFW 0.5 0.7

New Storage (200 West)
Mitigated pipe
break SWL 0.004 0.005
"Extremely
Unlikely" 102-SY/WAFW 0.2 0.2
Mitigated spray
release SWL 5 x 10-6 3 x 10-5
"Anticipated"
102-SY/WAFW 2 x 10-4 0.001
New Storage (200 East) RCSTS Unmitigated pipe
break SWL 0.01 0.02
"Incredible"
102-SY/WAFW 0.5 0.7
101-SY 0.003 0.004
Mitigated pipe
break SWL 0.004 0.005
"Extremely
Unlikely" 102-SY/WAFW 0.2 0.2
101-SY 0.001 0.002
Mitigated spray
release SWL 2 x 10-5 3 x 10-5
"Anticipated"
102-SY/WAFW 7 x 10-4 0.001
101-SY 4 x 10-6 7 x 10-6
Truck Transfer LR-56(H) In-transit breach
SWL 1 x 10-4 2 x 10-4
"Unlikely"
102-SY/WAFW 0.006 0.009
5,000-gal tanker In-transit breach
SWL 7 x 10-4 0.001
"Extremely
Unlikely" 102-SY/WAFW 0.03 0.04
LR-56(H) Breach at
load/unload facility SWL 0.01 0.008
"Unlikely"
102-SY/WAFW 0.4 0.3
5,000-gal tanker Breach at
load/unload facility SWL 0.05 0.04
"Unlikely"
102-SY/WAFW 2 2
Rail Transfer 10,000-gal rail car In-transit breach
SWL 0.001 0.002
"Extremely
Unlikely" 102-SY/WAFW 0.06 0.09
10,000-gal rail car Breach at
load/unload facility SWL 0.1 0.08
"Unlikely"
102-SY/WAFW 0.9 3
Truck Transfer or Load/unload Facility spill
SWL 4 x 10-5 5 x 10-5
Rail Transfer facilities "Anticipated to
Unlikely" 102-SY/WAFW 0.002 0.002
Preferred ITRS for Tank 102-SY Unmitigated spray
release 102-SY 200 700
New Storage "Extremely Unlikely
to Incredible"
(200 East or West)
Mitigated spray
release 102-SY 1 x 10-5 5 x 10-5
"Anticipated to
Unlikely"
Unmitigated
transfer pipe break 102-SY 0.1 0.5
"Incredible"
Mitigated transfer
pipe break 102-SY 0.02 0.1
"Unlikely"
Preferred PPSS for Tank 102-SY Unmitigated pipe
break 102-SY 0.02 0.2
New Storage "Incredible"
(200 East or West)
Mitigated pipe
break 102-SY 0.006 0.04
"Unlikely"
Unmitigated spray
release 102-SY 100 500
"Extremely

Unlikely to Incredible"

Mitigated spray
release 102-SY 2 x 10-6 6 x 10-6
"Anticipated to

Unlikely"
New Storage ITRS for Tank 101-SY Unmitigated spray
release 101-SY 2 9
(200 East or West) "Extremely
Unlikely to Incredible"

Mitigated spray
release 101-SY 2 x 10-7 6 x 10-7
"Anticipated to

Unlikely"

Unmitigated
transfer pipe break 101-SY 0.001 0.007
"Incredible"
Mitigated transfer
pipe break 101-SY 3 x 10-4 0.002
"Anticipated"
New Storage NTF Unmitigated spray
release 101-SY 0.4 0.6
"Incredible to Not

Reasonably

Foreseeable"
Mitigated spray
release 101-SY 2 x 10-6 5 x 10-6
"Unlikely to

Extremely Unlikely"

Beyond design
basis leak 101-SY 0.003 0.007
"Extremely

Unlikely to Not

Reasonably

Foreseeable"

aAccident location with the greatest health effect are summarized in this table.

For wastes anticipated to be transferred cross-site during this interim action, SWL, WAFW, and potentially Tank 101-SY and Tank 102-SY, accidents with potential to cause adverse health effects to the uninvolved workers or the off-site public include:

. Unmitigated spray releases from the ECSTS, ITRS, or PPSS for Tank 102-SY and ITRS for Tank 101-SY

. Releases from a breach at the truck or rail load/unload facility.

An unmitigated spray release has the potential to occur under any alternative including the no action, however, the probability of an unmitigated spray release is extremely unlikely to incredible (10-5 to 10-7 per year) for the ITRS and PPSS and extremely unlikely (10-5 to 10-6 per year) for the ECSTS.

A release from a load/unload facility under the truck transfer or rail transfer alternatives would be unlikely (10-3 to 10-4 per year).

There are no anticipated (1 to 10-2 per year) accidents with potential to significantly impact the uninvolved worker population or the off-site public, under any alternative.

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6 CUMULATIVE IMPACTS

Section 6 examines the cumulative environmental impacts which could result by adding the impacts of the proposed alternatives to past, present, and future actions at the Hanford Site. The impacts of implementing any of the alternatives, as discussed in Chapter 5, would not significantly alter the existing environment. However, if these impacts to the environment were added to all the other actions proposed at the Hanford Site, the impacts on the environment could be amplified.

The cumulative impacts of future activities at the Hanford Site are not fully known and the detailed planning and analysis to estimate cumulative impacts have not yet been performed. However, there is strong evidence that the potential impacts from the alternatives in this EIS would be small compared to the potential cumulative impacts of all the other proposed actions. Most of the land use, soils, and ecological impacts would be isolated to the Central Plateau of the Hanford Site which has been recognized as an area where waste management activities would continue for a number of years. Furthermore, there would be no liquid releases to surface or groundwater, and air emissions from the proposed alternatives would be considerably less than site-wide emissions. Finally, both radiation and toxic substance exposures for all projects are limited by federal and state regulations, which are established to minimize impacts to workers and the general public.

The no action alternative would not alter existing environmental conditions because there would be no change from present operations. Environmental effects from ongoing operations of Tank 101-SY are part of the annual assessment of the environmental impacts for the Hanford Site which have been addressed in Section 5.5 and, therefore, will not be considered further.

Other than the alternatives described in this EIS, actions proposed at the Hanford Site that could impact the environment include:

- Environmental Restoration Disposal Facility (ERDF)
- Waste Receiving and Processing Facility (WRAP)
- Laser Interferometer Gravitational-Wave Observatory (LIGO)
- HRA Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) for operable units (OUs)
- TWRS
- PFP Cleanout
- K Basin Spent Fuel Management
- Solid Waste Operations Complex, Enhanced Radioactive and Mixed Waste Storage Facility, Infrastructure Upgrades, and Central Waste Support Complex
- 200 Area Sanitary Sewer System
- Disposal of Naval Reactor Plants

Most of these actions are necessary to decontaminate and decommission Hanford facilities and remediate contaminated sites as discussed in Section 6.1. These actions are briefly summarized in Section 6.2 to provide a basis for a qualitative evaluation in Section 6.3 of the potential cumulative impacts if some or all of these proposed actions were implemented.

6.1 CONTEXT FOR CUMULATIVE IMPACT ANALYSIS

Most of the environmental modifications that have occurred at the Hanford Site were associated with the production of special nuclear materials for national defense. These actions include the construction and operation of nuclear reactors, separations facilities, fabrication facilities, waste disposal areas (burial grounds), waste management tanks, power plants, transmission lines, laboratories, roads, and office buildings necessary to support the Site's defense mission. The facilities were built between 1944 and the present. The Hanford Site's mission has changed from production of special nuclear materials to environmental remediation and cleanup.

This EIS considers alternatives for safe interim storage of Hanford tank waste. For cumulative impact analysis, the potential impacts from this EIS must be examined in the context of past, present, and proposed future activities at the Hanford Site. Other projects, not directly related to the Hanford Site mission, have been placed at the Hanford Site. The Washington Public Power Supply System (Supply System) has built an on-site nuclear power plant to generate electrical power. Construction of the LIGO is in progress and, although not part of the Hanford Site's clean-up mission, would contribute to on-site habitat modification and environmental impacts. In 1994, construction of the Environmental and Molecular Science Laboratory (EMSL) began. The 18,600-m2 (200,000-ft2) facility will be used to develop the science and technology needed to clean up environmental problems at government and industrial sites across the country.

Present actions and proposed future actions at the Site involve the remediation of contaminated areas and the decontamination and decommissioning of on-site facilities. These actions involve or would involve OUs, reactors, separations facilities, waste management tanks, and other facilities containing radioactive and hazardous materials. Because of the nature of these materials, it is not possible or desirable to close the facilities in an "as is" condition. Instead, special actions, including the construction and operation of new facilities, may be required to remediate the existing waste and contaminated facilities. TWRS is a part of this overall clean-up effort. Under the Tri-Party Agreement, HLW stored in the on-site SSTs and DSTs would be moved to processing facilities, processed, and immobilized for final disposal. This process would take decades.

There are a number of nationwide programmatic EISs, e.g. the Waste Management Programmatic EIS, that have the potential to have environmental impacts at the Hanford site. Project-level actions that could affect the Hanford environment have not been determined sufficiently at this time to allow evaluation of impacts. Consequently, the cumulative impact assessment focuses on reasonably foreseeable actions.

6.2 OTHER HANFORD SITE ACTIONS WHICH WOULD AFFECT THE ENVIRONMENT

Because the other actions listed in Section 6 are in various stages of development, quantitative characterization information about their potential environmental impacts is currently unknown. ERDF was reviewed under CERCLA and is now under construction. WRAP-I was reviewed under DOE/EIS-0113 and a supplement analysis, and is now under construction. NEPA or similar documentation is either being prepared or will be prepared for the other actions. However, to inform the public, DOE, and Ecology decision-makers of the potential cumulative impacts, proposed actions are summarized in this section. The following sections briefly describe other actions at the Hanford Site which could contribute impacts to those evaluated in the EIS.

6.2.1 ENVIRONMENTAL RESTORATION DISPOSAL FACILITY

On January 20, 1994, EPA signed the ERDF ROD authorizing construction of a centralized disposal facility for Hanford Site remediation waste. The ROD authorizes construction of only two cells and supporting facilities. Trench expansion would be completed on an as needed basis and expansion would require a subsequent ROD or ROD amendment. In keeping with this as needed philosophy, 165 acres required for construction of the two cells and supporting facilities have been cleared; the remainder of the 4 km2 (1.6 mi2) is being reserved for future expansion. Many of these 67 ha (165 acres) were state priority habitat. Trench excavation began May 15, 1995 and operations are expected to begin in September 1996. Any required trench expansion would occur concurrent with operation. Closure of the facility is expected in 2034.

6.2.2 WASTE RECEIVING AND PROCESSING FACILITY

The WRAP would be used to characterize and treat TRU waste prior to shipment to the Waste Isolation Pilot Plant (WIPP) for final disposal. The WRAP complex and associated storage facilities will occupy 40 ha (100 acres) and is located in the 200 West Area. Construction of the facility is scheduled to be complete by March, 1996 and it will start operations in September 1997. The WRAP was included in the Hanford Defense Waste EIS (DOE 1987).

6.2.3 LASER INTERFEROMETER GRAVITATIONAL-WAVE OBSERVATORY

The LIGO is a research program for the detection and study of cosmic gravitational waves predicted by Einstein's theory of general relativity. The facility would consist of a central 7,600-m2 (82,000-ft2) building at the vertex of two 4-km (2.5-mi) arms. The arms are culvert-like structures which enclose the beam tubes. Small buildings are located at the midpoint and end of each arm to support test mass chambers and pumping equipment. The LIGO facility would occupy approximately 60 ha (148 acres). Construction is expected to require 2 years and involve 50 to 150 personnel. The EA for the LIGO was released on October 12, 1993 by the National Science Foundation (NSF) (NSF 1993). A FONSI was issued on December 6, 1993.

6.2.4 HANFORD REMEDIAL ACTION

The HRA EIS will assist the DOE's remediation strategy by establishing future land-use objectives on the Benton County portions of the Site. Future land-use objectives are the bases for establishing remedial action objectives and identifying corresponding preliminary remediation goals under CERCLA. The HRA EIS will compare the potential environmental impacts to Hanford Site future land-use alternatives. This comparison of environmental impacts, primarily from remediation activities, will assist in determining a preferred site-wide future land-use alternative. Site specific decisions regarding remediation technologies and remediation activities will not be made in the HRA EIS, but rather by processes specified by CERCLA and RCRA. The HRA EIS is in preparation and the Draft EIS is expected to be released for public comment in early 1996.

A Comprehensive Land Use Plan (CLUP) to further define the HRA EIS's preferred alternative is being coordinated with the HRA EIS. The CLUP in its draft and final stages will be released as a companion document to the draft and final stages of the HRA EIS. Public comment on the CLUP will occur concurrently with the public comment periods of the HRA EIS.

6.2.5 TANK WASTE REMEDIATION SYSTEM

TWRS would involve actions necessary to manage, treat, store and dispose of tank wastes and Cs and Sr capsules at the Hanford Site. Assuming that the no action alternative for TWRS is not selected, the preliminary indications show that construction for TWRS would begin in 1998 and extend for up to 10 years. The operation period would extend for many years. Detailed cumulative impact analyses will be provided in the TWRS Draft EIS which is scheduled for release in December 1995.

6.2.6 PLUTONIUM FINISHING PLANT CLEANOUT

The PFP Stabilization Project would involve the removal and stabilization of reactive residual Pu-bearing material at the PFP to a form suitable for interim storage.

Pu-bearing materials are located in several of the PFP facilities. Most of the residues left in the PFP when production operations stopped in 1989 remain at the facility, either in storage containers or on surfaces in enclosed process areas as "holdup."

Removal would consist of physically and/or chemically removing residual Pu-bearing material from surfaces. These removed materials as well as materials in storage containers would be processed in glovebox-sized processes. When stabilized, the material would have minimal chemical reactivity and would remain in solid form with a low water and organic content to minimize readiolysis. All stabilized material would be stored within existing PFP vaults pending a DOE decision on future disposition.

The PFP Stabilization EIS is being prepared and a Draft EIS is expected in November 1995.

6.2.7 K BASIN SPENT FUEL MANAGEMENT

DOE is currently evaluating environmental impacts of alternatives for managing spent nuclear fuel and sludge currently stored in the water-filled K East and West Storage Basins (K Basins) at the Hanford Site. Proposed alternatives for managing the K Basin fuel pending ultimate disposition include:

- Continued storage in the K Basins (no action)
- Enhanced storage in the K West Basin
- Wet or dry storage at Hanford
- Stabilization through surface passivation (drying and canning in an inert atmosphere)
- Calcining (dissolving, oxidizing, and solidifying)
- On-site or foreign processing (dissolving, separating, and solidifying).

Alternatives involving fuel removal for on-site storage or processing would occur in the Central Plateau exclusive waste management use area. The processing alternative is assumed to require the most land use to accommodate the processing and storage facilities. The total land needed for this alternative is estimated to be 8 ha (20 acres). The main contributors to cumulative impacts at the Hanford Site would most likely be air emissions and liquid effluents if the calcining or fuel processing alternative is selected. Specific impacts will be evaluated in the K Basin Draft EIS expected in fall 1995.

6.2.8 SOLID WASTE OPERATIONS COMPLEX, ENHANCED RADIOACTIVE AND MIXED WASTE STORAGE FACILITY, INFRASTRUCTURE UPGRADES, AND CENTRAL WASTE SUPPORT COMPLEX

This proposed action would retrieve stored and suspect TRU waste from Trench 4C-T04 in the 200 West Area, and construct and operate facilities necessary to store these retrieved wastes, as well as newly generated wastes. An estimated 36 ha (89 acres) of land would be disturbed in the 200 West Area, 20 ha (50 acres) of which would be priority sagebrush habitat. An EA and FONSI were approved in September.

6.2.9 200 AREA SANITARY SEWER SYSTEM

This proposed action would consist of replacing about 50 failing and overloaded sewage treatment facilities in the 200 Areas with two modern sanitary sewage collection systems and evaporative lagoon systems, one in the east and one in the west. The new systems would eliminate most liquid discharges to the vadose zone in these areas. Construction of the facilities would require approximately 40 ha (99 acres) for the lagoons and access roads. Of these 40 ha (99 acres), approximately 15 ha (36 acres) of sagebrush habitat would be disturbed. A draft EA is currently being reviewed.

6.2.10 DISPOSAL OF NAVAL REACTOR PLANTS

This proposed action would dispose of decommissioned defueled cruiser, OHIO class and LOS ANGELES class Naval Reactor plants at the Hanford site. Approximately 4 ha (10 acres) of land would be required for land disposal of approximately 100 reactor compartment disposal packages. Disposal would require commitment of this land from the 218-E-12B low-level burial ground in the 200 East Area. A draft EIS was issued by the U.S. Department of the Navy in August 1995 (USN 1995).

Figure 6-1 presents a time line showing the proposed construction and operation for the actions covered by EAs and EISs. This timeline is dependent on document approval and available budget. The schedule corresponds to milestones specified in the TPA (DOE 1994). Cumulative effects would be highest when construction activities overlap because traffic problems would be most acute, most site clearing would be occurring, the demand for construction labor would be highest, and the largest increase in transient population would occur. Figure 6-1 shows that in the late 1990s simultaneous construction activities could occur for at least two actions in addition to the preferred alternative: TWRS and HRA actions. The initial site clearing and construction of facilities would generate the primary impacts to ecology, soils, and other aspects of the environment.

Figure (Page 6-9)
Figure 6-1. Construction and Operating Periods for Actions at the Hanford Site

6.3 POTENTIAL CUMULATIVE IMPACTS

This section evaluates the impacts from the proposed alternatives as they relate to existing site conditions and future actions. The discussion of cumulative impacts is organized into the following topics:

- Land Use, Ecology, and Soils
- Water Quality and Air Quality
- Off-site Radiation Considerations
- Population and Socioeconomic Impacts.

6.3.1 LAND USE, ECOLOGY, AND SOILS

Limits placed on land use, ecology, and soils impacts depend on the amount of land to be used for the various actions. The size, number, and location of proposed facilities affect land use compatibility, the amount of habitat to be removed for the projects, and the amount of soil to be removed from production. A comprehensive assessment of possible future land uses at the Hanford Site has been completed and documented in a future use report as discussed in Section 4.7.1 (FSUWG 1992). This future use report does not constitute official DOE policy or guidelines. However, DOE initiated the study as part of the scoping for the HRA EIS to help establish clean-up levels.

As shown in Figure 6-2, the Central Plateau encompasses the 200 East and West Areas, and the 600 Area adjacent to and between them. The area identified in the Central Plateau for cleanup would consist of a buffer zone and an "exclusive" waste management area. The future use report recommended that all future clean-up activities be placed in the "exclusive" waste management area while the buffer zone would serve "to reduce risks that are expected to continue to emanate from the 200 Area."

Figure (Page 6-11)
Figure 6-2. Hanford Site Central Plateau and "Exclusive" Waste Management Area

The suggested Central Plateau waste management area would consist of approximately 11,700 ha (28,800 acres) less 6,700 ha (16,600 acres) for the buffer zone and the remaining 4,900 ha (12,200 acres) for the "exclusive" waste management area. The 200 East and West Areas would constitute approximately 2,600 ha (6,400 acres) of the "exclusive" area. In the proposed "exclusive" waste management area, much of which is identified as state priority habitat, there are currently about 2,300 ha (5,800 acres) of relatively undisturbed land, which represents the maximum area of potential impact for the other proposed actions identified in Section 6.2.

6.3.1.1 Land Use

- The cumulative impacts to land use from the proposed alternatives are evaluated with respect to other Hanford actions requiring land proximate to the 200 Areas. Industrial uses at the Hanford Site presently consume about 6 percent 9,300 ha (23,040 acres) of the total Hanford Site area. Of all the alternatives evaluated in this EIS, the preferred and new storage alternatives would occupy the most land. Therefore, they are used to evaluate the cumulative impacts to land use. Since the RCSTS would be constructed in relatively undisturbed areas, the area affected by the preferred alternative 30 ha (74 acres) would increase the industrial land use on the Hanford Site to 9,330 ha (23,114 acres) which represents a 0.02 percent increase. The area affected by the new storage alternative 50 ha (124 acres) would increase the industrial land use to 9,350 ha (23,164 acres) which represents a 0.03 percent increase.

The additional land disturbance for alternatives evaluated in this EIS must be added to the acreage affected by the other site actions. The cumulative impacts to the Hanford Site would be heavily influenced by the other projects planned by DOE, which involve more land than the preferred or new storage alternatives. If all the proposed actions were placed in the "exclusive" waste management area as defined in the future use report, the cumulative effects of alternatives in this EIS and other projects would be within the range of impacts already anticipated for land disturbance.

The area of land disturbed by the preferred alternative is about 0.6 percent of the area allocated to "exclusive" waste management uses, and about 1 percent of the relatively undisturbed land. For the new storage alternative, the land disturbed is about 1 percent of the area allocated to "exclusive" waste management uses, and about 2 percent of the relatively undisturbed land.

Other proposed projects at the Hanford Site would require a total of 890 to 1,300 ha (2,200 to 3,200 acres). Most of the land would be in the "exclusive" waste management use area and its remaining area of undisturbed land.

6.3.1.2 Ecological and Biological Resources

- The cumulative effects of the preferred and new storage alternatives and other actions upon ecological and biological resources are similar to those for land use. Site preparation and construction of the various facilities would require that vegetation be cleared. The amount and type of vegetation cleared would depend on the location of the proposed facilities and the land requirements of the facilities.

The preferred and new storage alternatives, for example, would remove 9 ha (23 acres) and 30 ha (73 acres) of sagebrush habitat, respectively. As with the land use analysis presented in Section 6.3.1.1, the requirements of other projects may be greater than the impact of the preferred alternative. The ERDF, for example, would remove 414 ha (1,024 acres) of sagebrush, important habitat for rare and potentially endangered species such as the loggerhead shrike. Other projects would remove more relatively undisturbed habitat leading to potential cumulative impacts to sensitive species as well as other flora or fauna which inhabit the Hanford environs.

The waste management area would consist of the 200 East and West Areas, which are already industrialized and heavily disturbed. The area between the 200 East and West Areas and the buffer zone consist of vegetation very similar to that for the preferred alternative described in Section 4.4. As shown in Figure 6-3, the vegetation mix across the waste management area, excluding the 200 East and West Areas, is fairly uniform and consistent with the sagebrush habitat described in Section 4.4. For the purposes of this evaluation, the remaining undisturbed area in the waste management area is assumed to be sagebrush habitat. As a consequence, a maximum of another 2,300 ha (5,800 acres) of sagebrush could be removed. It is assumed that the buffer zone would remain undisturbed.

6.3.1.3 Soils

- Impacts upon soils would also be influenced by the amount of land proposed for industrial uses. The lack of rainfall prevents on-site soils from being classified as prime or unique farmland. The soil profile presented in Section 4.1.3 is characteristic of the waste management area. Using the waste management area would not involve prime or unique farmland, and the types of soil removed from potential productive use is similar to the soil impacted in Section 4.1.3.

Figure (Page 6-14)
Figure 6-3. Vegetation Map for Hanford Site

6.3.2 WATER QUALITY AND AIR QUALITY

None of the alternatives evaluated in this EIS would cause releases to surface water or groundwater. Therefore, water quality would not be impacted by implementing any of the alternatives. Nominal air emissions would be expected from operating the mixer pump, the NTF, and the load and unload facilities. These emissions would be indiscernible from those in the existing 200 Areas, and would be well within permitted levels. As discussed in Chapter 5, no adverse health effects from air emissions would be expected from the NTF operation.

Emissions for the projects listed in Section 6.1 have not yet been established as these projects are still in the preliminary stages of development. However, a limit may be placed upon the emissions from other actions at the site to comply with existing standards and regulations. Specific air emissions will be discussed in the EISs for those projects.

6.3.3 OFF-SITE RADIATION CONSIDERATIONS

Limits for radiation doses to the public from airborne emissions at DOE facilities are specified in the CAA Amendments published by the EPA. The regulation specifies that no member of the public shall receive a dose of more than 10 mrem per year from exposure to airborne radionuclide effluents (other than radon) released at DOE facilities. During 1994, the inhalation dose to the maximally exposed individual across the river from the 300 Area was 0.01 mrem (PNL 1995), or 0.1 percent of the EPA standard.

Normal operations for the preferred alternative would not result in radiation doses to members of the general public. The two tanks discussed in the new storage alternative have been evaluated for routine and extreme case air emissions as discussed in Section 5.4.9. The inhalation dose to the MEOSI from NTF operations is estimated to be 3.5 x 10-5 mrem per year. This value is almost 300 times lower than that for the maximally exposed member of the public in 1994 and 3 x 10-4 percent of the EPA standard. Therefore, the radiation doses from the proposed alternatives are not expected to have a cumulative impact on the general public.

6.3.4 POPULATION AND SOCIOECONOMIC IMPACTS

None of the proposed alternatives evaluated in this EIS would cause a net change in population and socioeconomic impacts. The new storage alternative combined with the RCSTS could require up to 230 workers, thus representing the largest number of workers needed for any of the alternatives. A portion of these workers is assumed to be from existing Hanford personnel; the remaining workers would be contracted from the Tri-City area workforce which could accommodate the relatively small number of workers required.

Cumulative consequences to the Hanford and Tri-Cities workforce from the other proposed actions are currently unknown and, therefore, impacts to the workforce cannot be evaluated in this EIS. Socioeconomic impacts would potentially occur throughout the construction and decommissioning phases of a project.

While employment for TWRS, ERDF, HRA and other actions may increase, employment for other facilities on the Hanford Site may decrease from the phasing out of Hanford operations. The EAs and EISs specific to those projects would evaluate impacts to the local workforce.

SECTION 6 REFERENCES

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7 STATUTORY AND REGULATORY REQUIREMENTS

This section discusses the environmental regulations applicable to construction and operation of the various alternatives. Relevant regulations are summarized in Section 7.1. The ability of the proposed alternatives to meet regulatory requirements is identified in Section 7.2. Section 7.3 lists the various agencies consulted and Section 7.4 discusses the applicability of the Tri-Party Agreement to the preferred alternative.

7.1 RELEVANT FEDERAL AND STATE REGULATIONS

This section summarizes Federal, State of Washington, and DOE regulations and requirements applicable to implementing the proposed alternatives. The alternatives would be implemented to comply with all applicable requirements and compliance agreements.

Table 7-1 presents a summary of potential permits and approvals which may be required of the alternatives. No new permits or approvals are required for the no action alternative.

7.1.1 FEDERAL ENVIRONMENTAL REQUIREMENTS

This section describes Federal environmental requirements relevant to the alternatives. These requirements are administered primarily by Federal agencies other than DOE or involve Federal regulatory requirements that have been delegated to the State of Washington and administered by Ecology. These requirements include statutory and regulatory requirements for hazardous, radioactive, and mixed waste management, threatened or endangered species, archaeological and historic resources, and Native American concerns.

- National Environmental Policy Act (42 U.S.C. 4321 et seq., as amended) - NEPA established a national policy for the protection of the environment and authorized the CEQ to administer the policy. In 1978, the CEQ proposed regulations implementing NEPA; the final regulations are codified in 40 CFR 1500 through 1508. DOE implementing procedures for NEPA are codified in 10 CFR Part 1021.

Table 7-1
Summary of Potential Permits and Approvals for the Alternatives

Environmental Media	Permit/Approval or Requirement	Regulation	Regulatory Agency
Air Emissions	Radiation Air Emissions Program (RAEP)	WAC 246-247	Department of Health (DOH)
Air Emissions	National Emissions Standards for Hazardous Air Pollutants (NESHAP)	40 CFR 61 Subpart H	EPA/DOH
Air Emissions	Notice of Construction (NOC)	WAC 173-400, WAC 173-460	Ecology, Benton County Clean Air Authority
Soil Column Wastewater Disposal	Solid Waste Discharge Permit (SWDP)	WAC 173-216	Ecology
Soil Column Wastewater Disposal	Approval of Engineering Report, Plans and Specifications, and Operations and Maintenance (O&M) Manual	WAC 173-240	Ecology
Domestic Wastewater Disposal	Septic Systems <54,888 L [14,500 gallons per day (gpd)] capacity design approval	WAC 246-272	DOH

Dangerous Waste	Dangerous Waste Permit RCRA Parts A and B	WAC 173-303 and 40 CFR 264, 265, 270	Ecology
Underground Storage Tanks	Tank Permit	WAC 173-360	Ecology
All Media	Cultural Resource Review Clearance	36 CFR 800	DOE and State Historic Preservation Officer (SHPO)
All Media	Endangered Species Approval	50 CFR 402.6	U.S. Fish and Wildlife Service (USFWS)

The requirements of NEPA specify that if a Federal action might have a significant effect on the quality of the human environment, the agency involved must prepare a detailed EIS.

. Resource Conservation and Recovery Act, [Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984 (42 U.S.C. 6901-6987 et seq., as amended)] - RCRA and the implementing regulations (40 CFR Parts 260 through 268) govern the cradle-to-grave management of hazardous waste and the hazardous constituents of mixed waste. HSWA also provides for the cleanup (and corrective actions) of RCRA waste sites. The base RCRA program has been delegated to the State of Washington and the state's statutes and regulations apply in lieu of the Federal requirements. The state's requirements are described further in Section 7.1.2.

The primary RCRA Federal requirements that apply (or could apply, if necessary) to the alternatives include:

- Section 3004(j), Storage Prohibition for Waste Subject to Land Disposal Restrictions.

- Section 3004(u), Continuing Releases - In the event of a release to the environment, this authority could be used by EPA to ensure cleanup of all hazardous waste and hazardous constituents.

. Comprehensive Environmental Response, Compensation, and Liability Act [42 U.S.C. Section 9601 et seq., as amended by Superfund Amendments and Reauthorization Act (SARA)] - CERCLA could apply to the alternatives in the event of a release of hazardous substances to the environment. The implementing regulations for CERCLA are found in 40 CFR Part 300. The list of hazardous substances is in 40 CFR Part 302.

. Clean Air Act (42 U.S.C. 7401 et seq., as amended) - The CAA and its implementing regulations (40 CFR Part 61) require that the public not receive an exposure to radionuclides of more than 10 mrem per year effective dose equivalent. The CAA sets ambient air quality standards, emission limits for major new source performance and for hazardous air pollutants, and requires operating permits for major emission sources.

. Endangered Species Act (16 U.S.C. 1536, as amended) - The Endangered Species Act requires Federal agencies in consultation with the USFWS to insure that their actions are not likely to jeopardize the continued existence of any threatened or endangered species. This requires an evaluation of habitat, breeding and nesting areas, feeding areas, migratory pathways, and range of threatened or endangered species.

. National Historic Preservation Act (16 U.S.C. 470, as amended) - The NHPA requires Federal agencies to consider the effects of their actions on historic and archaeological resources. This requires that sites to be developed be evaluated for evidence of historic, archaeological, and cultural resources and specific actions be taken regarding these resources if they are discovered.

. American Indian Religious Freedom Act (AIRFA) and Native American Graves Protection and Repatriation Act (NAGPRA) - AIRFA states that Native Americans have an inherent right of freedom to believe, express, and exercise their traditional religions. These rights include access to religious sites. The NAGPRA recognizes the significance of Native American gravesites, human remains, and funerary objects.

7.1.2 STATE OF WASHINGTON ENVIRONMENTAL REQUIREMENTS

State of Washington environmental requirements applicable to this EIS which are administered primarily by Ecology and the Washington State DOH follow.

- State Environmental Policy Act (Chapter 43.21C RCW) - SEPA is very similar to NEPA. SEPA requires any Washington State or local agency to evaluate all reasonable alternatives and their potential environmental impacts prior to taking an action that may significantly impact the environment. The SEPA action necessitating this EIS is issuing the state and local permits listed in Table 7-1. Because SEPA and NEPA are very comparable in their purpose, intent, and procedures, Ecology and

  DOE decided to prepare one EIS addressing the requirements of both SEPA and NEPA.

- Hazardous Waste Management Act (HWMA) (Chapter 70.105 RCW) - The HWMA and the implementing Dangerous Waste Regulations (Chapter 173-303 WAC) apply to the management of all dangerous waste and the dangerous waste component of mixed waste at the Hanford Site. EPA has delegated the RCRA base program and the authority to regulate the hazardous component of mixed waste to Washington State. The Tri-Party Agreement provides the framework for application of the state's requirements for dangerous waste treatment, storage, and disposal (TSD) units at the Hanford Site.

- Washington Clean Air Act (Chapter 70.94 RCW) - Ecology regulates the release to the atmosphere of nonradioactive contamination under the authority of Chapter 173-400 WAC. DOH has overall responsibility for radiation protection. DOH and Ecology have established a memorandum of agreement which defines the roles and responsibilities of each department regarding administration of the Washington CAA regulations at the Hanford Site. Under this agreement, DOH has authority over airborne radioactive emissions under the authority of Chapter 246-247 WAC.

7.1.3 DEPARTMENT OF ENERGY GENERAL ENVIRONMENTAL REQUIREMENTS

This section lists statutory and regulatory requirements and E.O.s DOE has the authority to implement that are relevant to the alternatives in the EIS. It also includes DOE self-imposed administrative requirements.

- E.O. 12088, Federal Compliance With Pollution Control Standards - E.O. 12088 of October 13, 1978 states that the head of each executive agency is responsible for ensuring that the agency takes all necessary actions for the prevention, control, and abatement of environmental pollution with respect to the Federal facilities and activities under its control. Each agency head is also responsible for compliance with applicable pollution-control standards, such as those defined under the Clean Water Act (CWA) and the CAA.

- E.O. 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations - E.O. 12898 requires maintaining environmental justice as part of each Federal agency's mission. Environmental justice is maintained by identifying and addressing disproportionately high and adverse human health or environmental effects of Federal agency programs, policies, and activities on minority populations and low-income populations.

- Administrative Orders - DOE has developed a uniform system of communicating policy and procedures to its employees. The system is based on administrative directives, or DOE orders, which contain information on procedures, responsibilities, and authorities for performing DOE's various functions. DOE orders relevant to the alternatives include the following.

  - DOE Order 5480.1B, Environmental Protection, Safety, and Health Protection Standards - DOE policy states that the Department will comply with all legally applicable Federal and state standards. In the event of conflicts between prescribed and recommended standards, those providing the greatest protection apply. This order provides radiation-protection standards for occupational and nonoccupational exposures and guidance on keeping exposures ALARA. It provides concentration guides for airborne contaminants, liquid effluents, and drinking water. It also establishes exposure standards aimed at achieving ALARA dosage rates for individuals and population groups in uncontrolled areas and sets monitoring requirements for DOE operations.

  - DOE Order 5480.20A, Personnel Selection, Qualification, Training and Staffing Requirements at DOE Reactor and Non-Reactor Nuclear Facilities - This order establishes selection qualification, training, and staffing requirements for personnel in the operation, maintenance, and technical support of DOE facilities.

- DOE Order 5484.1, Environmental Protection, Safety, and Health Protection Information Reporting Requirements - This order establishes the requirements and procedures for reporting information with environmental protection, safety, or health protection significance for DOE operations.

- DOE Order 5820.2A, Radioactive Waste Management - This order establishes hazardous waste management procedures for facilities operated under the authority of the Atomic Energy Act (AEA), as amended. The requirements follow, to the extent practical, regulations issued by the EPA pursuant to RCRA.

7.2 ABILITY OF PROPOSED ALTERNATIVES TO MEET REGULATORY STANDARDS AND REQUIREMENTS

This section discusses the ability of the proposed alternatives and the no action alternative to meet regulatory requirements, which include statutes, regulations, and groups of regulations consisting of the following:

. Protection of Threatened or Endangered Species
. Protection of Historic and Archaeological Resources
. Native American Concerns
. CAA Requirements
. Dangerous Waste Regulations
. Prime Farmland Protection.

7.2.1 PROTECTION OF THREATENED OR ENDANGERED SPECIES

Under the Endangered Species Act, no Federal agency action may jeopardize the continued existence of a threatened or endangered species. As discussed in Chapter 5 none of the alternatives would jeopardize the continued existence of any Federally listed threatened or endangered species. Informal consultation with the USFWS and the Natural Resource Trustee Council has resulted in general agreement regarding mitigation of lost habitat impacts. The mitigation plan for reducing habitat impacts is in Appendix D. DOE is committed to continuing consultation with USFWS and the State of Washington to formalize an agreement on the detailed plans for mitigation. The formal agreement will be documented in a MAP.

7.2.2 PROTECTION OF HISTORIC AND ARCHAEOLOGICAL RESOURCES

Under the NHPA, Federal agencies must consider actions that adversely affect site listed or eligible for inclusion in the NRHP. As discussed in Section 4.8, no historic properties or archaeological resources were identified during the cultural resources surveys in construction areas evaluated under each of the alternatives. Results of cultural resource surveys in areas to be disturbed during construction and restoration activities have been provided to the SHPO.

7.2.3 NATIVE AMERICAN CONCERNS

Under the AIRFA, Native Americans have an inherent right of access to religious sites. Under the NAGRA, Native American gravesites, human remains, and funerary objects are given special protection. Based on field surveys and meetings with the Native American Groups, no gravesites, human remains, or funerary objects are known to exist in the areas that would be directly disturbed by any of the alternatives. Potentially significant cultural resource sites have been identified in a survey of 530 ha (1,300 acres) being considered for restoration activities. The Mitigation Action Plan will assure avoidance of these sites during mitigation.

DOE has an active program of consultation with Native American Groups. This program included consultations regarding the RCSTS, NTF, and ITRS.

7.2.4 CLEAN AIR ACT REQUIREMENTS

All of the alternatives would be required to comply with all applicable Federal and state air quality regulations and standards. Compliance with these regulations and standards would be demonstrated by the acquisition of the permits under the following regulations:

- Control for New Sources of Toxic Air Pollutants (Chapter 173-460 WAC)
- NESHAPS under 40 CFR 61, Subpart H
- RAEP (Chapter 246-247 WAC).

Analyses performed in support of this EIS indicate that all anticipated emissions from the alternatives would be well within regulatory limits.

7.2.5 DANGEROUS WASTE REGULATIONS

The Hanford Site is a single RCRA facility identified by EPA/State Identification Number WA7890008967 that consists of over 60 TSD units conducting dangerous waste management activities. These TSD units are included in the Hanford Facility Dangerous Waste Part A permit application.

The RCSTS would be considered ancillary equipment to the DST system, and therefore would require a permit as a TSD unit. The DST system is operating under an interim status permit. The construction of the RCSTS would be allowed under the interim status permit. The RCSTS would receive a final status permit in 1999, along with the rest of the DST system. The ECSTS does not meet interim status or final status standards, and therefore cannot be issued a final status permit. Waste transfer facilities under the rail transfer and truck transfer alternatives would also need to be permitted. These transfer facilities would be permitted as ancillary equipment of the DST system.

If the new storage alternative is selected, the DOE would need to complete the Washington State Dangerous Waste Regulation permitting process for the new tanks as new or expanded dangerous waste TSD units.

All new facilities would be sited as required under WAC 173-303-282(6) and (7) to specify conditions relative to seismic risk, subsidence, slope and soil stability, air emissions, surface and ground-water contamination, site flood potential, plant and animal habitat, precipitation, adjacent land uses, and special land uses such as parks and wild and scenic rivers, prime farmland, and archaeological and historic sites.

7.2.6 PRIME FARMLAND PROTECTION

The Farmland Protection and Policy Act requires Federal agencies to give special consideration to activities proposed in prime and unique farmland. According to the U.S. Department of Agriculture (USDA), none of the alternatives would take place in an area determined to be prime or unique farmland.

7.3 CONSULTATIONS

The following Federal, state, local and regional agencies, and Native American Groups were contacted during the preparation of this EIS.

FEDERAL AGENCIES

- U.S. Fish and Wildlife Service
- U.S. Advisory Council on Historic Preservation
- U.S. Environmental Protection Agency
- U.S. Department of Agriculture
- U.S. Bureau of Land Management

STATE AGENCIES

- Washington Department of Fish and Wildlife
- Washington State Historic Preservation Officer
- Washington Department of Health
- Washington Department of Transportation

LOCAL AND REGIONAL AGENCIES

- Benton County Clean Air Authority

- TRIDEC

NATIVE AMERICANS

- Yakama Indian Nation
- Confederated Tribes of the Umatilla Indian Reservation
- Nez Perce Tribe.
- Wanapum People

7.4 HANFORD FEDERAL FACILITY AGREEMENT AND CONSENT ORDER (TRI-PARTY AGREEMENT)

The Hanford mission is to clean up the Site, provide scientific and technical excellence to meet global needs, and partner in the economic diversification of the region. The Hanford Federal Facility Agreement and Consent Order, also known as the Tri-Party Agreement governs the clean-up plans for the Hanford Site. The Tri-Party Agreement (DOE 1994) establishes the regulatory framework under which the Hanford Site waste management and cleanup must occur. It establishes an action plan for cleanup that contains priority actions/problems and milestones. The Tri-Party Agreement sets milestones to achieve coordinated cleanup of the Hanford Site and provides and uses enforceable milestones to keep the program on schedule. The Tri-Party Agreement establishes the applicability of RCRA and CERCLA and their amendments to the Hanford Site.

The Tri-Party Agreement has a number of provisions related to the DOE action which have the potential to influence the need for the action, the timing of the action, and the alternative selected. These Tri-Party Agreement provisions include the following.

- Any new hazardous or dangerous waste handling tanks and associated facilities must comply with applicable RCRA or Washington Dangerous Waste Regulation design, operation, and maintenance requirements. Hence, the need for double-shelled design, leak detection systems, and inspection provisions.

- The Tri-Party Agreement contains Milestone M-43-07, Complete Project W-058 Replacement of Cross Site Transfer System by February 1998, target Milestone M-43-07-T01 to complete definitive design of the RCSTS by August 1995 and interim Milestone M-43-07A to start construction of project W-058 by November 1995.

- The Tri-Party Agreement contains the following milestones which are indirectly related to the purpose and need for this action:

  - M-46-00 Double-Shell Tank Space Evaluation - This milestone requires an annual report beginning in September 1994 which projects tank volume needs, the basis of the projection, and DOE's plans for acquisition of additional tanks based on the tank volume projections.

  - M-46-01 Concurrence of Additional Tank Acquisition - This milestone requires an annual meeting of the three parties to establish new milestones, if required, for the acquisition of new tanks. This milestone was initiated in November 1994.

  - M-41-00 Complete Single-Shell Tank Interim Stabilization - This milestone and many related milestones requires completion of interim stabilization activities for all SSTs except 106-C, and completion of intrusion prevention at those same SSTs by September 2000. The planned interim stabilization schedule is shown in Table 7-2. Stabilization involves removal of as much liquid mixed waste as practical from a SST and pumping it to a DST containing compatible waste. This is done to minimize the amount of liquid which could leak to the ground, should the SST later begin to leak.

  - M-40-00 Mitigate/Resolve Tank Safety Issues for High Priority Watchlist Tanks - This milestone is complete when mitigation activities, if required, have been implemented in all Watchlist tanks to ensure safe storage of waste during the interim period until retrieval for treatment and/or disposal operations begin. This milestone is scheduled for completion in September 2001.

    Other interim M-40 milestones include closing all Unreviewed Safety Questions (USQs) for DSTs and SSTs such as high-flammable gas concentrations, potentially explosive mixtures of ferrocyanide, potential for nuclear criticality, and existence of a separable organic phase floating layer.

Implementing the preferred alternative would allow DOE to meet the requirements of Tri-Party Agreement Milestones M-43-07 and M-40-00.

Table 7-2
Single-Shell Tank Interim Stabilization Schedule

Tri-Party Agreement Schedule				Planned Tank Stabilization	
Milestone	Start	Milestone	End	200 East	200 West
M-41-01-T03	5/31/94	M-41-01-T02	12/31/94	102-BY 109-BY	-
M-41-01-T01	10/12/94	M-41-01-T02	12/31/94	102-C 107-C (105-C) 110-C	-
M-41-08	7/31/95	M-41-08-T01	3/31/96	-	102-U
M-41-09	1/31/96	M-41-09-T01	4/30/97	-	101-S 108-S 103-S 109-S 106-S 110-S 107-S
M-41-10	4/30/96	M-41-10-T01	12/31/98	101-A 101-AX	-
M-41-11	4/30/96	M-41-11-T01	5/31/97	-	103-U 108-U 105-U 109-U
M-41-12	4/30/97	M-41-12-T01	9/30/98	106-BX 105-BY 103-BY 106-BY	-
M-41-13	7/31/97	M-41-13-T01	12/31/96	-	106-U 111-U 107-U
M-41-14	6/30/97	M-41-14-T01	11/30/99	-	111-S 103-SX 112-S 104-SX 101-SX 105-SX 102-SX
M-41-15	6/30/97	M-41-15-T01	3/31/99	-	102-S 106-SX
M-41-16	3/30/98	M-41-16-T01	8/31/98	-	104-T
M-41-17	4/30/98	M-41-17-T01	5/31/98	-	107-T
M-41-18	4/30/98	M-41-18-T01	7/31/98	-	110-T
M-41-19	9/30/98	M-41-19-T01	3/31/99	103-C	-

Source: WHC 1995

SECTION 7 REFERENCES>

DOE, 1994, Hanford Federal Facility Agreement and Consent Order, Fourth Amendment, U.S. Department of Energy, Washington State Department of Ecology, U. S. Environmental Protection Agency, Richland, WA

WHC 1995, MWTF Path Forward Engineering Analysis Technical Task 3.8, Retrieval Sequence, WHC-SD-236A-ES-011, Revision 0., Paul J. Certa, Luanne S. Williams, Westinghouse Hanford Company, Richland, WA

8 LIST OF PREPARERS

This EIS was prepared by the team of MACTEC, Dames & Moore, Inc., and VECTRA GSI under a General Support Services Contract with DOE-RL. Overall project and technical management were provided by K. Perry Campbell and Thomas L. Anderson of Dames & Moore, Inc. The NEPA Document manager for DOE is Carolyn C. Haass and SEPA Document manager for Ecology is Geoff Tallent. Principals of the EIS and the sections they prepared are identified in Table 8-1.

Biographic summaries of the principals follow.

Thomas L. Anderson, Manager, Environmental Compliance Group, Dames & Moore, Inc.

BS, Botany, Ohio State University, 1973

Mr. Anderson is a senior environmental compliance expert with 20 years experience overseeing and conducting risk and environmental assessments, remedial investigations, feasibility studies, and EISs under CERCLA, RCRA, and NEPA requirements. As a special consultant to DOE Headquarters (DOE-HQ), he provided technical expertise in the interpretation and application of NEPA to DOE activities including interactions with Program and Operations Offices to provide technical understanding of proposed activities and to communicate requirements. Mr. Anderson has worked throughout the DOE complex providing expertise for NEPA documents at Hanford, LLNL, Paducah and Portsmouth Gaseous Diffusion Plants, Fernald, Nevada Test Site, Argonne National Laboratories, Rocky Flats Environmental Technology Site (RFETS), National Renewable Energy Laboratory, Oak Ridge National Laboratory, and West Valley Development Project. He has served as the technical lead to interpret and apply environmental regulations and policies as they related to new waste treatment technologies, active and inactive waste sites, and new facilities. Mr. Anderson also has experience communicating complex environmental issues to Federal, state, and local agencies, as well as to affected communities.

Table 8-1
List of Preparers

VOLUME 1

Principals	Section
T. Anderson	K. P. CamSummary
T. Anderson	K. P. Cam1beIntroduction
C. Haass	G. Tallen2 Purpose and Need for Action
R. Lober	
T. Anderson	D. Lowery3 Description of Alternatives
Y. Noorani	K. P. Campbell
D. Bjerklie	D. Lowery4 Affected Environment
L. Clark	I. Merrifield
J. Consort	F. Munter
C. B. Crouse	R. Palmer
A. D. Every	G. Waddell
M. Kelly	W. T. White
R. Langendoen	
T. Anderson	L. Lucket5 Environmental Impacts
T. Biever	E. Lurier
D. Bjerklie	I. Merrifield
L. Clark	J. Millard
J. Consort	K. Montague
C. B. Crouse	E. Mooney
A. D. Every	F. Munter
R. Gantenbein	L. Padgett
D. Guzzetta	R. Palmer
M. Kelly	P. Valentinelli
R. Kupp	G. Waddell
R. Langendoen	W. T. White
D. Lowery	R. Wild
T. Anderson	I. Merrif6elCumulative Impacts
D. Lowery	W. T. White
E. Lurier	
D. Guzzetta	W. T. Whi7e Statutory and Regulatory Requirements
I. Merrifield	
Y. Noorani	K. KjarmoAppendix A
D. Every	I. MerrifAppendix B

T. Anderson W. T. WhiAppendix C
D. Every I. MerrifAppendix D
R. Kupp K. MontagAppendix E
L. Luckett R. Wild
R. Kupp K. MontagAppendix F
L. Luckett R. Wild
VOLUME 2
K. P. Campbell K. KjarmoVolume 2
V. Miller

Terrence D. Biever, Staff Engineer, Dames & Moore, Inc.

MS, Civil/Environmental Engineering, University of Colorado, 1993
MS, Aerospace Engineering, University of Colorado, 1990
BS, Aerospace Engineering, University of Colorado, 1988

Mr. Biever provides project support on human health and risk assessments including fate and transport modeling, exposure assessment, and data review and evaluations. He is experienced in testing various media for radiological evaluations including in situ testing of the vadose zone and the ocean.

David M. Bjerklie, EIT, Hydrologist/Geohydrologist, Dames & Moore, Inc.

MS, Civil Engineering, University of Alaska, 1987
MS, Hydrology, University of New Hampshire, 1980
BS, Marine Biology, University of Maine, 1977

Mr. Bjerklie is a hydrologist/geohydrologist with over 10 years of experience managing and technically supporting numerous water resource investigations. His work has included all aspects of both surface water and ground-water studies as part of EAs, impact studies, hazardous waste studies, water supply investigations, construction dewatering evaluations, wetland investigations, and hydrologic and hydrogeologic characterizations. His experience includes field work, data analysis, reporting, regulatory concerns, and client and agency contact. Mr. Bjerklie has served as project and task manager for water resource sections of EISs and permit applications with responsibilities including estimation of erosion and sediment transport, drainage requirements, flooding potential, ground-water/surface water interaction, and water balance studies and statistical evaluations of hydrologic and climatologic data, qualitative assessment of water quality impacts from proposed projects using water quality and runoff models, and evaluation of water quality impacts from surface runoff and site development. This work has also included review and assessment of pertinent Federal, state, and local regulations and permits.

Projects have been conducted for DOE, the U.S. Navy, the U.S. Forest Service, state and local agencies, and private development throughout the northwestern United States.

K. Perry Campbell, PhD, Associate and Managing Principal, Dames & Moore, Inc.

PhD, Zoology, Pennsylvania State University, 1973
BS, Zoology, Pennsylvania State University, 1968

Dr. Campbell has over 20 years experience in project management and technical studies, including environmental impact, natural resource damage, and ecological risk assessments on multidisciplinary projects throughout the United States, Canada, and the Pacific Islands. He has directed or participated in environmental impact assessments of major oil development projects, electric energy projects, multistate utility corridors, nuclear waste management facilities, mines, mills, harbor developments, and associated infrastructure, and has provided expert testimony on the results of technical investigations. He has managed EIS and EA projects to meet both NEPA and SEPA requirements. Dr. Campbell has also conducted study designs, study management, technical reviews, quality assurance (QA) management, and designs of environmental monitoring programs to meet NRC standards for nuclear facilities and utilities, and has testified about this work before the Atomic Safety and Licensing Board. As environmental department manager for General Support Services at the Hanford Site, he directs the efforts of a multidisciplinary staff that provides technical support to many program areas at the Hanford Site.

Lisa A. Clark, Air Quality Scientist, Dames & Moore, Inc.

BS, Physics, State University of New York at Oswego, 1988

Ms. Clark is an air quality scientist with 6 years experience obtaining air permits and completing air quality impact evaluations. Specific task include compliance evaluations, air quality dispersion modeling, EISs, EAs, control technology assessments, emission estimations, regulatory compliance evaluation, visibility modeling, deposition studies, emission inventory reports, SARA - Community Right to Know toxic chemical release reports, best available control technology assessments, Quality Assurance/Quality Control (QA/QC) reports, Leak Detection and Repair Programs, and fenceline air monitoring. Ms. Clark was the primary author of several control technology assessments for criteria, toxic and radionuclide air emissions natural gas-fired turbines and reciprocating engines, waste water treatment plants, coal-fired power plants, paper and pulp recovery boilers, and oil refineries. Specific project experience includes conducting impact analyses for toxic air pollutants from a proposed action at the Hanford Site including toxic air pollutant emissions estimations, SCREEN2 modeling, and OSHA and Washington State Air Toxics Regulations Compliance evaluation. Ms. Clark also prepared Notice of Construction permit applications, air quality studies, visibility analyses, ISCST2 and COMPLEX1 dispersion modeling, sulfate and nitrate deposition calculations and modeling, Prevention of Significant Deterioration Analyses, and EIS sections for several proposed cogeneration plants.

James J. Consort, Project Geologist, Dames & Moore, Inc.

BS, Geology, University of California, Los Angeles, 1976
MS, Geology, San Diego State University, California, 1979

Mr. Consort has 15 years experience in geological investigations and designs. He provides technical support to DOE at the Hanford Site on CERCLA projects associated with the characterization and cleanup of contaminated soil and groundwater. As a project scientist for several RCRA facilities at the Hanford Site, he evaluated ground-water contamination and contaminant transport associated with potential crib and pond sources where radionuclides and other wastes were disposed. He also managed and implemented a remedial investigation that included monitoring soil and ground-water sampling, geophysical logging, and aquifer testing, and developed structure contour maps based on well data and high-resolution seismic data.

C. B. Crouse, PE, Principal Engineer and Associate, Dames & Moore, Inc.

PhD, Civil Engineering, California Institute of Technology, 1973
MS, Civil Engineering, California Institute of Technology, 1969
BS, Engineering, Case Institute of Technology, 1968

Dr. Crouse is a civil engineer with 21 years experience in earthquake engineering and engineering seismology, including determination of seismic design criteria and seismic design of structures, seismic safety surveys for existing structures, dynamic analysis of soil-structure interaction, seismic response of foundation soils, vibration testing of structures in the field, seismic hazard analyses, probability studies of environmental loads, studies of soil liquefaction, and centrifuge modeling of soil-structure systems. Projects sites included DOE facilities, nuclear and conventional power plants, off-shore structures, liquified natural gas and water-storage tanks, multi-story buildings, dams and reservoirs, hospitals, bridges, electrical transmission facilities, pipelines, and the superconducting super collider. Much of Dr. Crouse's project experience has been in the development of earthquake-induced vibratory ground motions, Section 2.5 of safety analysis reports (SARs), and related studies for various nuclear power plant and DOE facilities. He has defended this work before the NRC and the U.S. Geological Survey. At the West Valley Demonstration Project, Dr. Crouse provided analysis of seismic ground wave effects in building interactions, buried trenches, and underground tank vaults, including model development, data analysis, and presentations of results to NRC and DOE as part of the permitting procedure and the SARs. Dr. Crouse has also served on numerous seismology and structural policy making committees throughout the United States.

A. David Every, PhD, Senior Ecologist, Dames & Moore, Inc.

PhD, Botany, University of Washington, 1977
MS, Botany, University of Utah, 1969
BS, Zoology, University of Utah, 1967

Dr. Every is a senior ecologist with over 15 years experience on wetland and terrestrial ecological issues throughout the western states and Alaska. He has conducted or supervised baseline studies, habitat and resource inventories including threatened or endangered species studies, impact assessments, mitigation studies, reclamation planning, and permitting assistance for vegetation, wetlands, wildlife habitat, and wildlife. Dr. Every's projects have included thermal power plants, hydroelectric facilities, transmission lines, pipelines, highways, port developments, mines, oil production, resource management projects, and urban developments. Dr. Every has experience working for the U.S. Forest Service, the U.S. Navy, the USDA, and numerous state and local agencies and private clients. He has served as project manager for numerous EISs and permitting projects including the Amchitka Island Radar NEPA EIS and a U.S. Forest Service, Alaska Region in which four EISs were being developed simultaneously and on a short schedule. These four EISs were for one analysis area of the controversial long-term timber sale contract and were part of a court-ordered supplemental EIS process based on a legal challenge of an earlier EIS. Dr. Every has also provided expert testimony and written depositions for hearings on land use appeals concerning wetlands, wildlife habitat, and disputed wetland permitting projects.

R. Gantenbein, Jr. PE, Senior Air Quality Engineer, Dames & Moore, Inc.

BS, Civil Engineering, Oregon State University, 1961

Mr. Gantenbein is a civil and environmental engineer with 34 years of experience in the fields of public health and environmental control. His specialties are air pollution and noise control. His experience in air quality and emissions control has been gained from employment in the United States military, governmental control agencies, manufacturing industry, and private consulting. Additionally, he was the general manager for an air source testing consulting firm. He has had numerous project engineer and manager responsibilities with civil design and environmental control projects. He is responsible for air permitting, emissions impact analysis, and compliance auditing for Dames & Moore's industrial clients.

David J. Guzzetta, PhD, Certified Environmental Professional, Senior Environmental Scientist, Dames & Moore, Inc.

PhD, Environmental Science and Engineering, University of California, 1986
MS, Natural Science, California State University, 1975
BS, Zoology, San Jose State College, 1969

Dr. Guzzetta is a senior environmental scientist with 18 years experience in planning and implementing environmental studies, developing compliance strategies, and preparing environmental documents. He provides special expertise in NEPA interpretation and application, environmental program planning and management, environmental compliance, facility siting, and site characterization. He is responsible for NEPA support, including detailed reviews of all NEPA documents, at the Hanford Site. At DOE's PNL, Dr. Guzzetta prepared draft guidance to implement new NEPA regulations, prepared NEPA documents, developed and implemented the NEPA compliance program, and was responsible for NEPA documents for the NRC. In support of DOE's high-level nuclear waste management, he directed an EIS for licensing a repository, developed the compliance strategy and approach for characterization, developed plans to implement an Interagency Programmatic Agreement for historic and archaeologic concerns, assisted with the nuclear waste transportation program plan, managed NEPA document development, directed field and laboratory plan and procedures preparation, and conducted environmental studies.

Carolyn C. Haass, TWRS Environmental Program Manager, U.S. Department of Energy, Richland Operations Office

BS, Mineral Engineering Chemistry/Metallurgical Engineering, Colorado School of Mines, 1983

Ms. Haass is the TWRS Environmental Program Manager for DOE-RL. She has over 13 years of professional experience in hazardous and mixed waste sites including overseeing and managing environmental activities including RCRA, CAA, CWA, CERCLA, NEPA, and the Toxic Substances Control Act (TSCA). Ms. Haass is currently responsible for a wide variety of environmental projects for the TWRS program related to NEPA, Permitting (RCRA, CAA and CWA), environmental compliance, closure, waste minimization, risk assessment, Tri-Party Agreement and development of the TWRS environmental strategy.

Michael S. Kelly, Senior Archeologist, Manager of Cultural Resources Western Division, Dames & Moore, Inc.

MA, Anthropology, University of Nevada, Las Vegas, 1986
BA, Anthropology, University of California, Santa Barbara, 1978

Mr. Kelly has conducted numerous archeological surveys for various government and commercial clients. Some of these surveys supported EISs. Mr. Kelly has also functioned as the principal investigator for many cultural resources inventory plans for various Federal and local governmental entities and commercial concerns.

Kevin J. Kjarmo, Environmental Engineer, MACTEC

BS, Environmental Science, Washington State University, Pulman, 1993
BA, Economics, Washington State University, Pulman, 1993

For the past two years, Mr. Kjarmo has been an environmental engineer on the DOE Hanford TWRS program providing support to DOE in NEPA project planning. His NEPA support activities include management, preparation, technical review and strategy development, and coordination with Ecology to meet SEPA requirements. In addition, Mr. Kjarmo has supported the TWRS Environmental

Safety, Quality and Health program by participating in development of document review plans, management plans, and operating procedures.

Robert W. Kupp, Senior Engineer, Dames & Moore, Inc.

BS, Chemical Engineering, Wayne State University, Ohio, 1947

Mr. Kupp has over 25 years experience in safety analysis, hazard classification, and nuclear engineering and design. With his expertise, he has authored preliminary and final SARs for DOE sites, and performed assessments of industry and regional governments' hazardous wastes. Mr. Kupp was responsible for process design and analysis for nuclear projects at the DOE Hanford Site in Washington. He has contributed to an international study on TRU waste disposal for the EPA.

Richard R. Langendoen, PG, Senior Geologist, Dames & Moore, Inc.

BS, Geology, Washington State University, 1979

Mr. Langendoen is a senior geologist with 15 years of geotechnical and geosciences experience on a wide variety of projects throughout the Pacific Northwest. Areas of expertise include environmental impact assessments, soils and foundation studies, site development feasibility studies, and environmental contamination site characterization. Mr. Langendoen is responsible for a wide variety of projects related to baseline studies, EAs and geologic studies. He served as project manager for the NEPA EA element of an ongoing Remedial Investigation/Feasibility Study (RI/FS) for the cleanup and closure of the Oroville Landfill contaminated with pesticides, insecticides, and other chemicals. Mr. Langendoen has served as project and task manager for soils, geology, mineral resources, hydrogeology, and air elements of EISs for landfill, forest service, facility expansion, commercial and residential building, and roadway projects. Specific tasks have included performing initial and detailed site analyses, developing criteria for designating and mapping hazards, performing impacts analyses, and developing mitigation plans.

Robert W. Lober, Physical Scientist, U.S. Department of Energy, Richland Operations Office

MS, Environmental Soil Science, Colorado State University, 1992
BS, Soil Science, Colorado State University, 1985

Mr. Lober has 17 years experience with the USDA Agricultural Research Service studying various areas of ecosystem function. He works in environmental compliance for TWRS for DOE-RL. Mr. Lober's areas of professional expertise include solute fate and transport to groundwater using transport models; chemical, physical, and microbiological processes in soil, geological material, and wetlands, soil characterization and site assessment, statistical techniques; and soil/plant physical and chemical analysis.

He is a Certified Professional Soil Scientist and is certified by USDA Radiological Services as an independent user of radiation equipment. His work includes developing soil quality indicators for environmental and agronomic assessments, evaluation of reclamation strategies on disturbed lands, studying solute movement within the vadoze zone of disturbed soils. Mr. Lober developed a new soil analysis to measure nitrogen processes. His field experience includes setting up and monitoring and maintaining remote meteorological stations and data acquisition system.

Daniel J. Lowery, Project Environmental Scientist, Dames & Moore, Inc.

BA, Geography, California State University, 1987

Mr. Lowery is an environmental scientist with 7 years experience in land-use planning and environmental compliance, including NEPA. He participated in preparing environmental impact reports and statements for a variety of projects, including DOE projects, public works, water resources, mixed use development, transportation planning, and hazardous materials management. Mr. Lowery has been instrumental in several projects with high public visibility and controversy. He has been responsible for environmental project management and interagency coordination, including military actions and coastal development projects. Mr. Lowery has served as project and task manager for environmental impact reports and EISs addressing public health and safety, air and water quality, hazardous material management, hydrology, biology, traffic, geology, electrical energy transmission, and general environmental planning. He has performed services for numerous clients, including Federal and state governmental agencies and private clients.

Larry W. Luckett, Senior Health Physicist, Dames & Moore, Inc.

PhD (candidate), Nuclear Engineering, Rensselaer Polytechnical Institute, New

York
MS, Nuclear Engineering/Health Physics, Texas A&M University, 1973
BS, Physics, Trinity University, Texas, 1971

Mr. Luckett has over 22 years experience providing project management and consultation for radioactive waste management engineering, environmental assessment, siting, and licensing services worldwide. Mr. Luckett has performed assessments for various government and industry concerns including functioning as the principal investigator for nuclear projects and the project manager for radiological characterizations. He represented the U.S. Army Surgeon General on audits for project CLEAN-UP and provided consultation services for the Department of Defense (DOD) and DOE.

Evan A. Lurier, Staff Environmental Compliance Specialist, Dames & Moore, Inc.

BA, Biology, University of Rochester, New York, 1988

Mr. Lurier has 4 years of experience with NEPA documentation for a commercial site and for several DOE facilities including the West Valley Demonstration Project in New York, the Hanford Site in Washington, and for the Golden Field Office in Colorado. The EAs and EISs that he has prepared primarily involve hazardous and radioactive wastes.

Irene T. Merrifield, Staff Environmental Scientist, Dames & Moore, Inc.

BA, Environmental Design and Planning, University of Buffalo, New York, 1982

Ms. Merrifield has 4 years experience with NEPA documentation including EAs and EISs at Hanford and West Valley Demonstration Project, and other DOE facilities. Ms. Merrifield's environmental experience also includes researching and writing Phase I site evaluations and assisting with state environmental quality reviews and scoping requirements.

Jere B. Millard, PhD, Senior Health Physicist, Dames & Moore, Inc.

PhD, Health Physics, Colorado State University, 1986
MS, Health Physics, Colorado State University, 1974
MS, Radiation Biology, University of New Mexico, 1969
BS, Biology and Psychology, University of New Mexico, 1967

Dr. Millard is a senior health physicist with 15 years of technical and managerial experience in radiation protection and risk assessment projects with the DOE, EPA, NRC, and other Federal and state agencies. He has had over 20 papers on radiation protection published in scientific journals.

Dr. Millard is experienced with characterization, environmental sampling, and chemical analyses of radiological and hazardous constituents in environmental systems, is familiar with the assessment of potential impacts to human health and the environment, and has conducted radiological characterizations, prepared EISs, conducted health and safety training, and performed site audits and risk assessments.

Dr. Millard has received grants from DOE and EPA to assess potential impacts to public health and the environment from radiological and mixed waste sites, including a DOE research grant to investigate the environmental impacts resulting from discharge of radioactive liquid waste to a test reactor area disposal at Idaho National Engineering Laboratory (INEL). He has served as an expert witness in health physics and radiological impacts.

Vera Miller, Environmental Scientist, Dames & Moore, Inc.

BS, Biology, University of Oregon, 1989

Ms. Miller is an environmental analyst with over 6 years of experience on environmental permitting projects and with NEPA and CERCLA regulations. Ms. Miller has experience working on EISs, environmental permitting projects, oil spill contingency plans, and environmental monitoring programs. Her NEPA experience includes EISs addressing the PFP stabilization, a combined cycle combustion turbine power plant and associated natural gas pipeline, and several long term timber sales. Ms. Miller also supported the Exxon Valdez Biological Effects Monitoring Program, a National Resource Damage Assessment project studying the effects of oil spilled in Prince William Sound, Alaska.

Kelvin J. Montague, Staff Nuclear Engineer, Dames & Moore, Inc.

MS, Environmental Systems Engineering, Clemson University, South Carolina, 1992
BS, Physics, Presbyterian College, South Carolina 1988

Mr. Montague specializes in radiation shielding and environmental monitoring. He has performed shielding analysis and radiological dose assessment for a variety of high level and low level radioactive waste disposal projects, including the conceptual design of the Multi-Purpose Canister proposed for Spent Nuclear Fuel disposal, the DOE Monitor Retrievable Storage Facility, the DOE Mined Geological Disposal System and North Carolina Low-Level Radioactive Waste Facility. He has also provided technical support for government and industry on health effects for EISs and EAs.

Elizabeth J. Mooney, Project Toxicologist, Dames & Moore, Inc.

MA, Environmental Toxicology, The American University, 1987
BS, Zoology/Wildlife Ecology, Michigan State University, 1981

Ms. Mooney has over 10 years of professional experience in environmental toxicology and health sciences primarily in evaluating toxicological evidence from field investigations and laboratory studies. She specializes in human health and environmental risk assessments for hazardous waste sites and natural resources evaluations involving environmental toxicology and wildlife ecology. Ms. Mooney has functioned as the technical lead for assessments at DOE facilities including the RFETS in Golden, Colorado; INEL, the Hanford Site in Washington; and the West Valley Demonstration Project in New York. She also has performed assessments for DOD sites throughout the United States.

Florence Munter, Senior Environmental Regulatory Specialist, Dames & Moore, Inc.

BA with Honors, Environmental Science, Northeastern University, 1975

Ms. Munter is a senior environmental regulatory specialist with 19 years experience, including the environmental impact evaluation. She prepared an input-output analysis specific to an oil refinery project and presented the results of the refinery analysis at an Economic Development Conference at Toronto, Canada in 1975.

Ms. Munter worked for Federal environmental regulatory agencies for over 7 years. Responsibilities at EPA included preparing major sections of EISs, EAs, and related reports as well as being the principal preparer of comments on DOE and NRC EISs of national significance. While working at various regional offices and EPA headquarters, she functioned as a NEPA compliance specialist. She on developed an EA format and guidance, developed and advised an interdisciplinary staff on the preparation of impact analyses, and analyzed impact mitigation techniques specific to energy development projects.

Since 1981, Ms. Munter has provided regulatory and technical evaluations of waste constituents, proposed treatment methods, and disposal options for a variety of commercial, industrial, and government-contracted facilities. Her expertise on state and Federal laws specific to RCRA, CERCLA, and CWA is used in the preparing corrective actions and feasibility studies. She provides extensive regulatory and technical support to EG&G, Inc. at RFETS and INEL.

Yusuf G. Noorani, Principal Engineer, Vectra GSI

Graduate Studies, Inter-Disciplinary Environmental Science, University of Idaho, 1991-1993
BS, Mechanical Engineering, University of Missouri, 1985
BS, Physics, Chemistry, and Mathematics, University of Karachi, 1979

Mr. Noorani has over 9 years of experience in the DOE environmental restoration and waste management arena. He has extensive experience in all aspects of environmental investigations, permitting, audits, and data management and safety analysis. Currently, he is the General Support Services Contractor NEPA coordinator for the TWRS EIS at the Hanford Site. As the NEPA coordinator he is responsible for supporting TWRS Program Office for management, preparation, technical review and strategy, and coordination of NEPA documents.

Previously, he was an LLW Engineer on the Grout Program at Hanford. For the Grout Program, he provided technical review services to the TWRS Program Office. He is also experienced in development and review of SARs required by DOE Order 5480.23.

At INEL, he participated and managed the source term characterization of the Radioactive Waste Management Complex (RWMC), participated in SAR reviews, design reviews, technology development, and management of RI/FS of RWMC. Mr. Noorani, served at the DOE Weldon Springs Site Remedial Action Project outside St. Louis, Missouri, as an environmental engineer and data manager where he managed ground-water, surface water, geological, air monitoring, and other environmental databases. He was involved in site characterization, radon monitoring, design of disposal facility and waste water treatment plant, and overall environmental safety and health efforts. Additionally, he was responsible for analysis, verification, and validation of data in accordance with EPA and DOE regulations.

Lisa Richey Padgett, Environmental Scientist, Dames & Moore, Inc.

BA, Chemistry, North Carolina State University, 1988

Ms. Padgett has 8 years experience in applying environmental science to Federal studies. She provided technical support for the assessment of potential doses to the public from selected waste storage facilities at Western New York Nuclear Services Center to determine compliance with the requirements of 40 CFR 61 and NESHAPs. For the New York State Energy Research & Development Authority she performed gamma surveys and obtaining soil samples as part of a phased analysis to provide data of current soil concentrations, an assessment of the extent of off-site contamination in the vicinity of the Western New York Nuclear Services Center, and re-evaluate and interpret current and historical site data.

For Chem-Nuclear Systems, Inc., Ms. Padgett provided technical support for both the Performance Assessment and Safety Assessment portions of the license application for the North Carolina Low-Level Radioactive Waste Disposal Facility including developing waste inventory based on estimated physical, chemical, and radiological characteristics of waste expected to be received; estimating source terms for releases to air and water under normal and accident conditions; linking waste inventory data with ORIGEN 2 to generate source terms; using CAP-88PC to determine air dispersion factors (-/Qs) for releases during normal conditions; estimating doses for the public during normal and accident conditions and for workers during accident conditions and direct gamma exposure rates during normal waste handling and accidents using MicroShield.

Randall D. Palmer, Planning Manager, Environmental Services Group, Dames & Moore, Inc.

MLA, Landscape Architecture, Harvard University, 1984
BSLA, Landscape Architecture, Colorado State University, 1980

Mr. Palmer is a landscape architect with 10 years experience providing project coordination on EISs, EAs, and Environmental Restorations, land-use/visual resources, and applications of computer technology for siting and planning level studies. He has served as project manager for utility, energy, aesthetics, simulation, transportation, planning, Geographic Information System, mining and reclamation projects with specific tasks including permitting, resource investigation and modeling, facility siting and upgrades, corridor identification, and mapping. Mr. Palmer serves as a project manager for environmental studies on a Federal Highways Administration contract, including environmental investigations in 18 western states.

Geoff Tallent, Environmental Specialist, Washington State Department of Ecology

BS, Environmental Studies, Western Washington University, 1990

Mr. Tallent has five years experience in environmental project management, regulatory review, and permitting. He managed two SEPA/NEPA EISs for Hanford projects which involved two interdisciplinary teams that prepared and reviewed the EISs. His project management responsibilities included coordinating state agencies, DOE-RL, DOE-HQ, and contractors. Mr. Tallent is Ecology's representative on the Hanford Natural Resource Trustee Council which advises U.S. DOE on the management of natural resources at the Hanford Site under CERCLA.

Mr. Tallent's environmental review responsibilities include coordinating technical review of environmental documents, and ensuring that affected agency, stakeholders, and the public are involved in decision making. He researches, prepares, and reviews technical reports and interprets Federal and state environmental policies.

Paul J. Valentinelli, Project Health Physicist, Dames & Moore, Inc.

MS, Health Physics, Colorado State University, 1990
BS, Geology, Colorado State University, 1984

Mr. Valentinelli is a health physicist with 7 years experience. He provides expertise in radiochemistry laboratory safety, risk assessment, and dispersion and environmental modeling and has experience complying with RCRA, CERCLA, NEPA, National Pollutant Discharge Elimination System (NPDES), state environmental regulations, and DOE orders. He has performed and supported risk assessments at INEL, RFETS, Lowry Landfill, the Rocky Mountain Arsenal, numerous army and airforce installations, and private facilities. Mr. Valentinelli is the technical lead for project management, risk assessment, health physics, and air dispersion modeling on a project for RFETS.

Gregory L. Waddell, AICP, Manager, Land Use and General Planning, Dames & Moore, Inc.

BA, Urban and Regional Planning, Western Washington University, 1969

Mr. Waddell is a certified planner with 25 years experience managing and supporting environmental permitting efforts, environmental assessments, environmental impact statements, land-use, planning and siting studies, coordination and permitting assistance with land use, shoreline and construction permits, and public involvement/information. He served as project manager for a U.S. Navy Housing EIS that was NEPA driven. Mr. Waddell was the assistant project manager for the Toutle Park Road to State Road 12 West Environmental Impact Statement and Technical Expertise Reports for the Washington State Department of Transportation. As principal author for the North Gig Harbor Annexation and Draft EIS and EIS, Mr. Waddell reviewed the effects of the development of a county comprehensive land use plan and pre-annexation zoning scheme for approximately 322 ha (795 acres).

William T. White, PhD, Associate, Dames & Moore, Inc.

PhD, Sociology, University of Florida, 1974
MBA, Management, Georgia State University, 1986
MA, Sociology, University of Florida, 1971
ME, Nuclear Engineering, University of Florida, 1969
BS, Nuclear Engineering, North Carolina State University, 1967

Dr. White has over 23 years of experience in multidisciplinary project management and technical applications, including environmental impact, socioeconomic impact, and regional economic studies throughout the United States, Europe, and South America. He has directed or participated in environmental impact assessments for nuclear and fossil fueled plants, low-level radioactive waste disposal facilities, pipelines, highways, petrochemical plants, and assorted infrastructures. Dr. White has performed study design and management, technical review, and QA review for NRC projects. He has presented expert testimony to the Atomic Safety and Licensing Board for demographic studies for the Allens Creek Nuclear Station, the Virgil Summer Nuclear Station, the Summit Power Plant, and the Susquehanna Steam Electric Station. Dr. White has managed Dames & Moore's environmental support services at the Savannah River Site since 1984.

Ralph E. Wild, PhD, Senior Scientist, Dames & Moore, Inc.

PhD, Chemistry, Virginia Polytechnic Institute and State University, 1976
BS, Chemistry, Memphis State University, 1970

Dr. Wild is a senior scientist with 17 years experience in safety and radiological assessment, regulatory analysis and compliance, accident and exposure scenario development, environmental transport, dose assessment, radiochemistry, and environmental monitoring. He has provided expertise to the DOE, several states' radioactive waste commissions, and private clients. Dr. Wild was the principal investigator for safety assessment, including performance assessment and licensing, of the North Carolina Low-Level Radioactive Waste Disposal Facility. He was the licensing coordinator and technical manager responsible for the Illinois Low-Level Radioactive Waste Disposal Facility with responsibilities including analysis of facility design and operation, accident scenarios and exposure pathways, exposure scenario development, environmental transport calculations, and dose assessment and providing technical support during siting and licensing hearing processes. Dr. Wild served as task manager responsible for waste source options, one of four principal areas of technical support to NRC during its development of 10 CFR 61. Dr. Wild also performed environmental impact assessments for uranium and phosphate mines and mills, including air and water pathways dose assessments and radiation and radon level surveys, for a confidential client.

9 GLOSSARY

absorbed dose: The energy imparted to a material by ionizing radiation per unit mass of irradiated material. An absorbed dose of 1 rad is equivalent to absorption of 100 erg/g or 0.01 Joule/kg.

activity: The rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie (Ci) and the becquerel (Bq).

acute: Happening over a short time period, usually referring to accidents.

airborne release rate (ARR): The airborne release fraction over the leak time duration.

air quality: A measure of the levels of pollutants in the air.

air quality standards: The prescribed level of pollutants in the outside air that cannot be exceeded legally during a specified time in a specified area.

alpha particle: A positively charged particle consisting of two protons and two neutrons that is emitted from the nucleus of certain nuclides during radioactive decay. It is the least penetrating of the three common types of radiation (alpha, beta, and gamma).

ambient air: The surrounding atmosphere, usually the outside air, as it exists around people, plants, and structures. It is not the air in immediate proximity to emission sources.

annulus: Space between the two walls of a double-shell tank.

aquifer: A subsurface geologic formation that contains sufficient saturated permeable material to conduct groundwater and to yield significant quantities of groundwater.

atmospheric dispersion coefficient: The normalized ground level concentration of a contaminant in air at a specified distance from an emission source. Also called -/Q and expressed in units of s/m3

atom: The basic component of all elements; it is the smallest part of an element having all the chemical properties of that element. Atoms are made up of protons and neutrons (in the nucleus) and electrons.

atomic mass: The number of protons and neutrons in an atom. For example, uranium-238 has an atomic mass of 238 (92 protons and 146 neutrons).

As Low As Reasonably Achievable (ALARA): Making every reasonable effort to maintain exposures to radiation as far below the dose limits in 10 CFR 20 as is practical consistent with the purpose for which a licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed material in the public interest.

background radiation: The amount of radiation to which a member of the population is exposed from natural sources, such as terrestrial radiation due to naturally occurring radionuclides in the soil, cosmic radiation originating in outer space, and naturally occurring radionuclides deposited in the human body.

basalt: a dark, fine-grained rock of volcanic origin.

beta particle: An elementary particle emitted from a nucleus during radioactive decay. It is negatively charged, is identical to an electron, and is easily stopped by a thin sheet of metal.

biota: The plant and animal life of a region.

bounding: A process used in impact analysis in which conservative assumptions and/or analytical techniques are used. Bounding assures that impacts are not underestimated, and by encompassing actions with impacts of greatest significance, bounding also ensures that all reasonably foreseeable impacts are included in the analysis.

cancer: A malignant tumor of potentially unlimited growth, capable of invading surrounding tissue or spreading to other parts of the body by metastasis.

capable (fault): Descriptive term for a geological fault which has moved at or near the ground surface within the past 35,000 years, or has moved two or more times during the last 500,000 years.

carcinogen: An agent that may cause cancer. Ionizing radiations are physical carcinogens; there are also chemical and biological carcinogens.

carcinogenic: Exhibiting the characteristics of a carcinogen.

cask: A container designed for shipping, storage, and disposal of radioactive material that affords protection from accidents and provides shielding for radioactive material. The design features include special shielding, handling, and sealing features to provide positive containment and to minimize personnel exposure.

chemical processing: Chemical treatment of materials to separate specific constituents.

chronic: Occurring over a long time period, or continuous, as opposed to acute.

Code of Federal Regulations (CFR): A documentation of the regulations of federal executive departments and agencies.

committed dose equivalent: The dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

committed effective dose equivalent (CEDE): The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to those organs or tissues.

community (environmental justice definition): A group of people or a site within a given area exposed to risks that potentially threaten health, ecology, or land values.

complexants: Chemicals, usually organic, which assist in chelating (a type of chemical bonding) metallic atoms; examples include citrates, ethylenediamenetetraacetic acid (EDTA), and hydroxyethylenediamenetetraacetic acid (HEDTA).

condensate: Liquid obtained by condensation of a gas or a vapor.

confined aquifer: A subsurface water-bearing region having defined, relatively impermeable upper and lower boundaries and whose pressure is significantly greater than atmospheric throughout.

conservative: Conservative choices of parameters or assumptions are those that would tend to overestimate rather than underestimate impacts.

contaminant: Any gaseous, chemical, or other material that contaminates the air, soil, or water.

contamination (contaminated material): The deposition, solvation or infiltration of radionuclides on or into an object, material or area; the presence of unwanted radioactive materials or their deposition, particularly where it might be harmful. The term also refers to the presence of any hazardous substance at levels greater than those that occur naturally in the surrounding environment.

controlled area: An area, outside of a restricted area but inside the site boundary, access to which can be limited for any reason.

corrosion: The destruction of metal by chemical or electrochemical processes.

crib: An underground structure designed to receive liquid waste which can percolate into the soil directly an/or after traveling to a connected tile field.

critical: A condition in which a fissionable material is capable of sustaining a nuclear reaction.

criticality: State of being critical; refers to a self- sustaining nuclear chain reaction in which there is an exact balance between production and loss of neutrons in the absence of extraneous sources cumulative effects: Additive environmental, health, and socioeconomic effects that result from a number of similar activities in an area.

curie (Ci): A unit of measure of radioactivity equal to 37 billion disintegrations per second.

decay product: A nuclide formed by the radioactive decay of another nuclide, which is called the parent.

decay, radioactive: The spontaneous transformation of one nuclide into a different nuclide or into a different energy state of the same nuclide. The process results in the emission of nuclear radiation (alpha, beta, or gamma radiation).

decommissioning: Decommissioning operations remove facilities such as processing plants, waste tanks, and burial grounds from service and reduce or stabilize radioactive contamination.

decontamination: Removal of radioactive contamination from facilities, soils, or equipment by washing, chemical action, mechanical cleaning, or other techniques.
derived concentration guide (DCG): The concentration of a radionuclide in air or water that, under conditions of continuous exposure for one year by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation), would result in an effective dose equivalent of 100 mrem [(0.1 rem = 1 milisievert (mSv)].

design basis accident (DBA): An accident that is considered credible enough to be used to establish design and performance requirements for systems, structures, and components important to safety.

design basis earthquake (DBE): The maximum intensity earthquake that might occur along the nearest capable fault to a structure. Structures are built to withstand a design basis earthquake.

dispersion: Phenomenon by which a material placed in a flowing medium gradually spreads and occupies an ever-increasing portion of the low flow domain.

dose: A generic term often used to refer to absorbed dose, dose equivalent, effective dose equivalent, committed effective dose equivalent, or total effective dose equivalent.

dose equivalent: A term used to express the amount of effective radiation when modifying factors have been considered. It is the product of absorbed dose (rads) multiplied by a quality factor, distribution factor, and other modifying factors. It is measured in rem.

dose rate: The radiation dose delivered per unit time (e.g., rem per year).

double-shell tank (DST): A reinforced concrete underground vessel with two inner steel liners to provide containment and backup containment of liquid wastes; the annulus between the two steel liners is instrumented to detect leaks from the inner liner.

ecology: The science dealing with the relationship of all living things with each other and with the environment.

ecosystem: A complex of the community of living things and the environment forming a functioning whole in nature.

effective dose equivalent (EDE): The sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated.

effluent: A liquid waste, discharged into the environment, usually into surface streams.

Effluent Treatment Facility: A treatment facility on the Hanford Site that receives low-level liquid effluents and removes organic, hazardous, and radioactive contaminants. The final product of this plant is water that is pumped to the Treated Effluent Disposal Facility.

emergency response planning guidelines (ERPG) values: These values, which are specific for each chemical, are established for three general severity levels: exposure to concentrations greater than ERPG-1 values for a period of time greater than 1 hour results in an unacceptable likelihood that a person would experience mild transient adverse health effects, or perception of a clearly defined objectional odor; exposure to concentrations greater than ERPG-2 values for a period of time greater than 1 hour results in an unacceptable likelihood that a person would experience or develop irreversible or other serious health effects, or symptoms that could impair one's ability to take protective action; exposure to concentrations greater than ERPG-3 values for a period of time greater than 1 hour results in an unacceptable likelihood that a person would experience or develop life-threatening health effects.

emission standards: Legally enforceable limits on the quantities and/or kinds of air contaminants that may be emitted into the atmosphere.

endangered species: Plants and animals in an area that are threatened with either extinction or serious depletion of a species.

environment: The sum of all external conditions and influences affecting the life, development, and ultimately, the survival of an organism.

Environmental Impact Statement (EIS): A legal document required by the National Environmental Policy Act (NEPA) of 1969, as amended, to assess the environmental impacts of major Federal actions.

environmental justice: The fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no population of people should be forced to shoulder a disproportionate share of the negative environmental impacts of pollution or environmental hazards due to a lack of political or economic strength.

erosion: The process in which soil is carried away by the action of wind or water.

evaporator: A facility that mechanically reduces the water content in tank waste to concentrate the waste to reduce storage needs.

exceedence: A value that exceeds a prescribed limit.

exposure (to radiation): A measure of ionization produced in air by X-rays or gamma radiation, measured in roentgens. Also the condition of being made subject to the action of radiation. Acute exposure generally refers to a high level of exposure of short duration; chronic exposure is lower-level exposure of long duration.

fault: A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred in the past.

fission: The splitting or breaking apart of a heavy atom such as uranium. When a uranium atom is split, large amounts of energy and one or more neutrons are released.

fission products: A general term for the complex mixture of nuclides produced as a result of nuclear fission. Most, but not all, nuclides in the mixture are radioactive, and they decay, forming additional (daughter) products, with the result that the complex mixture of fission products formed contains about 200 different isotopes of over 35 elements.

floodplain: Valley floor constructed by an active river and periodically covered with floodwater from that river during intervals of over-bank flow.

fuel (nuclear, reactor): Fissionable material used as the source of power when placed in a critical arrangement in a nuclear reactor.

gamma rays: High-energy, short wavelength electromagnetic radiation accompanying fission and emitted from the nucleus of an atom. Gamma rays are very penetrating and require dense materials (e.g., lead) for shielding.

genetic effects: Radiation- or chemical-induced effects (primarily mutations) that affect the descendants of the exposed individual; also called "hereditary" effects.

geology: The science that deals with the earth: the materials, processes, environments, and history of the planet.

greenhouse: In radiation protection, a temporary structure used as a confinement barrier between a radioactive work area and a non-radioactive area to prevent the spread of contamination.

groundwater: The supply of fresh water under the earth's surface in an aquifer.

half-life (radiological): The time in which half the atoms of a radioactive substance disintegrate to another nuclear form; used as a measure of the persistence of radioactive materials. Half-lives vary from millionths of a second to billions of years.

hazardous waste: A solid waste or combination of solid wastes that, because of its quantity, concentration, or physical, chemical or infectious characteristics, may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible , or incapacitating reversible illness or pose a substantial present or potential hazard to human health or the environment when properly treated, stored, transported, disposed of, or otherwise managed. In this regulatory definition solid wastes may also be in a liquid phase.

health effects: Detrimental effects on human health as the result of exposure to radiation or toxic chemicals.

heavy metals: Metallic elements of high molecular weight, such as mercury, chromium, cadmium, lead, and arsenic, that are toxic to plants and animals at certain concentrations.

high-efficiency metal filter (HEMF): A filter that performs the same function as a high-efficiency particulate air (HEPA) filter, but which can be washed to allow re-use.

high-efficiency particulate air (HEPA) filter: A type of filter designed to remove 99.95 percent of the particles down to 0.3 mm in diameter from a flowing air stream.

high activity waste: Any waste that is above NRC Class C (10 CFR 61.55) waste.

high-level waste (HLW): The highly radioactive wastes that result from processing of spent nuclear fuel, including liquid waste produced directly in reprocessing, and any solid waste derived from the liquid, that contains a combination of TRU waste and fission products in concentrations that require permanent isolation (DOE Order 5820.2). All waste in Hanford's HLW storage tanks is radioactive and is managed as HLW, although some wastes do not meet the definition of HLW.

hydraulic sluicing (past practice sluicing): A method for removing slurry from double-shell tanks by dissolving/suspending in water and pumping the waste from the tanks.

intensity (earthquake): A numerical rating used to describe the effects of earthquake ground motion on people, structures, and the earth's surface. The numerical rating is based on an earthquake intensity scale such as the Modified Mercalli Intensity Scale commonly used in the United States.

interim stabilization: Removing the liquids that can be readily pumped from single-shell tank wastes and transferring these liquids to double-shell tanks.

interim storage: The temporary holding of waste on or away from the generator's site when disposal space is not available. Monitoring and human control are provided for interim storage facilities.

interstitial liquid (interstitial liquor): Liquid in a waste matrix accommodated in the pore spaces; some is capable of gravity drainage while the rest is held by capillary forces.

ion: An atom or molecule that has gained or lost one or more electrons and has become electrically charged.

ionization: The process that creates ions. Nuclear radiation, x-rays, high temperatures, and electric discharges can cause ionization.

ionizing radiation: Alpha particles, beta particles, gamma rays, x-rays, neutrons,high speed protons, and other particles capable of producing ions.

irradiation: Exposure to radiation.

isotopes: Different forms of the same chemical element that are distinguished by different numbers of neutrons in the nucleus. a single element may have many isotopes; some may be radioactive and some may be stable.

latent period: The period or state of seeming inactivity between the time of exposure of tissue to an acute radiation dose and the onset of radiation sickness.

latent cancer fatality (LCF): The death of an individual due to a cancer induced by previous exposure to radiation or toxic chemicals.

low-income communities: A community where 25 percent or more of the population is identified as living in poverty.

long-lived radionuclides: Radioactive isotopes with half-lives greater than about 30 years.

low-level waste: Radioactive waste not classified as high-level waste, spent fuel, transuranic waste, or byproduct waste per Atomic Energy Act - Section 11e(2), and DOE Order 5820.2.

maximally exposed off-site individual (MEOSI): A hypothetical member of the public assumed to permanently reside at the location of highest calculated dose.

mitigation: A series of actions implemented to ensure that project impacts will result in no net loss of habitat value or wildlife populations. The purpose of these actions is to avoid, minimize, rectify or compensate for any adverse environmental impact.

mixed waste: Waste that contains both radioactive and hazardous chemical components.

Modified Mercalli Intensity (MMI) Scale: A scale of measure used in the U.S. to show earthquake intensity.

nanocurie (nCi): One billionth of a curie.

National Environmental Policy Act of 1969 (NEPA): Law that requires that Federal agencies assess the environmental consequences associated with their actions.

National Register of Historic Places (NRHP): A list maintained by the National Park Service of architectural, historical, archaeological, and cultural sites of local, state, or national importance.

natural radiation or natural radioactivity: Background radiation. Some elements are naturally radioactive whereas others are induced to become radioactive by bombardment in a reactor or accelerator. Naturally occurring radiation is indistinguishable from induced radiation.

Neutralized Current Acid Waste (NCAW): The highly radioactive liquid waste remaining after plutonium is removed from dissolved irradiated fuel during reprocessing. It is the most radioactive of the waste streams from reprocessing operations.

Neutralized Cladding Removal Waste (NCRW): Waste that results from dissolving and removing the zirconium cladding from irradiated N Reactor fuel in the plutonium-uranium extraction process (PUREX). This waste has been neutralized to permit low-corrosive storage in carbon steel tanks. This waste stream has transuranic contamination.

neutron: A particle existing in or emitted from the atomic nucleus; it is electrically neutral and has a mass about equal to that of a stable hydrogen atom. Neutrons are used to split heavy atoms in the fission reaction.

nitrogen oxides (NOx): A mixture of nitrogen-oxygen containing compounds primarily formed as gaseous waste effluents in the combustion of most fossil fuels.

nuclear radiation: Radiation, usually alpha, beta, or gamma, which emanates from an unstable atomic nucleus.

Nuclear Regulatory Commission (NRC): The independent Federal commission that licenses and regulates nuclear facilities.

nucleus: The positively charged center of an atom.

nuclide: A species of atom having a specific mass, atomic number, and nuclear energy state.

offsite: Outside the boundaries of the Hanford Site.

off-site population: The collective sum of individuals located within an 80-kilometer (50-mile) radius of the accident location.

onsite: Any place within the Hanford Site boundary.

operations: All aspects of the operation of a plant or facility including engineering, maintenance, safety, and process operations.

organic compounds: Chemicals compound containing carbon.

particulates: Solid particles small enough to become airborne.

past practice sluicing: See hydraulic sluicing

pH: A measure of the hydrogen ion concentration in aqueous solution. Acidic solutions have a pH from 0 to 7, basic solutions have a pH from 7 to 14.

picocurie (pCi): One trillionth of a curie.

permeability: Ability of rock, groundwater, soil, or other substance to transmit liquid.

person-rem: The radiation dose commitment to a given population; the sum of the individual doses received by a population segment.

plume: The distribution of contaminants a distance away from a point source in a medium like groundwater or air.

population dose (population exposure): Summation of individual radiation doses received by all those exposed to the source or event being considered.

precipitate: An insoluble solid that can be separated from liquid by filtration (used as a noun).

prevention of significant deterioration (PSD): This standard establishes the acceptable amount of deterioration in air quality. When the air quality of an area meets the standards for a specific pollutant, the area is declared to be in attainment for that pollutant. When the air quality of an area does not meet the standard for a specific pollutant, the area is said to be in non-attainment for that pollutant. PSD requirements allow maximum allowable increases (increments) in ambient air pollutant concentration (sulfur dioxide, particulate, nitrogen oxide) for construction or modification of facilities which by definition do not "significantly deteriorate" the existing baseline air quality.

public comment: A written or verbal statement made in response to a position proposed by a government agency.

rad: The special unit of absorbed dose from ionizing radiation equal to an absorbed dose of 0.01 joules per kilogram of irradiated material.

radiation (ionizing): See ionizing radiation.

radiation monitoring (radiation protection monitoring, monitoring): The measuring of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.

radiation survey: Evaluation of an area or an object with instruments to detect, identify and quantify radioactive materials and radiation fields present.

radiation shielding: Reduction of radiation by interposing a shield of absorbing material between a radioactive source and a person, laboratory area, or radiation-sensitive device.

radiation area: Area containing radioactive materials in quantities significant enough to require control of personnel entry into the area.

radioactive (decay): Undergoing spontaneous nuclear transformation in which nuclear particles or electromagnetic energy are emitted.

radioactive waste: Solid, liquid, or gaseous material of negligible economic value that contains radionuclides in excess of threshold quantities.

radioactivity: The property of spontaneous decay or disintegration of unstable atomic nuclei, accompanied by the emission of radiation.

radioisotopes: Radioactive isotopes, i.e, unstable isotopes of an element that will eventually undergo radioactive decay.

radionuclide: A nuclide that is radioactive.

receptor: Individuals or populations that could be exposed to radiation, radioactive materials, or toxic chemicals.

rem (roentgen equivalent man): The special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by a quality factor. One rem = 0.01 Sv.

reprocessing: The process by which spent fuel is separated into waste material for disposal and into material such as uranium and plutonium to be reused.

respirable fraction (RF): That fraction of airborne droplets or particulate matter (aerosol) with individual particle aerodynamic equivalent diameter less than 10 microns. This is assumed to be important for inhalation consequences. Non-condensable gases and vapors have a respirable fraction of 1.

Richter scale: A scale by which earthquakes are measured with graded steps from 1 through 10. Each step is approximately 60 times greater than the preceding step and is adjusted for different regions of the earth.

risk: Quantitative expression of possible impact that considers both the probability that a hazard causes harm and the consequences of that event (e.g., for cancer risk, the product of the annual frequency of occurrence multiplied by the number of latent cancer fatalities).

roentgen: A unit of measure of ionizing electromagnetic radiation exposure (X and gamma rays)

salt cake: Concentrated waste in the form of crystallized salts resulting from the evaporation of liquid high-level waste.

salt well: A hole drilled or sluiced into a salt cake and lined with a cylindrical screen to permit drainage and jet pumping of interstitial liquid.

seismic load: The force due to earthquakes.

seismicity: The relative distribution and frequency of earthquakes.

shield: An engineered body of absorbing material used to protect personnel from radiation. Shielding is often provided by materials such as concrete, water, lead, or earth

shrubb-steppe: An important habitat type found on the Hanford Site. Shrub-steppe is characterized by vegetation requiring little moisture in areas of extreme temperature range. It is considered a priority habitat by Washington State.

single-shell tank (SST): Older style Hanford HLW underground storage tank composed of a single carbon steel liner surrounded by concrete.

sludge: The precipitated solids (primarily oxides and hydroxides) that settle to the bottom of the storage tanks containing liquid high-level waste.

sluicing: A method of waste retrieval which utilizes a high-volume, low-pressure stream of liquid to mobilize the waste prior to pumping.

slurry: A suspension of solid particles (sludge) in water.

solid waste (radioactive): Either solid radioactive material or solid objects that contain radioactive material or bear radioactive surface contamination.

source term: The quantity of radioactive material, released by an accident or operation, which causes exposure after transmission or deposition.

stabilization: Treatment of waste or a waste site to protect the biosphere from contamination.

stack: A vertical pipe or flue designed to exhaust gases and suspended particulates.

storage: Retention of material in a manner permitting retrieval.

subchronic (exposure): Exposures with durations ranging from 2 weeks to 7 years.

subsidence: Gradual or sudden sinking of the ground surface below natural grade level due to slow decay and compression of material or collapse of a large void space.

sump: A collection point (depression or tank) for liquids prior to their transfer.

supernatant: The radioactive layer of highly-mobile liquid containing soluble salts that remains above the salt cake and/or insoluble sludge in a waste tank; also called free liquid.

surface water: All water on the Earth's surface, as distinguished from groundwater.

tank: A large steel-lined concrete container located underground for storage of liquid waste.

tank farm: An installation of interconnected underground tanks for the storage of high-level radioactive liquid wastes.

tectonic: Pertaining to or designating the rock structures resulting from deformation of the earth's crust.

terrane: Any rock formation or series of formations.

toxicity: The quality or degree of being poisonous or harmful to plant or animal life.

transuranic (TRU) waste: Radioactive waste containing alpha-emitting transuranic radionuclides with half-lives greater than 20 years and concentrations greater than 100 nanocuries per gram of waste.

Treated Effluent Disposal Facility (TEDF): A facility on the Hanford Site that receives treated effluent from the Effluent Treatment Facility and disposes of it below ground where it percolates down through the vadose zone.

Tri-Party Agreement: The Hanford Federal Facility Agreement and Consent Order. It is an agreement signed in 1989 and amended in 1994 by the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the Washington State Department of Ecology that identifies milestones for key environmental restoration and waste management actions.

200 Areas plateau: Highest portion on the Hanford Site (excluding Rattlesnake and Gable Mountains), containing most of the waste processing and storage facilities.

242-A Evaporator: A facility in the 200 East Area that concentrates dilute liquid waste from the double-shell tanks to reduce the volume of waste in the tanks.

unconfined aquifer: An aquifer that has a water table or surface at atmospheric pressure.

unplanned release: Unplanned discharge of contaminated liquid or particulate material.

vadose zone: The unsaturated region of soil between the ground surface and the water table.

volatile organic compounds (VOCs): Organic compounds with a vapor pressure greater than 0.44 pounds per square inch at standard temperature and pressure.

volatilize: Cause to pass off as a vapor.

volume reduction (waste volume reduction): Various methods of waste treatment such as evaporation of liquids or compaction of solids, aimed at reducing the volume of waste.

waste concentration: Removal of excess water from liquid waste or slurries.

waste form: The form in which a waste exists at the time of interest.

watchlist tanks: Tanks that have been identified as watchlist tanks in accordance with Public Law 101-510, section 3137, Safety Measures for Waste Tanks at Hanford Nuclear Reservation, 1990. These tanks have been identified as the Priority 1 Hanford Site Tank Farm Safety Issues: " Issues /situations that contain most necessary conditions that could lead to worker (onsite) or offsite radiation exposure through an uncontrolled release of fission products, e.g., Tank SY-101."

water table: Upper boundary of an unconfined aquifer surface below which soil saturated with groundwater occurs.

water quality standard: Provisions of state or Federal law that consist of a designated use or uses for the waters of the United States and water quality criteria for such waters based upon those uses. Water quality standards are used to protect the public health or welfare, enhance the quality of water, and serve the purposes of the Clean Water Act.

wind rose: A diagram designed to show the distribution of wind directions at a given location; one variation shows wind speed groupings by direction.

x-rays: A penetrating form of electromagnetic radiation emitted when the inner orbital electrons of an excited atom return to their normal state.

APPENDIX A OPERATIONAL WASTE VOLUME PROJECTION FOR HANFORD DOUBLE-SHELL TANK FARMS

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Although the SIS-EIS considers only interim actions that can be accomplished through the year 2000, this OWVP for Hanford's DST waste presents a basis for evaluating future DST space needs through the end of fiscal year (FY) 2005. Section A.1 summarizes the projected range of tank space and the need to build additional DSTs based on recent analysis by the TWRS program. The assumptions and changes which have affected the OWVP, are discussed in Multi-Function Waste Tank Facility, Phase Out Basis (WHC 1995), and are summarized in Section A.2.

The most recent information shows that wastes in the TWRS current baseline can be managed within the existing waste tank capacity through FY 2003. Additional DST tank storage capacity is not needed until FY 2004 or later. Table A-1 provides a summary of the DST space need projections through FY 2005.

A.1 BACKGROUND

The OWVP system is a complex simulation which was developed to assist in managing the tank space and identifying needs for new tanks. The OWVP system simulates the evaporator operation, the 28 DSTs and the associated transfer systems. It considers the effects of chemistry, mass, volume, and operational logistics to evaluate various operational scenarios. This projection is based upon the best estimates of waste generation and composition provided by the waste generators.

WHC periodically issues an OWVP report based on best available data. The last WHC Operational Waste Volume Projection Report, Revision 20 was issued in September 1994 (WHC 1994). Since its issue, studies have been conducted to assess alternative scenarios for operating Hanford Tank Farms without constructing new tanks at least through 2004. A special OWVP report was prepared in June 1995 to support phase out of the Multi-Function Waste Tank Facility (MWTF) project (WHC 1995).

Table A-1
Double-Shell Tanks Space Need Projections
in Millions of Gallons

	FISCAL YEAR											
Waste Type and Needs	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005

(A) Concentrated Waste	14.8	15.2	16.1	17.5	18.3	17.9	18.0	18.1	18.1	18.2	18.7	17.1
(B) Supernate Liquid	9.1	5.8	4.8	5.0	4.9	5.0	4.8	4.8	4.8	4.8	4.8	6.5
(C) 200W Receiver Tank[a]	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
(D) 241-AW-102 and 241-AW-106[b] Evaporator Support	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
(E) Spare Space	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
(F) Impact of Evaporator Limits (Specific Gravity of 1.35 versus 1.5)	0.0	0.2	0.3	0.6	0.8	1.0	1.1	1.1	1.1	1.1	1.1	1.1
(G) Segregated Space	1.5	2.4	1.9	1.1	1.1	0.7	0.7	0.7	0.7	0.7	0.7	0.7
(H) Passive Mitigation[c] 241-SY-101	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(A+B+H) Total Space Needed for Waste Storage	23.90	21.00	20.90	22.50	23.20	22.90	22.80	22.90	22.90	23.00	23.50	23.60
(C+D+E+F+G) Total Space Needed for Operational Needs and Specific Use	7.30	8.40	8.00	7.50	7.70	7.50	7.60	7.60	7.60	7.60	7.60	7.60
CAPACITYED[d]	31.20	29.40	28.90	30.00	30.90	30.40	30.40	30.50	30.50	30.60	31.10	.31.20

Source: WHC 1995

[a]Staging space needed to receive and transfer 200 West Area waste streams (Tank 102-SY is the current 200 West Area receiver tank).

[b]Staging space needed to support evaporation of waste by 242-A Evaporator.

[c]Alternate decision for passive mitigation of Tank 101-SY by a 1:1 dilution ratio would add 8.3 million L (2.2 million gal) of needed space.

[d]28 DSTs provide 118,410,000 L (31,280,000 gal) of capacity.

Several management actions have been initiated since the Draft EIS was issued in August 1994, to ensure that the projected waste volume would not exceed the available waste storage capacity in the DSTs. These actions include the following.

- Improved tank space use.
- Reduced waste volume generation by the Hanford Site facilities.
- Decreased waste volume reduction factors for the 242-A Evaporator operations.
- Modified management practices to concentrate waste to the specific gravity operating limit of 1.35 in all future evaporator campaigns. This limit was selected by WHC based on empirical data.
- Revised waste segregation requirements as described in Section A.2. TRU solids and complexed waste will be segregated per DOE Order 5820.2A.

A.2 OPERATIONAL WASTE VOLUME PROJECTION ASSUMPTIONS AND CHANGES

The following major planning assumptions and management practice changes impacting OWVP at the tank farms are discussed in this section.

- Combination of Partially Full Separate Neutralized Cladding Acid Waste (NCAW) and Neutralized Cladding Removal Waste (NCRW) Tanks - In-tank washing of the NCAW solids from Tanks 101-AZ 132,000 L (35,000 gal) of solids and 102-AZ 360,000 L (95,000 gal) of solids would be combined into Tank 102-AZ. The NCAW supernatant and washes were assumed to be concentrated and combined into Tank 101-AY. The in-tank washing of the solids should be complete by FY 1999.

The following wastes would all be consolidated into Tank 103-AW during FY 1999:

- PFP TRU solids and residual liquids in Tank 102-SY 541,000 L (143,000 gal)
- NCRW solids from Tank 103-AW 1.84 million L (487,000 gal)
- NCRW solids from Tank 105-AW 1.14 million L (300,000 gal).

- Mitigation of Watchlist Tanks - Active mitigation of Watchlist Tank 101-SY by mixer pump would be continued at least through FY 2006. It is assumed that passive mitigation by dilution of other Watchlist flammable gas DSTs would not be necessary. If a decision is made for passive mitigation of the Tank 101-SY by 1:1 dilution ratio, approximately 8.3 million L (2.2 million gal) of additional DST space or two new DSTs would be needed.

- Spare Space - Operational space in Tanks 102-AW and 106-AW would be used to provide 2.7 million L (720,000 gal) of the required 7.6 million L (2 million gal) of spare space starting in FY 1999.

- Use of Tank 102-SY for Pumping Complexed SWL - Current SWL pumping practices require that a DST be available for receiving the liquid wastes pumped out of SSTs. Two of the tanks in the 200 West Area (Tanks 101-SY and 103-SY) are on the flammable gas Watchlist and cannot receive waste additions. Therefore, all SWL pumped in the 200 West Area will be routed through Tank 102-SY.

  Tank 102-SY contains a sludge layer of Pu-bearing solids. Pumping non-complexed SWL to Tank 102-SY with the Pu-bearing solids in the bottom should not present a problem. However, complexed wastes and TRU solids have been segregated, both to minimize the expense of disposal and to comply with DOE Order 5820.2A, "Radioactive Waste Management." The OWVP assumes that solids in Tank 102-SY would be retrieved to allow pumping of the complexed SWL from January 1999 through FY 2000 (WHC 1994). The preferred alternative in this EIS includes retrieval of Tank SY-102 solids.

- A cross-site transfer capability is assumed to be functional and available for this projection. The ECSTS is operable for the transfer of dilute waste starting in 1995 with the RCSTS becoming operational with the ability to transfer slurries in 1998.

- Contingency Space - A total of 8.3-million L (2.2-million gal) of spare space consisting of one aging and one non-aging waste tank is reserved in case of a leak and emergencies per requirements of DOE Order 5820.2A. In the past, an additional one tank contingency space has been set aside to account for inaccuracies in the projections.

  A management decision was made to eliminate the requirement for the additional contingency space set aside in addition to the required spare space. Therefore the special OWVP assumes no additional contingency space.

- SWL Volumes - The revised estimates for the SWL to be pumped from SSTs during 1995 through 2000 is assumed to be 23.5-million L (6.2-million gal). This amount was previously estimated at 13.6-million L (3.6-million gal). Approximately 42 percent of this waste is assumed to be complexed resulting in 9.8-million L (2.6-million gal) of complexed SWL which was previously estimated at 1.89-million L (500,000 gal). The revised waste volume reduction factors, from SWL to Double-Shell Slurry Feed, were 55 percent for non-complexed SWL and 10 percent for complexed SWL.

- Facility Generation Rate - Reassessment of the waste volume generation by various facilities contributing wastes to the tank farms has resulted in lower projections of the total facility generation rate.

- Privatization - TWRS Program privatization concepts are not included in this EIS. Privatization is currently believed to have no negative impact.

- TWRS Actions - The DST space needs for the TWRS actions such as retrieval, pretreatment, immobilization, and lag storage is not included in this projection. The TWRS EIS will evaluate these needs.

- Watchlist Tank Inventories - It is assumed that the Watchlist tanks inventories remain constant from 1995 through 2005.

- Headspace Above Pu-Bearing Solids - These projections assume headspace above Pu-bearing solids would be used to store Dilute Non-Complexed waste.

- All DSTs Remain Sound - The special OWVP assumes that all existing DSTs remain intact for at least another 10 years.

APPENDIX A REFERENCES

WHC, 1995, Multi-Function Waste Tank Facility, Phase Out Basis, Awadalla N.G., WHC-SD-W236A-ER-021, Revision 2, June 1995.

WHC, 1994, "Operational Waste Volume Projection", WHC-SD-WM-ER-029, Rev. 20, September 1994.

APPENDIX B SITE SELECTION PROCESS

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APPENDIX B SITE SELECTION PROCESS

This appendix discusses the site selection factors and summarizes the siting process for the RCSTS and the NTF.

B.1 SITE SELECTION FACTORS

Site selection for the main components, the RCSTS and NTF of the SIS program was based on several factors. The factors discussed in this section include engineering constraints, human safety, cost, and environmental impact.

B.1.1 ENGINEERING CONSTRAINTS

Design requirements and existing site features can be engineering constraints. A list of the major engineering constraints follow.

- The RCSTS would be designed to drain by gravity in case of failure of the pump system. The middle was to be the high point so that it would drain both ways. It was to be sloped at least 0.25 percent to preclude accumulation of solids in the line. For radiation and freeze protection, the lines were to be buried at least the appropriate minimum depth to assure that protection. To meet these requirements and minimize cost and environmental impact, the route must fit the existing topography.
- The point at which the RCSTS can exit the 200 West Area tank farm is dictated by the requirement to avoid going through existing facilities and contamination areas. That constraint limits the route options available for that segment of the RCSTS.
- The NTF also requires a large uncontaminated area that would not conflict with other existing or proposed facilities.
- Existing critical utility links are to be avoided by both the NTF and RCSTS.

B.1.2 HUMAN SAFETY

The primary safety consideration is to avoid routing the RCSTS or siting the NTF in or through areas with radioactive contamination that would unnecessarily expose construction workers. In addition, other facilities with exclusion zones that cannot be invaded for safety reasons must be avoided.

B.1.3 COST

The overall objective of this factor is to minimize the cost without compromising safety, schedule, or other factors. Important cost considerations are:

- Minimize the amount of pipe by picking the shortest RCSTS route
- Minimize the amount of cut and fill (trenching and berming) by choosing the flattest RCSTS route
- Construct the NTF (if needed) near the RCSTS to minimize the amount of pipe needed.

B.1.4 ENVIRONMENTAL IMPACT

Several guiding principles regarding environmental impacts were used in site evaluation where they did not compromise human safety, major engineering constraints, or meeting the schedule. In some cases, a comparison between alternative routes or sites was made to determine if an alternate route or site would reduce impacts. If it would not, the proposed route and site would be as good as an alternate, and cost and schedule concerns would cause it to be selected. The guiding principles to minimize environmental impact are:

- Use existing corridors and parallel the existing ECSTS to reuse previously disturbed areas.
- Minimize the disturbance of shrub-steppe habitat, a priority habitat designated for protection by the WDFW.
- Use as small an area as reasonable to minimize the overall impacts.

B.2 SUMMARY OF SITING PROCESS

The original route for the RCSTS and sites for NTF identified in the Draft EIS were selected primarily on the basis of safety and engineering constraints. The first guiding principle concerning environmental impact and cost considerations were also considered.

After the Draft EIS was issued, additional siting and routing studies were conducted. The determination that only two tanks would be evaluated in the Final EIS new storage alternative, created more flexibility concerning siting because less area would be required. This change allowed consideration of smaller alternative sites, such as an alternate site inside the 200 East Area in the interest of minimizing potential impacts (see Section 4.4.1). However, when safety considerations concerning contamination and exclusion zones and engineering constraints were applied, only sites that had mature big sagebrush were found. One of these is analyzed in the Final EIS as an alternate site for the 200 East Area tank location. Because there would be little difference in environmental impact between these sites, other selection criteria would be the primary determinants of any site selected to build new tanks.

A siting review group for the RCSTS comprised of DOE-RL, Dames & Moore, WHC, and PNL staff reviewed the siting criteria and determined what alternate routes and sites could be considered. The group met on the site and toured the possible locations on March 21, 1995.

During this review, two alternate segments for the RCSTS were found that had the potential of reducing the amount of mature sagebrush habitat that would be affected (Figure 3-4). The first alternate segment was from the vent station eastward, where the RCSTS route could parallel the ECSTS into the 200 East Area. Because of the uncertainty of contamination from the ECSTS, the new route would have to be far enough away that it could not use the existing access road. Evaluation found that this route would affect about 2 ha (5 acres) more mature sagebrush and offered no other advantages over the proposed route.

The second alternate route would extend from the 200 West Area fence to the vent station and would parallel an existing road and the ECSTS, using the access road along the north side of the ECSTS. Careful evaluation of this route alternative found that it would affect only about 0.6 ha (1.6 acres) less than the proposed route. This route had serious schedule and cost impacts as it increased the overall length of the corridor by over 300 m (1,000 ft). There is so little difference in impact that the schedule and cost considerations were of primary importance in selecting a preferred alternative route for the RCSTS.

The conclusion from this additional siting evaluation is that no alternate routes and sites were to be found that met the safety and engineering constraints and would have significantly less environmental impact. This process and conclusion was discussed with the Natural Resource Trustees Council, made up primarily of representatives of certain Federal and state regulatory agencies and tribes, on May 12, 1995.

APPENDIX C ENVIRONMENTAL JUSTICE EVALUATION

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APPENDIX C ENVIRONMENTAL JUSTICE EVALUATION

C.1 INTRODUCTION

This appendix considers minority and low-income populations that have the potential to be affected by actions at the Hanford Site.

E.O. 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, directs Federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations (E.O. 12898). E.O. 12898 Section 3-302 (c) (2) states that, "Each Federal agency ... shall ... analyze ... information for areas surrounding Federal facilities that are: (2) expected to have a substantial environmental, human health, or economic effect on surrounding populations."

E.O. 12898 also directs the Administrator of the EPA to convene an interagency Federal Working Group on environmental justice. The Working Group is directed to provide guidance to Federal agencies on criteria for identifying disproportionately high and adverse human health or environmental effects on minority and low-income populations. The Working Group has not yet issued the guidance directed by E.O. 12898, although it has developed draft working definitions. The approach to evaluating environmental justice used in this document is consistent with the Environmental Impact Statement for the Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel (DOE 1995). This approach may change as a result of future guidance issued by the Working Group or DOE. The conclusions are not expected to change because, based on the analyses prepared for this EIS, the impacts resulting from the proposed action under all alternatives present no significant risk to the population.

This analysis uses the following draft definitions:

. Minority - Individuals classified by the U.S. Bureau of the Census as Negro/Black/African American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, and other non-White persons. The minority population in an affected area is the number of individuals residing in the area who are members of a minority group.

- Low-Income Community - An area for which the median household income is 80 percent or below the median household income for the metropolitan statistical area (urban) or county (rural). While "80 percent" is used in this analysis based on definitions used by the U.S. Department of Housing and Urban Development, this percentage may change in the final guidelines under preparation by the Working Group and the DOE.

- Disproportionately High and Adverse Human Health Effects - Any human health effects, including cumulative or synergistic effects, on minority or low-income populations which substantially exceed generally accepted levels of risk. This draft definition prepared by the Working Group might change during preparation of the final guidelines.

- Substantially Affect Human Health - To impact human health such that there is a measurable incidence of any specific illness, disease, or disorder significantly higher than the national average. This is also a draft definition developed by the Working Group which might change during preparation of final guidelines.

With respect to the alternatives considered in this EIS, environmental justice issues are concerned with either socioeconomic conditions or health effects due to emissions.

Socioeconomic issues include the potential for direct effect in terms of disproportionately more layoffs among low-income or minority employees and indirect local economic effects on minority or low-income populations. Where local economies are dependent on one industry, there is substantial potential for indirect effects from fluctuations in activity in this industry. The Hanford Site represents a substantial portion of the area's labor force. In the high growth periods of boom-bust cycles, population influx tends to drive housing values up, which can make housing unaffordable for low-income persons. During business contractions, business activity drops, and unemployment rises.

Health effects are effects to off-site populations due to emissions from the Hanford Site. Emissions from alternatives considered in this EIS have been evaluated in terms of their health effects on the population residing within 80 km (50 mi) of the Hanford Site.

For each of the areas of technical analysis presented in this Final EIS, a review of impacts to the human and natural environment was conducted to determine if any potentially disproportionate, significant, and adverse impacts on minority populations or low-income populations were identified. The Hanford Site's "region of influence" for socioeconomic issues in the State of Washington is generally recognized to be Yakima, Grant, Adams, Franklin, Benton, Walla Walla, and Columbia Counties. Figure C-1 illustrates the region of influence for the Hanford Site. The analysis examines impacts under construction, routine operations, and accident conditions. If an adverse impact was identified, a determination was made whether minority populations or low-income populations were disproportionately impacted.

The population characteristics discussed in the following sections include:

- Minority population composition and distribution
- Income distribution

C.2 MINORITY POPULATION COMPOSITION AND DISTRIBUTION

Hispanics, residing predominantly in Franklin, Yakima, Grant, and Adams Counties, and Native Americans, residing primarily in Yakima County, are the area's principal minority groups.

The dominant minority group in the region of influence is Hispanic people. Hispanics comprised nearly 81 percent of the minority population surrounding the Hanford Site at the time of the 1990 census. Hispanic people constitute 8 percent of Benton County's population and 30 percent of Franklin County's population. Other counties in the region of influence which have relatively large concentrations of Hispanic peoples are Adams, Grant, and Walla Walla. Tables C-1 and C-2 present breakdowns of minority populations by county and city, respectively. The Hanford Site is also surrounded by a relatively large percentage (about 8 percent) of Native Americans, due to the presence of the Yakama Indian Reservation and tribal headquarters in the State of Washington.

Figure (Page C-4)
Figure C-1. Socioeconomic Region of Influence for Hanford Site in Washington

C.3 INCOME DISTRIBUTION

As presented in Table C-3, the area's low-income population is dispersed throughout the region, with the highest concentrations occurring in Franklin, Columbia, Yakima, Grant, and Adams Counties. Benton County has the lowest percentage of persons classified as having an income lower than the poverty threshold. At 23 percent, Franklin County has the highest percentage. These percentages reflect the economic base of the two counties. Benton County is more dependent upon the Hanford Site for its economic base, while Franklin County has a higher dependence upon agricultural activities.

C.4 IMPACT ANALYSIS

Potential impacts of the alternatives considered in this EIS were analyzed to determine whether any minority or low-income populations could be disproportionately impacted. The analysis focused on:

- Socioeconomic Impacts
- Health Effects.

C.4.1 SOCIOECONOMIC IMPACTS

Based on the magnitude and type of other activities in the area and analyses performed for this EIS, no socioeconomic impacts to the region of influence are anticipated.

Table C-1
Minority Composition of Counties in
Socioeconomic Region of Influence in Washington

County	Total Population	White		Hispanic		Black		Native American		Asian		Pacific Islander		Other	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
County	4,866,692	4,308,937	89	214,570	4	149,801	3	81,483	2	195,918	4	15,040	0	115,513	2
Adams	13,603	9,100	67	4,467	33	31	0	64	0	89	1	4	0	4,315	32
Benton	112,560	102,832	91	8,624	8	1,085	1	861	1	2,157	2	89	0	5,536	5
Columbia	4,024	3,874	96	463	12	1	0	27	1	16	0	-	0	106	3
Franklin	37,473	26,917	72	11,316	30	1,310	3	263	1	847	2	22	0	8,114	22
Grant	54,758	46,976	86	9,427	17	599	1	568	1	608	1	33	0	5,974	11
Walla Walla	48,439	43,290	89	4,703	10	720	1	359	1	566	1	59	0	3,445	7
Yakima	188,823	139,514	74	45,114	24	1,938	1	8,405	4	1,825	1	97	0	37,044	20

Source: U.S. Department of Commerce 1992a
U.S. Department of Commerce 1992b

Table C-2
Minority Composition of Cities and Towns with Populations Greater than 2,500 in Benton, Franklin, and Yakima Counties

County/ Town	Total Persons	White	Hispanic	Black	Native American	Asian & Pacific Islander	Other

		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Benton County													
Richland	32,354	30,022	93	1,112	3	366	1	234	1	1,118	3	614	2
Kennewick	42,155	38,003	90	3,578	8	411	1	273	1	771	2	2,697	6
West Richland	4,323	3,763	87	61	1	19	0	19	0	80	2	442	11
Prosser	4,476	3,617	81	1,038	23	5	0	18	0	48	1	788	18
Franklin County													
Pasco	20,337	12,175	60	8,392	41	1,125	6	250	1	499	2	6,288	31
Yakima County													
Grandview	7,169	3,883	54	3,443	48	107	2	7	0	13	0	3,159	44
Sunnyside	11,238	5,481	49	6,417	57	70	1	34	0	44	0	5,609	50
Toppenish	7,419	2,660	36	4,655	63	51	1	646	9	27	0	4,035	54
Wapato	3,795	1,217	32	2,450	65	12	0	343	9	74	2	2,149	57
Union Gap	3,012	2,473	82	513	17	4	0	81	3	56	2	398	13
Yakima	54,831	45,248	82	8,700	16	1,382	3	1,207	2	680	1	6,314	12
Selah	5,113	4,731	92	334	7	45	1	57	1	28	1	252	5

Source: U.S. Department of Commerce 1993a
U.S. Department of Commerce 1993b

Table C-3
Low-Income Persons in the Region of Influence, 1989

Totals for all Persons

	Total	Below Poverty Level	% Below Poverty Level
County	4,741,003	517,933	11
Adams	13,479	2,360	18
Benton	111,634	12,402	11
Columbia	3,910	757	19
Franklin	36,926	8,491	23
Grant	54,165	10,631	20
Walla Walla	44,520	7,144	16
Yakima	185,355	37,486	20

Source: U.S. Department of Commerce 1993c
U.S. Department of Commerce 1993d

While no increase in the Hanford facility's permanent operational workforce is anticipated, under the various alternatives, up to 185 temporary workers would be employed during the expected construction period of up to 36 months. This workforce increase can be sustained by site and local infrastructure, particularly since nearly 5,000 contractor and Federal employee positions have been eliminated at the Hanford Site in 1995. The full labor complement could be supplied from the local area, depending on the availability of appropriate labor skills.

C.4.2 HEALTH EFFECTS

Routine emissions would be within allowable limits, and normal emissions at the site boundary would be well within legal limits, which are protective of human health. The only persons potentially affected by routine emissions from any alternative would be Hanford Site personnel and appropriate measures are taken to protect worker health on-site. Under normal activities associated with the various alternatives, the dominant health effects were shown in Section 5 and Appendix E to be potential exposures received by the workers in the immediate vicinity of the project area. Exposures to workers are readily controlled through engineered systems and work practices to prevent workers from receiving high doses of radiation or chemical emissions. Work areas are monitored and workers participate in continuous monitoring programs so that exposures are restricted to well within allowable limits.

C.5 CONCLUSION

Potential socioeconomic and human health effects have been evaluated with regard to their possible impacts to minority and low-income populations.

Within 80 km (50 mi.) of the Hanford Site, minority groups comprise approximately 25 percent of the population, with concentrations in directions northeast, southeast, and southwest of the site. Within the same area, 42 percent of households are classified as low-income. Areas where more than 50 percent of households are low-income populations are located relatively close to the Hanford Site (DOE 1995).

Socioeconomic impacts due to the creation of temporary jobs for any of the alternatives are relatively minor in comparison to the larger impacts of planned workforce reduction at the Hanford Site. Nearly 5,000 contractor and Federal employee positions are being eliminated at the Hanford Site in 1995. The temporary employment provided by construction of the new facilities would amount to less than 5 percent of the planned workforce reductions. Thus, significant socioeconomic impacts are not anticipated, and minority and low-income populations would not be impacted. The new job opportunities associated with the proposed project could provide low-income groups with employment depending on availability of appropriate labor skills.

Based on the accident analyses performed for the alternatives presented within this EIS, the likelihood of a potential health effect to the off-site population is extremely unlikely to incredible (see Table F-1 for accident frequency terminology) for the preferred alternative and new storage alternative. For the truck and rail transfer alternatives, health effects to the off-site population from an accident are considered unlikely. For the no action alternative, health effects to the off-site population from an accident are considered extremely unlikely. While the probabilities of such accidents can be calculated, they are not anticipated. Therefore, adverse human health or environmental effects are not expected for any member of the public, and no minority or low-income population will be disproportionately affected.

APPENDIX C REFERENCES

DOE, 1995, Draft Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy concerning Foreign Research Reactor Spent Nuclear Fuel, Volume 2, Appendix A, Environmental Justice Analysis, DOE/EIS-0218D

"Executive Order 12898, February 11, 1994, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, Environmental Justice Guidance, Federal Register/Vol. 59, No. 32, Wednesday, February 16, 1994

U.S. Department of Commerce, 1993a, 1990 Census of Population, "Population and Housing Unit Counts", Oregon, CPH-2-39, Economics and Statistics Administration, Bureau of the Census, U.S. Department of Interior

U.S. Department of Commerce, 1993b, 1990 Census of Population and Housing, "Population and Housing Unit Counts", Washington, CPH-2-49, Bureau of the Census, March 1993

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APPENDIX D MITIGATION FOR LOST HABITAT

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APPENDIX D MITIGATION FOR LOST HABITAT

This appendix addresses the proposed mitigation strategy and its relationship to the site-wide mitigation program. Actions proposed as part of the alternatives would require clearing shrub-steppe habitat to construct new facilities. The part of that habitat dominated by mature sagebrush has been designated as a priority habitat by the State of Washington because of its importance to wildlife and because it is becoming relatively scarce in the state. Therefore, the loss of substantial acreage of this habitat type is an issue of concern for any alternative. Compensatory mitigation for unavoidable losses of this habitat, in the form of restored, enhanced, or newly established similar habitat, is planned.

The following sections discuss mitigation strategy in general, mitigation strategy for the Hanford site, and mitigation plans for the preferred alternative.

D.1 MITIGATION STRATEGY

Such a mitigation requirement assumes that the restoration of sagebrush habitat or creation of favorable conditions for it on disturbed sites is feasible. Revegetation projects (including some on the Hanford Site) have successfully planted and established sagebrush. The possible approaches to mitigation range from seeding to planting nursery stock to transplanting mature shrubs. While each strategy has its advantages, each also has disadvantages. Seeding is the cheapest method for revegetating barren soil, but the length of time to achieve mature sagebrush is likely to be years, even decades. There are also many factors that can interfere with the success of a seeding effort, and some sites are less amenable to this approach than others.

Planting nursery stock offers several advantages, including a higher likelihood of success, adaptability to a wide range of sites, and a slightly shorter time from planting to maturity than seeding. The costs are higher, and it may be necessary or desirable to establish a nursery nearby to optimize survival and use local genetic stock. Transplanting mature or near-mature plants from sites scheduled for construction would probably be the most expensive on a unit basis, and the techniques may be least proven; but the rewards could be substantial. Using this transplanting approach, it should be possible to establish habitat for wildlife species that require mature shrubs as a key component of the habitat. Transplanting would avoid the gap between the time of habitat loss and the time when replacement habitat is useable by a species of concern for which it is critical such as the loggerhead shrike.

D.2 HANFORD SITE MITIGATION STRATEGY

A Hanford site-wide mitigation strategy is being discussed by representatives of the DOE, their contractors, the WDFW, the USFWS, and other members of the Natural Resource Trustees Council. The development of the strategy is in a formative stage, with concepts and procedures for agreements being the initial focus.

Under a site-wide mitigation strategy, there should be a substantial savings of time to all parties because the negotiations of mitigation details could be done once, rather than repeatedly for each separate project. The results should be more predictable and success more readily achievable, because each project would contribute an increment to a comprehensive study of the critical information needed to assure success rather than have to rely on a more limited study that would be economically feasible for one project. The site-wide strategy would also facilitate a broader landscape and ecosystem approach to mitigation than would be expected with separate project mitigation. Perhaps the most significant benefit would be to the habitat and the species that use it, because efforts would be focused on creating, enhancing, or revegetating habitat rather than on negotiations.

D.3 MITIGATION PLANS FOR THE PREFERRED ALTERNATIVE

Since a site-wide mitigation strategy has not yet been adopted and implemented, the mitigation for the clearing of mature sagebrush habitat for the RCSTS would necessarily be a stand-alone program. The concepts, developed more fully in the MAP, generally follow the mitigation approach described in the Draft EIS and apply the key elements of the draft site-wide mitigation strategy. The following are key components of the mitigation strategy:

- Avoidance and minimization of impact through siting
- Salvage and transplant
- Restoration of temporarily disturbed habitat
- Compensation for lost habitat.

Each of these components are discussed in the following paragraphs.

Measures to avoid and minimize impacts have been applied to the extent feasible. The anticipated loss of mature sagebrush has been reduced substantially since the Draft EIS was published. The construction corridor for the RCSTS would incorporate previously cleared roadways to reduce the width of the construction corridor from a nominal 30.5 m (100 ft) to 26 m (85 ft). Another means of minimizing the impact is that mature shrubs would be salvaged from the area to be cleared and planted in the enhancement area.

Restoration of temporarily disturbed habitat could be an important feature of the mitigation program. It is anticipated that an average of 23 m (75 ft) of the RCSTS construction corridor could be restored, if there will be no need for further disturbance associated with the use of the RCSTS. However, if decommissioning of the RCSTS required removal of the pipes, the area would be disturbed again at the end of the useful life of the facility. About 8 ha (20 acres) of cleared sagebrush habitat could be restored in place and provide good potential habitat if the pipes can be left in place when decommissioned. In addition, about 0.6 ha (1.5 acres) of the corridor, now occupied by cheatgrass/rabbitbrush habitat, could be planted with sagebrush. The remainder must be kept clear of vegetation to prevent deep-rooted shrubs from drawing up contaminated material in the unlikely event a leak should occur. Since it is assumed that decommissioning of the RCSTS would require pipe removal, the method of restoration would be to add sagebrush seeds to a seed mixture of native grasses that would be sown on the disturbed areas. This combination will help prevent invasive plant species from excluding desirable native species. If tanks are built as part of the new storage alternative, some of the area disturbed for construction could also be similarly restored.

Compensation for lost habitat values would be accomplished by enhancing the habitat value of an area west of the 200 West Area (see Figure 5-2) that has had no sagebrush component for many years due to past fires, but has the other components of a mature habitat (e.g., understory species). A baseline characterization of the proposed compensation area is included in the MAP. The compensation site area has also been surveyed for cultural resources to make sure the mitigation action would not affect cultural resources. Enhancement would be through restoration of the shrubs in a selected area of habitat. Compensation for lost habitat value (for up to 50 years) is to be done at a ratio of 3 ha (7.4 acres) of replacement for each 1 ha (2.5 acres) lost.

Under the preferred alternative, 9 ha (23 acres) of mature sagebrush would be lost initially. As described in Section 5, at a ratio of 3:1, 28 ha (69 acres) would be replaced for this project. Of that, 9 ha (23 acres) would have mature sagebrush plants transplanted from the RCSTS corridor (salvaged prior to clearing of the corridor). These transplants would be placed at a density of 50 per ha (20 per acre) and will be supplemented with tubeling nursery stock at a density of 500 per ha (200 per acre). The remaining 18 ha (46 acres) would be planted with tubelings at a density of 750 per ha (300 per acre). If the new storage alternative is selected, the compensation would be done at the same ratio by expanding the proposed compensation area.

To assure that the concerns of tribes and natural resource agencies are considered, the detailed mitigation plans for inclusion in the MAP are being prepared in consultation with interested members of the Natural Resource Trustees Council. Since potentially significant cultural resource sites have been identified in the 560 ha (1,300 acre), a specific plan for avoidance of these sites will be included in the MAP. Procedures to follow in the event of encountering other cultural resource sites will also be specified. Tribes and natural resource agencies will be given the opportunity to participate in mitigation activities to make sure that their concerns are adequately considered during implementation of the MAP.

APPENDIX E ESTIMATION OF HEALTH EFFECTS FOR NORMAL AND ACCIDENT CONDITIONS

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APPENDIX E ESTIMATION OF HEALTH EFFECTS FOR NORMAL AND ACCIDENT CONDITIONS

This appendix provides information to support the evaluation of human health effects presented in Chapter 5 of this EIS. The characterization of receptor locations for airborne effluents is discussed in Section E.1. Calculation of the concentrations of airborne effluents at these receptors is discussed in Section E.2 for normal conditions and in Section E.3 for accident conditions. Conversion of these airborne concentrations to health effects is discussed in Section E.4.

E.1 RECEPTOR CHARACTERISTICS

The term receptor refers to individuals or populations that could be exposed to radiation, radioactive materials, or toxic chemicals. Population and individual receptors may include involved workers, uninvolved workers, and members of the general public. This section provides the distances from release points of interest to locations occupied by these receptors and describes how receptor populations were determined.

Because of the number of alternatives and options within the alternative considered in this EIS, a single release point is sometimes used to represent release points for several nearby facilities. Table E-1 lists the facilities used as release points to determine distances to receptor locations and the additional facilities assumed to be represented by each release point.

This combination of release points has no effect on individual worker receptors or off-site population receptors which are assumed to be at fixed distances from the release point, and has a negligible effect on distances to individual off-site receptors where the displacement of release points are a small fraction of the distance to the receptor. As discussed in Section E.1.2, maximally exposed uninvolved worker population receptor locations are selected on the basis of population-weighting of -/Qs. The relative positions of potential release points and occupied structures had no significant effects on the result of combining release points. Individual receptors are discussed in Section E.1.1 and population receptors are discussed in Section E.1.2.

Table E-1
Release Points Used to Determine Distances to Receptor Locations

Release Point	Other Facilities Represented
200 West Area	
241-SY Tank Farm	ITRS, PPSS, HLW Load/Unload Facility, DCRT 244-S (Salt Well Receiver Tank)
NTF	RCSTS Diversion Box #1
ECSTS Diversion Box 241-UX-251	None
200 East Area	
NTF Site "D"	RCSTS Diversion Box #2, ECSTS Diversion Box 241-ER-151
NTF Site "E"	None
241-A Tank Farm	244-A Lift Station (RCSTS Termination Point), HLW Load/Unload Facility

E.1.1 INDIVIDUAL RECEPTORS

Individual receptors are the maximally exposed involved worker, maximally exposed uninvolved worker, and maximally exposed member of the general public. The maximally exposed involved worker is assumed to be at the center of a 10-meter radius hemisphere. The hemisphere is centered on the release point.

Several of the facilities (e.g., the HLW Load/Unload Facility) and some of the equipment [(e.g., the 19,000-L (5,000-gal) tanker trailer truck and 38,000-L (10,000-gal) rail tanker car] considered in this EIS have not yet been designed. In other cases, the locations of workers in the immediate vicinity of a release point are difficult to determine. For these reasons, the maximally exposed uninvolved worker is assumed to be located 100 m (330 ft) from the release point. This is the minimum distance that -/Qs calculated by the Gaussian plume models commonly used for this type of assessment can be considered reliable.

Two sets of receptor locations are used to represent the maximum off-site individual. This is a hypothetical individual that remains at the site boundary for the entire duration of the release. In the case of normal conditions, the individual is assumed to be present for 8,760 hr/yr. The first set of receptors is located along the existing site boundary. Distances for some of the release points shown in Table E-1 to this boundary are listed in Table E-2. In the future, land beyond Highways 240 and 24 to the west and south and land beyond the Columbia River to the north may be transferred to other agencies and become outside the site boundary. Table E-3 shows distances from the release points of interest to the potential new boundary which is the nearest in a given direction of the existing boundary, Highways 240 and 24, and the Columbia River.

E.1.2 POPULATION RECEPTORS

Because the total number of workers involved in many of the activities of the alternatives at any time are not known, involved worker populations are not specifically evaluated. Exposures to workers in the involved population are bounded by those exposures received by the maximally exposed individual worker.

The assessment of health effects of accidents on uninvolved worker populations is a two-step process. This process was simplified by the facts that all accidental releases under the alternatives considered would be ground level releases and that no large structures that could cause building wake effects were identified in the vicinity of the release points. This allowed a polar grid of -/Qs to be calculated as described in Section E.3.2. This grid was then used with facility layouts for the 200 Areas and building occupancy data derived from the Hanford Site telephone book to locate the maximally exposed uninvolved worker population and the location with the highest product of -/Q and number of workers. The locations of maximum uninvolved worker populations are shown in Tables E-4 and E-5 by distance and direction from each release point.

The population distribution shown in Table E-6 was used to assess health effects to the off-site population for both normal and accident conditions. For accident conditions, the maximum off-site population was identified using the same procedure used for uninvolved workers. The locations of the maximum off-site population receptors are given in Tables E-4 and E-5.

Table E-2
Distance to Receptor Locations Along the Existing Boundary

Area Facilities	200 East NTF Site "E"	NTF Site "D"	A Tank Farm	200 West NTF	SY Tank Farm
		RCSTS DB#2	244-A Lift	RCSTS DB#1	DCRT 244-S
Direction	Distance (m)				
S	17,990	18,910	19,840	13,060	13,090
SSW	15,950	16,160	17,230	13,270	13,340
SW	17,970	17,620	17,610	15,530	14,750
WSW	17,820	18,900	21,250	13,290	12,620
W	17,460	18,500	20,940	13,020	12,430
WNW	17,900	18,950	22,000	13,260	12,780
NW	19,130	19,850	21,030	16,820	16,300
NNW	18,960	19,640	21,210	17,730	17,370
N	22,160	23,050	24,800	19,820	19,100
NNE	26,550	25,940	23,280	28,240	28,230
NE	21,120	20,400	17,640	26,330	26,890
ENE	18,520	17,450	15,060	23,070	23,670
E	18,310	17,310	15,460	23,000	23,670
ESE	22,520	21,470	18,980	27,520	28,230
SE	25,890	25,660	23,020	22,330	22,900
SSE	20,670	20,460	20,240	18,660	17,470

DB = Diversion Box
1 m = 3.3 ft

Table E-3
Distance to Receptor Locations Along the Potential New Boundary

Area Facilities	200 East NTF Site "E"	NTF Site "D"	A Tank Farm	200 West NTF	SY Tank Farm
		RCSTS DB#2	244-A Lift	RCSTS DB#1	DCRT 244-S
Direction	Distance (m)				
S	7,970	8,330	9,560	3,400	3,800
SSW	7,320	7,760	9,040	3,980	3,800
SW	7,320	7,750	9,030	4,320	3,950
WSW	8,900	9,250	9,870	4,860	4,060
W	9,660	10,660	12,890	5,180	4,300
WNW	12,920	14,090	16,480	6,610	5,420
NW	11,140	11,710	12,670	10,330	9,260
NNW	10,640	11,350	12,870	11,280	11,100
N	12,000	12,910	15,560	11,280	11,110
NNE	14,950	14,500	12,920	14,840	13,920
NE	13,790	12,780	10,650	18,270	19,150
ENE	13,450	12,570	10,720	17,880	18,710
E	15,010	14,320	12,600	20,310	21,040
ESE	22,720	21,560	18,960	27,270	28,230
SE	25,200	25,340	22,980	8,910	7,790
SSE	10,050	10,640	12,830	5,060	4,300

DB = Diversion Box
1 m = 3.3 ft

Table E-4
Atmospheric Dispersion Factors for Accidental Releases
From the 200 West Area

Release Point	Receptor	-/Q (s/m3)a 0-2 Hr Averaging	0-8 Hr Averaging	8-24 Hr Averaging
241-SY Tank Farm ITRS Load/Unload Facility DCRT 244-S	Maximum Uninvolved Worker (100 m)	1.09 x 10-2	6.78 x 10-3	NA
	Maximum Uninvolved Worker Population (575 Workers, NNW @ 1,300 m)	1.41 x 10-4 (8.11 x 10-2)	7.31 x 10-5 (4.20 x 10-2)	NA
	Maximum Off-site Individual - Existing Boundary (W @ 12,430 m)	1.42 x 10-5	6.20 x 10-6	4.10 x 10-6
	Maximum Off-site Individual - Potential Boundary (W @ 4,300 m)	4.30 x 10-5	2.02 x 10-5	1.38 x 10-5
	Maximum Off-site Population b	3.42 x 10-6 (3.32 x 10-1)	1.28 x 10-6 (1.21 x 10-1)	1.01 x 10-6 (7.39 x 10-2)
NTF RCSTS Diversion Box 1	Maximum Uninvolved Worker (100 m)	1.09 x 10-2	6.78 x 10-3	NA
	Maximum Uninvolved Worker Population (625 Workers, NW @ 1,750 m)	1.01 x 10-4 (6.31 x 10-2)	5.12 x 10-5 (3.20 x 10-2)	NA
	Maximum Off-site Individual - Existing Boundary (W @ 13,020 m)	1.35 x 10-5	5.89 x 10-6	3.89 x 10-6
	Maximum Off-site Individual - Potential Boundary (S @ 3,400 m)	4.55 x 10-5	2.22 x 10-5	1.55 x 10-5
	Maximum Off-site Population b	3.42 x 10-6 (3.32 x 10-1)	1.28 x 10-6 (1.21 x 10-1)	1.01 x 10-6 (7.39 x 10-2)
ECSTS Diversion Box (241-UX-251)	Maximum Uninvolved Worker (100 m)	1.09 x 10-2	6.78 x 10-3	NA
	Maximum Uninvolved Worker Population (575 Workers, NNW @ 1,300 m)	1.41 x 10-4 (8.11 x 10-2)	7.31 x 10-5 (4.20 x 10-2)	NA
	Maximum Off-site Individual - Existing Boundary (W @ 12,430 m)	1.42 x 10-5	6.20 x 10-6	4.10 x 10-6
	Maximum Off-site Individual - Potential Boundary (W @ 4,300 m)	4.30 x 10-5	2.02 x 10-5	1.38 x 10-5
	Maximum Off-site Population b	3.42 x 10-6 (3.32 x 10-1)	1.28 x 10-6 (1.21 x 10-1)	1.01 x 10-6 (7.39 x 10-2)

aPopulation-weighted -/Qs (persons-s/m3) are given in parentheses.
bThe maximum population for 0-2 hr and 0-8 hr releases is 94,203 at 64 to 80 km (40 to 50 mi) west. The maximum population for 8-24 hr releases is 73,156 at 48 to 64 km (30 to 40 mi) southeast. -/Qs are calculated at the midpoint of the distance interval.
NA = Not Applicable
1 m = 3.3 ft

Table E-5
Atmospheric Dispersion Factors for Accidental Releases From the 200 East Area

Release Point	Receptor	-/Q (s/m3)a 0-2 Hr Averaging	0-8 Hr Averaging	8-24 Hr Averaging
NTF Site "E"	Maximum Uninvolved Worker (100 m)	1.09 x 10-2	6.78 x 10-3	NA
	Maximum Uninvolved Worker Population	1.33 x 10-4	7.36 x 10-5	

				NA
	(890 Workers, ESE @ 1,750 m)	(1.18 x 10-1)	(6.55 x 10-2)	
	Maximum Off-site Individual - Existing Boundary (E @ 18,310 m)	1.63 x 10-5	7.28 x 10-6	4.86 x 10-6
	Maximum Off-site Individual - Potential Boundary (E @ 15,010 m)	1.98 x 10-5	8.95 x 10-6	6.01 x 10-6
	Maximum Off-site Population[c]	3.42 x 10-6	1.28 x 10-6	1.01 x 10-6
		(3.32 x 10-1)	(1.21 x 10-1)	(7.39 x 10-2)
NTF Site "D"	Maximum Uninvolved Worker (100 m)	1.09 x 10-2	6.78 x 10-3	NA
RCSTS Diversion Box 2 ECSTS Diversion Box (241-ER-151)	Maximum Uninvolved Worker Population	4.07 x 10-4	2.21 x 10-4	NA
	(417 Workers, NNW @ 600 m)	(1.70 x 10-1)	(9.22 x 10-2)	
	Maximum Off-site Individual - Existing Boundary (E @ 17,310 m)	1.72 x 10-5	7.72 x 10-6	5.16 x 10-6
	Maximum Off-site Individual - Potential Boundary (E @ 14,320 m)	2.08 x 10-5	9.39 x 10-6	6.32 x 10-6
	Maximum Off-site Population[c]	3.42 x 10-6	1.28 x 10-6	1.01 x 10-6
		(3.32 x 10-1)	(1.21 x 10-1)	(7.39 x 10-2)
241-A Tank Farm	Maximum Uninvolved Worker[b] (100 m)	1.09 x 10-2	6.78 x 10-3	NA
244-A Lift Station Load/Unload Facility DCRT 244-A	Maximum Uninvolved Worker Population[b]	1.87 x 10-3	1.11 x 10-3	NA
	(161 Workers, SE @ 250 m)	(3.01 x 10-1)	(1.79 x 10-1)	
	Maximum Off-site Individual - Existing Boundary (E @ 15,460 m)	1.93 x 10-5	8.68 x 10-6	5.82 x 10-6
	Maximum Off-site Individual - Potential Boundary (E @ 12,600 m)	2.35 x 10-5	1.07 x 10-5	7.24 x 10-6
	Maximum Off-site Population c	3.42 x 10-6	1.28 x 10-6	1.01 x 10-6
		(3.32 x 10-1)	(1.21 x 10-1)	(7.39 x 10-2)

[a] Population-weighted -/Qs (persons-s/m^3) are given in parentheses.
[b] Structures occupied by uninvolved workers are nearer than 100 m.
[c] The maximum population for 0-2 hr and 0-8 hr releases is 94,203 at 64 to 80 km (40 to 50 mi) west. The maximum population for 8-24 hr releases is 73,156 at 48 to 64 km (30 to 40 mi) southeast. -/Qs are calculated at the midpoint of the distance interval.
NA = Not Applicable
1 m = 3.3 feet.

Table E-6
Distribution of Off-Site Population Within 80 Kilometers (50 Miles) of the Hanford Site

Interval (mi)	0-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50	Total
Midpoint (m)	805	2,414	4,023	5,633	7,242	12,070	24,140	40,234	56,327	72,421	
Direction											
N	0	0	0	0	0	0	434	822	969	2,418	4,643
NNE	0	0	0	0	0	0	268	1,030	5,220	17,567	24,085
NE	0	0	0	0	0	0	393	6,176	2,658	1,145	10,372

ENE	0	0	0	0	0	0	423	1,217	1,652	664	3,956
E	0	0	0	0	0	0	452	1,373	1,416	751	3,992
ESE	0	0	0	0	0	0	289	1,674	270	767	3,000
SE	0	0	0	0	0	0	1,141	35,519	73,156	4,918	114,734
SSE	0	0	0	0	0	0	2,796	8,309	2,394	5,891	19,390
S	0	0	0	0	0	0	2,842	1,622	237	1,144	5,845
SSW	0	0	0	0	0	0	713	11,983	503	738	13,937
SW	0	0	0	0	0	0	1,308	19,589	1,132	637	22,666
WSW	0	0	0	0	0	0	1,956	5,406	16,336	7,525	31,223
W	0	0	0	0	0	0	771	1,295	6,269	94,203	102,538
WNW	0	0	0	0	0	0	641	1,087	1,189	2,375	5,292
NW	0	0	0	0	0	0	548	738	784	809	2,879
NNW	0	0	0	0	0	0	544	909	876	4,979	7,308
Total	0	0	0	0	0	0	15,519	98,749	115,061	146,531	375,860

Source: PNL 1993

E.2 AIRBORNE CONCENTRATIONS AT RECEPTORS UNDER NORMAL CONDITIONS

This section discusses calculations to estimate the concentrations of potentially hazardous materials released under normal conditions. Normal emissions from existing facilities at the Hanford Site are reported annually (WHC 1994a, DOE 1994a) and provide the basis for evaluating the no action alternative. Data on normal emissions specific to the other alternative actions are not available, with the exception of emissions from the NTF. Health effects of emissions from other facilities are evaluated qualitatively in Section 5 by comparison to those from existing emissions. Section E.2.1 characterizes the emission rates of hazardous materials from the NTF. Section E.2.2 identifies the atmospheric dispersion factors applied to these emissions and the resulting concentrations at receptor locations.

E.2.1 EMISSION RATES OF HAZARDOUS MATERIALS

Emission rates of hazardous materials from the NTF are available for a nominal case and an extreme case (DOE 1994b, WHC 1994b). Emissions of radionuclides are shown in Table E-7. Emissions of chemicals are shown in Table E-8. The nominal case is representative of emissions expected from the NTF under the alternatives in this EIS. The extreme case is intended to bound future uses of the NTF. The principal difference between the two cases is the assumed tank heat load. The nominal case assumes two tanks, each with a load of 32,000 watts (110,000 BTU/hr). The extreme case assumed a load of 32,000 watts (110,000 BTU/hr) for one tank and 205,000 watts (700,000 BTU/hr) for the other. A greater variety of organic compounds are assumed to be emitted and at a higher rate under the extreme case.

E.2.2 ATMOSPHERIC DISPERSION FACTORS AND RECEPTOR CONCENTRATIONS

Atmospheric concentrations at receptors of interest were estimated for the NTF. The CAP88-PC program (DOE 1992) was used for radionuclides and the ISCST2 program (EPA-A5D/4-92-008) for hazardous chemicals. The NTF primary ventilation stack would be 46 m (150 ft) tall and 1.8 m (6 ft) in diameter. CAP88-PC was used to estimate average annual concentrations in the 16 compass directions at distances ranging from 100 to 80,000 m (0.06 to 50 mi). Maximum

Table E-7
Radionuclide Emissions from the NTF

Emissions (Ci/yr)

Radionuclide	Nominal Casea	Extreme Caseb
3H	7.13 x 10-1	1.77 x 100
90Sr	7.93 x 10-8	5.96 x 10-7
90Y	7.77 x 10-8	5.83 x 10-7
106Ru	NA	2.48 x 10-6
106Rh	NA	2.46 x 10-6
113Sn	NA	4.45 x 10-6
125Sb	NA	2.21 x 10-5
129I	3.54 x 10-5	7.17 x 10-5
137Cs	2.27 x 10-9	1.51 x 10-8
137mBa	2.18 x 10-9	1.41 x 10-8
239Pu	1.92 x 10-11	3.70 x 10-11

Source: DOE 1994b

aNominal Case assumes two tanks at 32,000 watts (110,000 BTU/hr) and a discharge of 0.5 m3/s (1,000 scfm).
bExtreme Case assumes one tank at 32,000 watts (110,000 BTU/hr), one tank at 205,000 watts (700,000 BTU/hr), and a discharge of 0.5 m3/s (1,000 scfm).
Ci = Curie
NA = Not Applicable. Assumed not to be present.

Table E-8
Chemical Emissions from the NTF

Chemical	Emissions (g/s)	
	Nominal Case a	Extreme Case b
Acetone	2.2 x 10-3	2.3 x 10-3
Benzene	NA	5.7 x 10-6
1-Butanol	1.4 x 10-2	1.4 x 10-2
Carbon Tetrachloride	NA	4.3 x 10-8
2-Hexanone	5.8 x 10-5	1.7 x 10-4
4-Methyl-2-Pentanone	4.1 x 10-3	1.2 x 10-2
Kerosene	1.4 x 10-10	1.7 x 10-2
Tributyl Phosphate	1.4 x 10-10	4.1 x 10-10
Ammonia	3.4 x 10-6	4.9 x 10-6
Ag	2.8 x 10-15	2.8 x 10-15
As	1.8 x 10-13	1.8 x 10-13
Ba	9.1 x 10-16	9.1 x 10-16
Ca	6.1 x 10-15	6.1 x 10-15
Cu	1.4 x 10-15	1.4 x 10-15
Mg	1.2 x 10-15	1.2 x 10-15
Na	3.3 x 10-11	3.3 x 10-11
Pb	4.1 x 10-15	4.1 x 10-15
Sb	5.6 x 10-15	5.6 x 10-15
Se	3.6 x 10-15	3.6 x 10-15
AlO2	1.2 x 10-11	1.2 x 10-11
OH-	5.1 x 10-12	5.1 x 10-12
F-	9.8 x 10-13	9.8 x 10-13
Fe(OH)3	1.7 x 10-12	1.7 x 10-12
Cr(OH)3	4.6 x 10-13	4.6 x 10-13

Source: WHC 1994b

aNominal Case assumes two tanks at 32,000 watts (110,000 BTU/hr) and a discharge of 0.5 m3/s (1,000 scfm).
bExtreme Case assumes one tank a 32,000 watts (100,000 BTU/hr), one tank at 205,000 watts (700,000 BTU/hr), and a discharge of 0.5 m3/s (1,000 scfm).
g/s = grams/second
NA = Not Applicable. Assumed not to be present.

concentrations were found to occur at a distance of 200 m (660 ft) from the stack. A joint frequency distribution based on 5 years of Hanford specific meteorology data at a height of 61 m (200 ft) (PNL 1993) was used in conjunction with the population distribution shown in Table E-6. A flat terrain was assumed. Since the inhalation doses reported in Section 5.4.9.2 are the primary parameters of interest and are reported directly by the code, airborne concentrations are not tabulated here.

ISCST2 was used to calculate 1-hour and 24-hour averaged concentrations at locations of interest using built-in joint frequency distributions considered to represent "worst case" dispersion conditions. ISCST2 was also given terrain elevation information extracted by hand from topographic maps. The program considers the effect of stack-tip downwash and found maximum concentrations of chemicals at 400 m (1,300 ft) for a 24-hour averaging period. Concentrations of individual chemicals are shown in Table E-9.

E.3 AIRBORNE CONCENTRATIONS AT RECEPTORS UNDER ACCIDENT CONDITIONS

Airborne concentrations of hazardous materials under accident conditions were estimated by multiplying the quantity of respirable material released by the concentrations of hazardous materials in the waste as in equation 1.

where:

Cair = concentration of contaminant in air (Ci/m3 for radionuclides, -g/m3 for chemicals)

Cwaste = concentration of contaminant in waste (Ci/L for radionuclides, mg/L for chemicals)

CF = unit conversion factor for chemical (103 -g/mg)

RV = respirable volume released (L)

RD = release duration (s)

-/Q = air dispersion factor (s/m3).

Table E-9
Maximum 24-Hour and Annual Ground Level Concentrations for Emissions from Two DSTs

ASILs				
		24-Hour Concentration (-g/m3)		
Annual Concentration (-g/m3)		WAC 173-460-150		
	Extreme Case,	Distance From		Distance From
Distance From	Distance From			
	2 Tank Emissions	Source, On-site		Source, Off-
site Source, On-site	Source, Off-site		24-Hr ASIL	Annual ASIL
Chemical	(g/s)	400m		10,771m
200m	12,978m	(-g/m3)	(-g/m3)	
Acetone	2.3x10-3	4.1x10-2		3.4x10-3
1.3x10-2	1.0x10-2	5.9x103	NA	
Benzene	5.7x10-6	1.0x10-4		8.3x10-6
3.2x10-5	2.5x10-5	NA	1.2x10-1	
1-Butanol	1.4x10-2	2.5x10-1		2.0x10-2
7.9x10-2	6.2x10-2	5.0x102	NA	
Carbon Tetrachloride	4.3x10-8	7.6x10-7		6.3x10-8
2.4x10-7	1.9x10-7	NA	6.7x10-2	
2-Hexanone	1.7x10-4	3.0x10-3		2.5x10-4
9.7x10-4	7.5x10-4	6.7x101	NA	
4-Methyl-2-Pentanone (MIBK)	1.2x10-2	2.1x10-1		1.8x10-2
6.8x10-2	5.3x10-2	6.8x101	NA	
Normal Paraffin Hydrocarbon	1.7x10-2	3.0x10-1		2.5x10-2
9.7x10-2	7.5x10-2	NA	NA	
(Kerosene)				
Tributyl Phosphate	4.1x10-10	7.2x10-9		6.0x10-10
2.3x10-9	1.8x10-9	7.3	NA	
Ammonia	4.9x10-6	8.7x10-5		7.2x10-6
2.8x10-5	2.2x10-5	1.0x102	NA	
Ag	2.8x10-15	4.9x10-14		4.1x10-15
1.6x10-14	1.2x10-14	3.0x10-2	NA	
As	1.8x10-13	3.2x10-12		2.6x10-13
1.0x10-12	8.0x10-13	2.3x10-2	NA	
Ba	9.1x10-16	1.6x10-14		1.3x10-15
5.2x10-15	4.0x10-15	1.7	NA	
Ca	6.1x10-15	1.1x10-13		8.9x10-15
3.5x10-14	2.7x10-14	1.7x101	NA	
Cu	1.4x10-15	2.5x10-14		2.0x10-15
7.9x10-15	6.2x10-15	3.3	NA	
Mg	1.2x10-15	2.1x10-14		1.8x10-15
6.8x10-15	5.3x10-15	3.3x10-1	NA	
Na	3.3x10-11	5.8x10-10		4.8x10-11
1.9x10-10	1.5x10-10	6.7	NA	
Pb	4.1x10-15	7.2x10-14		6.0x10-15
2.3x10-14	1.8x10-14	5.0x10-1	NA	
Sb	5.6x10-15	9.9x10-14		8.2x10-15
3.2x10-14	2.5x10-14	1.7	NA	
Se	3.6x10-15	6.4x10-14		5.3x10-15
2.0x10-14	1.6x10-14	6.7x10-1	NA	
A1O2	1.2x10-11	2.1x10-10		1.8x10-11

6.8x10-11	5.3x10-11	6.7	NA	
OH-	5.1x10-12	9.0x10-11		7.5x10-12
2.9x10-11	2.3x10-11	NA	NA	
F-	9.8x10-13	1.7x10-11		1.4x10-12
5.6x10-13	4.3x10-12	5.3	NA	
Fe(OH)3	1.7x10-12	3.0x10-11		2.5x10-12
9.6x10-12	7.5x10-12	3.3	NA	
Cr(OH)3	4.6x10-13	8.1x10-12		6.7x10-13
2.6x10-12	2.0x10-12	1.7	NA	

NA = Not applicable

This section describes the hazardous material inventories used and the procedure used to estimate -/Qs used as described in Section E.4 to estimate health effects. Concentrations of radionuclides and toxic chemicals by waste type are described in Section E.3.1. Dispersion factors utilized for determining concentrations at receptor locations are identified in Section E.3.2.

E.3.1 CONCENTRATIONS OF RADIONUCLIDES AND TOXIC CHEMICALS IN WASTE

A total of five types of wastes are considered in this EIS:

- Salt well liquid (SWL)
- West Area Facility Waste (WAFW)
- Tank 101-SY slurry (101-SY)
- Tank 102-SY slurry (102-SY)
- Bounding slurry waste (BSW).

The basis for the radionuclide concentrations assigned to these wastes is discussed in Section E.3.1.1. Information on the concentrations of toxic chemicals in these wastes is discussed in Section E.3.1.2.

E.3.1.1 Radionuclides

- The radionuclide concentrations in SWL, WAFW, 101-SY, 102-SY, and BSW are described as follows:

- Salt well liquid - SWL is drainable liquid collected and pumped from salt wells installed in SSTs. Radionuclide concentrations in SWL vary from tank to tank in the SST tank farms. Savino and Hey (WHC 1994c) have derived radionuclide concentration estimates for various SST and DST wastes. The estimates are based on data obtained for laboratory analyses of samples of tank solids and liquids. Mean concentrations and concentrations corresponding to various "percentiles" are provided. One of these data sets is called "100 percentile of all SST liquids inventory" and consists of the highest concentration of each radionuclide measured in all samples of liquids from SSTs. Radionuclide concentrations are shown in Table E-10. Unit dose factors included in Tables E-10 through E-13 are discussed in Section E.4.1.

Table E-10
Radionuclide Concentrations in SWL

Radionuclide	Concentration (Ci/L)	Unit Inhalation CEDEa (rem/L)
14C	9.7 x 10-7	1.9 x 10-3
60Co	1.1 x 10-4	2.2 x 10+1
90Sr	2.0 x 10-2	3.9 x 10+3
90Y	2.0 x 10-2	1.7 x 10+2
99Tc	1.1 x 10-4	9.4 x 10-1
106Ru	2.7 x 10-8	1.2 x 10-2
125Sb	1.4 x 10-6	1.7 x 10-2
129I	1.1 x 10-7	1.7 x 10-2
134Cs	3.0 x 10-6	1.2 x 10-1
137Cs	2.0 x 10-1	5.4 x 10+3
144Ce	1.1 x 10-9	4.1 x 10-4
154Eu	4.6 x 10-2	1.2 x 10+4
155Eu	2.0 x 10-3	7.7 x 10+1
238Pu	7.8 x 10-5	2.2 x 10+4
239Pu	1.8 x 10-4	5.2 x 10+4
241Pu	1.4 x 10-3	6.9 x 10+3
241Am	1.5 x 10-4	6.6 x 10+4
	2.9 x 10-1	1.7 x 10+5

Source: (WHC 1994c)

aCommitted Effective Dose Equivalent

Table E-11
Radionuclide Concentrations in 102-SY Slurry and West Area Facility Waste

Radionuclide	Concentration (Ci/L)	Unit Inhalation CEDE (rem/L)
3H	2.3 x 10-7	2.0 x 10-5
14C	5.6 x 10-7	1.1 x 10-3
60Co	6.6 x 10-5	1.3 x 101
79Se	4.6 x 10-6	4.3 x 10-2
90Sr	2.8 x 10-2	5.5 x 103
90Y	2.8 x 10-2	2.4 x 102
94Nb	2.9 x 10-7	1.1 x 10-1
99Tc	1.3 x 10-5	1.1 x 10-1
137Cs	3.3 x 10-2	9.7 x 102
144Ce	9.8 x 10-4	3.5 x 102
154Eu	5.2 x 10-4	1.4 x 102
155Eu	5.7 x 10-4	2.2 x 101
237Np	5.4 x 10-7	3.3 x 102
238Pu	2.4 x 10-4	6.6 x 104
239Pu	2.1 x 10-3	6.1 x 105
241Am	1.6 x 10-2	6.6 x 106
244Cm	2.0 x 10-5	4.7 x 103
	1.1 x 10-1	7.3 x 106

Table E-12
Radionuclide Concentrations in Tank 101-SY Slurry

Radionuclide	Concentration (Ci/L)	Unit Inhalation CEDE (rem/L)
14C	1.7 x 10-6	3.3 x 10-3
59Ni	1.3 x 10-7	1.1 x 10-4
63Ni	3.6 x 10-5	7.8 x 10-2
79Se	3.8 x 10-7	3.5 x 10-3
90Sr	2.3 x 10-2	4.5 x 10+3
93mNb	6.8 x 10-6	2.0 x 10-1
99Tc	2.0 x 10-4	1.6 x 10+0
137Cs	5.7 x 10-1	1.7 x 10+4
237Np	4.5 x 10-8	2.8 x 10+1
239Pu	1.1 x 10-5	3.3 x 10+3
241Am	1.7 x 10-4	7.1 x 10+4
242Cm	4.7 x 10-7	7.6 x 10+0
244Cm	1.0 x 10-5	2.4 x 10+3
	5.9 x 10-1	9.8 x 10+4

Source: WHC 1993a

Table E-13
Radionuclide Concentrations in Bounding Slurry Waste

Radionuclide	Concentration (Ci/L)	Unit Inhalation CEDE (rem/L)
14C	5.6 x 10-6	1.1 x 10-2
60Co	5.6 x 10-3	1.1 x 10+3
79Se	1.5 x 10-7	1.4 x 10-3
90Sr	2.7 x 10+1	5.3 x 10+6
90Y	2.7 x 10+1	2.3 x 10+5
99Tc	1.1 x 10-1	9.4 x 10+2
106Ru	2.2 x 10-6	9.8 x 10-1
125Sb	2.5 x 10-3	3.0 x 10+1
129I	5.8 x 10-5	8.5 x 10+0
134Cs	3.5 x 10-4	1.4 x 10+1
137Cs	3.2 x 10+0	9.3 x 10+4
144Ce	1.5 x 10-8	5.6 x 10-3
147Pm	1.0 x 10-3	3.8 x 10+1
154Eu	1.8 x 10-1	4.6 x 10+4
155Eu	1.4 x 10-3	5.6 x 10+1
237Np	2.9 x 10-4	1.8 x 10+5

238Pu	1.7 x 10-3	4.6 x 10+5
239Pu	1.5 x 10-2	4.6 x 10+6
241Pu	4.2 x 10-2	2.0 x 10+5
241Am	1.0 x 10-1	4.3 x 10+7
242Cm	3.0 x 10-8	4.8 x 10-1
244Cm	5.9 x 10-4	1.4 x 10+5
	5.8 x 10+1	5.4 x 10+7

Source: WHC 1994c

This set of concentrations is hypothetical. No single SST contains liquid where the concentration of each radionuclide is as high as shown in Table E-10. To the extent that the samples are representative of SST liquids, this set of data provides a conservative bound on radionuclide concentrations that would be expected to be encountered in SWL.

. West Area Facility Waste - WAFW consists of routine wastes from the T-Plant, S-Plant, and the PFP laboratories. Wastes from T-Plant account for most of the volume and wastes from the PFP laboratories account for the majority of the radioactivity in these wastes. Waste from the PFP laboratories contains approximately 5 to 10 percent solids by weight and is considered to be TRU waste although average TRU concentrations are slightly below the threshold of 100 nCi/g of TRU. All of these wastes are currently transferred to Tank 102-SY for storage. Since TRU nuclides, particularly 241Am, control inhalation dose from most solids-bearing tank wastes (see Section E.4), WAFW is assigned the same radionuclide concentrations as 102-SY slurry. These concentrations are shown in Table E-11.

. Tank 101-SY Slurry - Under the new storage alternative, the entire contents of Tank 101-SY would be mixed, retrieved with in-line dilution, and stored in new tanks. The radionuclide concentrations shown in Table E-12 are based on "Window E" core samples from Tank 101-SY and are volume-weighted to reflect the contributions of the convective and non-convective layers in the tank. These concentrations do not reflect dilution.

. Tank 102-SY Slurry - Several alternative actions include retrieval of the sludge in Tank 102-SY. The sludge would be mixed with at least twice its volume of diluent (2:1 dilution) and retrieved with either of two systems. For this EIS, the entire volume of supernatant now in the tank would be used as diluent. This would provide a 3.6:1 dilution. The resultant radionuclide concentrations are shown in Table E-11 and are based on concentration data from Tank Characterization Report for Double-Shell Tank 241-SY-102 (WHC 1995a).

. Bounding Slurry Waste - BSW is a hypothetical waste used to estimate the maximum impacts that could occur during possible future uses of the facilities and systems considered in this EIS. BSW is a composite consisting of one-third by volume of the "100 percentile of all solids inventory" and two-thirds "100 percentile of all liquids inventory" developed by Savino and Hey. Each "100 percentile inventory" consists of the highest concentration of each radionuclide measured in any tank solid and any tank liquid. Most of the radionuclides are in tank solids and 33 percent by volume is a very high solids content relative to the capabilities of current and planned transfer pumps and pipelines. Accordingly, to the extent that the samples in the database used by Savino and Hey are representative of tank solids and liquids, the radionuclide concentrations shown in Table E-13 provide a conservative bound on radionuclide concentrations that would be expected to be encountered in the systems considered in this EIS (WHC 1994c).

E.3.1.2 Toxic Chemicals

- The chemical characteristics of tank wastes is less well-known than the radiological characteristics. Although a program to determine the chemical characteristics of tank wastes is being vigorously pursued, much of the information being generated is intended to support the design of a waste treatment system. As an example of the analytes and ranges of concentrations of chemicals that have been seen, chemical concentrations in SWL and BSW, based on information currently available, are shown in Table E-14.

Although characterization reports have been issued for about 20 tanks, including Tanks 101-SY and 102-SY, much of the available information is based on historical records such as invoices for orders of chemicals and process information rather than on analysis of samples. In keeping with the quantity and quality of data currently available, a qualitative approach has been taken in most cases to estimating airborne concentrations of chemicals and their corresponding health effects. This approach is discussed in Section E.4.2.

E.3.2 AIRBORNE DISPERSION FACTORS AND CONCENTRATIONS AT RECEPTORS

This section describes calculation of -/Qs necessary to evaluate health effects. The PAVAN computer code (NUREG 1991) developed by the NRC to evaluate airborne releases during nuclear power reactor accidents was used to estimate -/Qs for the short-duration releases (0 to 24 hours) from accidents associated with the alternatives considered in this EIS.

Table E-14
Concentrations of Toxic Chemicals in Tank Wastes

Chemical	Concentration (g/L)	
	SWL	BSW
Ammonia	1.1	6.9
Sb	0.037	0.61
As	0.003	1.9
Ba	0.053	13
Be	0.0003	0.048
Cd	0.05	8.7
Ca	1.1	33
Ce	1.75	2.0
Cr+3	16	34
Co	0.0013	0.22
Cyanide	5.3	8.9
Dy	NA	0.03
La	0.19	12
Hg	0.084	6.8
Nd	0.14	2.4
Oxalate	NA	92
Se	0.080	1.2
NaOH	180	211
Na	250	323
Te	NA	0.31
Tl	0.25	4.5
Total Organic Carbon (TOC)	40	52
U	1.4	96
V	0.0041	0.05

Source: WHC 1995b

NA = Not Available

PAVAN uses the Guassian plume model to calculate -/Qs from a user-supplied joint frequency distribution. -/Qs are calculated for averaging times of 0 to 2 hours, 0 to 8 hours, 8 to 24 hours and 1 to 4 days. Average annual -/Qs are also calculated. PAVAN uses three different techniques to estimate -/Qs over these averaging times. The direction-dependent logarithmic interpolation method described in Regulatory Guide 1.145 (NRC 1982) provides -/Qs in each direction that would not be exceeded more than 0.5 percent of the total time. -/Qs calculated with this method were found to be highest (most conservative) and were used for assessment of accident health effects.

The joint frequency distribution (PNL 1993) input to PAVAN to calculate -/Qs for accidents is the same as that input to CAP88-PC to assess health effects for normal conditions. Table E-4 shows -/Qs for accidental releases from the 200 West Area and Table E-5 shows -/Qs for releases from the 200 East Area. The tables include information on receptor distance and direction, and include population-weighted -/Qs. The averaging times of 0 to 2 hour, 0 to 8 hour, and 8 to 24 hour correspond to durations of exposures of workers and the general public as discussed in Appendix F.

E.4 DOSE AND HEALTH EFFECTS

Consequences to the workers and the offsite public from radionuclides and toxic chemicals are measured as dose and health effects. Section E.4.1

characterizes the methodology applied to assessing radiological health effects and Section E.4.2 describes the methodology applied to assessing toxic chemical health effects.

E.4.1 RADIOLOGICAL HEALTH EFFECTS

The health effects of exposure to radiation can take many forms. Effects from acute radiation exposures range from nausea and fatigue to hemorrhage and death. Acute exposures can also cause temporary or permanent sterility. Approximately half of the people receiving an acute whole body dose of 100 to 200 rads would be expected to experience the milder acute effects and approximately half of the people receiving an acute whole body dose of 500 rads would be expected to die within 60 days. The rad is a unit of radiation absorbed dose and is equivalent to 100 ergs/g of exposed material. Health effects of chronic exposures to low levels of radiation are expressed over longer periods of time. These effects can include fatal and non-fatal cancer, and heritable autosomal and chromosomal damage and congenital abnormalities. Chronic effects are usually expressed in terms of rem. A rem is a unit of effective dose and is defined as the product of an absorbed dose in rads and a quality factor specific to the type of radiation involved.

In this EIS, "dose" means CEDE. A committed dose equivalent is the dose equivalent (rem) that will be received by an organ or tissue over a 50-year period following the intake. The CEDE is the weighted sum of the committed dose equivalents to each organ and tissue. The intake considered in this document is inhalation.

Risk coefficients or factors for chronic exposures to low levels of radiation are derived from data for exposures of large groups of individuals to large doses over a relatively short time. DOE recommends that health effects of radiation exposures be evaluated in terms of LCFs using risk factors of 4 x 10-4 LCF/person-rem for workers and 5 x 10-4 LCF/person-rem for the general population. These factors reflect the different sensitivities to radiation based on sex and age and are taken from the Preamble to 10 CFR Part 20 (56 FR 22363).

The most appropriate application of these risk factors is to large groups of people receiving low chronic doses of radiation over long periods of time. Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements (DOE 1993) includes examples where these factors are applied to individuals to estimate ICR. ICR is the increase in the probability that an individual will develop fatal cancer. This practice is not universally accepted but is used in this EIS.

To apply these risk factors, dose must first be estimated. This was accomplished using the GENII computer program (PNL 1988a, PNL 1988b, PNL 1988c) to calculate unit dose factors (rem/L). These factors give the dose in rem that corresponds to inhalation of the radioactive material contained in 1 L (0.26 gal) of tank waste. Unit dose factors based on the PNL default radionuclide solubilities provided with GENII are shown in Tables E-10 through E-13.

Dose (CEDE) from a given accidental release is calculated as:

where:

RVol = volume of respirable tank waste released during exposure period (L)

BR = breathing rate (m3/sec)

-/Q = atmospheric dispersion factor (s/m3)

U = unit dose factor (rem/L).

Respirable volumes released during accidents are discussed in Appendix F. A breathing rate of 3.33 x 10-4 m3/sec was used for all receptors except the maximally exposed involved worker for which a value of 7.2 x 10-4 m3/sec was used.

E.4.2 TOXIC CHEMICAL HEALTH EFFECTS

Exposure to toxic chemicals can induce development of systemic toxic effects and cancers.

The Hanford Site has developed risk acceptance guidelines for toxic chemicals based on permissible exposure limits-time weighted average (PEL-TWA) and ERPG.

These guidelines are intended for the evaluation of accidents. Comparative evaluations performed during development of these guidelines led to the conclusion that, based on radiological and chemical risk acceptance guidelines, chemical releases may be more limiting than radiological releases of tank wastes only when release durations are shorter than 2 minutes 40 seconds. Since the shortest release duration of the accidents considered in this EIS is 30 minutes, effects of toxic chemicals have not been evaluated for most accidents. The exception is a "flash" release of toxic gases during drawdown of a tank.

A methodology for estimating systemic and carcinogenic effects from exposure data is described in Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part A) (EPA 1989). The remainder of this section describes the methodology and applies it to normal emissions from the NTF.

Systemic toxic effects are evaluated in terms of a Hazard Quotient (HQ). The HQ for a chemical is the ratio of the exposure level (E) or intake of the chemical to the Reference Dose (RfD) for the chemical:

If the HQ exceeds 1.0, there may be concern for potential health effects.

The EPA methodology considers three exposure durations, each with its own RfD:

- Chronic exposures (7 year to lifetime exposures)
- Subchronic exposures (2 week to 7 year exposures)
- Acute (less than 2 week exposures).

When dealing with exposures from multiple chemicals, HQs may be summed for each exposure duration for screening purposes. This is expected to overestimate the potential for health effects due to differences in the nature and significance of effects induced by exposures to different chemicals.

Carcinogenic effects are evaluated in terms of the incremental risk of developing cancer (fatal and nonfatal) as the result of chronic exposure to a chemical. At lower risk levels (ICR . 0.01, equation 4), the ICR is based on the product of a chronic daily intake averaged over 70 years and a slope factor (SF). At higher risk levels, risk is an exponential function of this product. SFs are usually the upper 95th percentile confidence interval of the dose response curve for the chemical.

where CDI = chronic daily intake.

ICR is considered to be additive for exposure to multiple chemicals.

Chronic daily intake (CDI) of airborne contaminants in the HQ and ICR equations is calculated as:

where:

CDI = chronic daily intake of the contaminant (mg/kg-d)
C = contaminant concentration in air (mg/m3)
IR = daily intake rate (m3/d)
EF = exposure frequency (d/yr)
ED = exposure duration (yr)
BW = body weight (kg)
AT = averaging time (d).

As indicated in Table E-15, different parameter values are used for chronic exposures to carcinogenic and non-carcinogenic contaminants.

Table E-15
Intake Parameters and Values

Parameter	Non-carcinogenic	Carcinogenic
IR - Daily Intake Rate (m3/d)	10	20
EF - Exposure Frequency (d/yr)	365	365
ED - Exposure Duration (yr)	6	30
Conversion Factor (mg/-g)	0.001	0.001
BW - Body Weight (kg)	16	70
AT - Averaging Time (d)	2,190	25,550

Source: EPA 1989

Data on RfDs and SFs are available from a number of sources. The Integrated Risk Information System (IRIS) (EPA 1994) is the source of toxicity information preferred by EPA for Superfund risk assessments. Data from the IRIS for chronic exposures to chemicals released from the NTF is shown in Table E-16.

Table E-16
Toxicological Health Effects from NTF Emissions

Chemical	Concentration (-g/m3)	Intake (mg/kg-d) Noncarcinogenic	Intake (mg/kg-d) Carcinogenic	RfD (mg/kg-d)	SF (mg/kg-d)-1	HQ	ICR
Acetone	1.00 x 10-02	6.25 x 10-6	1.22 x 10-6	NA	NA	NA	NA
Benzene	2.50 x 10-05	1.56 x 10-8	3.06 x 10-9	NA	2.90 x 10-02	NA	8.88 x 10-11
1-Butanol	6.20 x 10-02	3.88 x 10-5	7.59 x 10-6	NA	NA	NA	NA
Carbon Tetrachloride	1.90 x 10-07	1.19 x 10-10	2.33 x 10-11	NA	5.25 x 10-02	NA	1.22 x 10-12
2-Hexanone	7.50 x 10-04	4.69 x 10-7	9.18 x 10-8	NA	NA	NA	NA
4-Methyl-2-Pentanone	5.30 x 10-02	3.31 x 10-5	6.49 x 10-6	2.24 x 10-02	NA	1.48 x 10-03	NA
Kerosene	7.50 x 10-02	4.69 x 10-5	9.18 x 10-6	NA	NA	NA	NA
Tributyl Phosphate	1.80 x 10-09	1.13 x 10-12	2.20 x 10-13	NA	NA	NA	NA
Ammonia	2.20 x 10-05	1.38 x 10-8	2.69 x 10-9	2.86 x 10-02	NA	4.81 x 10-07	NA
Ag	1.20 x 10-14	7.50 x 10-18	1.47 x 10-18	NA	NA	NA	NA
As	8.00 x 10-13	5.00 x 10-16	9.80 x 10-17	NA	5.00 x 10+01	NA	NA
Ba	4.00 x 10-15	2.50 x 10-18	4.90 x 10-19	1.43 x 10-04	NA	1.75 x 10-14	NA
Ca	2.70 x 10-14	1.69 x 10-17	3.31 x 10-18	NA	NA	NA	NA
Cu	6.20 x 10-15	3.88 x 10-18	7.59 x 10-19	NA	NA	NA	NA
Mg	5.30 x 10-15	3.31 x 10-18	6.49 x 10-19	NA	NA	NA	NA
Na	1.50 x 10-10	9.38 x 10-14	1.84 x 10-14	NA	NA	NA	NA
Pb	1.80 x 10-14	1.13 x 10-17	2.20 x 10-18	NA	NA	NA	NA
Sb	2.50 x 10-14	1.56 x 10-17	3.06 x 10-18	NA	NA	NA	NA
Se	1.60 x 10-14	1.00 x 10-17	1.96 x 10-18	NA	NA	NA	NA
AlO2	5.30 x 10-11	3.31 x 10-14	6.49 x 10-15	NA	NA	NA	NA
OH-	2.30 x 10-11	1.44 x 10-14	2.82 x 10-15	NA	NA	NA	NA
F-	4.30 x 10-13	2.69 x 10-16	5.27 x 10-17	NA	NA	NA	NA
Fe(OH)3	7.50 x 10-12	4.69 x 10-15	9.18 x 10-16	NA	NA	NA	NA
Cr(OH)3	2.00 x 10-12	1.25 x 10-15	2.45 x 10-16	NA	NA	NA	NA
Total						1.48 x 10-03	9.00 x 10-11

NA = not applicable

Specific information on continuous emissions of chemicals from facilities considered in this EIS are available only for the NTF. Although this EIS considers interim actions over a 5-year period, it is reasonable to assume that these emissions could continue beyond that period. Accordingly, NTF emissions are treated as chronic emissions based on the EPA guidance (EPA 1989). Table E-16 shows HQ and ICR values for the maximum off-site individual at the existing boundary calculated for NTF "extreme case" emissions (see Section E.2). As indicated by the low values of HQ and ICR, no non-carcinogenic systemic toxic and no carcinogenic health effects would be expected from these emissions.

APPENDIX E REFERENCES

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APPENDIX F ACCIDENTS CONSIDERED DURING INTERIM ACTIVITIES

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APPENDIX F ACCIDENTS CONSIDERED DURING INTERIM ACTIVITIES

This appendix discusses potential accidents which could occur during implementation of the proposed alternatives. The discussion includes estimates of the frequency of occurrence of the accident scenarios and the quantity of hazardous materials released during each accident. Design features and institutional and organizational controls which can prevent or mitigate potential accidents are also discussed. This appendix is organized by the systems which would be utilized by one or more alternatives identified in Section 3.

Accidents can be initiated by operational events, natural phenomena, and external events and may be categorized according to their frequency of occurrence, as shown in Table F-1.

Table F-1
Accident Frequency Categories

Accident Description	Annual Frequency (yr-1)	Category
Anticipated - May occur more than once during the lifetime of the facility	1	
		Reasonably Foreseeable
	10-1	
	10-2	
Unlikely - May occur at some time during the lifetime of the facility	10-3	
	10-4	
Extremely Unlikely - Probably will not occur during the lifetime of the facility	10-5	
	10-6	
Incredible - Not credible during the lifetime of the facility	10-7	
	< 10-7	Not Reasonably Foreseeable

It is important to distinguish between the frequency of the event that initiates the sequence of events and the frequency of the accidental release of hazardous materials expected to result from the sequence of events. Equipment or component failures or human errors are common initiators of accidents and often have frequencies in the anticipated and unlikely ranges. Natural phenomena can also initiate accident sequences. The frequencies of occurrence of natural events such as earthquakes exceeding Uniform Building Code levels, 100-year floods, and maximum wind gusts are usually within the unlikely range. Natural phenomena such as severe earthquakes, tornados, and lightning strikes are usually in the extremely unlikely range. The frequency of the accidental release of hazardous materials is the product of the frequency of each event in the sequence leading to the event.

DOE orders establish a design process for nuclear facilities that ensures that there is an inverse relationship between the frequency of occurrence of an accident and its consequences. DOE Order 5480.23, Nuclear Safety Analysis Reports, defines hazard categories and Section 1300-3 of DOE Order 6430.1A, General Design Criteria, establishes a safety classification system for structures, systems, and components. Risk acceptance guidelines used in the design process at Hanford are defined in WHC-CM-4-46, Nonreactor Facility Safety Analysis Manual (WHC 1988). The purpose of the risk acceptance guidelines is to determine whether additional mitigative features need to be incorporated into the design of a structure, system, or component and not to define any particular level of risk as acceptable.

The principal actions to be accomplished during the interim period, 1995 through 2000, assessed by this EIS are:

- Continued removal of SWL from SSTs
- Provision of a capability for cross-site transfer of waste from the 200 West Area to the 200 East Area via a system that complies with applicable rules and regulations
- Provision of adequate tank waste storage capacity for wastes associated with tank farm operations and other Hanford facility operations during the interim period
- Mitigation of flammable gas buildup in Watchlist Tank 101-SY.

Actions considered to continue mitigation of flammable gas buildup in Tank 101-SY are active mitigation using mixer pumps and passive mitigation by retrieval and dilution of tank contents. Accidents associated with the mixer pumps and with facilities to retrieve, dilute, and store the contents of Tank 101-SY are discussed in Section F.1.

SST interim stabilization is accomplished by removing drainable liquids from SST salt wells using submersible pumps or jet pumps. The liquids removed are collected in DCRTs and transferred to designated DSTs. The shielding piping used during these operations is old and some is above ground. Accidents associated with salt well pumping are discussed in Section F.2.

Eventually, the liquids removed from the SST salt wells and Tank 101-SY could be processed through Evaporator 242-A in the 200 East Area to reduce the waste volume. The SY Tank Farm and several million gallons of SWL are in the 200 West Area. Both below-ground and above-ground alternatives are considered for the cross-site transfer of these wastes. Accidents associated with underground transfers are discussed in Section F.3 and those associated with above-ground transfers are discussed in Section F.4.

The primary pathway for exposure of workers and the general public as the result of accidents associated with the actions considered here is inhalation of tank waste released as aerosols and vapors during potential accidents. To support the evaluation of health effects using the methods discussed in Appendix E, discussion of each accident includes an estimate of the "respirable volume" at the point of release. Hanford safety assessment documents generally assume that material released as vapors and as droplets with diameters of 50 -m (0.002 in) or less are respirable. Droplets with diameters of greater than 50 -m (0.002 in) are assumed to condense and settle and those smaller than 50 -m (0.002 in) are assumed to remain airborne and evaporate to a respirable size. Calculation of airborne concentrations of hazardous materials at downwind locations occupied by workers and members of the general public is discussed in Appendix E.

F.1 RETRIEVAL AND STORAGE

Prior to the initiation of full-scale retrieval of tank wastes under the TWRS program, it may be necessary to retrieve and store wastes now stored in Tanks 101-SY and 102-SY.

Tank 101-SY is currently designated as a hydrogen Watchlist tank as the result of GREs that have occurred in the past. In the absence of mitigative measures, concentrations of flammable gases such as hydrogen and NOx increase in the tank vapor space during GREs. If concentrations approach the LFL for the gas mixture, combustion could occur and lead to the release of hazardous materials. Flammable gas buildup is considered to be mitigated by actions which limit the concentration of flammable gases in the tank vapor space to no more the 25 percent of the LFL. The LFL is defined as 3 percent hydrogen by volume in a NOx atmosphere (PNL 1994a).

Section F.1.1 discusses an active approach to mitigating the buildup of flammable gases. The active approach relies on a mixer pump to keep the waste mixed so that stratification cannot occur. Although flammable gases are still generated in the waste, they are released gradually thereby preventing the short-duration increases in gas concentrations in the tank vapor space associated with GREs. A passive approach to mitigation is to dilute the waste to dissolve the components of the sludge layer that trap gases. This can be accomplished by retrieving, diluting, and storing the waste. Accidents associated with the tank retrieval using the ITRS are discussed in Sections F.1.2 and those associated with storage are discussed in Section F.1.3. Accidents associated with PPSS, an ITRS alternative, are discussed in Section F.1.4. If storage tanks for the diluted waste are located in the 200 East Area, cross-site transfer will be necessary. Accidents associated with such transfer are discussed separately in Section F.3.1.

The waste currently stored in Tank 102-SY presents a different problem. This tank is the only non-Watchlist tank in the SY Tank Farm and is used for storage of SWL and facility wastes generated in the 200 West Area. It is also used as the staging tank for cross-site transfers. Tank 102-SY currently contains 269,000 L (71,000 gal) of sludge that is classified as TRU waste. Some of the SWL contains complexing agents that could dissolve this sludge if added to Tank 102-SY. Dissolution of the sludge could result in an increase in the volume of TRU waste. This could be avoided by retrieving the sludge prior to the introduction of complexed SWL. Retrieval options considered are the ITRS and PPSS. Accidents associated with retrieval using the ITRS are discussed in Section F.1.2 and those associated with retrieval using the PPSS are discussed in Section F.1.4.

F.1.1 MITIGATION MIXER PUMPS

Accidents involving operation of the mitigation mixer pump installed in Tank 101-SY were evaluated in Environmental Assessment for Proposed Mixing Operations to Mitigate Episodic Gas Releases in Tank 241-SY-101, (DOE 1992a) and found not to result in any significant impact. The evaluation included removal of the existing slurry distributor, and installation, operation, and removal of the mitigation jet mixer pump. The pump was assumed to be operated for four hours per day, seven days per week.

A spare 150-hp mixer pump from the Hanford Grout Program was modified and installed in Tank 101-SY on July 3, 1993. The ability of this pump to mitigate flammable gas buildup has been demonstrated on Tank 101-SY during approximately 1 year of testing (PNL 1994b, KEHC 1993). Based on these tests, it was concluded (PNL 1994a) that the jet mixer pump is capable of maintaining mitigation indefinitely and a long-term pump operations plan was developed for Tank 101-SY. The plan calls for operation of the pump from 5 minutes to 180 minutes per day 3 days per week. Since this is well within the operating conditions evaluated in the EA, no additional accident analysis has been performed.

F.1.2 INITIAL TANK RETRIEVAL SYSTEM

The ITRS is designed to retrieve both solids and liquids from selected DSTs. The selected DSTs include hydrogen Watchlist tanks, proposed process feed tanks, and tanks selected for retrieval to provide additional liquid waste storage space. The selected tanks include Tank 101-SY but not Tank 102-SY. The Safety Assessment, Initial Tank Retrieval Systems. Project W-211 (WHC 1995a) considers a range of accidents that could occur during ITRS retrieval of these tanks. The hazards identified in this SA are considered to be generally applicable to retrieval of DSTs, including Tank 102-SY.

The SA included quantitative estimates of the following five accident scenarios involving both radioactive materials and toxic chemicals:

- Unfiltered riser release
- Waste spill from contaminated pump
- Transfer pipe break
- Pressurized spray release
- Toxic gas release.

The SA also evaluated a release of toxic gases from the tank ventilation system during tank drawdown.

Accident frequencies and quantities of respirable radioactive materials released and release rates of "flash" gases derived from the safety assessment (WHC 1995a) are summarized in Table F-2 and discussed in the following sections.

F.1.2.1 Unfiltered Riser Release

- This accident scenario is identical to that described in A Safety Assessment for Proposed Pump Mixing Operations to Mitigate Episodic Gas Release in Tank 241-SY-101, Rev. 8 (LANL 1994). It is assumed that the primary tank ventilation system fails while a riser is open for installation of a pump. In this scenario, natural convection flow patterns are established due to the heating of the dome gas from the hotter waste surface. Based on the prior safety assessment, 327 g (0.72 lb) of suspended waste is convected to the environment in 1 hour at ground level (DOE 1992b). Based on a density of 1.4 g/ml (11.7 lb/gal) (WHC 1993a), this is equivalent to a release of 0.023 L (0.006 gal) of respirable material. The release is categorized as extremely unlikely (WHC 1995a).

There are several mitigating factors that would be expected to reduce the duration and consequences of an unfiltered release from a riser. These factors include use of temporary enclosures, use of protective equipment by workers, monitoring of direct radiation and airborne radioactivity by HP Technicians, and use of work procedures specific to the task.

Table F-2
Summary of ITRS Accident Releases

Accident Scenario	Frequency (yr-1)	Exposure Duration (hr)		Respirable Volume (L)
Unfiltered Riser Release	Extremely Unlikely	On-site	1	0.023
		Off-site	1	0.023
Spill from Contaminated Pump	Unlikely	On-site	1	0.00262
			7	0.00165
				0.00427
		Off-site	1	0.00262
			2	0.00542
			3	0.00804
Unmitigated Pipe Break (Seismic)	Incredible	On-site	1	1.0203
			7	0.6428
				1.66
		Off-site	1	1.0203
			7	0.6428
				1.66
Mitigated Pipe Break (Seismic)	Unlikely	On-site	1	0.2559
			7	0.1612
				0.417
		Off-site	1	0.2559
			7	0.1612
				0.417
Unmitigated Pipe Break (Excavation)	Incredible	On-site	1	0.384
			7	0.242
				0.625
		Off-site	1	0.384
			7	0.242
				0.625
Mitigated Pipe Break (Excavation)	Unlikely	On-site	1	0.0122
			7	0.0077
				0.0198
		Off-site	1	0.0122
			7	0.0077
				0.0198
Unmitigated Spray Release	Extremely Unlikely to Incredible	On-site	8	4,550
		Off-site	8	4,550
Mitigated Spray Release	Anticipated to Unlikely	On-site	8	0.00033
		Off-site	8	0.00033
Toxic Gas Release	Anticipated	Not Applicable		0.236 m3/s or

84.7 mg/s

F.1.2.2 Waste Spill From Contaminated Pump

- This accident scenario is similar to that described in A Safety Assessment for Proposed Pump Mixing

Operations to Mitigate Episodic Gas Release in Tank 241-SY-101, Rev. 8 (LANL 1994). The accident scenario assumes that the pump installation is unsuccessful and that the pump is removed from the tank after it becomes contaminated with waste material. Following removal of the pump, waste trapped in the pump inlet is spilled on the ground surface. The accident scenario does not take credit for the fact that the pump assembly will be drained and bagged in plastic as it is removed from the riser. An SA for a similar event estimated that 654 L (173 gal), assuming a density of 1.4 g/ml (11.6 lbs/gal) of waste would be spilled and that 0.18 kg (0.4 lbs) would be expected to become airborne (LANL 1994).

For consistency with treatment of spills in more recent SAs, the quantity of airborne respirable material is calculated using ARRs from Mishima (DOE 1993) and exposure times adjusted. The spill of 654 L (173 gal) of waste is assumed to form a pool on the surface for one hour and then soak into the ground causing the soil to remain saturated with waste for 23 hours. While waste is pooled on the surface, respirable material is released at a rate of 4.0 x 10-6 of the pool volume per hour (DOE 1993). Respirable material is released from the saturated ground at a rate of 3.6 x 10-7 of the liquid volume per hour (DOE 1993). Workers are assumed to be exposed for 8 hours and the general public for 24 hours. The resultant volumes of respirable material are shown in Table F-2.

Mitigating factors that would reduce the consequences of a spill from a contaminated pump include high pressure flush rings for rinsing and bagging the pump as it is removed from the riser, use of protective equipment such as respirators, and quickly covering the spill area to prevent subsequent airborne release.

F.1.2.3 Transfer Pipe Break

- Transfer pipe breaks could be caused by excavation accidents or BDBE. The ITRS safety assessment developed different accident scenarios for each initiating event (WHC 1995a). Each of these two accidents are described in the following paragraphs.

. Excavation Accident - This accident scenario assumes that excavation equipment causes a breach of the primary transfer pipe and its secondary containment in the interval between leak testing and initiation of pumping. Pumping then begins at the rate of 530 L/min (140 gpm) and causes a pool of waste to form on the ground surface. Pumping would continue until the leak is detected. Once pumping is stopped, waste in the ruptured line is assumed drain back into the pool 390 L (103 gal). The ITRS safety assessment assumed that pumping would be terminated after 3 hours and that 390 L (103 gal) would drain back.

The unmitigated case assumes (WHC 1995a) that the leak is detected by the first material balance performed after pumping begins. Considering the time to fill the transfer line, this corresponds to a 4-hour leak. The mitigated case assumes that the leak detection system shuts down the pump within 5 minutes. Both cases assume a 0.5:1 dilution (diluent:waste) of the waste spilled and that the spilled waste is available for resuspension for 8 hours. For consistency with pipe break scenarios for similar systems, this EIS assumes an 8-hour leak for the unmitigated case and a 2-hour leak for the mitigated case. Since dilution is performed in-line, the transfer line would initially contain undiluted waste. With these assumptions, the unmitigated leak volume would be 255,000 L (67,300 gal) and the mitigated leak volume would be 64,000 L (16,900 gal).

The quantity of respirable material released in 8 hours is estimated by assuming (WHC 1995a) that the pool remains on the surface for 1 hour and then saturates the ground for the remaining 7 hours. An airborne release rate of 4.0 x 10-6/hr is assumed for the pool and of 3.6 x 10-7/hr for the saturated soil. The quantities of respirable material released during each phase are shown in Table F-2.

The ITRS SA (WHC 1995a) classifies both the unmitigated and mitigated excavation accidents as incredible based on the analysis used to estimate the frequency of RCSTS excavation accidents (WHC 1995b) but assumes somewhat different event trees. For this EIS, the unmitigated accident is assumed to be incredible and the mitigated accident to be unlikely.

. Seismic Accident - The seismic transfer pipe break accident is initiated by a beyond design basis accident and causes rupture of the primary transfer pipe and its encasement. The ITRS SA (WHC 1995a) assumes that the unmitigated leak continues for 8 hours at 530 L/s (140 gal/s). This is considered to be an incredible event. The quantity of respirable material released is estimated by assuming that the pool remains on the surface for 1 hour and then saturates the ground for the remaining 7 hours. An airborne release rate of 4.0 x 10-6/hr is assumed for the pool and of 3.6 x 10-7/hr for the saturated soil. The quantities of respirable material released during each phase, assuming undiluted waste is spilled, are shown in Table F-2.

The ITRS SA treats the mitigated case as an impossible event on the basis that the system is designed to withstand a design basis earthquake. For this EIS, the mitigated case is treated as a 2-hour leak that remains available for resuspension for 8 hours and is considered an unlikely event. The quantity of respirable material released is estimated by assuming that the pool remains on the surface for 1 hour and then saturates the ground for the remaining 7 hours. An airborne release rate of 4.0 x 10-6/hr is assumed for the pool and of 3.6 x 10-7/hr for the saturated soil. The quantities of respirable material released during each phase, assuming undiluted waste is spilled, are shown in Table F-2.

F.1.2.4 Pressurized Spray Release

- Spray releases may be defined as a pressurized release of a liquid from a hole/opening such that droplets and mists are formed. Some of the droplets and mists remain airborne and are released to the environment. Unmitigated and mitigated accident scenarios have been evaluated for pressurized spray releases.

. Unmitigated Spray Release - This accident scenario involves a spray release in a pump pit, which is advertently left uncovered during the transfer operations (WHC 1995a). Equipment in a pump pit includes piping, motor-operated three-way valves, and pumps. Valves are welded and are provided with double stem packing. Even though the system will have been hydrostatically tested, it is postulated that a leak develops through the stem packing. The length of the opening is assumed to be 5 cm (2 in), the typical circumference of a 8 cm (3 in) valve stem and the width is assumed to be 0.1 mm (0.004 in) (WHC 1995a). These dimensions maximize the fraction of respirable material in the spray. The pressure of the transfer system is assumed to be 28 kg/cm2 (400 psig). The resulting total flow of 0.190 L/s (0.05 gal/s) through the opening. Based on a respirable fraction of 0.8, respirable material would be released at the rate of 0.158 L/s (0.04 gal/s). The spray release continues for 8 hours releasing in the release of 4,500 L (1,200 gal) of respirable waste.

The frequency of this unmitigated spray release is considered to be extremely unlikely to incredible. The most significant factor controlling the consequences of this accident is that it assumes that the pit cover blocks are not in place. The frequency of the unmitigated seismic pipe break is assumed to incredible. The frequency of the mitigated case is assumed to be extremely unlikely.

. Mitigated Spray Release - This accident scenario is similar to the unmitigated spray scenario, with the exception that the pump pit covers are assumed to be in place during system operation. The leak paths for dispersing aerosols from the pump pit into the environment would be through openings around the cover blocks. The volume of waste released is calculated using the assumptions that the pump pit drain is plugged and that the leak detection system fails to detect accumulating liquid. It is further assumed that escaping spray will saturate the pit volume. Saturated air will hold 100 mg/m3 [1.0 x 10-4 ounces (oz)/ft3] of respirable liquid aerosol particles. This saturated air is assumed to be forced from the pit at the volumetric flow rate of the leak, 1.58 x 10-4 m3/s (5.58 x 10-3 ft3/s) (WHC 1995a). The leak is assumed to continue for 8 hours resulting in the release of 3.3 x 10-4 L (9.7 x 10-5 gal) of respirable waste.

F.1.2.5 Toxic Gas Release

- The ITRS safety assessment (WHC 1995a) evaluated a release of toxic gases from the tank ventilation system as the level of waste in the tank was reduced during a waste transfer. Gases are released as the hydrostatic pressure on the liquid decreases. The release of ammonia (NH3) and N20 were modeled using a process simulator. A drop of 92.9 cm/d (36.6 in/d) was assumed in the waste level. The simulation included release of gases already in the waste and additional gases generated by radiolysis during the drawdown period. The initial NH3 concentration was 11.3 g/L (1.5 oz/gal) and the initial average hydrostatic pressure was 1.80 atmosphere. The initial concentration of N20 was not specified. Ventilation rates of 14 and 28 m3/min (500 and 1,000 ft3/min) were considered. Concentrations of the gases were found to be greatest at the lower ventilation rate. The peak concentrations were 103 mg/m3 (1.0 x 10-4 oz/ft3) for NH3 and 256 mg/m3 (2.6 x 10-4 oz/ft3) for N20. The total gas release rate was 0.236 m3/s (8.3 ft3/s) or 84.7 mg/s (2.99 x 10-3 oz/s).

F.1.3 NEW TANK FACILITIES

New HLW tank facilities would be required to support mitigation of flammable gas potential by dilution. These facilities would be designed and constructed to current DOE high safety standards. These standards apply to the high-integrity DSTs, and require monitoring and control systems, ventilation system, double containment, and rigorous OSRs.

Two new tanks and support facilities would be constructed in either the 200 West Area or at one of two potential sites in the 200 East Area. To allow maximum flexibility in the use of the new tanks, they would be connected to the RCSTS. The RCSTS is described in Section F.3.2

The operation of these new tanks would be similar to past and continuing tank farm operations on the Hanford Site. No new or unique accident scenarios would be anticipated. With new construction using current technology and lessons learned from past operations, it is anticipated that the probability of abnormal events and accidents would be lower than for similar existing facilities. It is also anticipated that the consequences, because of better instrumentation and control, would be less severe.

The section discusses accidents that could occur if the NTF were constructed. The information presented is based primarily on Multi-Function Waste Tank Facility - Preliminary Safety Analysis Report, Rev. A, Vol. II, (WHC 1994a) and additional analysis related to the multi-function waste tank facility (WHC 1994b). These documents evaluated the frequency of occurrence and consequences of a large number of accident categories. These categories include:

- Pressurized Spray Releases
- Transfer Pipe Leaks
- Leaks from Failures of the Waste Tank
- Leaks from Waste Misrouting
- Pressurization of a Contaminated Process Pit
- Nuclear Criticality
- Flammable Gas Burn
- Tank Bump
- Overheating of a Waste Tank
- Gaseous Release of Toxic Material
- Release of Materials from a Pressurized Tank Dome
- Chemical Reactions due to Misrouting
- Aircraft Crash.

These accidents are discussed in the following sections. The frequencies, durations, and source terms (respirable volume released) of selected accidents are summarized in Table F-3. These accidents have been selected to show the full range of frequencies and consequences for the NTF.

F.1.3.1 Pressurized Spray Releases

- Spray releases may be defined as a pressurized release of a liquid from a hole/opening such that droplets and mists are formed. Some of the droplets and mists remain airborne and are released to the environment.

The NTF would use pumps to move radioactive liquid waste to and from the waste tanks in a system of underground transfer pipes and pump and valve pits. Although constructed, tested, and controlled to high standards some leaks would be anticipated.

Spray release accidents could be initiated by events such as valve failures and cracking of pipes. These initiating events are in the anticipated to unlikely range. Seismic events could also initiate spray releases. The resulting spray release can have severe consequences but can be easily mitigated by requiring the pit cover blocks to be in place. For this reason,

Table F-3
Summary of NTF Accident Releases

Accident Scenario	Single Event Frequency (yr-1)	Exposure Duration (hr)	Respirable Volume (L)
Pressurized Spray Release (Mitigated)	5 x 10-4 to 1 x 10-5 Unlikely to Extremely Unlikely	On-site 31.4	0.00304
		Off-site 94	0.0091
Pressurized Spray Release (Unmitigated)	2 x 10-7 to 8 x 10-8 Incredible to Not Reasonably Foreseeable	On-site 8	625
		Off-site 8	625
Tank Leak (BDBE)	7 x 10-6 to 8 x 10-8 Extremely Unlikely to Not Reasonably Foreseeable	On-site 1 7	1.76 1.11 2.87
		Off-site 1 23	1.76 3.63 5.39
Misrouting Leak	2 x 10-4 to 4 x 10-6 Unlikely to Extremely Unlikely	On-site 1 7	1.45 0.915 2.36
		Off-site 1 23	1.45 3.01 4.46
Pressurization of Contaminated Pit (Unmitigated)	3 x 10-3 to 1 x 10-4 Unlikely	On-site 2	4.5 x 10-4
		Off-site 2	4.5 x 10-4
Tank Overheating (Unmitigated)	5 x 10-5 to 5 x 10-7 Extremely Unlikely to Incredible	On-site 8	0.80
		Off-site 24	2.39

pit cover blocks are designed to Safety Class 1S and are required to be in place (WHC 1994a). The confinement provided by the pit structure also prevents the direct release of leakage to the soil column.

A large range of pressurized spray leaks has been evaluated by Muhlestein using a quantified event tree approach (WHC 1994b). Spray leaks initiated by human error or equipment failure were found to be more likely than those initiated by seismic events (WHC 1994b). Regardless of the initiating event, spray leaks were found to be in the unlikely to extremely unlikely category and result in small releases when cover blocks are in place. This section considers a spray leak in a process pit with cover blocks in place when most other safety systems have failed. Section F.1.3.2 considers a similar spray leak in transfer piping in a pit when the cover blocks are not in place.

The accident frequency and release quantity correspond to a spray leak in a NTF valve pit during a waste transfer. The cover blocks are in place but the ventilation system is inoperative, the pit drain is blocked, and the pit leak detection is inoperative. This sequence of events has an estimated frequency of 5 x 10-4 to 1 x 10-5/yr (WHC 1994b). Under these conditions, the air inside the pit is assumed to become saturated with vapor from the spray and to be forced out through small spaces around the cover blocks. The release is terminated when liquid begins to overflow to the ground surface around the pit. This is estimated (WHC 1994a) to require 94 hours and to result in the release of a total of 0.0091 L (0.0024 gal) of respirable liquid. If the release begins at the start of a worker's shift, the worker could be exposed for 31.4 of the 94-hour release. It is conservatively assumed that the off-site individual is exposed for the entire 94 hours.

F.1.3.2 Transfer Pipe Leaks

- The waste to be stored in the NTF would be transferred into, out of, and among the tanks via encased underground transfer pipes. If the NTF is constructed in the 200 West Area, encased transfer piping would connect the NTF transfer pit to RCSTS Diversion Box 1. If the NTF is constructed at either of the two sites in the 200 East Area, encased transfer piping would connect the NTF transfer pit to an RCSTS Diversion Box 2 that would be added for this purpose. It is anticipated that the distance between transfer pit and diversion box would be greater for an NTF in the 200 East Area.

As discussed in Section F.1.3.1, transfer pipe leaks can be considered as a type of pressurized spray leak. Some of these events result in no release, some in release to the soil column, some in release of aerosols, and some in both soil column and aerosol releases. To bound the entire category, this section considers an unmitigated spray release from a leak detection riser in a transfer pit. The event is assumed to be initiated by a seismic event during a waste transfer when the pit cover blocks are not installed. The earthquake causes rupture of the primary transfer pipe but leaves the secondary encasement pipe intact. This creates the potential for pressurization of the transfer pipe leak detection system and a large spray release directly to the atmosphere. The release is maximized by assuming that the following events also occur:

- Leak detection fails in the transfer pipe
- Transfer pit drain is blocked
- Leak detection in the diversion box fails
- Transfer pipe leak detection riser flange is not tight
- Leak detection riser is pressurized.

The estimated frequency for the sequence of events is 2 x 10-7 to 8 x 10-8/yr (WHC 1994b). Based on adjustment of the size of the opening in the riser flange to optimize the production of respirable aerosol, a release rate of 0.0217 L/s (0.006 gal/s) was calculated (WHC 1994a). Leach (WHC 1994a) assumed workers were exposed to this aerosol for 8 hours and the public for 24 hours. Since a spray of this magnitude would be visible at some distance, it is assumed for this evaluation that the spray release is detected and terminated in 8 hours. Workers and the public would then be exposed to 625 L (165 gal) of respirable aerosol.

The accident scenario developed by Muhlestein (WHC 1994b) postulates a BDBE as the initiating event but reduces the frequency of occurrence by assuming independent failure of design features such as pipe and pit leak detection systems. Because a BDBE is assumed, no design feature can be assumed to function. The leak detection riser would not be pressurized unless the primary pipe ruptured but the secondary pipe remained intact. Although no quantitative estimate is available, it is anticipated that this reasoning would yield an accident frequency in the range of extremely unlikely to incredible.

F.1.3.3 Leaks From Failures of the Waste Tank

- The NTF would be constructed utilizing the best current technology and lessons learned for DSTs and instrumentation. However, it is assumed that leaks from failure of the primary waste tank could occur either through corrosion or a seismic event. The following features may mitigate an HLW tank leak:

- Level indication
- Secondary (annulus) tank containment
- Liquid detection system in the annulus
- Ventilation flow in the annulus
- Annulus ventilation continuous monitor
- Annulus HEPA filter system.

If all of these systems should fail, the entire contents of the tank could be released to the soil column. Some of the waste could reach the surface and be released to the atmosphere, particularly if there were large cracks in the primary and secondary tank shells. A BDBE is considered to be the only credible initiating event. Muhlestein (WHC 1994b) estimated the frequency of a BDBE initiated simultaneous failure of all of these systems at 7 x 10-6 to 8 x 10-8/yr.

To estimate the consequences of the loss of the entire contents 4.39 million L (1.16 million gal) of a new DST, Leach assumed (WHC 1994a) that 10 percent of the volume formed a pool on the ground surface and was released to the atmosphere at a rate of 10-10 per second. The release was assumed to occur for 24 hours. For consistency with more recent SAs (WHC 1995c), modeling of release to the atmosphere has been changed for this evaluation. The very conservative assumption that 10 percent of the tank volume reaches the surface is retained. The pool is assumed to be present for 1 hour and the ground is assumed to remain saturated with waste liquid for an additional 23 hours. A release rate of 4 x 10-4/hr is assumed for the pool and 3.6 x 10-7/hr for the saturated ground. Using these assumptions, a respirable volume of 2.87 L (0.76 gal) would be released during 8 hours and of 5.39 L (1.42 gal) during 24 hours, the assumed exposure time of worker and the public, respectively.

The method used to estimate the accident frequency assumes a BDBE but also assumes that the failure of each design feature remains independent of the others. It could be argued that the occurrence of a DBE would cause simultaneous failure of all design safety systems and, in this case, the frequency of the accident would be equal to the frequency of the earthquake, 1.44 x 10-5/yr.

F.1.3.4 Leaks From Waste Misrouting

- Misrouting during waste transfers could result in transfer of liquid waste to an open pipe in a process pit. This misrouting could result in either an overflow of the process pit or structural damage to or overflowing of the tank to which the process pit drains. The following features serve to mitigate the consequences of such a misrouting:

- Level indication differences between withdrawal and receiving tanks
- Pit drain
- Liquid detection system in the process pit.

The frequency of a waste misrouting event in conjunction with failure of the potentially mitigating features is estimated between 2 x 10-4/yr and 4 x 10-6 per year (WHC 1994b). If the process pit drain is blocked and the pit liquid detection system does not operate, liquid would fill the pit and leak out, forming a pool at grade. The transfer pump pit could be filled in less than 1 hour at a transfer rate of 6.31 L per second (100 gpm). Since material balances are performed at approximately 2-hour intervals the transfer pit could overflow. Leach assumed (WHC 1994a) that the overflow was detected after 16 hours and that an additional 8 hours was required to cover the spill. Using a combination of pool and saturated soil release rates (WHC 1995c), 2.36 L (0.62 gal) of respirable material would be released in 8 hours and 4.46 L (1.18 gal) in 24 hours.

If the pit drain is open and the pit liquid detection system does not operate, the tank might be damaged from overfilling. However, the soil release consequences would be less than from a process pit, because the tank free space at the maximum liquid level is greater than the volume of the process pits. If a tank failure was caused by overfilling, the consequences would be bounded by the postulated full tank leak accident discussed in Section F.1.3.3.

F.1.3.5 Pressurization of a Contaminated Process Pit

- During long-term operation, process pits would become contaminated with dried waste solutions resulting from spills or leaks. Contamination is normally confined by the induced flow HEPA filter system.

An accident involving pressurization of a process pit might be caused by the inadvertent transfer of incompatible materials from a process pit resulting in failure of a test port during a pneumatic testing of the pipe encasement. Air leaking from the test port could resuspend contamination and transport it from the process pit, either via the pit ventilation system or around the cover blocks. Features that may mitigate the consequences of such an event include the process pit cover block(s), the ventilation flow path from the process pit, and the ventilation system filters. Although the frequency of this accident has been estimated (WHC 1994b) at 3 x 10-3 to 1 x 10-4/yr, its consequences are very small, even without filtration of the release (WHC 1994a). Leach estimated a release of 4.5 x 10-4 L (1.2 x 10-4/gal) of respirable material.

F.1.3.6 Nuclear Criticality

- A criticality SA of Hanford Site HLW tanks has concluded that the waste is highly subcritical (WHC 1994c). The subcritical nature of the waste in the waste tanks was demonstrated by evaluating the two independent criticality parameters. The first criticality parameter is the concentration of Pu in the waste. If the Pu concentration in the waste is less than critical Pu concentration, the waste is subcritical. The safe critical Pu concentration is 2.6 g/L (0.02 lbs/gal). The highest measured Pu concentration in the HLW solids was 0.35 g/L (0.003 lbs/gal). The second criticality parameter is the relative amounts of neutron absorbers and Pu in the waste. If the ratio of the mass of neutron absorbers to Pu mass is less than the minimum subcritical ratio for any neutron absorber present, the waste is subcritical. Analysis has shown that each solid waste sample contained sufficient neutron absorbers to be subcritical. Because the waste in the NTF waste tanks would be highly subcritical, no facility-specific criticality accident scenarios were developed for the NTF.

F.1.3.7 Flammable Gas Burn

- A major function of the NTF would be to provide mitigation for an accident involving a flammable gas burn event. The NTF would be constructed and operated to provide state-of-the-art protection from this event. The NTF's key prevention measures are: Reliable ventilation to prevent high gas concentrations in the tank vapor space and good mixing to prevent gas accumulation in the waste.

In addition to the accumulation of a flammable gas mixture, there must be an initiating source to cause a burn. Factors such as electrical sources, sparks, and lighting have been considered in assessing this risk. It has been concluded that the frequency of flammable gas burn is in the range of 1 x 10-6 to 1 x 10-7/yr (WHC 1993b). A more recent review, using a quantified event tree approach, estimated the frequency of a flammable gas burn in NTF tank without primary tank or riser failure at extremely unlikely to incredible (WHC 1994b).

Evaluation of the results of mitigation mixer pump test data from Tank 101-SY led to the conclusion that the mixer pump can mitigate flammable gas buildup indefinitely in this tank (PNL 1994a).

F.1.3.8 Tank Bumps

- A tank bump is a sudden release of vapor resulting from the loss of circulation in the waste and resultant buildup of temperature gradients in a waste tank. Tank bumps occurred at the Hanford Site between 1954 and 1968 in HLW tanks containing waste with a high radioactive heat load. Existing high-heat load waste tanks are equipped with airlift circulators to prevent buildup of temperature gradients. The NTF storage tanks would be equipped with mixing pumps that can serve the same purpose.

Tank bumps are considered to be bounded by the tank overheating scenario described in Section F.1.3.9.

F.1.3.9 Overheating of a Waste Tank

- The temperature of HLW in the NTF would be controlled by two parallel ventilation systems. These ventilation systems would be designed to prevent thermal damage to the tank and to prevent boiling of the waste. If the waste in the tanks boils, excessive quantities of vapor could enter the ventilation train and result in the loss of filtration.

Overheating could be caused by addition of incompatible wastes or process chemicals resulting in an exothermic reaction. The heat generated would be in addition to the radioactive decay heat of the waste and the heat produced by the operation of the mixing pump. If one of the tank ventilation systems fails and the mixing pump continues to run, the heat production rate could exceed the remaining cooling capacity. A longer term failure could result in partial crystallization of the waste. This is considered to be an operational problem. For a relatively large airborne release to occur, the filtration on the once-through ventilation system must also be ineffective.

Because the existing tank waste and transfer criteria are not completely defined, it is not possible to calculate the possible heat production due to adverse reactions. Leach evaluated (WHC 1994a) a scenario that assumes that the tank contains waste with the design-basis radioactive-decay heat-load, that no ventilation is operating, that there is no filtration on the once-through ventilation system, and that the mixer pump continues to operate for 24 hours under these conditions. It was assumed that all the heat from mixer pump operation was used to boil off waste. The frequency of this sequence of events was estimated (WHC 1994b) at 5 x 10-5 to 5 x 10-7/yr. Leach estimated that 0.80 L (0.211 gal) of respirable liquid would be released in 8 hours and 2.39 L (0.63 gal) in 24 hours.

F.1.3.10 Gaseous Release of Toxic Material

- Leach (WHC 1994a) chose two scenarios to evaluate gaseous release of toxic materials from the NTF. The first scenario assumes a sudden increase in ammonia release resulting from a rollover (burp) or sudden mixing of the contents of the waste tank. The second scenario assumes an increase in ammonia release rate due to elevated temperature in the tank. It was assumed that the off-gas condenser was inoperable and that no other device in the ventilation system was effective in reducing ammonia release. The ammonia release rate for the burp scenario is 4,200 mg/s and 229 mg/s for the high-temperature scenario. Muhlestein estimated (WHC 1994b) the frequency of both the these scenarios at 1 x 10-2 to 3 x 10-4/yr.

F.1.3.11 Release of Materials From a Pressurized Tank Dome

- A loss of the heat removal capability of both ventilation systems combined with continued full-power operation of both mixing pumps and the maximum radioactive heat load is not sufficient to pressurize the tank dome space. The adiabatic boil-off rate is less than the design volumetric flow for the NTF once-through ventilation system (Cloud 1993). Chemical reactions and unregulated high-volumetric steam flow into the tank dome space may lead to pressurization of the tank dome space. These postulated events and their consequences are considered to be bounded by other accident scenarios.

F.1.3.12 Chemical Reactions Due to Waste Misrouting

- Section F.1.3.4 considered spills resulting from misrouting of waste transfers to open pipes and overfull tanks. This section discusses accidents due to chemical reactions where waste is transferred to a tank containing incompatible waste.

There are chemical reactions, other that those that generate hydrogen gas, that are of potential concern to the NTF. These reactions do not necessarily require incompatible waste mixing to occur. Chemical reactions have been studied for existing tank waste (WHC 1993b) and are briefly summarized as follows.

. Nitrated Organics - Organic compounds used at the Hanford Site are present in the waste as salts and are mixed with nitrates. There are two types of reactions to consider; first an exothermic reaction between nitrates or nitrites and organic compounds, and second exothermic reactions involving nitrate and organic compounds in the presence of uranium, sometimes called a "red oil" reaction. A "red oil" formation requires a high temperature, exceeding 135yC (275y F) and cannot be formed in the alkaline wastes stored in the Hanford Site waste tanks.

  To produce a nitrate or nitrite salt reaction with organic compounds, the following four conditions are necessary:

  - High concentration of organic material (ARH 1976)
  - An optimum near-stoichiometric mixture
  - High temperature, greater than 200yC (392y F) (ARH 1977)
  - Water content less than 20 percent by weight (ARH 1976).

. Organic Materials - Organic materials identified in this section could also produce flammable gases by radiolytic decomposition. This is essentially the same mechanism as the hydrogen burn described in Section F.1.3.7 and is limited and controlled by the same mitigation effects.

. Ammonium Nitrate - Ammonium nitrate is stable at standard temperature and pressure (i.e., normal tank conditions). However, the aqueous alkaline environment of the waste tanks could drive the equilibrium toward ammonia which could be released to the tank vapor space. If ammonia gas and nitrogen oxides exist together, then ammonia could combine with nitrogen dioxide to form ammonium nitrate.

. Ferrocyanide Reactions - Early studies (DOE 1987) suggested that a ferrocyanide reaction could cause an explosion within the tank. This scenario was subsequently deemed not Reasonably Foreseeable (WHC 1994d).

F.1.3.13 Aircraft Crash

- The airspace above the Hanford Site is used by many types of aircraft, typically on a limited basis. The Hanford Site airspace is used by commercial air carriers, air taxis, general aviation, military aviation, contracted pesticide and herbicide aerial applicator aircraft, and Hanford Site bioscience surveillance aircraft. Commercial aircraft are considered to present the most threat to the NTF on the basis that they are the largest aircraft to routinely overfly the Hanford Site. Muhlestein estimated a frequency of approximately 8 x 10-8/yr for airplane crashes at the Hanford site. Based on this frequency, accidents involving airplane crashes are not reasonably foreseeable.

F.1.4 PAST PRACTICES SLUICING SYSTEM

A PPSS is being designed to retrieve the contents of Tank 106-C. Tank 106-C is a SST with a capacity of 2,000,000 L (530,000 gal) and now contains approximately 746,000 L (197,000 gal) of sludge. Because of decay heat from the large quantity of 90Sr in the sludge, approximately 23,000 L/mo (6,000 gal/mo) of water are added to the tank to prevent drying of the sludge. An EA and FONSI have been issued for PPSS retrieval of Tank 106-C (DOE 1995).

For this EIS, it is assumed that PPSS design can be adapted for retrieval of the 269,000 L (71,000 gal) of sludge in Tank 102-SY. To evaluate accidents that could be associated with this application of the PPSS, scenarios and source terms taken from Preliminary Safety Evaluation for 241-C-106 Waste Retrieval, Project W-320 (WHC 1994e) have been modified for better consistency with safety analyses for other systems considered in this EIS. Two types of accident scenarios have been evaluated, Transfer Pipe Breaks, Section F.1.4.1, and Pressurized Spray Leaks, Section F.1.4.2.

F.1.4.1 Transfer Pipe Breaks

- Transfer pipe breaks could occur as the result of BDBEs, excavation accidents, and operational failure such as corrosion or blockage of the pipe. If secondary containment is also breached, waste would be released to the environment. The spill would include waste pumped prior to recognition of the accident and shutdown of the pump as well as drainback of waste in the pipeline. The PPSS for Tank 106-C has a pumping rate of 350 gpm and includes 610 m (2,000 ft) of piping to allow circulation of sluicing fluid between Tanks 106-C and 102-AY. There is no design for a PPSS for Tank 102-SY; pipe runs would be expected to be much shorter and drainback is considered to be negligible.

A seismic event would be the most likely event to rupture both pipes; however, when drainback is ignored, the volume spilled would be the same whether one or both pipelines were ruptured. The PSE for Tank 106-C (WHC 1994e) assumed a 2-hour unmitigated leak and a 10-second mitigated leak for the seismic event. The duration of the unmitigated leak is not based on any particular design or administrative control. The duration of the mitigated leak is based on the activation of a seismic cutoff switch. Based on pumping rate alone, a 2-hour leak would spill 159,000 L (42,000 gal) and a 10-second leak would spill 221 L (58 gal). It was assumed that 10 percent of the leak reaches the surface where it becomes resuspended at a rate of 1 x 10-5/hr. These assumptions result in smaller releases of respirable material than obtained using assumptions that are more consistent with recent safety assessments for other systems considered in this EIS.

More recent accident analyses assume an 8-hour unmitigated pipe leak and a 2-hour mitigated pipe leak. These times assume detection of the leak during a work shift change and by periodic material balance, respectively. The entire volume of the spill is assumed to remain on the surface for 1 hour and to maintain saturation of surface soil for the remainder of the accident. These assumptions yield leak volumes of 636,000 L (168,000 gal) for the unmitigated leak and 159,000 L (42,000 gal) for the mitigated leak. The resuspension rate of the liquid pool is 4.0 x 10-6/hr and 3.6 x 10-7/hr for the saturated soil. The quantities of respirable materials that would be released under both sets of assumptions are shown in Table F-4.

Table F-4
Summary of PPSS Accident Releases

Accident Scenario	Frequency (yr-1)	Exposure Duration (hr)	Respirable Volume (L)
Unmitigated Pipe Break	Incredible	On-site 1	2.54
		7	1.60
			4.14
		Off-site 1	2.54
		23	5.27
			7.81
Mitigated Pipe Break	Unlikely	On-site 1	0.636
		7	0.401
			1.04
		Off-site 1	0.636
		23	1.32
			1.96
Unmitigated Spray Release	Extremely Unlikely to	On-site 2	831

	Incredible			
		Off-site	2	831
Unmitigated Spray Release	Extremely Unlikely to Incredible	On-site	8	3,312
		Off-site	8	3,312
Mitigated Spray Release	Anticipated to Unlikely	On-site	8	0.0000438
		Off-site	8	0.0000438

The PSE for the Tank 106-C PPSS estimated accident frequencies were based on the frequency of the initiating event and did not consider whether the system was in use at the time of the accident. Using this approach, the unmitigated seismic transfer pipe break has a frequency of unlikely (7.0 x 10-4/yr) and the operational accident has a frequency of anticipated (1.7 x 10-2/yr). No frequency was given for the excavation accident. This is a more conservative approach than used to estimate accident frequencies for other systems considered in this EIS. The unmitigated 8-hour leak is considered to incredible and the 2-hour mitigated leak is considered to be unlikely.

F.1.4.2 Pressurized Spray Leaks

- Pressurized spray leaks could occur in valve and transfer pits due to misaligned or failed jumpers. For the unmitigated case (i.e., pit cover blocks off), the PSE (WHC 1994e) assumed a 5-cm long (2-in) 0.1-mm (0.004-in) wide crack in a valve stem operating at a pressure of 180 psig and estimated a respirable material release rate of 0.114 L/s (0.03 gal/s). As indicated in Table F-4, a 2-hour leak would result in release to the atmosphere of 831 L (220 gal) of respirable material and an 8-hour leak in the release of 3,312 L (875 gal).

The PSE (WHC 1994e) estimated the quantity of respirable material released to the atmosphere for a mitigated spray leak based on the displacement of vapor-laden air from the pit as it filled with liquid emerging from a broken or disconnected jumper. An aerosol loading of 10 mg/m3 (6 x 10-7 lbs/ft3) was assumed for the vapor. The displacement rate of 0.062 m3/s (2.2 ft3/s) was based on 180 psig through a 5-cm (2-in) diameter, squared-edged orifice. Under these conditions, 4.38 x 10-5 L for respirable waste would be released to the atmosphere in 8 hours.

Based on analogy to the ITRS system and consideration of the limited operating time of the PPSS, the unmitigated spray release frequency is considered to be extremely unlikely to incredible and the mitigated spray release frequency to be anticipated to unlikely.

F.2 INTERIM STABILIZATION OF SINGLE SHELL TANKS

This section describes the activities involved in interim stabilization and characterizes the potential accidents which could result.

Interim stabilization of SSTs is accomplished by saltwell jet pumping. Jet pumps are used to remove interstitial liquids from saltcake and sludge in the SSTs. Pumping rates vary from approximately 0.19 to 19 L/min (0.05 to 5.0 gpm). The interstitial liquids are routed to DCRTs through transfer piping and valve pits. Depending on the location of the SST and the DCRT, transfer piping may be double-encased in concrete or another steel pipe or single-encased (direct buried). Existing salt well transfer piping is beyond its design life and is pressure tested every 6 months to minimize leaks. Transfer valve pits are equipped with cover leak detection interlocked to the appropriate pumps and covered by heavy shield blocks. The valve pits are designed to allow several SSTs to be pumped simultaneously to a common DCRT.

DCRTs are housed in underground reinforced concrete vaults. The steel tanks have capacities of either 76,000 L (20,000 gal) for Tank 244-S or 95,000 L (25,000 gal) for Tanks 244-TX and 244-U. The DCRT vaults include HEPA ventilation systems, interlocked leak detection systems, and tank sluicing systems. Permanent neutron detectors are installed in DCRT 244-TX and portable detectors can be used in steel Tank 244-S. There are no provisions for neutron monitoring in DCRT 244-U. SWL accumulated in DCRTs in the 200 West Area is presently transferred to Tank 102-SY. SWL can be transferred through the ECSTS.

A number of reports have evaluated accidents associated with salt well pumping activities. Safety Study of Interim Stabilization of Nonwatchlist Single-Shell Tanks (WHC 1992) evaluated spray leaks, equipment fires, hydrogen fires, waste stability, and transfer pipe leaks. Environmental Assessment, Waste

Tank Safety Program (DOE 1994) focused on issues associated with interim stabilization of Watchlist SSTs. A FONSI was issued for these activities on February 25, 1994. A more recent report, Safety Analysis; Tank Farms Waste Transfer System Leaks, Breaks, and Spray Releases (WHC 1994f), is generally applicable to interim stabilization of SSTs. This more recent report is used as the basis for evaluating accidents during interim stabilization of SSTs. The accidents evaluated are:

- Salt Well Transfer Piping Leaks
- Salt Well System Spray Leaks.

F.2.1 SALT WELL TRANSFER PIPING LEAKS

Salt well transfer piping includes both double-encased and single-encased steel piping. More than 80 percent of the salt well transfer piping is single-encased pipe which is 2.5 cm to 8 cm (1 to 3 in) in diameter and shielded by 0.9 m (3 ft) of soil. The pipe may be either buried or bermed on the ground surface. All of this piping is beyond its 10-year design life. Stahl (WHC 1994f) estimated a failure frequency of 3.0 x 10-7/hr-ft based on the Hanford Site soil conditions and the age of the pipe. This failure frequency was then used with pipe lengths and assumptions regarding pumping rates to estimate transfer piping leak frequencies and maximum leak volumes for salt well jet pumping of individual tank farms. The maximum leak volumes are based on maximum rather than nominal transfer pump rates and assume 16-hour releases. The results are shown in Table F-5.

Table F-5
Estimated Frequencies and Maximum Volumes for Salt Well Transfer Line Leaksa

Farm	Tanks	Frequency	Volume (L)
		200 East Area	
A & AX	A-101, AX-101	2.6/yr Anticipated	36,300
BX	BX-106	4.2 x 10-2/yr Anticipated	18,200
BY	BY-102, BY-103, BY-105, BY-106, BY-109	3.1/durationb Anticipated	72,700
C	C-102, C-103, C-105, C-106, C-107, C-110	0.34/duration Anticipated	72,700
		200 West Area	
S	S-101, S-102, S-103, S-106, S-107, S-108, S-109, S-110, S-111, S-112	0.85/yr Anticipated	90,800
SX	SX-101, SX-102, SX-103, SX-104, SX-106	2.0/duration Anticipated	54,500
T	T-104, T-107,T-110,T-111	4.7/yr Anticipated	54,500
U	U-102, U-103, U-105, U-106, U-107, U-108, U-109, U-111	0.46/duration Anticipated	72,700

Source: WHC 1994f

aFrequencies are based on pipe failure only and do not include operator error or failure of other systems such as leak detection.

bSalt well pumping expected to take less than 1 year.

The maximum leak volumes are based on the assumptions that leak detection does not function and that the leak is not discovered for 16 hours. Based on prior experience with similar piping, it was assumed that the entire volume reaches the ground surface where it forms a pool for 1 hour and keeps the soil saturated thereafter. The quantity of respirable radioactive material released was estimated using an ARR of 4 x 10-6/hr for pools for the first hour and an ARR of 3.6 x 10-7/hr for saturated soil for the remainder of the accident. Workers were assumed to be exposed for 8 hours and members of the public for 24 hours. The volumes of respirable material released are shown in Table F-6.

Table F-6

Summary of Accident Releases During Pumping and Transfer of SWL

Accident Scenario	Frequency (yr-1)	Exposure Duration (hr)	Respirable Volume (L)
Unmitigated Transfer Piping Leak (90,800 L)	2.3 x 10-3 to 1.0 x 10-2 Unlikely	On-site 1	0.363
		15	0.490
			0.853
		Off-site 1	0.363
		23	0.752
			1.11
Mitigated Transfer Piping Leak (18,200 L)	0.46 to 2.0 Anticipated	On-site 1	0.0727
		7	0.0458
			0.118
		Off-site 1	0.0727
		15	0.981
			0.171
Unmitigated DCRT Spray Leak (207 psig)	1.1 x 10-5 Extremely Unlikely	On-site 8	28.5
		Off-site 24	85.5
Mitigated DCRT Spray Leak (207 psig)	1.1 x 10-2 Anticipated	On-site 8	3.03 x 10-5
		Off-site 24	9.09 x 10-5
Unmitigated Salt Well Spray Leak (80 psig)	1.1 x 10-4 Unlikely	On-site 8	7.31
		Off-site 24	21.9
Mitigated Salt Well Spray Leak (80 psig)	0.11 Anticipated	On-site 8	1.92 x 10-5
		Off-site 24	5.76 x 10-5

Source: WHC 1994f

The frequencies shown in Table F-5 are based on current interim OSRs. It was estimated that the frequency of salt well transfer piping leaks could be reduced by a factor of 1,000 by requiring material balance discrepancy (MBD) surveillances (WHC 1994f). MBD surveillances combined with restrictions on the number and types of salt well tanks (i.e., High Source Term) could reduce the maximum leak volume to 4,500 to 18,200 L (1,200 to 4,800 gal). Table F-6 shows respirable volumes released based on a leak volume of 18,200 L (4,800 gal) as a mitigated case. Including frequencies of 0.1 failure per year for failure of leak detection and of 0.05 failure per year for failure to respond to a leak detection alarm (WHC 1994b) would shift the frequency of pipe leaks in the 200 West Area Salt Well Transfer System into the Unlikely category.

F.2.2 SALT WELL SYSTEM SPRAY LEAKS

Spray leaks could occur in SST pump pits, DCRT pump pits, and valve pits during pumping and transfer of salt well liquids. Stahl estimated (WHC 1994e) frequencies of occurrence and release rates for spray leaks during transfer of SWLs from a SST to a DCRT and from a DCRT to a DST. Stahl noted that these accidents are also applicable to Diversion Boxes 241-UX-154 and 241-ER-151 on the ECSTS and to other diversion boxes in the SST/DST and Aging Waste Facility waste transfer system.

Section F.2.2.1 describes the potential accidents which could occur in SST to DCRT transfers and Section F.2.2.2 describes DCRT to DST transfer accident potential.

F.2.2.1 Spray Leak During SST to DCRT Transfer

- This accident scenario assumes (WHC 1994f) that a jumper was improperly installed during routine maintenance in a jumper pit providing liquid transfer from the SST to a DCRT. The jumper misalignment is assumed not to be discovered during visual inspections or leak testing before the pit is returned to service. The jumper is assumed to leak at both ends. A maximum flow of 19 L/min (5.0 gpm) and pressure of 80 psig are assumed. It is also assumed that the spray leak is not detected for 16 hours and that an additional 8 hours are required to terminate the leak. Workers are exposed to spray aerosol for 8 hours (one shift) while members of the public are exposed for 24 hours.

Two accident scenarios were analyzed: an unmitigated spray release with cover blocks not in place and a mitigated spray release with cover blocks in place. As discussed in the following sections, these scenarios have different frequencies of occurrence, release durations, and release rates.

- Unmitigated Spray Release - The frequency of a spray leak in pump and valve pits is estimated to be 0.112/yr (WHC 1994f). This frequency estimate assumes continuous operation and considers the length of pipe, the number of gaskets and valves in a pit, and the frequency of jumper misalignment. Due to the relatively low flow rate, it is assumed that leak detection would not be activated. Inclusion of the frequency for failure to replace cover blocks (0.001/yr) reduces the frequency for an unmitigated spray release during SST to DCRT transfer to 1.1 x 10-4/yr. The quantities of respirable liquids for 8-hour worker exposures and 24-hour public exposures are shown in Table F-5 and are based on optimization of the aerosolization rate (WHC 1994f).

- Mitigated Spray Release - The accident scenario for a mitigated spray release during SST to DCRT transfers from a misaligned jumper assumes that cover blocks are in place. Leak detection functions are assumed not to be active due to the low flow rate. These assumptions do not alter the duration of the release relative to the unmitigated case but do alter the frequency of occurrence and release rate. The frequency of the event is 0.112/yr (WHC 1994f). The spray saturates the atmosphere inside the pit and the aerosol is forced out as liquid accumulates in the pit. Assuming a vapor loading of 10 g/m3 and a pipe pressure of 80 psig, workers would be exposed to 1.92 x 10-5 L of respirable liquids and the public to 5.76 x 10-5 L.

F.2.2.2 Spray Leak During DCRT To DST Transfer

- This accident scenario
assumes that a jumper was improperly installed resulting in misalignment during routine maintenance in a jumper pit providing liquid transfer from the DCRT to another tank (e.g., Tank 102-SY or a load and unload facility) (WHC 1994f). The jumper misalignment is assumed not to be discovered during visual inspections or leak testing before the pit is returned to service. The jumper is assumed to leak at both ends. The DCRT pumps in the T and U Tank Farms operate at a pressure of 207 psig and that in the S Tank Farm at 80 psig, all with flow rates ranging from 189 L to 379 L/min (50 to 100 gpm). It is assumed that the spray leak is not detected for 16 hours and that an additional 8 hours are required to terminate the leak. Workers are exposed to spray aerosol for 8 hours (one shift) while members of the public are exposed for 24 hours.

Two accident scenarios were analyzed: an unmitigated spray release with cover blocks not in place and a mitigated spray release with cover blocks in place. As discussed in the following paragraphs, these scenarios have different frequencies of occurrence, release durations, and release rates.

- Unmitigated Spray Release - The frequency of a spray leak in pump and value pits is estimated to be 0.112/yr (WHC 1994f). This frequency estimate assumes continuous operation and considers the length of pipe, the number of gaskets and valves in a pit, and the frequency of jumper misalignment. Inclusion of frequencies for leak detection failure (0.1/yr) and failure to replace cover blocks (0.001/yr) reduces the frequency for an unmitigated spray leak in a DCRT pump pit to 1.1 x 10-5/yr. The quantities of respirable liquids for 8-hour worker exposures and 24-hour public exposures are shown in Table F-6 and are based on optimization of the aerosolization rate (WHC 1994f).

- Mitigated Spray Release - The accident scenario for a mitigated spray release from a DCRT pump pit from a misaligned jumper assumes that cover blocks are in place and the leak detection functions. These assumptions do not alter the duration of the release relative to the unmitigated case but do alter the frequency of occurrence and release rate. The frequency of the event is 0.112/yr (WHC 1994f). The spray saturates the atmosphere inside the pit and the aerosol is forced out as liquid accumulates in the pit. Assuming a vapor loading of 6.2 x 10-4 lbs/ft3 (10 g/m3) and a pipe pressure of 207 psig, workers would be exposed to 3.03 x 10-5 L (8 x 10-6 gal) of respirable liquids and the public to 9.09 x 10-5 L (2.4 x 10-5 gal).

F.3 UNDERGROUND CROSS-SITE TRANSFER

Underground cross-site transfer could be accomplished through the use of the ECSTS or, if constructed, through the RCSTS. The ECSTS was constructed in the 1950s, and is expected to have a higher failure rate than the RCSTS which would be designed to meet current safety standards. Four of the six lines in the ECSTS are believed to be plugged. One of the remaining lines passed a pressure test in June 1995.

Two major types of accidents can be hypothesized for the cross-site transfer systems. The first is a pipe break, or its equivalent. Depending on the leakage rate, location, and duration, the liquid waste released could remain totally below grade or could reach the surface and be released to the atmosphere. The second is a spray leak. Spray leaks could occur in a diversion box or in pump and valve pits. Depending upon the spray characteristics (flow, geometry, particle size) and pit status (cover in place or not), the consequences of spray leaks could range from very low to severe.

Although the types of accidents that could occur during operation of the ECSTS and RCSTS are similar, their frequencies of occurrence and release rates are different. Accidents involving the ECSTS are discussed in Section F.3.1 and those involving the RCSTS in Section F.3.2.

F.3.1 EXISTING CROSS-SITE TRANSFER SYSTEM

The ECSTS is comprised of the 241-ER-151 Diversion Box located in the 200 East Area, 241-UX-154 Diversion Box located in the 200 West Area, 241-EW-151 Vent Station located at the high point between the 200 East and West Areas, and approximately 5.6 km (3.5 mi) of concrete-encased stainless steel pipe that is buried at depths of 1.5 to 5 m (5 to 15 ft). There are six ECSTS pipelines, of which four are believed to be plugged. Each has a nominal pipe size of 8 cm (3 in). There are 58 encasement test risers spaced regularly along the concrete encasement between the diversion boxes. These test risers provide access to the encasement void space for leak detection. The concrete encasement slopes in both directions from the vent station and drains into a catch tank at each diversion box. Catch tank contents can be transferred to a designated DST and held for later processing. Additional descriptive information regarding the ECSTS is in Chapter 3 of this EIS.

Five events associated with the ECSTS are considered to adequately encompass the range of plausible accident scenarios. They are:

- Waste transfer line leak
- Overflow of the 241-EW-151 Vent Station Catch Tank
- Rupture of the encasement and pipeline, either by an earthquake during a transfer of waste, or by excavation activities with a subsequent transfer of waste
- Spray release from a diversion box with the cover blocks installed
- Spray release from a diversion box with the cover blocks not installed.

Accident scenarios for the first three events were developed in Operational Safety Analysis Report, Cross-Country Waste Transfer System, (WHC 1989) and in Safety Analysis; Tank Farms Waste Transfer System Leak, Breaks, and Spray Releases, (WHC 1994f). Frequencies of occurrence and release rates for these five accidents are summarized in Table F-7.

Table F-7
Summary of ECSTS Accident Releases

Accident Scenario	Frequency (yr^{-1})	Exposure Duration (hr)	Respirable Volume (L)
Waste Transfer Line Leak	Anticipated	On-site N/Aa	N/A
		Off-site N/A	N/A
Overflow of the Vent Station Catch Tank	Unlikely	On-site N/A	N/A
		Off-site N/A	N/A
Rupture of the Pipeline and Encasement	Unlikely	On-site 1 7	0.318 0.200 0.518
		Off-site 1 23	0.318 0.658 0.976
Unmitigated Spray Release w/cover Blocks not Installed	1.1×10^{-5} Extremely Unlikely	On-site 8	28.5
		Off-site 24	85.5

Mitigated Spray Release w/Cover Blocks Installed	1.1 x 10-2 Anticipated	On-site 8	3.03 x 10-5
		Off-site 24	9.09 x 10-5

Source: WHC 1989, WHC 1994f

aN/A = Not Applicable. Waste liquids are not expected to reach the ground surface.

F.3.1.1 Waste Transfer Line Leak

- For this accident scenario, leaks could occur in an ECSTS pipeline during waste transfer. The majority of the leak volume would be retained within the concrete encasement. Plugged drain lines leading to the catch tanks from the encasement would result in waste liquid being backed up into the pipe chase of Diversion Box 241-ER-151 and/or 241-UX-154, which would overflow to encasements leading to various other sumps and catch tanks. Some of the waste liquid in these encasements could escape to the surrounding soil through joints or small cracks. Entrop (WHC 1989) estimated that up to 79,500 L (21,000 gal) of waste could be released into the encasement and that 10 percent of this volume would be released to the soil through small cracks in pipeline or diversion box encasements. Since the hydrostatic head for this ground release would be very small, the flow rate at any single leak point would likely be very low, approximately 2 L/min (0.5 gpm). Based on this very low flow rate, Entrop concluded that no waste liquid would reach to ground surface. Accordingly, Table F-7 shows no release of respirable material for this accident.

An ECSTS waste transfer line leak is an anticipated event based on an analysis of transfer pipe failure rates by Stahl (WHC 1994f). Stahl estimated the failure rate of 3.0 x 10-7 per hr-ft for pipes similar to that in the ECSTS. The ECSTS is 5.6-km (3.5-mi) long and has a nominal pumping rate of 190 L/min (50 gpm). If the ECSTS were used to transfer all the SWL from the 200 West Area and the free liquid from Tank 102-SY, several leaks of this type would be expected to occur in the ECSTS. If drain lines within the diversion box were plugged or if there were large cracks in the ECSTS encasement, a significant volume of waste liquid could reach the ground surface. The integrity of the concrete encasement cannot be directly determined at this time. The consequences of waste transfer pipe leaks under these conditions are bounded by the encasement rupture accident considered in Section F.3.1.3.

Several factors would tend to reduce the frequency of waste transfer pipe leaks. Current practice at the Hanford Site is to perform a hydrostatic test prior to each use of an ECSTS pipeline. This test entails pressurizing the pipeline to a predetermined pressure and subsequent monitoring of the pipeline pressure for a period of time to ensure that no leak path (as would be revealed by a pressure drop in the pipeline) exists. Leakage could be detected through inspection of encasement test risers, recognition of a discrepant material balance, or liquid level rise in a catch tank. Leaks could be detected by a conductivity probe located inside the ECSTS Diversion Boxes.

F.3.1.2 Overflow of The 241-EW-151 Vent Station Catch Tank

- An open vent valve on an ECSTS pipeline could cause the 241-EW-151 Vent Station Catch Tank to overflow into the pipeline encasement. To pump liquid into the 241-EW-151 Vent Station Catch Tank, it would be necessary to have an obstruction in the pipeline somewhere past the vent station and have the vent station vent valve left open. This scenario is unlikely.

Liquid entering the 241-EW-151 Vent Station Catch Tank would eventually actuate the high-level alarm in the catch tank, which is transmitted to the Computer Automated Surveillance System (CASS) in the 2750E Building. Also, any increase in ambient radiation levels in the vicinity of the vent station would be transmitted to the CASS. The CASS operator would then notify the appropriate personnel so that corrective actions could be taken. Failure to identify the event or failure to take the proper corrective actions would result in solution overflowing to the ECSTS encasement with subsequent drainage into the Catch Tanks 241-UX-302-B and/or 241-ER-311. Catch Tank 241-UX-302-B is associated with Diversion Box 241-UX-154. Catch Tank 241-ER-311 is associated with Diversion Box 241-ER-151. Should the increase in level in these catch tanks go unnoticed, the leak would be detected by the recognition of a MBD. Material balances are performed every 2 hours.

Entrop (WHC 1989) estimated that these factors would limit the overflow to the ECSTS encasement to 20,900 L (5,520 gal). As discussed in Section F.3.1.1, only 10 percent of this volume would be expected to escape the encasement and none would be expected to reach the ground surface.

F.3.1.3 Rupture of the Encasement and Pipeline

- Both the ECSTS pipelines and their concrete encasement could be ruptured by either an excavation accident or a seismic event. The leak would be maximized if the encasement ruptured immediately adjacent to an ECSTS diversion box. A recent study of similar accidents for the RCSTS estimated frequencies for leaks detected within 2 hours of 7.5 x 10-7/yr for the excavation-initiated events and 5.4 x 10-8/yr for events initiated by a BDBE (WHC 1995b).

The frequency of the excavation-initiated event for the RCSTS is considered applicable to the ECSTS but that of the BDBE-initiated events is not. Entrop concluded that seismic events with horizontal ground motion exceeding 0.05 g would be sufficient to damage both the ECSTS pipelines and encasement. The design basis earthquake for the RCSTS is 0.2 g with a frequency of 1.44 x 10-4/yr. An earthquake with a horizontal ground motion of 0.09 g has an estimated frequency of 2 x 10-3/yr (WHC 1994a, WHC 1994g). On this basis, the frequency of a release from an earthquake-induced rupture of the ECSTS pipeline and encasement is estimated as Unlikely.

Entrop estimated that a maximum of 79,500 L (21,000 gal) of waste could leak from the ruptured pipeline and encasement under these conditions. It is assumed that this entire volume reaches the ground surface and forms a pool for 1 hour. Respirable radioactive material is assumed to be released from this pool at the rate of 4.0 x 10-6/hr (DOE 1993). Thereafter, soil at the site of the release remains saturated, releasing respirable material at the rate of 3.6 x 10-7/hr (DOE 1993) until covered 24 hours after the initial spill began. The volume of respirable material released during an 8-hour work shift is 0.518 L (0.137 gal) and the total volume of respirable material released in 24 hours is 0.976 L (0.26 gal).

F.3.1.4 Spray Release From a Diversion Box With Cover Blocks Installed

- A recent safety analysis of hazards involving leaks, breaks, or spray releases from waste transfer systems associated with the tank farms at the Hanford Site included evaluation of spray releases applicable to the ECSTS Diversion Boxes (WHC 1994f). Four initiating events were identified for a spray release within a pit or diversion box. These events are failures of gaskets, valve packing, and piping, and a faulty jumper connection due to a maintenance error. The total frequency of occurrence of these initiating events was calculated to be 0.112 per year, with the dominant contributor being leaks from valve packing. This frequency assumes two gaskets, two valves, and 6 m (20 ft) of piping in the pit, and continuous operation of the diversion boxes.

The ECSTS diversion boxes are equipped with conductivity probes that would detect the leak. Inclusion of frequency for leak detection failure (0.1/yr) (WHC 1994b) reduces the frequency of a mitigated spray release in an ECSTS diversion box to 1.1 x 10-2/yr which corresponds to an anticipated event.

Stahl assumed that the spray leak occurred at both ends of the jumper and remained undetected for 24 hours (WHC 1994f). It is assumed that the spray saturates air inside the diversion box to a vapor loading of 10 mg/m3 (6 x 10-7 lbs/ft3) and that this air is forced between the cover blocks as the leak continues. The corresponding volume of respirable material released is 9.09 x 10-5 L. The volume released as a respirable aerosol during an 8-hour work shift is 3.03 x 10-5 L (8 x 10-6/gal).

F.3.1.5 Spray Release From a Diversion Box With Cover Blocks Not Installed

- The initiating events for a spray release accident with cover blocks not installed are the same as discussed in Section F.3.1.4; however, based on a frequency of 0.001/yr for failure to install the cover blocks (WHC 1994b), the frequency of occurrence drops to 1.1 x 10-5/yr which corresponds to Extremely Unlikely. Stahl assumed (WHC 1994f) a pressure of 207 psig and maximized the amount of respirable aerosol but adjusting the size of the slit through which the spray escapes. Stahl also assumed a 24-hour release which corresponds to a respirable volume of 85.5 L (22.6 gal) and 28.5 L (7.5 gal) during an 8-hour work shift. This release rate is approximately one to two orders of magnitude less that release rates for similar accidents involving NTF, RCSTS, and ITRS. The resulting spray may not be readily visible from a distance and would therefore be more difficult to detect.

F.3.2 REPLACEMENT CROSS-SITE TRANSFER SYSTEM

The RCSTS has many characteristics in common with the ECSTS, including similar accident scenarios. Since the RCSTS is longer 10.5 km (6.2 mi), operates at a higher pressure, 1,200 psig, and has a higher transfer rate, 530 L/min (140 gpm), than the ECSTS, the accident scenarios could result in larger releases. However, as a newly designed and constructed system, it would be more risk-free than the ECSTS. The RCSTS would not have the aging problems of the existing system (corrosion, secondary concrete containment cracking), and its design reflects the current state-of-the-art and incorporates lessons learned over the past 40 years of operation.

New features which add to the system reliability and integrity include the following:

- Hard-connected piping used in place of jumpers which historically have had a number of significant failures.
- Diversion box(es) designed to eliminate the need to remove cover blocks for routine maintenance and inspection activities. A stairwell with Safety Class 1 doors provides access for these activities. The geometry of the doors, stairwell, and support building entry does not provide a direct path to the atmosphere for a spray leak. Cover blocks are installed directly over heavy equipment (e.g., pumps) and are no larger than required to allow replacement of the equipment to further reduce the likelihood of a spray release directly to the atmosphere.
- Double containment provided for each transfer line by a concentric outer pipe rather than the single concrete encasement for the ECSTS pipelines. This provides greater leak detection sensitivity and separate leak detection for each transfer line.
- The control and alarm systems are more sensitive and reliable.

Potential RCSTS accident frequencies and consequences were evaluated in Cross-Site Transfer System Preliminary Safety Analysis Report (WHC 1995c).

Quantitative estimates were provided for four accidents:

- Transfer line breaks
  - Beyond design basis (unmitigated)
  - Design basis (mitigated)
- Spray releases
  - Cover blocks not in place (unmitigated)
  - Cover blocks in place (mitigated).

The frequencies of occurrence, exposure durations, and quantity of respirable materials released are summarized in Table F-8. Descriptions of these accidents are provided in Sections F.3.2.1 and F.3.2.2.

Table F-8
Summary of RCSTS Accident Releases

Accident Scenario	Frequency (yr-1)	Exposure Duration (hr)		Respirable Volume (L)
Transfer Pipe Break (Unmitigated)	2.2 x 10-6 to 5.4 x 10-8 Extremely Unlikely to Not Reasonably Foreseeable	On-site	1	1.17
			7	0.736
				1.91
		Off-site	1	1.17
			23	2.42
				3.59
Transfer Pipe Break (Mitigated)	1.5 x 10-5 to 1.1 x 10-6 Extremely Unlikely	On-site	1	0.404
			7	0.255
				0.659
		Off-site	1	0.404
			23	0.836
				1.24
Unmitigated Spray Release	1.9 x 10-9 Not Reasonably	On-site	8	6,700

	Foreseeable			
		Off-site	8	6,700
Mitigated Spray Release	0.11 to 0.03 Anticipated	On-site	8	0.0075
		Off-site	8	0.0075

Source: (WHC 1995c)

F.3.2.1 Transfer Line Breaks

- The RCSTS transfer line consists of an 8-cm (3-in) diameter, Schedule 40 stainless steel pipe within a 15-cm (6-in) diameter carbon steel pipe. The primary piping is of all-welded construction. An electronic system in the annular space is capable of detecting and identifying the approximate location of any leak. The secondary containment pipe is a closed system and can be pressure tested to confirm its integrity. Such testing would be performed at least once per year (WHC 1995c). All of these new design features add to the integrity of the RCSTS and would result in lower probability of accident and/or failure events.

Lindberg estimated the frequencies of transfer line breaks initiated by excavation accidents and by a BDBE (WHC 1995b). It was determined that common backhoes used for construction were not capable of rupturing both the primary and secondary pipes; however, an oversized backhoe could cause a double break. The excavation scenario considered the following events and frequencies:

. Excavation occurs (1.0)
. Waste transfer in progress (0.3/yr)
. Oversized backhoe is available and used (0.01)
. Administrative control fails - wrong area excavated (0.1)
. Location fails - "terra tape" and marker posts not seen (0.1)
. Rupture occurs (0.5)
. Warnings fail - material balance, flow, pressure, level without leak detection (0.05).

The result of this scenario would be a leak lasting more than 2 hours with a frequency of 7.5 x 10-7/yr which corresponds to Incredible. If warnings are recognized and responded to, the frequency becomes 1.5 x 10-5/yr (Extremely Unlikely) but the leak is limited to not more than 2 hours.

The earthquake scenario considered (WHC 1995c) the following events and frequencies:

. BDBE occurs (1.44 x 10-4/yr)
. Waste transfer in progress (0.3/yr)
. Administrative control fails - manual shutdown not performed (0.05)
. Leak detection fails (0.5)
. No response to leak detection occurs (0.001)
. Warnings fail - material balance, flow, pressure, level (does not include leak detection) (0.05)

Two event tree branches lead to spills of more than 2 hours. The more likely of the two assumes that leak detection and material balance and other warnings fail and has a frequency of occurrence of 5.4 x 10-8/yr. This sequence is considered not reasonably foreseeable. The frequency of a leak of not more than 2 hours is 1.1 x 10-6/yr which corresponds to Extremely Unlikely.

It could be argued that failures of engineered systems are not independent for a BDBE so that the frequency of leak detection failure would be 1.0. It could also be argued that it is inappropriate to consider both failure to execute a manual shutdown and failure to perform material balance under these conditions. This would increase the frequency of an 8-hour release to 2.2 x 10-6/yr.

The total volume of waste spilled during an unmitigated transfer pipe break is 292,000 L (77,100 gal). This includes 254,000 L (67,200 gal) pumped in the 8 hours before the leak is detected and 37,500 L (9,900 gal) that drains from the filled line through the break. A 2-hour leak would spill 101,000 L (26,700 gal). It is conservatively assumed that all of the waste spilled reaches the ground surface.

The following paragraphs describe unmitigated and mitigated RCSTS pipe break accidents.

. Unmitigated Transfer Pipeline Break - An unmitigated transfer pipeline break is assigned a frequency of occurrence ranging from Extremely Unlikely to Not Reasonably Foreseeable. This frequency range reflects a usage factor of 0.3 and the assumptions that a BDBE would cause simultaneous failure of all engineered systems and that material balance would not be performed. It is assumed that 292,000 L (77,000 gal) of waste are spilled in the 8 hours before the leak is detected. The spill forms a pool on the ground surface for 1 hour and then keeps the soil saturated until the spill area is covered 16 hours after detection. Respirable material is released from the pool at a rate of 4.0 x 10-6/hr and from the saturated ground at a rate of 3.6 x 10-7/hr. The total amount of respirable material released in 24 hours is 3.59 L (0.9 gal). A total of 1.91 L (0.5 gal) would be released during an 8-hour work shift.

- Mitigated Transfer Pipeline Break - The mitigated transfer pipe break assumes that the initiating event is within the design basis and is considered to be Extremely Unlikely. The scenario assumes that the leak is detected within 2 hour and would spill 101,000 L (27,000 gal) of waste to the ground surface. Respirable material is released from the pool at a rate of 4.0 x 10-6/hr and from the saturated ground at a rate of 3.6 x 10-7/hr. The total amount of respirable material released in 24 hours is 1.24 L (0.33 gal). A total of 0.659 L (0.174 gal) would be released during an 8-hour work shift.

F.3.2.2 Spray Releases

- Spray releases and accidents are less likely in the RCSTS diversion box(es) than in existing process pits since the diversion boxes use welded stainless steel piping instead of jumpered steel piping. Also, the system design makes it less likely that aerosol will be sprayed directly to the atmosphere. However, since the RCSTS would operate at much higher pressures than existing transfer piping, potential releases are correspondingly larger.

Information on unmitigated and mitigated RCSTS spray releases and accidents from Cross-Site Transfer System Preliminary Safety Analysis Report (WHC 1995c) is discussed in the following paragraphs.

- Unmitigated Spray Release - The unmitigated spray release accident assumes that a valve in a RCSTS diversion box fails creating a 3 cm (1.2 in) by 0.15 mm (0.006 in) crack. The transfer system pressure is assumed to be 2,000 psig. It is also assumed that there are no additional barriers to prevent release, that is, the diversion box is open to the sky. Respirable material is assumed to be released at the rate of 0.231 L/s (0.06 gal/s) which, in an 8-hour release produces 6,700 L (1,800 gal) of respirable material (WHC 1995c). A release of this magnitude would be expected to have catastrophic consequences. No frequency was provided for the scenario.

  To assign an accident frequency estimate to the RCSTS unmitigated spray release, an event sequence was developed which reflects the unique design features of the RCSTS diversion boxes. These features provide access for all routine maintenance and inspection functions through an access corridor with a 90-degree turn and doors at each end. The lower door opens into a shield baffle within the diversion box and is entirely below grade. This geometry eliminates the possibility of the release of a spray directly to the atmosphere via this route. A route would exist if it were necessary to replace heavy equipment such as a pump. A relatively small removable shield block located in the roof of the diversion box directly over the pump would need to be removed to allow use of a crane to remove and replace the defective component. If the block were not replaced before operations resumed, a direct path to the atmosphere would exist and an unmitigated spray release could occur should a valve or weld subsequently fail.

  The frequency that the shield block would need to be removed can be estimated from failure data for large pumps in a chemical environment (WHC 1995d). The overall failure rate is estimated to be 6.0 x 10-5/hr with 8.5 percent of these failures being catastrophic. Thus the frequency of a failure requiring replacement is 5.1 x 10-6/hr. It is assumed that there is a 0.1 percent chance that the blocks would not be replaced before resuming operations. The failure rate of a valve in an RCSTS diversion box (WHC 1995c) is 3.5 x 10-6/hr and there are approximately 12 valves in a diversion box. Assuming 24-hour operation, the frequency of an RCSTS unmitigated spray release is 1.9 x 10-9/yr and not reasonably foreseeable.

- Mitigated Spray Release - The mitigated spray release scenario differs from the unmitigated case in that it assumes that the diversion box is closed. This requires that doors in the entry stairwell be closed, that the small cover block(s) be in place, and that a small penetration to allow connection of a portable exhauster be closed.

It is assumed that the confined spray saturates the air inside the diversion box with vapor at a loading of 100 mg/m3 (6 x 10-6 lbs/ft3). This saturated air is assumed to be forced out of the diversion box by the combination of the rise in humidity due to evaporation and the accumulation of bulk liquid in the box. The estimated total release is 0.0075 L (.002 gal) in the 8 hours assumed to elapse before the leak is detected. Approximately 40 percent of this release occurs in the first 20 seconds. The frequency of this event for a RCSTS consisting of four diversion boxes and operating 643 hr/yr is 0.11/yr (WHC 1995c). Current plans are to construct only one diversion box which reduce the frequency to 0.03/yr. In either case, the mitigated spray scenario is an anticipated event.

This scenario does not consider the presence of leak and radiation detectors which could limit the duration of the release; however, based on the modeling of evaporative release, they reduce the release only by about one-half. On the non-conservative side, drawings (e.g., H-2-822231), (WHC 1995c) show a HEPA filter that appears to draw from the entry stairwell and exhaust into the diversion box. The flow rate of this filter could not be found but could be considerably higher than the 0.187 m3/min (6.6 ft3/min) assumed for the vapor release rate.

F.4 ABOVE-GROUND CROSS-SITE TRANSFER

This evaluation considers two options for above-ground cross-site transfer of high-level tank wastes from the 200 West Area. The first option is the use of tanker trailer trucks. Two tanker sizes are considered: 3,800 L (1,000 gal) and 19,000 L (5,000 gal). Accidents associated with the movement of loaded tanker trailer trucks are discussed in Section F.4.1. The second option for above-ground cross-site transfer of high-level tank waste from the 200 West Area is the use of 38,000 L (10,000 gal) rail tanker cars. Accidents associated with the movement of loaded rail tanker cars are discussed in Section F.4.2. Either of these above-ground transfer options would require construction and operation of new HLW load and unload facilities in the 200 East and 200 West Areas to process the HLW in the tankers. Accidents at these facilities are discussed in Section F.4.3.

F.4.1 TANKER TRAILER TRUCKS

This section discusses accidents that could occur while using tanker trailer trucks to transport of HLW between the 200 East and West Areas. Two types of tanker trailer trucks are considered. The LR-56(H) Cask System is licensed and operated in France as a Type B quantity package for radioactive liquids and has a capacity of approximately 3,800 L (1,000 gal) (WHC 1994h). The second tanker trailer truck has a capacity of 19,000 L (5,000 gal). No tanker of this size currently exists for the transport of HLW; however, a shielded 19,000-L (5,000-gal) tank truck has been used to transport high activity LLW at the Savannah River Site. It is assumed that neither the LR-56(H) nor the 19,000-L (5,000-gal) tanker trailer truck would be licensed as Type B packages for use in the United States.

The movement of vehicles carrying radioactive materials is more strictly controlled on the Hanford Site than on public roadways. This control includes:

- Speed restrictions - Vehicles transporting HLW are limited to 40 kmph (25 mph) under good conditions and 16 kmph (10 mph) under icy, snowy, and reduced visibility conditions.
- Escorts required - Escorts accompany the vehicle to monitor road conditions, control local traffic, and control proximity of other vehicle to the transport vehicle. When appropriate, roads would be closed.

This evaluation does not specifically address whether either of these tanker trailer trucks meet equivalent safety requirements at the Hanford Site. Such a determination would be made based on a SARP. A SARP has not been prepared for either the LR-56(H) or 19,000-L (5,000-gal) package. Packaging design criteria have been developed for the slightly modified LR-56(H) planned for use at Hanford (WHC 1994h).

The following initiating events are postulated for potential releases during truck transport of HLW on the Hanford Site:

- In-transit punctures
- Fire-induced breaches
- Collisions and rollovers

- Criticality.

The frequencies of these initiating events, the likelihood that they would result in the release of package contents, and the quantity of material released are discussed in the following sections.

F.4.1.1 In-Transit Punctures

- Objects thrown up by passing vehicles, propelled by wind or near-by explosions, or deliberately directed projectiles could strike the tanker trailer truck during transit. Both International (IAEA Safety Series No. 6, Regulations for the Safe Transport of Radioactive Material, 1985 Edition) and DOE regulations (DOE/RL Order 5480.3, Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes) contain the same requirement regarding puncture of Type B packages. The package must withstand without failure a free drop through a distance of 1 m (40 in) onto the top end of a vertical cylindrical mild steel bar mounted on an essentially unyielding horizontal surface and striking in a position for which maximum damage is expected.

Although the French LR-56(H) met this requirement, a separate demonstration would be required for Type B certification in the United States. The ability of the larger and yet undesigned 19,000 L (5,000 gal) tanker to meet this requirement is unknown. Certification is not required if the tankers are not transported by public conveyance and if equivalent safety can be demonstrated (DOE 1985). The accident scenarios discussed in Section F.4.1.3 bound any reasonably foreseeable puncture scenarios.

F.4.1.2 Fire Induced Breaching

- A fire of sufficient energy and duration to cause the breaching of an LR-56(H) Cask System or a 19,000-L (5,000-gal) HLW package in the absence of the collisions and rollovers discussed in Section F.4.1.3 is considered to be extremely unlikely. Based on statistics for trucks over 4,000 kg (8,500 lb) operated on the Hanford Site, the frequency of a random fire (one not associated with a collision or rollover) is 6.5 x 10-10/km (1.04 x 10-9/mi) (WHC 1993c). The contribution of random truck fires is considered in Section F.4.1.3.

F.4.1.3 Collisions and Rollovers

- Collisions and rollovers could lead to release of the contents of the LR-56(H) or 19,000-L (5,000-gal) tanker trailer truck, particularly if a fire also occurred. A previous analysis concluded that only accidents involving uncontrolled fires and rollovers would result in the release of radioactive materials from packages transported by truck. The frequencies of these types of accidents have been estimated from Hanford Site accident report data for trucks with gross vehicle weights over 4,000 kg (8,500 lb) (Wilson 1992, WHC 1993c) and are summarized in Table F-9. The total frequency of events that could result in release of radioactive materials is 2.7 x 10-9/km (4.3 x 10-9/mi). The frequency of truck accidents in the State of Washington is 2.62 x 10-7/km (4.2 x 10-7/mi). Based on data presented in NUREG/CR-4829, Shipping Container Response to Severe Highway and Railway Accident Conditions, a similar analysis of transportation of Hanford radioactive materials concluded that only 0.6 percent of these accidents would result in a release (WHC 1994i). This corresponds to a release frequency of 2.5 x 10-9/mi.

Table F-9
Accident Frequencies for Trucks at the Hanford Site

Accident Initiator	Result	Frequency (/mile)	(/kilometer)
Random Fire	Uncontrolled Fire	1.04 x 10-9	6.46 x 10-10
Collision	Uncontrolled Fire	6.27 x 10-11	3.90 x 10-11
Rollover, Good Road	Uncontrolled Fire	2.38 x 10-11	1.48 x 10-11
Rollover, Harsh Road	Breach, No Fire	3.10 x 10-9	1.93 x 10-9
Rollover, Harsh Road	Breach, Fire	3.77 x 10-11	2.34 x 10-11
Total		4.26 x 10-9	2.65 x 10-9

Source: Wilson 1992

Both sets of frequency data include radioactive material packages ranging from strong tight containers to Type B fissile containers. In the period 1971 through 1982, 45 Type B packages survived transportation accidents with no package failure and no release of radioactive materials (SNL 1984). Although the trucks considered here would transport Type B quantities, the transport packages cannot be assumed to meet Type B package requirements.

To estimate the frequency of accidents for the two tanker trailer truck options, a total frequency of an accident resulting in release of any radioactive material is assumed to be 4.3 x 10-9/mi, the more conservative of the two estimates. The distance between the SY and A Tank Farms, the assumed locations of the HLW load and unload facilities, is 10.7 km (6.5 mi) (WHC 1995e). Based on this distance, the frequency of an accident releasing any radioactive material would be 2.8 x 10-8 per trip.

The quantity of material released is assumed to be a function of the severity of the accident. Fractional release frequencies of rail accidents (WHC 1993d) are shown in Table F-10 and are considered to be applicable to truck accidents. Of those accidents resulting in any release, 27.9 percent release less than 1 percent of the contents, 24.5 percent release 90 to 100 percent of the contents. No other release fraction interval accounts for more that 4 percent of the total release frequency. The 100 percent release accident is therefore used as the basis of evaluated tanker trailer truck accidents. The frequency of this accident is 6.8 x 10-9 per trip.

Table F-10
Fractional Release Frequencies for Rail Accidents

Percent Released	Frequency/mile
0.0001 - 0.99	6.70 x 10-9
1.00 - 9.999	2.39 x 10-10
10 - 19.999	6.45 x 10-10
20 - 29.999	7.09 x 10-10
30 - 39.999	7.09 x 10-10
40 - 49.999	6.45 x 10-10
50 - 59.999	8.38 x 10-10
60 - 69.999	5.80 x 10-10
70 - 79.999	2.58 x 10-10
80 - 89.999	7.74 x 10-10
90 - 100	5.89 x 10-9
Total	2.4 x 10-8

Source: WHC 1993d, Appendix 6.4.

Table F-11 shows the total probability and quantity of respirable material released during accidents in which 100 percent of the tanker contents is lost for each of the types of high-level tank waste considered in this EIS. The amount of respirable material released is based on the assumption that the entire contents are spilled on the ground and that the area remains uncovered for 24 hours. During the first hour, the spill forms a pool that releases material at the rate of 4.0 x 10-6/hr. The spill then sinks into the ground but keeps the area wet. During this phase, respirable radioactive material is released at the rate of 3.6 x 10-7/hr. Workers are assumed to be exposed for one shift (8 hour). The public is exposed until the spill area is covered.

F.4.1.4 Criticality

- The LR-56(H) Cask System and 19,000-L (5,000-gal) tanker trailer truck, and the contents allowed in them, would be required to meet the subcriticality requirements of DOE/RL Order 5480.3 for hypothetical accident conditions. Analyses are required to demonstrate that criticality is not a credible event. Criticality analyses routinely use extremely

Table F-11
Summary of Maximum Accident Releases from Transport Vehicles During Cross-Site Transfers

Accident Scenario	Frequency of Complete Loss of Contents	Exposure Duration (hr)	Respirable Volume Released (L)
LR-56(H) Tank Breach	6.8 x 10-9/trip	On-site 1	0.0151

SWL	2.9 x 10-5	7	0.0095
102-SY Supernatant	4.7 x 10-6		0.0246
101-SY (1:1 Dilution)	1.5 x 10-5		
	4.9 x 10-5		
		Off-site 1	0.0151
		23	0.0313
			0.0464
5,000 Gal Tank Truck Breach	6.8 x 10-9/trip	On-site 1	0.0756
SWL	5.7 x 10-6	7	0.0476
102-SY Supernatant	9.4 x 10-7		0.123
101-SY (1:1 Dilution)	3.0 x 10-6		
	9.6 x 10-6		
		Off-site 1	0.0756
		23	0.156
			0.232
Rail Tank Breach	5.7 x 10-8/trip	On-site 1	0.152
SWL	2.4 x 10-5	7	0.0955
102-SY Supernatant	3.9 x 10-6		0.248
101-SY (1:1 Dilution)	1.3 x 10-5		
	4.1 x 10-5		
		Off-site 1	0.152
		23	0.314
			0.466

conservative bounding conditions (such as ideal moderation, perfect reflection of neutrons at the boundaries, and optimum geometry. Mechanisms that could segregate fissionable isotopes from the rest of the liquid waste (e.g., settling, chemical or thermally induced precipitation out of solution, unintended filtering effects) would be evaluated. Administrative controls would be established to limit the quantities of fissionable materials. Sampling would be performed as necessary to ensure that administrative controls are being met.

Hanford Site high-level tank wastes have been found to be highly subcritical because of the relatively high concentrations of neutron absorbers to Pu in the wastes (WHC 1994c). Since it is very likely that the high-level tank wastes that would be transported by tanker trailer truck would be highly subcritical, no criticality accident scenarios have been developed.

F.4.2 RAIL TANK CARS

This section discusses accidents that could occur while using a 38,000-L (10,000-gal) rail tanker car to transport high-level tank waste from the 200 West to the 200 East Area. The tanker car has not been designed for HLW at Hanford but is assumed to be a heavily-shielded, double-wall steel tank. A shielded 19,000-L (5,000-gal) rail tank car is used to transport high activity LLW at the Savannah River Site.

This evaluation does not address whether this type of HLW transport package can be designed or will meet Hanford equivalent safety requirements. The latter determination would be made based on a SARP.

The movement of rail cars carrying radioactive materials at the Hanford Site is strictly controlled (WHC 1993d). Controls include:

- Train speed is limited to 6 kmph (4 mph) while coupling.
- Speed is limited to maximum of 40 kmph (25 mph). Speed is limited to 16 kmph (10 mph) on paved road crossings, during icy or snowy conditions, and when visibility is limited. Speed is limited to 8 kmph (5 mph) on rail spurs.
- Patrol blockages are established to stop traffic at paved road crossings.
- At least one spacer car is required on either side of the HLW tank car.
- At least one person in the locomotive cab must keep the cars under observation at all times.

These controls would reduce the likelihood and consequences of rail car accidents.

The frequencies of these initiating events, the likelihood that they would result in the release of container contents, and the quantity of material released are discussed in the following sections.

The following initiating events are postulated for potential releases during rail car transport of SWLs or 200 West Area facility wastes on the Hanford Site:

- In-transit punctures
- Fire-induced breaches
- Collisions and Derailments
- Criticality.

F.4.2.1 In-Transit Punctures

- In-transit punctures could conceivably occur if a piece of broken rail were thrown up by the car wheels. Due to the limited train speeds, the energy of such an object would be low. Track maintenance and routine and pre-transfer track inspections would keep the tracks clear of spikes and rail debris and, in general, greatly minimize the likelihood of a puncture event. A misaligned coupler with another rail car could also conceivably cause a puncture, but with minimum coupling operations and with the use of automatic hood-and-shelf type couplers such an event would essentially be precluded.

F.4.2.2 Fire-Induced Breaches

- A fire of sufficient energy and duration to cause the breaching of a rail tank car designed to transport HLW is considered to be extremely unlikely if the fire is not related to derailment or a collision. Track crews currently spray weed killer at least once every 2 years in a 3 m (10 ft) swath on either side of the centerline of the tracks, thus decreasing the possibility of a vegetation fire next to the tracks. Loose tumbleweeds are removed as necessary. To minimize the potential impact from the diesel fuel of the locomotive catching on fire at least one railroad spacing car would be placed between the engine and the HLW rail tank car.

F.4.2.3 Collisions and Derailments

- Collisions or derailments could cause loss of the integrity of the HLW rail tanker car. In view of speed limitations and requirements for blockades at road crossings only, collisions involving derailments or fires are considered to be credible initiating events. Derailment is considered to be the most likely of the potential initiating events (WHC 1993d). The SARP for the rail tank cars used to transport LLW at the Hanford Site includes frequencies and release fractions. These data are shown in Table F-11 and are based on national rail statistics with adjustments to reflect the more controlled and safer transport conditions within the Hanford Site. The total frequency of a rail accident that would result in any release of radioactive materials is 1.5 x 10-8/km (2.4 x 10-8/mi). The entire contents are lost with a frequency of 3.7 x 10-9/km (5.9 x 10-9/mi). The distance by rail between the A and SY Tank Farms, the assumed locations of the HLW load and unload facilities, is 15.5 km (9.7 mi). The frequency of any accidental release 2.3 x 10-7/trip and 5.7 x 10-8/trip for a total loss of contents. Table F-11 shows the probability of an accident involving complete loss of the rail tanker car contents for each type of high-level tank waste considered in this EIS and the amount of respirable material that would be released. The amount of respirable material released is based on the assumption that the entire contents are spilled on the ground and that the area remains uncovered for 24 hours. During the first hour, the spill forms a pool that releases material at the rate of 4.0 x 10-6/hr. The spill then sinks into the ground but keeps the area wet. During this phase, respirable radioactive material is released at the rate of 3.6 x 10-7/hr. Workers are assumed to be exposed for one shift (8 hours). The public is exposed until the spill area is covered.

F.4.2.4 Criticality

- The HLW rail tanker car and its contents would be required to meet the subcriticality requirements or DOE/RL Order 5480.3 for hypothetical accident conditions. Analyses are required to demonstrate that criticality is not a credible event. Criticality analyses routinely use extremely conservative bounding conditions (such as ideal moderation, perfect reflection of neutrons at the boundaries and optimum geometry). Mechanisms that could segregate fissionable isotopes from the rest of the liquid waste (e.g., settling, chemical or thermally induced precipitation out of solution, unintended filtering effects) would be evaluated. Administrative controls would be established to limit the quantities of fissionable materials. Sampling would be performed as necessary to ensure that administrative controls are being met.

Hanford Site high-level tank wastes have been found to be highly subcritical because of the relatively high concentrations of neutron absorbers to Pu in the wastes (WHC 1994c). Since it is very likely that the high-level tank waste transported in the HLW rail tank car would be highly subcritical, no criticality accident scenarios are developed.

F.4.3 LOAD AND UNLOAD FACILITIES

High-level waste load and unload facilities would be designed to protect both workers and the general public from the hazards associated with the loading and unloading of the tanker trailer trucks and rail tank cars. Design criteria for a load and unload facility would comply with the following DOE orders:

- DOE Order 6430.1A, General Design Criteria
- DOE Order 5820.2A, Radioactive Waste Management
- DOE Order 5480.28, Natural Phenomena Hazards Mitigation.

Compliance with these DOE orders assures that adequate accident related preventive and mitigative measures would be considered during the design of the load and unload facilities. Furthermore, such a facility would not be allowed to begin operations until a Final SAR, prepared in accordance with the extensive requirements of DOE Order 5480.23, Nuclear Safety Analysis Reports, has been approved by the appropriate authorities.

The load and unload facilities would accommodate rail tanker cars, tanker trailer trucks, or both depending on the option selected. The facility would be similar in concept to the existing 204-AR facility for unloading of low-level waste but would differ considerably in design and operation to accommodate handling of HLW liquids. Some of the features that would distinguish the HLW load and unload facilities from the 204-AR facility include (WHC 1993c):

- Placement of pumps and valves in shielded cells equipped with remotely operated controls

- Drive-through bays to eliminate backing of transport vehicles

- Remotely-operated fill/drain lines and vent lines

- Heavily-shielded bay access doors

- Differential pressure zones in the HVAC system to isolate areas based on expected level of contamination with dual stage HEPA filtration in contaminated zones.

Three categories of initiating events are often examined in the performance of an accident safety analysis: operational events, natural phenomena, and external events. Each category of initiating event is capable of resulting in different types of accidents (e.g., fires and spills). Accident scenarios induced by seismic events and high winds or tornadoes have often received the most attention in the performance of safety analyses. External events include the crashing of aircraft and energetic (i.e., accident) events at facilities located near the facility being evaluated. An examination of transportation routes and facilities around likely potential sites for an HLW load and unload facility in the 200 Areas revealed no sources that could provide the necessary energy to cause an accident scenario more severe than those postulated in the following sections. Though not methodically evaluated, an accident at an HLW load and unload facility induced by nearby transportation routes and/or facilities is considered to be extremely unlikely.

Accident analyses specific to the HLW load and unload facilities are not yet available. For purposes of this evaluation, scenarios for the following accident categories are considered:

- Spills
- Spray releases
- Fires.

The frequency of occurrence and quantities of respirable material released during these accident events are summarized in Table F-12. These accident categories are further discussed in Sections F.4.3.1, F.4.3.2, and F.4.3.3, respectively. Other accident scenarios could be postulated, but their consequences would likely be relatively small and limited to local contamination and to in-facility workers. Examples of such accidents include

Table F-12

Summary of Accident Releases for the HLW Load and Unload Facilities

Accident Scenario	Frequency/100 Tankers	Exposure Duration (hr)	Respirable Volume (L)
Loading/Unloading Spill	Anticipated to Unlikely	On-site 0.5	0.00568
		Off-site 0.5	0.00568
LR-56(H) Earthquake Breach	3.2 x 10-5 Extremely Unlikely	On-site 8	2.53
		Off-site 12	3.79
5,000 Gal Tank Truck Earthquake Breach	3.2 x 10-5 Extremely Unlikely	On-site 8	12.6
		Off-site 12	18.9
Rail Car Tank Earthquake Breach	3.2 x 10-5 Extremely Unlikely	On-site 8	25.2
		Off-site 12	37.9

Source: WHC 1991

overflow of a catch tank located in a pit, containment breach during changeout of a HEPA filter, and loss of off-site power (LOOP). Regarding LOOP, a standby generator would be provided to power key loads in the event of a LOOP. If the standby generator also failed, then an uninterruptible power supply would provide power to essential items such as emergency lights and fire monitoring and alarm components. LOOP and failure of the standby generator would result in loss of the differential pressure zones previously discussed.

F.4.3.1 Spills

- Various hardware failures or human errors could lead to a spill within the HLW load and unload facilities. Leaks could occur in pipes, valves, pumps, and connectors due to mechanical failure or human error. Holding tanks, catch tanks, or the transport tanker could fail or be overfilled. A BDBE could also cause spills, either by damaging facility components or by rupture of a loaded transport vehicle. Small leaks up to 38 L (10 gal) are categorized (WHC 1994j) as anticipated events, and larger spills up to 1,900 L (500 gal) are categorized as unlikely. A DBE (0.25 g) has a frequency of 4 x 10-4 to 1 x 10-3/yr (WHC 1991). Frequencies and released quantities of waste are shown in Table F-12.

The safety assessment for the 204-AR facility considered a spill during filling of a tank car (WHC 1991). It was assumed that a gasket failed during filling at 757 L/min (200 gpm) and 10 percent of the flow spilled to the floor over a 30-minute period. The frequency of the spill was estimated at 2.7 x 10-2/yr based on a failure rate of 3 x 10-6/hr for each of 23 gaskets in a facility requiring 4 hours to fill each of 100 rail cars. Although a quantitative estimate cannot be made without design information, it is reasonable to expect that the frequency would be less at the HLW load and unload facilities. It was assumed that 0.1 percent of the spill became airborne and that each stage of a two-stage HEPA filter removed 99.95 percent of the material. The resulting quantity of respirable material released is 0.00568 L (0.0015 gal) with a corresponding frequency of anticipated to unlikely. The monitoring and alarm systems common to facilities of this type at the Hanford Site would be expected to reduce both the frequency and consequences of this spill.

An earthquake-induced spill was analyzed for the 204-AR facility (WHC 1991). The frequency of the DBE was taken as 7 x 10-4/yr and it was assumed that 100 tankers per year were processed at the rate of 4 hour/tanker. The frequency of the accident is therefore 3.2 x 10-5/yr. It was assumed that the entire contents of the transport vehicle were spilled to the ground and not covered for 12 hours. During this time, 0.001 of the spill was assumed to become airborne. The corresponding amounts of respirable liquid released from each of the different transport vehicles is shown in Table F-12. The frequencies assume 100 tankers/year, 4 hours per tanker regardless of vehicle capacity.

F.4.3.2 Spray Releases

- The same mechanisms that cause leakage can also cause spray releases (e.g., failure of pipes, valves, pumps, and connections between them). A spray leak is an anticipated event. The frequency and magnitude of any resultant release is difficult to assess without design information. The magnitude of the release would probably be less than those for mitigated spray leaks postulated for other proposed facilities such as the RCSTS and NTF. The frequencies could be somewhat higher since new connections must be made each time a vehicle is loaded or unloaded. Spray releases at the HLW load and unload facilities are considered to be bounded by the spill scenario discussed in Section F.4.3.1 due to the large fractional release assumed for respirable material.

F.4.3.3 Fires

- Mechanisms for a fire at an HLW load and unload facility are extremely limited. There would be very little combustible material in the load/unload bay, and throughout the facility in general. The likelihood of electrical fires would be minimized by the use of industry accepted electrical system design standards, which include the use of overcurrent and short circuit protection devices. Further electrical fires, with no significant fuel supply, are not significant. Lightning protection equipment would also be installed in accordance with applicable industry standards. An aircraft crash at an HLW load and unload facility could lead to a fire scenario. However, the total frequency of aircraft accidents (due to all types of aircraft) at the postulated NTF in the 200 Areas is less than 1 x 10-7/yr (WHC 1994b). Accordingly, accidents in the HLW load and unload facilities due to fires are considered to be bounded by the transportation accidents considered in Section F.3.

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DRAFT NOTICE OF AVAILABILITY

DEPARTMENT OF ENERGY

Final Environmental Impact Statement for the Safe Interim Storage of Hanford Tank Wastes at the Hanford Site, Richland, Wa.

AGENCY: Department of Energy.

ACTION: Notice of Availability

SUMMARY: The Department of Energy (DOE), Richland Operations Office is giving notice of the availability of the final environmental impact statement (EIS) for the Safe Interim Storage (SIS) of Hanford Tank Wastes (DOE/EIS-0212). The SIS EIS has been prepared jointly with the Washington State Department of Ecology (Ecology). The final EIS was prepared in accordance with the requirements of the National Environmental Policy Act of 1969 (NEPA); Council on Environmental Quality (CEQ) regulations implementing NEPA, 40 CFR parts 1500-1508; DOE NEPA Implementing Procedures, 10 CFR 1021; and the Washington State Environmental Policy Act (SEPA) (WAC 197-11 and RCW 43.21C). The final EIS addresses interim management strategies for continued safe storage of tank wastes performed under the Tank Waste Remediation System (TWRS) Program. Final disposal actions for Hanford tank wastes are being considered in the TWRS EIS, which is currently in the preliminary draft stage of preparation.

The final EIS has been distributed to interested parties, Federal and State agencies, and is available in DOE reading rooms and designated information locations which are identified in this notice. DOE plans to issue a Record of Decision on the final EIS in November 1995.

ADDRESSES: Requests for copies of the final EIS and for further information on the final EIS should be directed to:
Mr. Guy D. Schein
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U.S. Department of Energy
Richland Operations Office
P.O. Box 550, MS-A7-75
Richland, WA 99352
(509) 376-0413

Ms. Carolyn Haass
U.S. Department of Energy
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Richland,WA 99352
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Mr. Geoff Tallent
Washington State Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600
(360) 407-7112

Information on the DOE NEPA process may be obtained from:

Ms. Carol Borgstrom, Director
Office of NEPA Policy and Assistance (EH-42)
U.S. Department of Energy
1000 Independence Avenue SW.
Washington DC 20585
(202) 586-4600 or 1-800-472-2756.

SUPPLEMENTARY INFORMATION:

Background

DOE and Ecology issued a draft EIS for public comment and published a Notice of Availability in the Federal Register July 20th, 1994 (59 FR 39329). During the 45 day comment period, DOE held five public hearings in order to obtain public comments on the draft EIS. In addition, public comments were received by mail, a toll-free telephone line, and facsimile. The comments are summarized and responded to in Volume 2 of the final SIS

EIS.

Public comments on the draft EIS were assessed and considered both individually and collectively by DOE and Ecology. Some comments resulted in modifications to the EIS. Other comments were responded to with an explanation of why a change was not warranted. The majority of the responses answered or further explained technical issues comments, referred commentors to information in the EIS, explained the relationship of this EIS to other related NEPA documents, communicated government policy, or indicated that the comment was beyond the scope of this EIS. In generating the final EIS, DOE and Ecology considered all comments received on the draft.

During the preparation of the final SIS EIS, progress was made in the resolution of unacceptable flammable gas generation in Tank 101-SY, the principle safety issue evaluated in the draft EIS. An experimental mixer pump was introduced into Tank 101-SY to stir the contents and prevent the build up and sudden release of flammable gases. Based on several months of operational data, the mixer pump has been determined to successfully mitigate the unacceptable generation of flammable gases. As a result, DOE and Ecology have selected as part of their preferred alternative in the final EIS, continued operations of the mixer pump to resolve the safety issues in Tank 101-SY. Mixer pump operations would continue until final waste disposal decisions are reached and implemented through the TWRS EIS. The preferred alternative evaluated in the draft SIS EIS, which included retrieval and dilution of Tank 101-SY into newly constructed double shell tanks, remains in the final EIS as a technical alternative to mixer pump operations, although the number of new tanks has been reduced from six to two based on further studies of required dilution.

Based on public comments, the purpose and need statement of the final SIS EIS was broadened to specifically include all aspects of waste management required prior to the implementation of disposal decisions under the TWRS EIS. The final EIS recognizes four specific areas of waste management requiring interim actions.

- Removal of salt well liquids (SWLs) from old single shell tanks to reduce the likelihood of leaks
- Establishment of new cross-site waste transfer capability through systems compliant with current regulations for interim storage in compliant double shell tanks
- Maintenance of adequate tank storage capacity for future waste
- Mitigate hydrogen generation in Tank 101-SY

These waste management activities form the basis for the purpose and need statement of the final SIS EIS.

Alternatives

The alternatives evaluated in the final SIS EIS have been modified from those evaluated in the draft EIS to reflect the changes made to the purpose and need statement, and reflect the range of alternatives available to the agencies to safely manage high level tank wastes until final disposal decisions are made and implemented. The alternatives evaluated in the final EIS include:

Preferred Alternative - The preferred alternative would continue retrieval of SWLs, and operation of the existing mixer pump in Tank 101-SY. It would construct and operate a new pipeline system, termed the replacement cross-site transfer system (RCSTS), and a retrieval and transfer system in Tank 102-SY. The existing cross site transfer system (ECSTS) would continue to be used until the RCSTS becomes operational or the ECSTS is no longer operational.

Truck Transfer Alternative - The truck transfer alternative would also continue to retrieve SWLs, but would transfer wastes utilizing truck tankers instead of pipelines. the alternative would also include constructing and operating a high level radioactive waste load and waste unload facilities. This alternative would use existing roadways utilizing either a modified tanker trailer truck or a French truck the LR-56(H). The alternative would not construct or operate a retrieval system in Tank 102-SY. The continued long-term operation of the existing mixer pump in Tank 101-SY would mitigate its flammable gas safety concerns. The existing cross site transfer system would be utilized until the replacement system is operational.

Rail Transfer Alternative - The rail transfer alternative would be identical to the truck transfer alternative except wastes would be transported by rail instead of truck.

New Storage Alternative - The new storage alternative would continue SWL retrievals and transfer wastes through the RCSTS like the preferred alternative, but would resolve the safety issue of Tank 101-SY by retrieval and dilution instead of continued operation of the mixer pump. The alternative would construct and operate two new double-shell tanks and their associated facilities to receive the diluted wastes from Tank 101-SY, and install retrieval systems in Tanks 102-SY and 101-SY. The existing cross site transfer system would be utilized until the replacement system is operational.

No Action Alternative - The no action alternative would continued retrieval of SWLs and transfer wastes to the extent possible utilizing the ECSTS. No new transfer capability would be constructed at this time. Operation of the existing mixer pump in Tank 101-SY would continue to mitigate its flammable gas safety concerns. This alternative would not provide a transfer capability that is compliant with current Federal and State regulations.

Availability of Copies of the Final EIS:

Copies of the final EIS are being distributed to Federal, State, and local officials and agencies, organizations and individuals known to be interested in the EIS, and persons and agencies that commented on the draft EIS. Additional copies may be obtained by contacting Mr. Schein, Ms. Haass or Mr. Tallent at the above addresses. Copies of the final EIS, including appendices, reference material, comment letters, public hearing transcripts, and the DOE responses to comments, will be available for public review at the locations listed below.

The final EIS is separately bound in two volumes. Volume 1 contains the final EIS document and Volume 2 contains the Public Comment Response document.

DOE Public Reading Rooms

(1) U.S. Department of Energy, Headquarters, Freedom of Information Reading Room, 1E-190 Forrestal Building, 1000 Independence Avenue, SW., Washington DC 10585, (202) 586-6020, Monday-Friday: 9 a.m. to 4 p.m.

(2) U.S. Department of Energy, Richland Operations Office, Public Reading Room, Washington State University Tri-Cities, 100 Sprout Road, Room 130W, Richland, WA 99352, (509) 376-8583, Monday-Friday: 8 a.m. to 12 p.m. and 1 p.m. to 4 p.m.

(3) Suzzallo Library, SM25, University of Washington, Seattle, WA 98185, (206) 543-9158, Monday-Thursday: 7:30 a.m.to 12;00 p.m.; Friday: 7:30 a.m. to 6:30 p.m.; Saturday: 9:00 a.m. to 5 p.m.; Sunday: 12 p.m. to 12 midnight.

(4) Foley Center, Gonzaga University, East 502 Boone Avenue, Spokane, WA 99258, (509) 328-4220, Extension 3125.

(5) Portland State University, Branford Price Millar Library, SW., Harrison and Park, Portland, OR 97207, (503) 725-3690.

You may also receive a copy of the final EIS by calling the Hanford Cleanup Hotline toll-free 1-800-321-2008. If you have special accommodation needs, contact Michele Davis at (206) 407-7126 or (206) 407-7155 Telecommunications Device for the Deaf (TDD).

Signed in Richland, Wa this _____th day of ______1995, for the United States Department of Energy.

John D. Wagoner
Manager, U.S. Department of Energy,
Richland Operations Office