

# NEVADA TEST SITE



## ANNUAL SITE ENVIRONMENTAL REPORT FOR CALENDAR YEAR 2000 *October 2001*

*Prepared by Bechtel Nevada  
Post Office Box 98521  
Las Vegas, NV 89193-8521*

*Prepared for the  
U.S. Department of Energy  
National Nuclear Security Administration  
Nevada Operations Office  
Contract No. DE-AC08-96NV11718*

**Bechtel Nevada**

**NEVADA TEST SITE  
ANNUAL SITE ENVIRONMENTAL REPORT  
FOR CALENDAR YEAR 2000**

**August 2001**

**Work Performed Under  
Contract No. DE-AC08-96NV11718**

**Prepared for:**

**U.S. Department of Energy  
National Nuclear Security Administration  
Nevada Operations Office**

**Prepared by:**

**Bechtel Nevada  
Post Office Box 98521  
Las Vegas, Nevada 89193-8521**

## **DISCLAIMER**

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced directly from the best available copy.

Available for sale to the public from:

U.S. Department of Commerce  
National Technical Information Service  
5285 Port Royal Road  
Springfield, VA 22161-0002  
Telephone: (800) 553-6847  
Fax: (703) 605-6900  
E-mail: [orders@ntis.fedworld.gov](mailto:orders@ntis.fedworld.gov)  
Online ordering: <http://www.ntis.gov/ordering.htm>

Available electronically at <http://www.doe.gov/bridge>.

Available for a processing fee to the U.S. Department of Energy and its contractors, in paper, from:

U.S. Department of Energy  
Office of Scientific and Technical Information  
P.O. Box 62  
Oak Ridge, TN 37831-0062  
Telephone: (865) 576-8401  
Fax: (865) 576-5728  
E-mail: [reports@adonis.osti.gov](mailto:reports@adonis.osti.gov)

**NEVADA TEST SITE  
ANNUAL SITE ENVIRONMENTAL REPORT  
FOR CALENDAR YEAR 2000**

Editors: Yvonne E. Townsend and Robert F. Grossman

October 2001

Work Performed Under  
Contract No. DE-AC08-96NV11718

Prepared for:

U.S. Department of Energy  
National Nuclear Security Administration  
Nevada Operations Office

Prepared by:

Bechtel Nevada  
Post Office Box 98521  
Las Vegas, Nevada 89193-8521

This page intentionally left blank

---

# AUTHORS AND CONTRIBUTORS

## **1.0 Summary**

Donald M. Van Etten, BN  
Robert F. Grossman, BN

## **2.0 Introduction**

Brian Dozier, BN  
Robert F. Grossman, BN

## **3.0 Compliance Summary**

Elizabeth Calman, BN  
Colleen M. Beck, DRI  
Orin L. Haworth, BN  
Alfred J. Karnes, BN  
Patrick Matthews, BN  
Mike O'keefe, BN  
Phyllis M. Radack, BN  
Carlton Soong, BN  
Cathy A. Wills, BN

## **4.0 Environmental Program Information**

Brian Dozier, BN  
Daniel Levitt, BN  
Alfred J. Karnes, BN

## **5.0 Radiological Environmental Programs**

Robert F. Grossman, BN  
Dennis Hansen, BN  
William T. Hartwell, DRI  
Sigmund L. Drellack, BN

## **6.0 Nonradiological Environmental Programs**

Colleen M. Beck, DRI  
Elizabeth C. Calman, BN  
Alfred J. Karnes, BN  
Cathy A. Wills, BN

## **7.0 Site Hydrology**

Sigmund Drellack, BN

## **8.0 Groundwater Monitoring**

Lloyd Desotell, BN  
Daniel Levitt, BN  
William T. Hartwell, DRI

## **9.0 Quality Assurance**

Robert Elkins, BN

---

This page intentionally left blank

---

# ACKNOWLEDGEMENTS

The skill, dedication, and perseverance of Angela L. McCurdy in text processing and graphics support were crucial to the production of this report. Also, very crucial to the production of this report was the graphics support provided by Ashley V. Housewright.

---

This page intentionally left blank

# TABLE OF CONTENTS

	<u>Page</u>
Authors and Contributors .....	iii
Acknowledgements .....	v
Table of Contents .....	vii
List of Figures .....	xiii
List of Photographs .....	xiv
List of Tables .....	xv
Measurement Units and Nomenclature .....	xvii
List of Acronyms and Expressions .....	xix
1.0 Summary .....	1-1
1.1 Environmental Management .....	1-2
Radiological Environment .....	1-2
Onsite Environmental Surveillance .....	1-3
Monitoring System Design .....	1-4
Offsite Environmental Surveillance .....	1-4
Low-Level Waste Disposal .....	1-5
Nonradiological Monitoring .....	1-5
1.2 Compliance Activities .....	1-6
1.3 Groundwater Protection .....	1-7
1.4 Radioactive and Mixed Waste Storage and Disposal .....	1-7
1.5 Quality Assurance .....	1-8
1.6 Issues and Accomplishments .....	1-8
Principal Compliance Problems for 2000 .....	1-8
Accomplishments for 2000 .....	1-8
1.7 Conclusion .....	1-10
2.0 Introduction .....	2-1
2.1 NTS Site Characteristic .....	2-1
2.2 Topography and Terrain .....	2-3
2.3 Precipitation .....	2-3
2.4 Temperature .....	2-3
2.5 Wind .....	2-5
2.6 Evaporation .....	2-5
2.7 Geology .....	2-5
2.8 Hydrogeology .....	2-7
2.9 Ecology .....	2-7
2.10 Cultural Resources .....	2-8
2.11 NTS Nuclear Testing History .....	2-8
2.12 Surrounding Areas .....	2-9
2.13 Demography .....	2-9
2.14 Mission and Nature of Operations .....	2-9
2.15 Stockpile Stewardship .....	2-11
2.16 Environmental Management .....	2-11
2.17 Hazardous Materials Spill Center (HSC) .....	2-11
3.0 Compliance Summary .....	3-1
3.1 Compliance Status .....	3-1
National Environmental Policy Act .....	3-1
Clean Air Act (CAA) .....	3-2

	<u>Page</u>
NTS NESHAP Asbestos Compliance .....	3-2
Radioactive Emissions on the NTS .....	3-3
NTS Air Quality Permit Compliance .....	3-3
Non-NTS Operations .....	3-4
Clean Water Act .....	3-4
NTS Operations .....	3-4
Non-NTS Operations .....	3-5
Safe Drinking Water Act (SWDA) .....	3-5
NTS Operations .....	3-5
NTS Water Haulage .....	3-6
Non-NTS Operations .....	3-6
Resource Conservation and Recovery Act (RCRA) .....	3-6
NTS RCRA Compliance .....	3-6
Hazardous Waste Reporting for Non-NTS Operations .....	3-6
Underground Storage Tanks (USTs) .....	3-6
NTS Operations .....	3-6
Non-NTS Operations .....	3-7
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Superfund Amendments and Reauthorization Act (SARA) .....	3-7
Federal Facilities Agreement and Consent Order (FFACO) .....	3-7
Remedial Activities - Surface Areas .....	3-7
Emergency Planning and Community Right-To-Know Act (EPCRA) .....	3-10
Non-NTS Tier II Reporting Under SARA Title III .....	3-10
DOE Order 435.1 Radioactive Waste Management .....	3-10
State of Nevada Chemical Catastrophe Prevention Act .....	3-11
Toxic Substances Control Act (TSCA) .....	3-11
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) .....	3-11
Threatened and Endangered Species Protection .....	3-11
Historic Preservation .....	3-12
Migratory Bird Treaty Act .....	3-13
Executive Order (EO) 11988 Floodplain Management .....	3-13
Executive Order (EO) 11990 Protection of Wetlands .....	3-13
3.2 Agreements with States and Agencies .....	3-13
3.3 Current Environmental Compliance Issues and Actions .....	3-14
Clean Air Act (CAA) .....	3-14
Non-NTS Air Quality Permits .....	3-15
Clean Water Act (CWA) .....	3-15
Safe Drinking Water Act (SDWA) .....	3-15
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) .....	3-15
Pollution Prevention (P2) and Waste Minimization .....	3-16
Solid/Sanitary Waste .....	3-15
Radiation Protection .....	3-16
NTS Operations .....	3-16
Non-NTS BN Operations .....	3-17
Environmental Compliance Audits .....	3-17
Occurrence Reporting .....	3-17
Legal Actions .....	3-17
3.4 Permits For NTS Operations .....	3-17
4.0 Environmental Program Information .....	4-1

	<u>Page</u>
4.1 Routine Radiological Environmental Monitoring Plan .....	4-1
Air Monitoring .....	4-1
Surface Water .....	4-2
Groundwater .....	4-3
Water Supply Wells .....	4-3
Permitted Facilities Wells .....	4-4
Aquifer Monitoring .....	4-4
Vadose Zone Monitoring (VZM) .....	4-5
Biota Monitoring .....	4-6
NTS Chukar Sampling Sites .....	4-7
Direct Radiation Monitoring .....	4-7
4.2 Pollution Prevention and Waste Minimization .....	4-8
Employee and Public Awareness .....	4-8
Pollution Prevention Activities .....	4-8
Volume and Toxicity Reduction .....	4-10
Recycling Activities .....	4-10
4.3 Hazardous Materials Spill Center (HSC) .....	4-19
4.4 Radioactive Waste Management Sites .....	4-10
Disposal Activities .....	4-10
Storage Activities .....	4-11
4.5 Historic Preservation .....	4-12
4.6 Underground Test Area Project .....	4-12
4.7 Hydrologic Resource Management Program .....	4-14
Post-Shot Wells .....	4-14
Groundwater Quantity .....	4-15
Fallout Recharge Studies .....	4-15
Radiography Studies of Nuclear Debris .....	4-16
Environmental Isotope Studies .....	4-17
4.8 NTS Well and Borehole Plugging Plan .....	4-17
4.9 Industrial Sites Project .....	4-18
5.0 Radiological Environmental Programs .....	5-1
5.1 Air Surveillance Activities .....	5-1
Air Particulate Sampling .....	5-1
Gross Alpha and Beta Results .....	5-3
Plutonium Results .....	5-3
Americium Results .....	5-5
Gamma-Emitting Radionuclides .....	5-5
Tritium in Air .....	5-8
Tritium in Air Results .....	5-8
5.2 Environmental Dosimetry .....	5-12
Ambient Gamma Monitoring .....	5-12
Thermoluminescent Dosimeter Monitoring Data .....	5-12
5.3 Water Surveillance Activities .....	5-14
Containment Ponds .....	5-14
Sewage Lagoons .....	5-16
5.4 Biota Surveillance Activities .....	5-16
Vegetation Sampling .....	5-16
Animal Sampling .....	5-18
Results .....	5-20

---

	<u>Page</u>
5.5 Radiological Dose Assessment .....	5-21
Radioactive Emissions .....	5-22
Laboratory Sources .....	5-22
Area Sources .....	5-22
Offsite Radiological Dose Estimates .....	5-23
Dose from Airborne Emissions .....	5-23
Dose from Consumption of Wild Game .....	5-23
Total Offsite Dose to Maximally Exposed Individual (MEI) .....	5-23
Onsite Biota Doses .....	5-24
5.6 Community Environmental Monitoring Program .....	5-25
Data Collection and Dissemination .....	5-25
Community Environmental Monitors (CEMs) .....	5-28
CEMP Air Surveillance Network (ASN) .....	5-28
CEMP Thermoluminescent Dosimetry (TLD) Network .....	5-28
CEMP Pressurized Ion Chamber (PIC) Network .....	5-29
Analytical Results .....	5-29
Procedures and Quality Assurance .....	5-29
Standard Operating Procedures .....	5-29
Field Quality Assurance Samples .....	5-29
Laboratory Quality Assurance Samples .....	5-30
Air Sampling Results .....	5-30
Gross Alpha .....	5-30
Gross Beta .....	5-30
Gamma Spectroscopy .....	5-30
TLD Results .....	5-30
Pressurized Ion Chamber (PIC) Results .....	5-31
6.0 Nonradiological Environmental Programs .....	6-1
6.1 Water Surveillance .....	6-1
Safe Drinking Water Act (SDWA) .....	6-1
Bacteriological Sampling .....	6-1
Organic Compound Analysis .....	6-1
Metal Analysis .....	6-2
Other Inorganic Chemical Analysis .....	6-2
Inspections .....	6-2
6.2 Air Surveillance .....	6-2
Monitoring of NTS Operations .....	6-2
6.3 Ecological Monitoring .....	6-3
Habitat Mapping .....	6-3
Sensitive Species Monitoring .....	6-4
Sensitive Plants .....	6-4
Western Burrowing Owl .....	6-4
Bat Species of Concern .....	6-6
Wild Horses .....	6-7
Raptors .....	6-8
Monitoring Natural Water Sources .....	6-10
Monitoring Man-Made Water Sources .....	6-12
7.0 Site Hydrology .....	7-1
7.1 Surface Water .....	7-1
7.2 Groundwater .....	7-1

---

	<u>Page</u>
7.3 Hydrologic Modeling .....	7-5
7.4 Hydrogeologic Framework for the NTS and Vicinity .....	7-6
Hydrogeologic Units of the NTS Area .....	7-7
Hydrostratigraphic Units of the NTS Area .....	7-7
Lower Clastic Confining Unit (LCCU) .....	7-7
Lower Carbonate Aquifer (LCA) .....	7-7
Upper Clastic Confining Unit (UCCU) .....	7-8
Lower Carbonate Aquifer, Upper Thrust Plate (LCA3) .....	7-8
Mesozoic Granite Confining Unit (MGCU) .....	7-8
Tertiary and Quaternary Hydrostratigraphic Units .....	7-8
Alluvial Aquifer (AA) .....	7-8
Structural Controls .....	7-9
Hydraulic Properties .....	7-11
General Hydraulic Characteristics of NTS Rocks .....	7-11
Effect of Underground Nuclear Explosions on Hydraulic Characteristics .....	7-11
7.5 Hydrogeology of the NTS Former Test Areas .....	7-12
Frenchman Flat .....	7-12
Geologic Overview of Frenchman Flat .....	7-12
Hydrogeology Overview of Frenchman Flat .....	7-14
Water-level Elevation and Groundwater Flow Direction .....	7-15
Yucca Flat .....	7-15
Geology Overview of Yucca Flat .....	7-16
Hydrogeology Overview of Yucca Flat .....	7-17
Water-level Elevation and Groundwater Flow Direction .....	7-19
Pahute Mesa .....	7-20
Geology Overview of Pahute Mesa .....	7-20
Hydrogeology Overview of Pahute Mesa .....	7-22
Water-level Elevation and Groundwater Flow Direction .....	7-23
Rainier Mesa .....	7-23
Geology Overview of Rainier Mesa and Shoshone Mountain .....	7-24
Hydrogeology Overview of Rainier Mesa and Shoshone Mountain .....	7-24
Water-level Elevation and Groundwater Flow Direction .....	7-24
7.6 Conclusion .....	7-24
8.0 Groundwater Monitoring .....	8-1
8.1 Introduction .....	8-1
8.2 Groundwater Monitoring Analytes .....	8-5
8.3 Groundwater Monitoring Results .....	8-5
Tritium .....	8-5
Onsite Supply Wells .....	8-5
Onsite Monitoring Wells .....	8-6
Offsite Locations .....	8-8
Gross Alpha .....	8-9
Onsite Supply Wells .....	8-9
Drinking Water Endpoints .....	8-10
Onsite Monitoring Wells/Offsite Locations .....	8-10
Gross Beta .....	8-10
Onsite Supply Wells .....	8-10
Onsite Monitoring Wells/Offsite Locations .....	8-12
Gamma Spectroscopy .....	8-12

---

	<u>Page</u>
Radium .....	8-12
Plutonium .....	8-12
Strontium .....	8-12
8.4 Summary of Groundwater Monitoring .....	8-13
8.5 Groundwater Monitoring Oversight Activities .....	8-13
Community Environmental Monitoring Program-Water Monitoring Project .....	8-13
Sample Locations .....	8-13
Procedures and Quality Assurance .....	8-13
Tritium Results .....	8-14
Gross Alpha, Gross Beta, Gamma Spectrum and Plutonium Results .....	8-15
8.6 Summary of Groundwater Monitoring Oversight Activities .....	8-15
8.7 Vadose Zone Monitoring .....	8-15
9.0 Quality Assurance .....	9-1
9.1 Policy .....	9-1
9.2 Overview of the Laboratory QA Program .....	9-1
9.3 Measurement Quality Objectives (MQO's) .....	9-2
Representativeness .....	9-2
Comparability .....	9-3
Precision .....	9-3
Accuracy .....	9-3
Blank Analysis .....	9-3
Interlaboratory Comparison Studies .....	9-4
9.4 Results for Duplicates, Laboratory Control Samples, Blank Analysis, and Interlaboratory Comparison Studies .....	9-4
Duplicates (Precision) .....	9-5
Laboratory Control Samples (Accuracy) .....	9-5
Blank Analysis .....	9-5
Interlaboratory Comparison Studies .....	9-5
9.5 Estimates of Data Quality .....	9-6
References .....	R-1
Distribution List .....	D-1

# LIST OF FIGURES

	<u>Page</u>
Figure 2.1	Nevada Test Site Location in Nevada . . . . . 2-2
Figure 2.2	Nevada Test Site Operational Areas, Principal Facilities, and Testing Areas . 2-4
Figure 2.3	Annual Climatological Wind Rose Patterns for the Nevada Test Site - 2000 . . 2-6
Figure 2.4	Land Use Around the Nevada Test Site . . . . . 2-10
Figure 5.1	Air Sampling Network on or near the Nevada Test Site - 2000 . . . . . 5-2
Figure 5.2	Time Series Plot of Alpha for ASL and GEL - 2000 . . . . . 5-4
Figure 5.3	Time Series Plot of Beta - 2000 . . . . . 5-4
Figure 5.4	Time Series Plot of Plutonium in Air - 2000 . . . . . 5-6
Figure 5.5	Time Series Plot of Plutonium vs Alpha - 2000 . . . . . 5-6
Figure 5.6	Trend in Annual Averages for <sup>239+240</sup> Pu Concentrations . . . . . 5-7
Figure 5.7	Time Series Plot for <sup>239+240</sup> Pu Annual Averages . . . . . 5-7
Figure 5.8	Time Series Plot of <sup>241</sup> Am in Air All Location - 2000 . . . . . 5-8
Figure 5.9	Time Series Plot of Tritium in Air - 2000 . . . . . 5-10
Figure 5.10	Time Series Plot of HTO vs Temperature . . . . . 5-10
Figure 5.11	Time Series Plot of HTO vs Precipitation - 2000 . . . . . 5-11
Figure 5.12	Trend in Annual Averages for HTO Concentrations Onsite . . . . . 5-11
Figure 5.13	Time Series Plot for Tritium in Air on the NTS . . . . . 5-12
Figure 5.14	Historical Time Series of Boxplots of TLD exposures . . . . . 5-14
Figure 5.15	Surface Water Sampling Locations on the Nevada Test Site - 2000 . . . . . 5-15
Figure 5.16	Nevada Test Site Onsite Surface Biota Radiological Monitoring Sites - 2000 . . . . . 5-17
Figure 5.17	View of the SEDAN Sampling Site about 100 m West of the Lip of the Crater where Plants were Sampled during October 2000 . . . . . 5-19
Figure 5.18	Closeup View of Vegetation (Rubber Rabbitbrush) Sampled at SEDAN about 100 m West of the Crater Edge during October 2000 . . . . . 5-19
Figure 5.19	CEMP, MET, PIC and Air Sampling Sites on or near the Nevada Test Site . . 5-26
Figure 5.20	The CEMP Station at Beatty, Nevada . . . . . 5-27
Figure 6.1	Location of Known Owl Burrows on the Nevada Test Site - 2000 . . . . . 6-5
Figure 6.2	Feral Horse Sightings and Horse Sign Observed on the Nevada Test Site - 2000 . . . . . 6-9
Figure 6.3	Location of Known Raptor Nests on the Nevada Test Site - 2000 . . . . . 6-11
Figure 7.1	Hydrographic Subbasins on or Near the Nevada Test Site . . . . . 7-2
Figure 7.2	Natural Springs and Seeps on the Nevada Test Site . . . . . 7-3
Figure 7.3	Groundwater Subbasins of the Nevada Test Site and Vicinity . . . . . 7-4
Figure 7.4	Generalized Geologic Map of the Nevada Test Site and Vicinity . . . . . 7-10
Figure 7.5	Corrective Action Units and Corrective Action Sites on the Nevada Test Site . . . . . 7-13
Figure 7.6	Conceptual East-West Cross Section Through Frenchman Flat Showing Subbasins Formed by Fault Blocks . . . . . 7-14
Figure 7.7	Generalized West-East Hydrogeologic Cross Section Through Central Yucca Flat . . . . . 7-17
Figure 7.8	Generalized Geologic Cross Section through Pahute Mesa . . . . . 7-21

Figure 8.1	Areas of Potential Groundwater Contamination on the Nevada Test Site .....	8-2
Figure 8.2	Nevada Test Site Onsite Groundwater Monitoring Locations - 2000 .....	8-3
Figure 8.3	Nevada Test Site Offsite Groundwater Monitoring Locations - 2000 .....	8-4
Figure 8.4	Wells with a History of Detectable Tritium .....	8-6
Figure 8.5	Nevada Test Site Groundwater Monitoring Locations with a History of Detectable Tritium - 2000 .....	8-7
Figure 8.6	Annual Averages of Gross Alpha in Supply Wells .....	8-9
Figure 8.7	Historical Time Series for Gross Alpha in Tap Water .....	8-11
Figure 8.8	Annual Averages of Gross Beta in Supply Wells .....	8-11
Figure 8.9	Weighing Lysimeter and Precipitation Data from March 1994 through July 2001 .....	8-17
Figure 8.10	Soil Water Content in Pit 3 Waste Cover (North Site) Using an Automated Monitoring System .....	8-17

## LIST OF PHOTOGRAPHS

View of Shoshone Mountain .....	1-12
Ranier Mesa .....	2-12
Frenchman Flat Under Water .....	3-24
Frenchman Flat in the Spring .....	4-20
Eleana Range .....	7-34
Pahute Mesa .....	8-42
Shoshone Mountain Looking South of Mid Valley .....	9-12

# LIST OF TABLES

	<u>Page</u>
Table 1.1	Radionuclide Emissions on the NTS - 2000 <sup>(a)</sup> . . . . . 1-11
Table 1.2	NTS Radiological Dose Reporting - 2000 . . . . . 1-11
Table 3.1	Active Air Quality Permits - 2000 . . . . . 3-19
Table 3.2	Active Air Quality Permits for Non-NTS Facilities - 2000 . . . . . 3-20
Table 3.3	Sewage Discharge Permits - 2000 . . . . . 3-20
Table 3.4	NTS Drinking Water System Permits - 2000 . . . . . 3-21
Table 3.5	Permits for NTS Septic Waste Hauling Trucks - 2000 . . . . . 3-21
Table 3.6	Permits Required for NTS Operations . . . . . 3-22
Table 3.7	Quantity of Wastes Disposed of in Solid Landfills - 2000 . . . . . 3-22
Table 3.8	Off-Normal Occurrences at NTS Facilities - 2000 . . . . . 3-23
Table 4.1	Pollution Prevention Results, Reduction in Volume and Toxicity of Hazardous Waste - 2000 . . . . . 4-19
Table 4.2	Ongoing Recycling Activities - 2000 . . . . . 4-19
Table 5.1	Descriptive Statistics for Gross Alpha in Air ( $\times 10^{-15}$ $\mu\text{Ci/L}$ ) - 2000 . . . . . 5-32
Table 5.2	Descriptive Statistics for Gross Beta in Air ( $\times 10^{-14}$ $\mu\text{Ci/L}$ ) - 2000 . . . . . 5-33
Table 5.3	Descriptive Statistics for $^{238}\text{Pu}$ in Air ( $\times 10^{-18}$ $\mu\text{Ci/mL}$ ) - 2000 . . . . . 5-34
Table 5.4	Descriptive Statistics for $^{239+240}\text{Pu}$ in Air ( $\times 10^{-18}$ $\mu\text{Ci/mL}$ ) - 2000 . . . . . 5-35
Table 5.5	Descriptive Statistics for $^{241}\text{Am}$ in Air ( $\times 10^{-18}$ $\mu\text{Ci/mL}$ ) - 2000 . . . . . 5-36
Table 5.6	Descriptive Statistics for $^{137}\text{Cs}$ in Air ( $\times 10^{-16}$ $\mu\text{Ci/mL}$ ) - 2000 . . . . . 5-37
Table 5.7	Descriptive Statistics for Radionuclides Detected in Air Samples by Gamma Spectroscopy ( $\times 10^{-13}$ $\mu\text{Ci/mL}$ ) - 2000 . . . . . 5-38
Table 5.8	Descriptive Statistics for Airborne Tritium Concentrations - 2000 . . . . . 5-39
Table 5.9	Descriptive Statistics for TLD Annual Exposures, (mR/yr) - 2000 . . . . . 5-40
Table 5.10	Listing of Atypical TLD Data Values - 2000 . . . . . 5-42
Table 5.11	Descriptive Statistics for Radioactivity in E Tunnel Effluent and Ponds ( $\times 10^{-9}$ $\mu\text{Ci/mL}$ ) - 2000 . . . . . 5-43
Table 5.12	Descriptive Statistics for Gross Beta Radioactivity in Sewage Lagoons - 2000 . . . . . 5-43
Table 5.13	Radionuclide Activities in NTS Biota Samples - 2000 . . . . . 5-44
Table 5.14	Summary of Annual Radionuclide Emissions by Source <sup>(a)</sup> (Multiply Ci by 37 to obtain Gbq) - 2000 . . . . . 5-46
Table 5.15	Internal Dose Estimates for E Tunnel Biota - 2000 . . . . . 5-47
Table 5.16	Air Filter Analyses and Techniques . . . . . 5-47
Table 5.17	Results of Field and Laboratory Quality Assurance Samples . . . . . 5-47
Table 5.18	Gross Alpha Results for the Offsite Air Surveillance Network - 2000 . . . . . 5-48
Table 5.19	Gross Beta Results for the Offsite Air Surveillance Network - 2000 . . . . . 5-49
Table 5.20	TLD Monitoring Results for Offsite Stations - 2000 . . . . . 5-50
Table 5.21	Summary of Gamma Exposure Rates ( $\mu\text{R/hr}$ ) as Measured by PIC - 2000 . . . 5-51
Table 5.22	Average Natural Background Radiation for Selected U.S. Cities (Excluding Radon) . . . . . 5-52
Table 6.1	Frequency of Coliform Bacteria Monitoring for NTS Public Water Systems . . . 6-13
Table 6.2	Analyses of Well Water Samples - 2000 . . . . . 6-13

	<u>Page</u>
Table 6.3	Number of known Locations of Sensitive Plants on the NTS . . . . . 6-14
Table 6.4	Summary of Burrow use by Pairs of Owls on the NTS - FY 2000 . . . . . 6-14
Table 6.5	Number of Horse Observed on the NTS by Age Class, Gender, and Year Since 1995 . . . . . 6-15
Table 6.6	Raptor Species that Occur and Breed on the NTS . . . . . 6-15
Table 6.7	Summary of Raptor Reproduction Observed on the NTS . . . . . 6-15
Table 6.8	Summary of NTS Raptor Mortality Records from 1990-2000 . . . . . 6-16
Table 6.9	Seasonal Data from Selected Natural Water Sources on the NTS Collected During FY 2000 . . . . . 6-16
Table 6.10	NTS Drinking Water Permits - 2000 . . . . . 6-17
Table 7.1	Hydrogeologic Units of the NTS Area . . . . . 7-26
Table 7.2	Summary of Hydrologic Properties for Hydrogeologic Units at the Nevada Test Site . . . . . 7-27
Table 7.3	Information Summary of Nevada Test Site Underground Nuclear Tests . . . . . 7-28
Table 7.4	Hydrostratigraphic Nomenclature for the Frenchman Flat Area . . . . . 7-29
Table 7.5	Hydrostratigraphy of Yucca Flat Area . . . . . 7-30
Table 7.6	Hydrostratigraphic Units of the Pahute Mesa-Oasis Valley Area . . . . . 7-31
Table 8.1	Sampling and Analysis Schedule for RREMP Groundwater Monitoring . . . . . 8-18
Table 8.2	Summary of Tritium Results - 2000 . . . . . 8-19
Table 8.3	Summary of Gross Alpha Results - 2000 . . . . . 8-23
Table 8.4	Summary of Gross Beta Results - 2000 . . . . . 8-25
Table 8.5	Summary of Gamma Results - 2000 . . . . . 8-27
Table 8.6	Summary of <sup>226</sup> Ra Results - 2000 . . . . . 8-28
Table 8.7	Summary of <sup>228</sup> Ra Results - 2000 . . . . . 8-30
Table 8.8	Summary of <sup>238</sup> Pu Results - 2000 . . . . . 8-32
Table 8.9	Summary of <sup>239+240</sup> Pu Results - 2000 . . . . . 8-34
Table 8.10	Summary of <sup>90</sup> Sr Results - 2000 . . . . . 8-36
Table 8.11	Summary of the DRI Groundwater Monitoring Program - 2000 . . . . . 8-38
Table 8.12	Summary of the DRI Groundwater Tritium Results - 2000 . . . . . 8-40
Table 8.13	Summary of the DRI Monitoring Results - 2000 (pCi/L) . . . . . 8-41
Table 9.1	Summary of Field Duplicate Samples - 2000 . . . . . 9-7
Table 9.2	Summary of Laboratory Control Samples (LCS) - 2000 . . . . . 9-8
Table 9.3	Summary of Laboratory Blank Samples - 2000 . . . . . 9-9
Table 9.4	Summary of Interlaboratory Comparison Samples for the BN In-House Analytical Services Laboratory - 2000 . . . . . 9-10
Table 9.5	Summary of Interlaboratory Comparison Samples for the Subcontract Radiochemistry Laboratory - 2000 . . . . . 9-11
Table 9.6	Summary of Interlaboratory Comparison Thermoluminescent Dosimetry (TLD) Samples for the BN In-House Dosimetry Group - 2000 . . . . . 9-11

# MEASUREMENT UNITS AND NOMENCLATURE

Radioactivity data in this report are expressed in both traditional units (e.g., pCi/L) and International System (abbreviated SI) units. These units are explained below.

- background** Ambient background radiation to which people are exposed. Naturally occurring radioactive elements contained in the body, in the ground, and in construction materials, cosmic radiation, and radioactivity in the air all contribute to an average radiation dose equivalent to humans of about 350 mrem per year. In laboratory measurements of radioactivity in samples, background is the activity determined when a sample of distilled water is processed through the system (Also called a blank).
- becquerel** Abbreviation Bq. The Bq is the SI unit for disintegration rate. 1 Bq = 1 disintegration per second.
- concentration** Activity per unit volume or weight. Usually expressed as  $\mu\text{Ci/mL}$ ,  $\text{pCi/m}^3$  or  $\text{pCi/g}$ .
- curie** Abbreviation Ci. The historic unit for disintegration rate.  $1 \text{ Ci} = 3.7 \times 10^{10}$  disintegrations per second =  $3.7 \times 10^{10}$  Bq. The usual submultiples of Ci are mCi ( $10^{-3}$  Ci or one thousandth Ci),  $\mu\text{Ci}$  ( $10^{-6}$  Ci or one millionth Ci), and pCi ( $10^{-12}$  or one trillionth Ci).
- EDE** Effective dose equivalent - radiation dose corrected by various weighting factors that relate dose to the risk of serious effects.
- rem** Rem (for roentgen equivalent man) is the unit for expressing dose equivalent, or the energy imparted to a person when exposed to radiation. The commonly used subunit is the millirem ( $10^{-3}$  rem or one thousandth rem), abbreviated mrem.
- roentgen** Abbreviation R. A unit expressing the intensity of X or  $\gamma$  radiation at a point in air. The usual unit is mR or  $10^{-3}$  R (one thousandth R).
- volume** The SI unit for volume is  $\text{m}^3$  (cubic meter). Other units used are liter (L) and mL ( $10^{-3}$  L or one thousandth liter). One cubic meter = 1,000 L, 1 L = 1.06 quarts.

The elements and corresponding symbols used in this report are:

<u>Element</u>	<u>Symbol</u>	<u>Element</u>	<u>Symbol</u>
Actinium	Ac	Iron	Fe
Aluminum	Al	Krypton	Kr
Argon	Ar	Lead	Pb
Arsenic	As	Lithium	Li
Barium	Ba	Mercury	Hg
Beryllium	Be	Nitrogen	N
Bismuth	Bi	Oxygen	O
Boron	B	Plutonium	Pu
Cadmium	Cd	Potassium	K
Calcium	Ca	Radium	Ra
Cesium	Cs	Radon	Rn
Chlorine	Cl	Selenium	Se
Chromium	Cr	Silver	Ag
Cobalt	Co	Strontium	Sr
Copper	C	Thallium	Tl
Europium	Eu	Thorium	Th
Fluorine	F	Thulium	Tm
Hydrogen	H	Tritium	$^3\text{H}$
Iodine	I	Uranium	U

---

This page intentionally left blank

# LIST OF ACRONYMS AND ABBREVIATIONS

AA	Alluvial Aquifer
AIP	Agreement in Principle
AMEM	Assistant Manager for Environmental Management
ANOVA	Analysis of Variance
APCD	Air Pollution Control Division
ARL/SORD	Air Resources Laboratory, Special Operations and Research Division
ASA	Auditable Safety Analysis
ASCII	American Standard Code for Information Interchange
ASER	Annual Site Environmental Report
ASL	Analytical Services Laboratory
ASN	Air Surveillance Network
BCG	Biota Concentration Guide
BEEF	Big Explosives Experimental Facility
BEIDMS	Bechtel Environmental Integrated Data Management System
BHPS	Bureau of Health Protection Services
BLM	Bureau of Land Management
BN	Bechtel Nevada
BOD	Biochemical Oxygen Demand
CAA	Clean Air Act
CADD	Corrective Action Decision Document
CAIP	Corrective Action Investigation Plan
CAP	Corrective Action Plan
CAP88-PC	Clean Air Package 1988 (EPA software program for estimating doses)
CAS	Corrective Action Site
CAU	Corrective Action Unit
CEDE	Committed Effective Dose Equivalent
CEI	Compliance Evaluation Inspection
CEMP	Community Environmental Monitoring Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGTO	Consolidated Group of Tribes and Organizations
CP	Control Point
CRMP	Community Radiation Monitoring Program
CTLP	Community Technical Liaison Program
CWA	Clean Water Act
CX	Categorical Exclusion
CY	Calendar Year
DAC	Derived Air Concentration
DAF	Device Assembly Facility
DAS	Disposal Authorization Statement
DCG	Derived Concentration Guide
D&D	Deactivation and Decommissioning
DDR	Data Discrepancy Report
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/HQ	DOE Headquarters
DOELAP	DOE Laboratory Accreditation Program
DOE/NV	DOE Nevada Operations Office
DQO	Data Quality Objectives

---

DRI	Desert Research Institute, University and Community College System, Nevada
DWR	Division of Water Resources
EA	Environmental Assessment
EDE	Effective Dose Equivalent
EHS	Extremely Hazardous Substances
EIS	Environmental Impact Statement
ELU	Ecological Landform Unit
EMAC	Ecological Monitoring and Compliance
EML	Environmental Measurements Laboratory (DOE)
EO	Executive Order
EOD	Explosive Ordnance Disposal (NTS)
EODU	Explosive Ordnance Disposal Unit
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Reporting and Community Right-to-Know Act
ERA	Environmental Resource Associates
ERP	Environmental Restoration Project
ESA	Endangered Species Act
ESHD	Environment, Safety and Health Division
ET	Evapotranspiration
FFACO	Federal Facilities Agreement and Consent Order
FFCAct	Federal Facilities Compliance Act
FIFRA	Federal Insecticide Fungicide and Rodenticide Act
FY	Fiscal Year
GCD	Greater Confinement Disposal
GCU	Granite Confining Unit
GIS	Geographic Information System
gpm	Gallons per Minute
HGU	Hydrogeologic Unit
HRMP	Hydrologic Resources Management Program
HSC	Hazardous Materials Spill Center
HSU	Hydrostratigraphic Unit
HTO	Tritiated Water
HWSU	Hazardous Waste Storage Unit
ICMP	Integrated Closure and Monitoring Plan
ICRP	International Commission on Radiological Protection
ID	Identification
IICU	Intrusive Confining Unit
INEEL	Idaho National Engineering and Environmental Laboratory
IT	International Technology
JASPER	Joint Actinide Shock Physics Experimental Research Facility
LANL	Los Alamos National Laboratory
LAO	Los Alamos Operations (BN)
LCA	Lower Carbonate Aquifer
LCA3	Lower Carbonate Aquifer, Upper Thrust Plate
LCCU	Lower Clastic Confining Unit
LDR	Land Disposal Restrictions
LLNL	Lawrence Livermore National Laboratory
LLW	Low Level (Radioactive) Waste
LLWMU	Low Level Waste Management Unit
LO	Livermore Operations (BN)
LTHMP	Long-Term Hydrological Monitoring Program
MAPEP	Mixed Analyte Performance Evaluation Program
MDC	Minimum Detectable Concentration

---

MEI	Maximally Exposed Individual
MGCU	Mesozoic Granite Confining Unit
MLLW	Mixed Low Level Waste
MOU	Memorandum of Understanding
MQO	Measurement Quality Objectives
MSL	Mean Sea Level
MTRU	Mixed Transuranic
NAC	Nevada Administrative Code
NAFR	Nellis Air Force Range
NAGPRA	Native American Graves Protection and Repatriation Act
NDEP	Nevada Division of Environmental Protection
NDOW	Nevada Division of Wildlife
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NLVF	North Las Vegas Facility (BN)
NNSA/NV	National Nuclear Security Administration, Nevada Operations Office
NPDES	National Pollution Discharge Elimination System
NR	National Register
NRHP	National Register of Historic Places
NRS	Nevada Revised Statutes
NSHPO	Nevada State Historic Preservation Office
NTS	Nevada Test Site
NTSWAC	Nevada Test Site Waste Acceptance Criteria
NVLAP	National Voluntary Laboratory Accreditation Program (NIST)
OEMP	Offsite Environmental Monitoring Program
ORSP	Offsite Radiological Safety Program
P2	Pollution Prevention
PA	Performance Assessment
PCB	Polychlorinated Biphenyl
PE	Performance Evaluation
PEP	Performance Evaluation Program
PES	Performance Evaluation Study
PIC	Pressurized Ion Chamber
PM-OV	Pahute Mesa-Oasis Valley
PPOA	Pollution Prevention Opportunity Assessments
QA	Quality Assurance
QAP	Quality Assessment Program
RBRC	Rechargeable Battery Recycling Corporation
RCRA	Resource Conservation and Recovery Act
RCT	Radiological Control Technician
R&IE-LV	Radiation & Indoor Environments National Laboratory - Las Vegas (EPA)
RMAD	Reactor Maintenance Assembly and Disassembly
RMP	Resource Management Plan
ROD	Record of Decision
RREMP	Routine Radiological Environmental Monitoring Plan
RSD	Relative Standard Deviation
RSL	Remote Sensing Laboratory (BN)
RT	Rainier Test
RWID	Radioactive Waste Information Document
RWMBART	Radioactive Waste Management Basis Assistance and Review Team
RWMS	Radioactive Waste Management Site

---

RWMS-3	Radioactive Waste Management Site, Area 3
RWMS-5	Radioactive Waste Management Site, Area 5
SAFER	Streamlined Approach for Environmental Restoration
SARA	Superfund Amendments and Reauthorization Act
SCCC	Silent Canyon Caldera Complex
SDWA	Safe Drinking Water Act
SERDP	Strategic Environmental Research and Development Program
SQL	Structured Query Language
STL	Special Technologies Laboratory (BN)
SWL	Static Water Level
SWNVF	Southwest Nevada Volcanic Field
SWRWMP	Sitewide Radioactive Waste Management Program
TaDD	Tactical Demilitarization Development
TCU	Tuff Confining Unit
TLD	Thermoluminescent Dosimeter
TMA	Timber Mountain Aquifer
TMCC	Timber Mountain Caldera Complex
TRU	Transuranic
TSA	Topopah Spring Asquifer
TSCA	Toxic Substances Control Act
TTR	Tonopah Test Range
UCCU	Upper Clastic Confining Unit
UGTA	Underground Testing Area
U.S.	United States of America
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	Underground Storage Tank
VCU	Volcaniclastic Confining Unit
VZM	Vades Zone Monitoring
WAMO	Washington Aerial Measurements Operations (BN)
WEF	Waste Examination Facility
WI	Work Instructions
WIPP	Waste Isolation Pilot Plant
WPM-OV	Western Pahute Mesa - Oasis Valley
WRCC	Western Regional Climate Center
WVCU	Wahmonie Volcanic Confining Unit
YF-LCU	Yucca Flat Lower Confining Unit
YMP	Yucca Mountain Program