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National Security Technologies LLC
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Nevada Test Site

National Emission Standards for Hazardous Air Pollutants Calendar Year 2007

June 2008

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National Nuclear Security Administration

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National Emission Standards for Hazardous Air Pollutants Calendar Year 2007

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EXECUTIVE SUMMARY

2007 RADIOLOGICAL DOSE TO THE PUBLIC MEETS FEDERAL STANDARD

The Nevada Test Site (NTS) is operated by the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. From 1951 through 1992, the NTS was operated as the nation's site for nuclear weapons testing. The release of man-made radionuclides from the NTS as a result of testing activities has been monitored since the first decade of atmospheric testing. After 1962, when nuclear tests were conducted only underground, the radiation exposure to the public surrounding the NTS was greatly reduced. After the 1992 moratorium on nuclear testing, radiation monitoring on the NTS focused on detecting airborne radionuclides which come from historically contaminated soils resuspended into the air (e.g., by winds) and tritium-contaminated soil moisture emitted to the air from soils through evapotranspiration.

To protect the public from harmful levels of man-made radiation, the Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAP) (Title 40 Code of Federal Regulations [CFR] Part 61 Subpart H) limits the release of radioactivity from a U.S. Department of Energy facility (e.g., the NTS) to 10 millirem per year (mrem/yr) effective dose equivalent to any member of the public. This is the dose limit established for someone living off of the NTS from radionuclides emitted to air from the NTS. This limit does not include the radiation doses that members of the public may receive through the intake of radioactive particles unrelated to NTS activities, such as those that come from naturally occurring elements in the environment (e.g., naturally occurring radionuclides in soil or radon gas from the earth or natural building materials), or from other man-made sources (e.g., medical treatments).

The NTS demonstrates compliance using environmental measurements of radionuclide air concentrations at critical receptor locations. This method was approved by the U.S. Environmental Protection Agency for use on the NTS in 2001 and has been the sole method used since 2005. There are six critical receptor locations on the NTS that are actually pseudo-critical receptor locations because they are hypothetical receptor locations; no person actually resides at these onsite locations. Annual average concentrations of detected radionuclides are compared with Concentration Levels (CL) for Environmental Compliance values listed in 40 CFR 61, Appendix E, Table 2. Compliance is demonstrated if the sum of fractions (CL / measured concentrations) of all detected radionuclides at each pseudo-critical receptor location is less than one.

In 2007, as in all previous years for which this report has been produced, the NTS has demonstrated that the potential dose to the public from radiological emissions to air from current and past NTS activities is well below the 10 mrem/yr dose limit. Air sampling data collected onsite at each of the six pseudo-critical receptor stations on the NTS had average concentrations of nuclear test-related radioactivity that were a fraction of the limits listed in Table 2 in Appendix E of 40 CFR 61. They ranged from less than 1 percent to a maximum of 20 percent of the allowed NESHAP limit. Because the nearest member of the public resides approximately 20 kilometers (12 miles) from the NTS boundary, concentrations at this location would be only a small fraction of that measured on the NTS.

Table of Contents

Appendices

List of Figures

List of Tables

List of Acronyms and Abbreviations

Am	americium
ARL/SORD	Air Resources Laboratory, Special Operations and Research Division
CAP88-PC	Clean Air Package 1988 (EPA software program for estimating doses)
CAU	Corrective Action Unit
CEDE	collective effective dose equivalent
CFR	Code of Federal Regulations
Ci	curie(s)
Ci/s	curie(s) per second
cm	centimeter(s)
cm/yr	centimeter(s)/year
Cs	cesium
CY	calendar year
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DPF	Dense Plasma Focus
DRA	Desert Rock Meteorological Observatory
EDE	effective dose equivalent
EPA	U.S. Environmental Protection Agency
Eu	europium
°F	degrees Fahrenheit
FFACO	Federal Facility Agreement and Consent Order
ft	foot or (feet)
ft^3/min	cubic feet per minute
g/cm^3	gram(s) per cubic centimeter
gal	gallon(s)
GBq	gigabecquerel
^3H	tritium
HEPA	high-efficiency particulate air
HTO	tritiated water
in./yr	inch(es) per year
I	iodine
JASPER	Joint Actinide Shock Physics Experimental Research
km	kilometer(s)
km^2	square kilometers
Kr	krypton
L	liter(s)
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
m	meter(s)
m^3	cubic meter(s)
mCi	millicurie(s)
MEDA	Meteorological Data Acquisition
MEI	maximally exposed individual
mi	mile(s)
mi^2	square mile(s)
MIDNET	Meteorological Integrated Data Network
mrem	millirem or milli-roentgen equivalent man (1 mrem = 0.001 (1×10^{-3}) rem

List of Acronyms and Abbreviations (continued)

mrem/yr	millirem per year
m/s	meter(s) per second
NESHAP	National Emission Standards for Hazardous Air Pollutants
NLVF	North Las Vegas Facility
NNSA/NSO Site Office	U.S. Department of Energy, National Nuclear Security Administration Nevada
NOAA	National Oceanic and Atmospheric Administration
NTS	Nevada Test Site
NTTR	Nevada Test and Training Range
pCi/L	picocurie(s) per liter
pCi/m^3	picocurie(s) per cubic meter
Pu	plutonium
rem	roentgen equivalent man
REOP	Real Estate/Operations Permit
RWMS	Radioactive Waste Management Site
s	second(s)
Sr	strontium
STAR	Stability Array (grouping of meteorological data)
Th	thorium
TRU	transuranic (nuclides with atomic numbers greater than uranium)
U	uranium
UCC	Yucca Flat Meteorological Observatory
UGTA	Underground Test Area
VERB	Visual Examination and Repackaging Building
µCi	microcurie (1 µCi = 0.000001 (1 x 10^{-6}) Ci)
µrem/yr	microroentgen equivalent man per year
Xe	xenon
yd^3	cubic yard(s)
yr	year(s)

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National Nuclear Security Administration
Nevada Site Office
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(under Subpart H, Title 40 Code of Federal Regulations [CFR] 61.94)
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Site Name: Nevada Test Site

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SECTION I
FACILITY INFORMATION

SITE DESCRIPTION

The Nevada Test Site (NTS) is operated by the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) as the site for experiments in support of the national Stockpile Stewardship Program and the activities listed below. Located in Nye County, Nevada, the site's southeast corner is about 105 kilometers (km) (65 miles [mi]) northwest of the major population center, Las Vegas, Nevada. The NTS covers about 3,561 square kilometers (km^2) (1,375 square miles [mi^2]), an area larger than Rhode Island. Its size is 46 to 56 km (28 to 35 mi) east to west and from 64 to 88 km (40 to 55 mi) north to south. The NTS is surrounded, except on the south side, by public exclusion areas (Nevada Test and Training Range [NTTR]) that provide another 24 to 104 km (15 to 65 mi) between the NTS and public lands (Figure 1.0). The NTS is characterized by desert valley and Great Basin mountain topography, with a climate, flora, and fauna typical of the southwest deserts. Population density within 80 km (50 mi) from the NTS boundary is about 1.0 person/km^2 (2.6 persons/mi^2). Restricted access, low population density in the surrounding area, and extended wind transport times are advantageous factors for the activities conducted at the NTS. Surface waters are limited to perched springs and ephemeral lakes on the NTS, and slow-moving groundwater is present hundreds to thousands of feet below the land surface.

SOURCE DESCRIPTION

The sources of radionuclides include current and previous activities conducted on the NTS (Figure 2.0). The NTS was the primary location for testing of nuclear explosives in the Continental U.S. between 1951 and 1992. Historical testing has included (1) atmospheric testing in the 1950s and early 1960s, (2) underground testing between 1951 and 1992, and (3) open-air nuclear reactor and rocket engine testing (U.S. Department of Energy [DOE], 1996a; 2008). No nuclear tests have been conducted since September 23,1992 (DOE, 2000). Radionuclides remaining on the soil surface in some NTS areas after several decades of radioactive decay have the potential to become re-suspended into the atmosphere at concentrations that can be detected by onsite air sampling stations. This report and those produced since 1992, have shown that these airborne radionuclides are well within the limit established by the Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAP) of 10 millirem per year (10 mrem/yr) from NTS sources.

Limited non-nuclear testing includes spills of hazardous materials at the Non-Proliferation Test and Evaluation Complex, private technology development, demilitarization activities, and site remediation activities.

Programs and activities involving radioactive materials include laboratory analyses; handling, transport, storage, and assembly of radioactive targets for the Joint Actinide Shock Physics Experimental Research (JASPER) gas gun; conducting subcritical experiments at U1a; pulsed neutron generator activities at the Dense Plasma Focus (DPF) Facility; and operation of radioactive waste management sites (RWMSs) for low-level radioactive and mixed waste (DOE, 1996a). Monitoring and evaluation of the various activities conducted onsite indicate that the potential sources of offsite radiation exposure in calendar year (CY) 2007 were releases from (1) diffuse sources of tritium (^{3}H) and re-suspension of plutonium (^{238}Pu and $^{239+240}Pu$) and americium (^{241}Am) at the sites of past nuclear tests; (2) evaporation of tritiated water (HTO) from

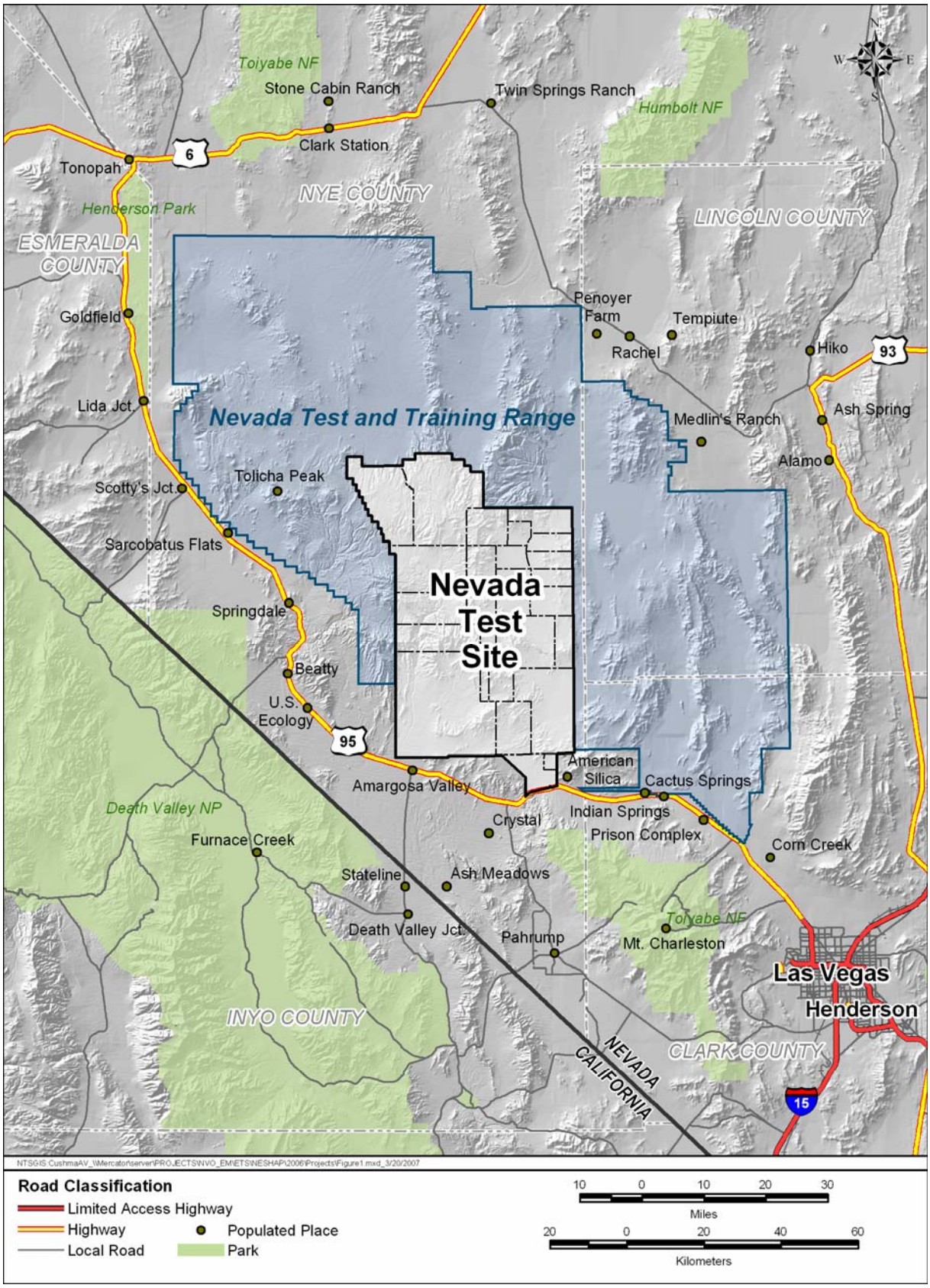

Figure 1.0 Map of the NTS and Surrounding Populated Area

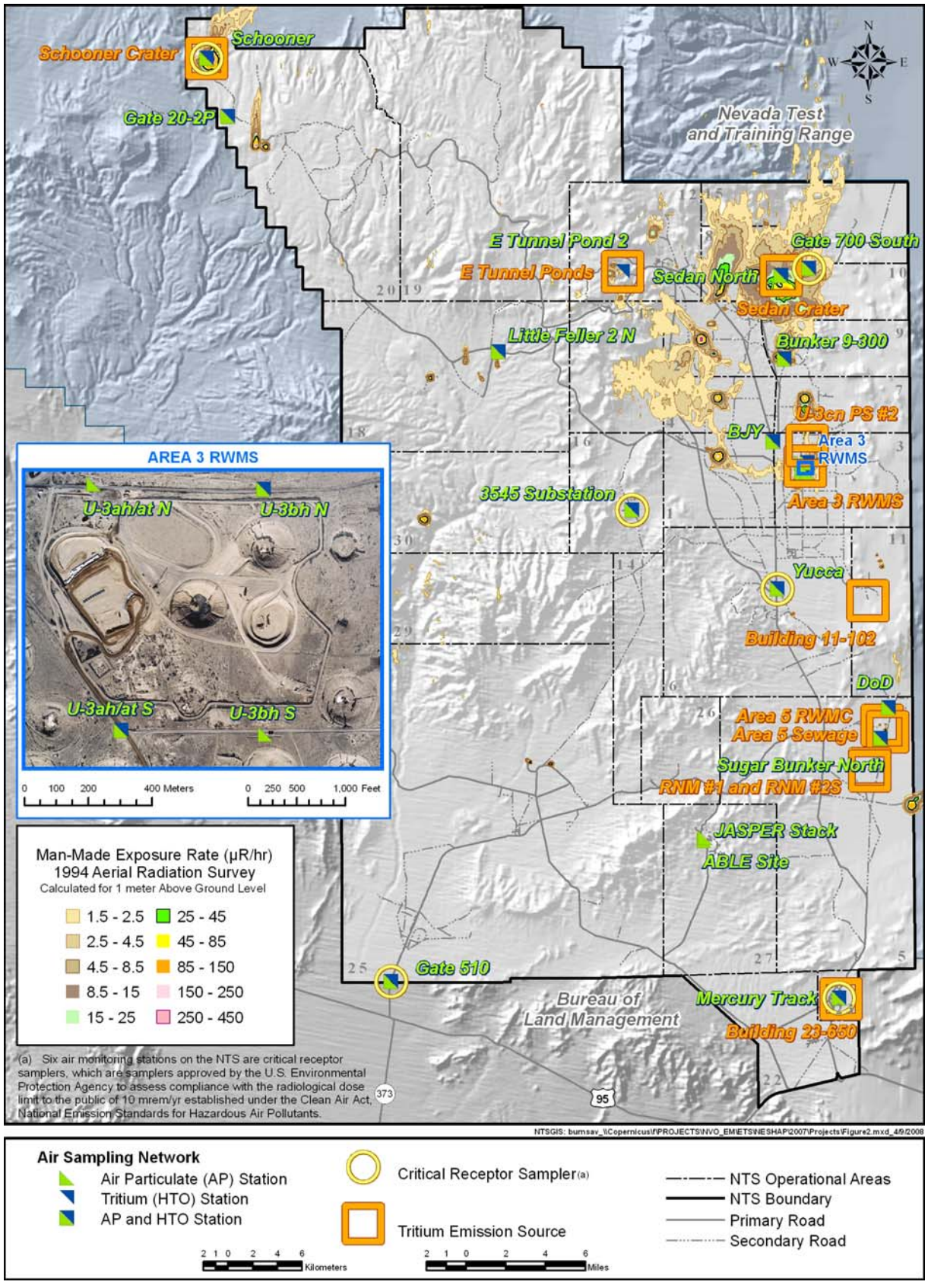

Figure 2.0 Sources of Radioactive Contamination and Air Sampling Network on the NTS

ponds, such as the E Tunnel ponds in Area 12, water ponding from the Underground Test Area (UGTA) Project pumping wells used to characterize the aquifers at the sites of past underground nuclear tests, and a sewage lagoon in Area 5 in which water containing low concentrations of tritium from Building A-1 at the North Las Vegas Facility (NLVF) was disposed; (3) the Area 3 and Area 5 RWMS facilities; and (4) onsite radioanalytical laboratories. It is improbable that radioactive emissions would be released into the atmosphere during the preparation and performance of subcritical experiments at U1a due to their deep underground location and the small amount of radioactive materials involved. The following sections present a general description of the present emission sources on the NTS and at the NLVF.

North Las Vegas Facility

At the NLVF, parts of the Building A-1 basement were contaminated with tritium by a previous contractor in 1995. The incident involved the release of tritium as HTO. This unusual occurrence led to a very small potential exposure (<0.001 mrem/yr) to an offsite person. The HTO emission has continued at lower levels (re-emanation from building materials), even after cleanup activities in November and December 1997. A description of the incident and the potential effective dose equivalent (EDE) for offsite exposure during CY 2007 are presented in Appendix A.

Tunnel Operations

Nuclear explosive tests have been conducted within tunnel complexes mined into the Rainier Mesa region (Area 12) and in Areas 15 and 16. When these tests were conducted, purging gases from the tunnels occasionally resulted in releases of radioactivity, and contaminated water drained from the tunnels into containment ponds (Energy Research and Development Administration, 1977). No nuclear testing activities have occurred since 1992.

Ponds

Water contaminated with radionuclides seeped from the tunnels in Area 12 and was collected in ponds resulting in water evaporation and seepage into the soil. The tunnels have been sealed, but water continues to seep from E Tunnel. The only radiological contaminant which produces a measurable air emission from evaporation of the water is tritium (as HTO). Calculation of the source term for this emission is described in Appendix B.

To characterize the groundwater regime under the NTS, suitable wells are being drilled and existing wells re-completed in the vicinity of certain underground tests and at other locations on the NTS, as determined by hydrologists. During these drilling operations, if the tritium level exceeds 4×10^5 picocuries per liter, contaminated water is pumped from the wells and diverted to lined containment ponds, as required by the State and explained in the Underground Test Area Program Waste Management Plan (DOE, 2002). During CY 2007, water containing tritium was pumped from wells RNM #1, RNM #2S, and U-3cn PS #2. Calculations of the tritium emissions from this source are described in Appendix B.

In the basement of Building A-1 in the NLVF, a vacant radiation source well used in the past for calibrating radiation instruments had been filling with water due to the soil bottom in the well and a rise in the ground water level. Concentrations of tritium found in the water from this source well were attributed to the tritium contaminating incident at the NLVF in 1995. A representative of the state of Nevada was informed of the problem and approved the disposal of the water by evaporation with evaporative coolers outside the north side of Building A-1 and by disposal in the Area 5 Sewage Lagoon at the NTS when the evaporative coolers were not effective. The

tritium emissions from the evaporative coolers and the Area 5 Sewage Lagoon are estimated in Appendices A and B, respectively.

Laboratories

Radiological analyses were conducted in laboratories located in Area 23 Buildings 650 and 652 (in Mercury), Building CP-95A (in Area 6), and the Device Assembly Facility (in Area 6). Because these facilities process environmental samples, very little radioactivity passes through them. However, there is potential for some radionuclides to be discharged into the atmosphere from the hood ventilation systems during sample processing, particularly of spiked samples, or from loss of radioactive standards in liquid or gaseous form.

This year, the only laboratory emission was tritium gas used by laboratory personnel at Area 23 Building 650 while calibrating analytical equipment. The tritium emission from this source is described in Appendix C.

Non-volatile radioactive standards and sealed radiation sources were controlled in accordance with Title 10 Code of Federal Regulations (CFR) Part 835.

Radioactive Waste Management Sites

The Area 3 RWMS and the Area 5 RWMS are used for the disposal of packaged, dry low-level waste (LLW) in pits and trenches. The Area 5 RWMS is also used for the accumulation of mixed waste and the storage of transuranic (TRU) and mixed TRU wastes. Concrete pads are used for temporary storage of these wastes. Both facilities are considered a diffuse source of radiological effluents. The only radioactive emission detected by the various types of samplers located downwind of these sites and attributed to site operations was tritium as HTO in atmospheric moisture. The calculation of the tritium source term for these emissions is explained in Appendix D. Since the Area 3 RWMS LLW site is in a location where the surrounding surface soil has been contaminated by past nuclear tests, the re-suspension of this soil by wind or vehicular activity results in above-background levels of plutonium being detected in air samples collected outside the perimeter fence. Due to past disposal of waste containing tritium at the Area 3 RWMS, air samplers for tritium were installed at the northeast and southwest corners of the perimeter fence in 2004. The calculation of the tritium source term for these emissions is also explained in Appendix D.

JASPER

Approval by the U.S. Environmental Protection Agency (EPA) was obtained in June 1999 for the construction of a hydrogen gas gun in Building 5100 in Area 27 using special nuclear material and other actinide materials as targets. To assure that the emissions are in conformance with NESHAP, a stack monitoring system was installed downstream of high-efficiency particulate air (HEPA) filters. In June 2000, the construction and startup phase was completed. Beginning in June 2003, equation-of-state experiments, with the two-stage light gas gun, were begun using plutonium as target material. From the results of the stack monitoring system, no radioactive emissions from the experiments conducted during CY 2007 were detected.

DPF Facility

In 2007 NTS operations began at the DPF Facility, which was relocated from the NLVF to the NTS, Building 11-102. Operations at the NLVF produced a neutron flux using a deuterium-deuterium D(d,n)3He reaction (no radionuclide emissions to air) while operations at the NTS

used the deuterium-tritium D(t,n)4He reaction. A 2006 NESHAP evaluation of a maximum release of 2 kilocuries of tritium gas from this facility resulted in an estimated EDE to a maximally exposed individual (MEI) of 0.86 microrem (µrem)/yr. Operations during 2007 released a small fraction of the potential maximum to air. The tritium emission from this source is described in Appendix C.

Surface Areas Contaminated with Tritium, Plutonium, or Americium

Tritium emanation from the cratering tests Sedan and Schooner was detectable in atmospheric moisture samples collected on molecular sieves by special air samplers. Derivation of the tritium emissions for these locations is described in Appendix D.

Surface soils in some areas on the NTS were contaminated with plutonium and/or tritium from either nuclear device safety, atmospheric, or cratering tests, using nuclear explosives. An investigation of these areas during the Nevada Applied Ecology Group studies, updated by the Desert Research Institute (DOE, 1991), developed an inventory of radionuclides (Table 1.0). The inventory is an estimate of the curies (Ci) of each radionuclide in surface soil (within 0–30 centimeters [cm] of the surface, most activity in the top 5 cm) within each study area.

Table 1.0 Inventory of ^{241}Am, ^{238}Pu, and $^{239+240}$Pu in Surface Soil[a] at the NTS

NTS Administrative Area Studied	Study Site Area in mi^2 / Percent of Total Administrative Area	Radionuclide Inventory (Ci)		
		^{241}Am	^{238}Pu	$^{239+240}$Pu
1	26.5 / 100	4.2	6.5	24[b]
2	19.7 / 100	2.9	8.6	22[b]
3	32.3 / 100	4.6	3.1	37
4	16.0 / 100	6.6	13	40[b]
5	2.9 / 3	0.6	0.1	4.8[b]
6	32.3 / 81	1.7	3.3	8.4[b]
7	19.3 / 100	2.2	0.6	16[b]
8	13.9 / 100	17	8.0	110
9	20.0 / 98	4.2	2.2	89
10	20.0 / 99	19	19	110
11	4.0 / 16	3.3	0.5	29
12	39.6 / 100	5.7	8.5	39[b]
15	35.3 / 100	8.0	7.8	63[b]
16	14.3 / 50	0.7	1.5	3.7[b]
17	31.4 / 100	2.8	4.5	18[b]
18	27.3 / 31	19	5.6	100
19	148.3 / 100	21	32	140[b]
20	6.2 / 6	23	30	41
25	0.9 / 0.004	0	0	0
26	0.2 / 0.009	0	0	0
30	0.3 / 0.0051	3.2	4.5	14[b]

Source: (DOE, 1991)
(a) Soil within 0–30 cm of the surface with most activity in the top 5 cm.
(b) DOE (1991) indicated that these levels were probably the result of historical fallout from nuclear tests in surrounding areas.

These contaminated areas on the NTS could become sources of radionuclide exposure to the public if the soils were to be re-suspended, e.g., during windy conditions, surface cleanup, construction, vehicular travel, or similar activities. Figure 2.0 shows the approximate locations of the contaminated areas based upon an aerial survey conducted in 1994. These areas are considered diffuse sources of radioactive emissions. The derivation of the radioactive emissions for these NTS contaminated areas is explained in Appendix E.

Environmental Restoration Projects

Under the *Federal Facility Agreement and Consent Order* (FFACO) between the DOE, the U.S. Department of Defense, and the state of Nevada (FFACO, 1996), radioactive soil contamination generated by historical NTS activities is addressed. Two surface areas northwest of the NTS on the NTTR including the Tonopah Test Range have had partial source removal, resulting in a decrease in the offsite EDE. These surface areas are DOUBLE TRACKS, remediated in 1996, and CLEAN SLATE I in 1997. The monitoring plan for such activities required continuous air sampling before, during, and after cleanup operations until the concentration in air returned to background levels. In 2000, NNSA/NSO suspended air monitoring and will not resume until active remediation efforts begin again. During 2007, no further remediation work or air monitoring was conducted in these areas.

Environmental restoration projects that involved the removal and haulage of materials and soil containing low concentrations of radioactivity were evaluated for potential radionuclide emissions to air and potential dose offsite. These are performed in accordance with 40 CFR 61, Subpart H requirements. Summaries of evaluations performed in 2007 can be found in Appendix F. The results of these evaluations showed radioactive emissions much less than the quantity of that would result in an offsite dose of 0.1 mrem/yr. Only emissions for radionuclides producing the majority of the dose, ^{241}Am and $^{239+240}$Pu in particular, were included in the Source Type category, “Miscellaneous Projects,” shown in Table 2.0.

Borehole Management Project

The current primary objective of the Borehole Management Project is to plug and abandon NTS legacy boreholes for which there is no future use. During the course of executing the field work, there is a potential for encountering radiological contamination that may become airborne. Operations during 2007 did result in a measurable emission of radioactivity, all of which was considered ^{239}Pu and is included in the Source Type category, “Miscellaneous Projects,” shown in Table 2.0.

Research and Construction Projects

Multiple research projects are conducted on the NTS that involve the use of radioactive sources. The vast majority of these use sealed sources and no emissions are produced. In 2007 no special projects were conducted in which a release of radionuclides occurred.

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SECTION II
AIR EMISSIONS DATA

Each potential source of NTS emissions was characterized by one of the following methods: (1) monitoring methods using procedures previously developed at the NTS; (2) measuring radionuclide inventory in laboratories and identifying losses of radionuclides that were released to the environment; (3) measuring tritiated water concentrations in liquid effluents discharged to containment ponds and assuming all the effluent evaporates over the course of the year to become an air emission; (4) using re-suspension calculations; and (5) using a combination of environmental measurements and the Clean Air Package 1988 (CAP88-PC) air dispersion model (EPA, 2006) to calculate the emissions. According to 40 CFR 61.93 (b)(4)(ii) (CFR, 2002), no credit was taken for pollution control equipment in determining air emissions. The emissions for NESHAP reporting are listed in Table 2.0. These emissions are conservative (worst-case). Appendices A through E describe the methods used to determine the emissions from the sources listed in Table 2.0.

Table 2.0 Summary of Annual Air Emissions Data by Source[a] (Multiply Ci by 37 to obtain gigabecquerels [GBq])

Source Type	Type of Emissions Control	Distance to Nearest Member of the Public	Nuclide	Annual Quantity (Ci)
Point Sources				
Building 650, Area 23	None	5.5 km (3.4 mi)	^{3}H	0.000011
Building A-1, NLVF [a]	None	0.1 km (0.06 mi)	^{3}H	0.012
DPF Facility	None	36 km (22 mi)	^{3}H	120
Area Sources				
E Tunnel Ponds	None	50 km (31 mi)	^{3}H[b]	9.3
RWMS-3 (Area 3)	None	47 km (29 mi)	^{3}H[c]	96
RWMS-5	None	36 km (22 mi)	^{3}H[c]	3.9
Schooner	None	20 km (12 mi)	^{3}H[c]	69
Sedan	None	50 km (31 mi)	^{3}H[c]	250
Well RNM #1	None	22 km (14 mi)	^{3}H[b]	0.000052
Well RNM #2S	None	22 km (14 mi)	^{3}H[b]	0.045
Well U-3cn PS #2	None	49 km (30 mi)	^{3}H[b]	0.12
Area 5 Sewage Lagoon	None	36 km (22 mi)	^{3}H[b]	0.0003
Miscellaneous Projects	None	20-60 km (12-37 mi)	^{238}Pu[d]	0.0039
Miscellaneous Projects	None	20-60 km (12-37 mi)	$^{239+240}Pu$[d]	0.031
Miscellaneous Projects	None	20-60 km (12-37 mi)	^{241}Am [d]	0.00034
Grouped Area Sources				
All NTS Areas	None	20-60 km (12-37 mi)	^{241}Am[e]	0.047
All NTS Areas	None	20-60 km (12-37 mi)	^{238}Pu[e]	0.050
All NTS Areas	None	20-60 km (12-37 mi)	$^{239+240}Pu$[e]	0.29

(a) All locations are at the NTS except Building A-1, in North Las Vegas.
(b) Emission based on tritiated water discharged into containment pond(s) or on the ground.
(c) Emission based on environmental surveillance results and CAP88-PC software
(d) Sum of emissions estimates; see Appendix F for individual activity estimates.
(e) Sum of emissions estimated from re-suspension model; see Table E.1 for individual area estimates

A summary of the NTS total CY 2007 emissions for NESHAP reporting, by radionuclide, is provided in Table 3.0.

Table 3.0 Total Estimated NTS Emissions for CY 2007 (Multiply Ci by 37 to obtain GBq)

Radionuclides	2007 Total Quantity (Ci)
^{3}H	550
^{241}Am	0.047
^{238}Pu	0.054
$^{239+240}Pu$	0.32

Note: This table includes conservative point and diffuse source release estimates.

SECTION III
DOSE ASSESSMENTS

DOSE ASSESSMENT METHOD

The NTS demonstrates compliance with dose limits using environmental measurements of radionuclide air concentrations near the NTS borders and near areas of known potential sources of radionuclide emissions. This critical receptor method was approved by EPA Region IX for use on the NTS in 2001 (EPA, 2001) and has been the sole method used to demonstrate compliance since 2005. The six critical receptor locations listed below and displayed in Figure 2.0 were approved.

Area 6, Yucca
Area 10, Gate 700
Area 16, Substation 3545
Area 20, Schooner
Area 23, Mercury Track
Area 25, Gate 510

These can be thought of as pseudo-critical receptor locations because no person actually resides at these onsite locations, but they are used as such to conservatively represent hypothetical offsite critical receptors.

Compliance with the NESHAP inhalation dose limit to the public of 10 mrem/yr is demonstrated if the measured annual average concentration of each detected radionuclide at each of these locations is less than the NESHAP Concentration Levels (CL) for Environmental Compliance. The CLs represent the annual average concentration of each radionuclide that would result in an EDE of 10 mrem/yr (see Table 4.0). If multiple radionuclides are detected, then compliance with NESHAP is demonstrated when the sum of the fractions (determined by dividing each radionuclide's concentration by its CL and then adding the fractions together) is less than 1.0. The comparisons for 2007 air sampling results from the six compliance stations are presented in Table 4.0.

COMPLIANCE ASSESSMENT

Table 4.0 lists the average concentrations of detected radionuclides and their fraction of the NESHAP compliance level for each of the six NTS compliance stations. The concentration average for each detected man-made radionuclide was below three percent of the compliance levels except for the tritium average at the Schooner sampler station, which was 20 percent of the compliance level. The average concentration of tritium is high at Schooner because the air sampler is only 269 meters (m) from the center of the crater and located within the area that received ejecta from the cratering experiment (Figure 3.0). At the Schooner station, the highest sum of the fractions of measured annual concentrations divided by the NESHAP CL for each radionuclide was 0.20, well below 1.0 and therefore in compliance with NESHAP. Scaling this sum of fractions to the 10 mrem/yr limit gives an estimated EDE of only 2.0 mrem/yr from air emissions for a hypothetical individual living year-round at this station. The MEI, in a sense, may now be considered to hypothetically reside at the onsite Schooner critical receptor location, a much more conservative assumption for public exposure to NTS radionuclide air emissions. Figure 4.0 displays the sum of fraction results for the Schooner station, 2001 to 2007. Schooner has the highest sum of fractions of all critical receptor locations.

No one resides at Schooner or along the borders near the air sampling stations. The dose at offsite populated locations 20–80 km (12–50 mi) from the Schooner station would be much lower due to wind dispersion, and likely much less than 1 mrem/yr, similar to the MEI dose estimates made using CAP88-PC software, 1992 through 2004 (Figure 5.0).

Table 4.0 Measured Radionuclide Concentrations at NTS Compliance Sampling Stations

Location	Radionuclide	Average Concentration in Air (pCi/m^3)[a]	CL[b] (pCi/m^3)	Average Concentration as Fraction of CL
Yucca	^{3}H	0.51×10^{-0}	1500	0.0003
Gate 700		0.49×10^{-0}		0.0003
Substation 3545		0.43×10^{-0}		0.0003
Schooner		298.17×10^{-0}		0.199
Mercury		0.40×10^{-0}		0.0003
Gate 510		0.30×10^{-0}		0.0002
Yucca	^{241}Am	3.42×10^{-6}	0.0019	0.0018
Gate 700		11.69×10^{-6}		0.0062
Substation 3545		0.77×10^{-6}		0.0004
Schooner		1.69×10^{-6}		0.0009
Mercury		4.59×10^{-6}		0.0024
Gate 510		1.42×10^{-6}		0.0007
Yucca	^{238}Pu	2.35×10^{-6}	0.0021	0.0011
Gate 700		2.33×10^{-6}		0.0011
Substation 3545		1.26×10^{-6}		0.0006
Schooner		1.30×10^{-6}		0.0006
Mercury		0.97×10^{-6}		0.0005
Gate 510		-0.20×10^{-6}		-0.0001
Yucca	$^{239+240}Pu$	11.13×10^{-6}	0.0020	0.0056
Gate 700		58.80×10^{-6}		0.0294
Substation 3545		15.14×10^{-6}		0.0076
Schooner		1.73×10^{-6}		0.0009
Mercury		9.87×10^{-6}		0.0049
Gate 510		2.79×10^{-6}		0.0014
Yucca	Sum of Fractions by Location			0.0088
Gate 700				0.0370
Substation 3545				0.0089
Schooner				0.2014
Mercury				0.0081
Gate 510				0.0022

(a) picocuries per cubic meter (pCi/m^3)

(b) Source: Table 2 in Title 40 CFR 61, Appendix E (Compliance Procedures Methods for Determining Compliance with Subpart I)

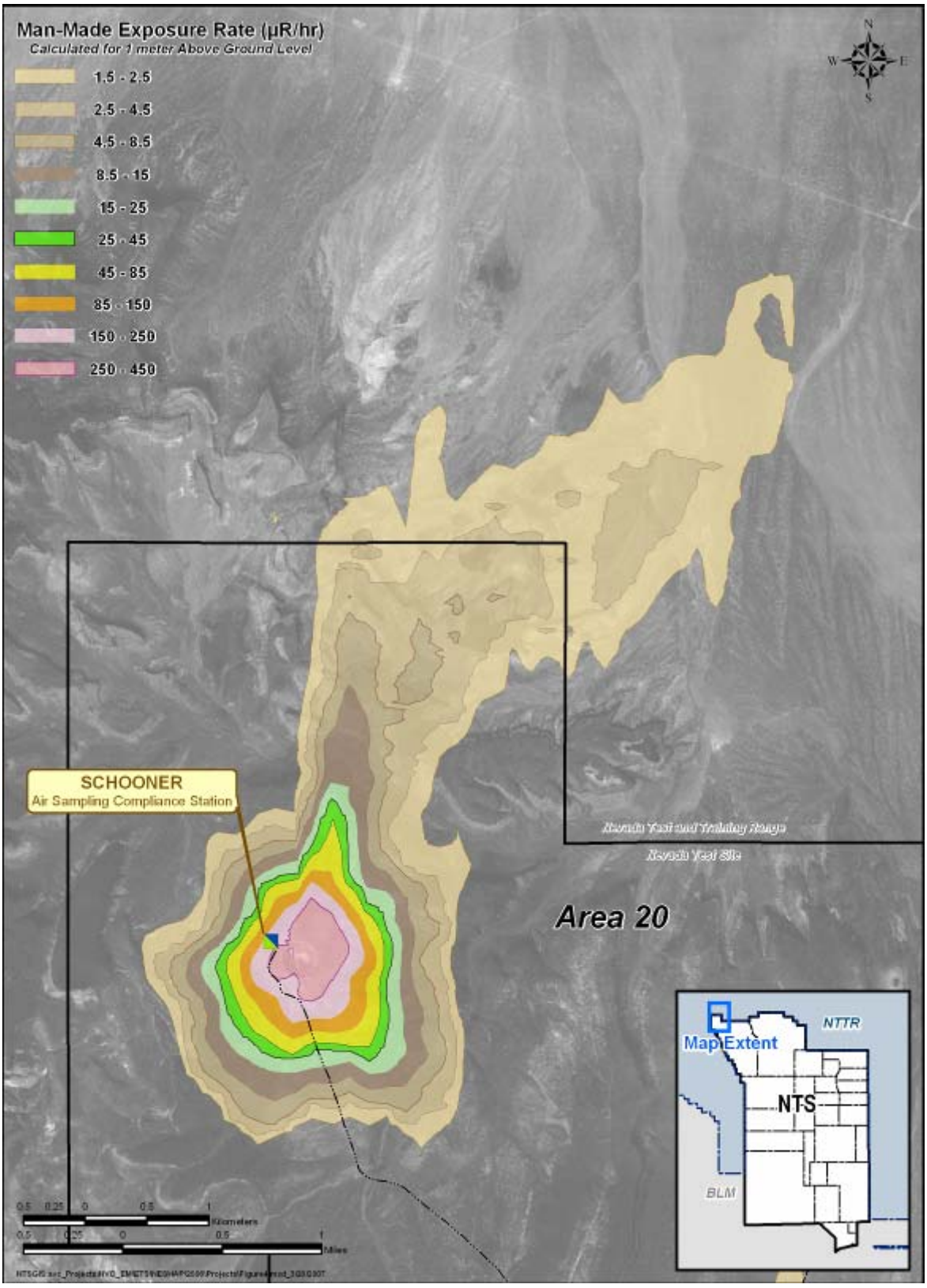

Figure 3.0 Schooner Air Sampling Compliance Station

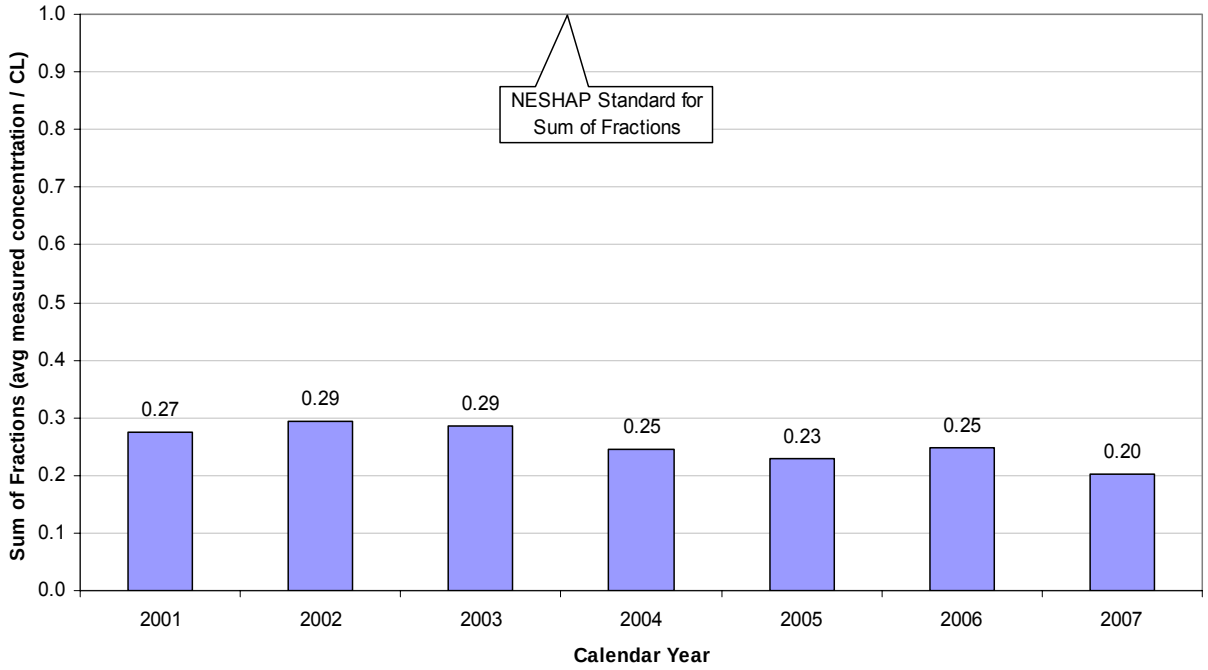

Figure 4.0 Sum of Fractions (Annual Average Radionuclide Concentrations Divided by CLs) for the Schooner Critical Receptor Location, CY 2001 to CY 2007

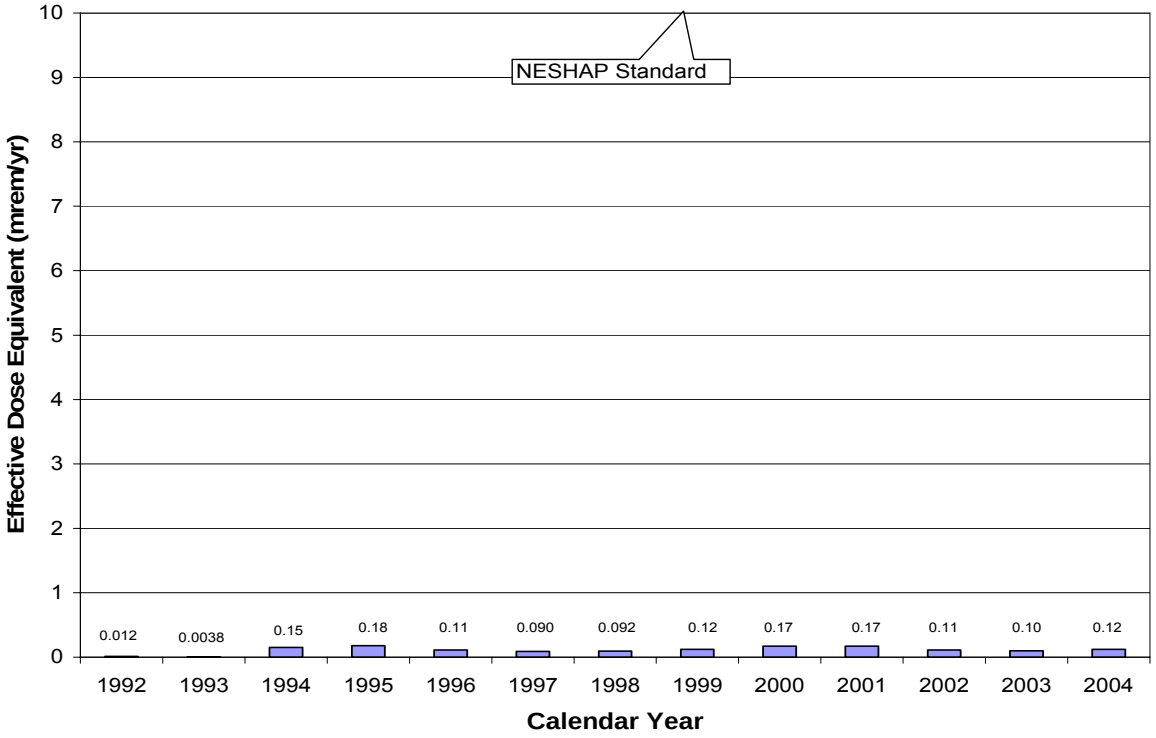

Figure 5.0 Effective Dose Equivalent to MEI from CY 1992 to CY 2004

SECTION IV
ADDITIONAL INFORMATION

NEW CONSTRUCTION/MODIFICATION ACTIVITIES AT THE NTS

Several projects were evaluated to determine if they have the potential to release airborne radionuclides that would expose the public to a dose greater than 0.1 mrem/yr. For any project or facility with this potential, the EPA requires point-source operational monitoring. These projects are identified below with a brief summary of the evaluations. More detailed descriptions of the dose evaluations can be found in Appendix F.

- Certain radioactively contaminated soil, vegetation, and animal samples collected during the period of nuclear detonations at the NTS and in the South Pacific were stored in Building 26-2106. The samples were collected by several organizations at the NTS to assess the distribution of radioactive fallout and its effect upon the environment. As these samples were no longer of use, work was conducted to consolidate, characterize and dispose of these samples. As part of this plan, samples were fed into a shredder, which broke open the sample containers and deposited the soil and debris into B-25 boxes. Samples were collected from the boxes and analyzed to characterize the radioactive and other hazardous components so that proper disposal could be determined. The CAP88-PC dose estimate, using wind blowing directly to nearest offsite residents, was 0.0067 mrem/yr at Amargosa Valley (formerly called Lathrop Wells), 28.7 km (17.8 mi) southwest of the shredder.

- Due to the removal and disposal of soil contaminated with radioactivity and/or hazardous chemicals in Areas 23, 25, and 26 (Corrective Action Unit 300), an evaluation of the potential radiation doses to the offsite public resulting from soil re-suspension was conducted to determine whether the doses would be less than the limit of 0.1 mrem/yr, as specified by 40 CFR 61, Subpart H. The location with the potential for having the highest radionuclide emissions was evaluated. The resultant dose to the MEI offsite was only 3.8×10^{-8} mrem/yr at Amargosa Valley, 24 km (14.9 mi) south-southwest of the work location.

- Due to the removal and disposal of materials contaminated with radioactivity and/or hazardous chemicals in Area 6 (former Decon Facility) and in Area 15 (EPA Farm), an evaluation of the potential radiation doses to the offsite public resulting from soil re-suspension was conducted and determined the doses would be 0.00067 mrem/yr at the nearest offsite residents (Amargosa Valley).

- TRU waste was shipped to the NTS from the Lawrence Livermore National Laboratory (LLNL) through the early 1980s in 58 oversized boxes. These boxes could not be shipped off of the NTS under current shipping regulations so repackaging was required. Since examination and repackaging in the Visual Examination and Repackaging Building (VERB) in Area 5 required handling of the waste, a dose assessment was made to ensure that airborne radioactive emissions from the examination and repackaging operation would be in compliance with NESHAP. Based on this assessment, the effective dose equivalent to the MEI offsite was estimated to be 7.7×10^{-5} mrem/yr at Crystal, 44.47 km (27.6 mi) south-southwest of the VERB.

- Soil samples collected by LLNL at past nuclear test locations were analyzed for their grain size distribution in Bunker 06-806. The grain-size analysis was conducted in a containment

tent equipped with a HEPA filter, all within the Bunker to minimize any contamination of the outside environment. To determine whether the modification of the Bunker facility for this project was in compliance with NESHAP, a determination was made whether the potential emissions from the Bunker could result in a radiation dose equal to or greater than 0.1 mrem/yr to the MEI offsite. No emission controls were used in the assessment. Using wind blowing 100% of the time towards the nearest offsite resident, it was determined that the amount of $^{239+240}$Pu released was five orders-of-magnitude lower than the amount that would result in an EDE of 0.1 mrem/yr.

- On April 30, 2007, the Borehole Management Project site preparation crew was preparing to gain access to the wellhead at borehole U9z PS#2, Area 9, when an emission of radioactivity occurred that led to some level of internal exposure to workers at the location. Two air samplers were in operation during the release. Sample results were used to estimate the emission to air. This was accomplished by dividing the measured radioactivity concentration by the predicted air concentration calculated by CAP88-PC for a 1 Ci release. From this, it was conservatively estimated that 0.03 Ci of $^{239+240}$Pu was released. The details of the emission estimate are given in Appendix F.

UNPLANNED RELEASES DURING CY 2007

No unplanned releases occurred during 2007.

SOURCES OF EMISSIONS

In summary, all sources of radionuclide emissions from the NTS or the NLVF identified and characterized in 2007 include the following:

- Evaporation of tritiated water from the Building A-1 basement at the NLVF (see Appendix A)
- Evaporation of tritium from Area 5 Sewage Lagoon, which received liquid effluents from the Building A-1 basement at the NLVF; from E Tunnel containment ponds in Area 12, which received water seeping from the Tunnel complex; and from UGTA well pumping activities (see Appendix B)
- Release of tritium gas during the calibration of analytical equipment in Building 650 in Mercury (see Appendix C)
- Release of tritium gas during operations at the DPF Facility (see Appendix C)
- Evapotranspiration of tritium from the Sedan and Schooner craters and from the areas including the Area 3 and Area 5 RWMSs (see Appendix D)
- Re-suspension of ^{241}Am, ^{238}Pu, and $^{239+240}$Pu from soil deposits on the NTS areas (see Appendix E)
- Miscellaneous environmental restoration, research, waste management, and construction projects resulting in the emission of radionuclides (see Appendix F)

CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See 18 U.S.C. 1001.

Name: Stephen A. Mellington, Acting Manager, NNSA/NSO

Signature: Stephen A. Mellington Date: 6/5/08

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APPENDICES

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Appendix A

PUBLIC DOSE CALCULATIONS FOR THE RELEASE OF TRITIUM FROM BUILDING A-1, NLVF

As discussed in the 1995 National Emission Standard for Hazardous Air Pollutants (NESHAP) report (U.S. Department of Energy, 1996b), a container of tritium-aluminum foils was opened in the Atlas Facility at the North Las Vegas Facility (NLVF) area and emitted at least 1 curie of tritium into a basement area used as a fixed radiation source range. Environmental surveillance began on Friday, July 14, 1995, the day notification of the tritium leak occurred. Environmental tritiated water (HTO) samplers were installed at three locations outside the facility. Later, an HTO sampler was installed in the basement and operated continuously so that progress on cleanup of the spill could be monitored. After cleanup began, the environmental samplers were removed, but the basement air sampler continued operation through January 5, 1998, at which time samples were collected once each quarter. The 1996, 1997, and 1998 results and effective dose equivalent (EDE) to the maximally exposed individual (MEI) offsite at the perimeter fence were reported in the annual NESHAP reports.

During the years 1999 through 2007, air sampling for HTO in the basement was conducted intermittently. For calendar year 2007, the results of two atmospheric moisture samples collected April 24 to May 2, 2007 (966 picocuries per cubic meter [pCi/m^3]), and October 9 to October 15, 2007 (720 pCi/m^3), and the basement ventilation rate of 673 cubic feet per minute (ft^3/min), were used to estimate the annual tritium emission: 1,135 (average 2003–2007) pCi/m^3 x 673 ft^3/min x 0.02832 m^3/ft^3 x 525,600 min/year (yr) x 10^{-9} millicuries (mCi)/pCi = 11 mCi/yr. An additional 1.3 mCi of tritium was released from Building A-1 by evaporating water from the radiation source well, resulting in a total emission of 12.3 mCi. The Clean Air Package 1988 average dose factor used for dose assessments from 1995 to 2001 (5.0 x 10^{-6} millirem per year per millicurie [mrem/yr]/mCi) was multiplied with this emission to obtain the EDE (0.06 microroentgen equivalent man per year [µrem]/yr) to the nearest member of the public outside the perimeter fence of Building A-1. A comparison of the past and current emission rates and radiation dose to the MEI are presented in Table A.1.

Table A.1. Comparison of Tritium Emission Rates from Building A-1, NLVF from 1995–2007

Year	Tritium Emission Rate (mCi/yr)	EDE to MEI (µrem/yr)
1995	123	0.96
1996	52	0.25
1997	110	0.53
1998	16	0.08
1999	301	1.4
2000	370	1.8
2001	200	0.96
2002	(not sampled)	-
2003	9.3	-
2004	11	-
2005	20	0.10
2006	13.2	0.07
2007	12.3	0.06

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APPENDIX B
CALCULATION OF TRITIUM EMISSIONS FROM NEVADA TEST SITE PONDS

During calendar year 2007, the air emissions of tritium as tritiated water from Nevada Test Site (NTS) ponds containing tritium were conservatively estimated from the product of the volume of water discharged into the ponds, or to the ground, and measurements of the tritium content of the water. Table B-1 lists the estimates and the values used in the estimates.

Table B.1 Tritium Concentrations and Water Volumes used to Estimate Tritium Emissions from NTS ponds or Underground Test Area Well Sampling Activities

Location	Tritium Concentration (pCi/L)[a]	Water Volume (L)[b]	Tritium Emission (Ci)[c]
E Tunnel Ponds	5.97×10^{5}	1.56×10^{7}	9.3
Area 5 Sewage Lagoon	1.91×10^{3}	2.44×10^{5}	0.00047
Well RNM #1	7.00×10^{2}	7.43×10^{5}	5.2×10^{-5}
Well RNM #2S	1.00×10^{5}	4.48×10^{5}	0.045
U-3cn PS #2	7.66×10^{6}	1.59×10^{4}	0.12

(a) pCi/L = picocurie(s) per liter
(b) L = liter
(c) Ci = curie(s)

Water continues to drain from the E Tunnel into several ponds after attempts failed in the past to seal the tunnel.

The water discharged into the Area 5 Sewage Lagoon was removed from the basement of Building A-1, North Las Vegas Facility, where water in a source well containing tritium, attributed to the contaminating event referred to in Appendix A, was rising due to changes in the groundwater level.

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APPENDIX C
POTENTIAL RADIONUCLIDE EMISSIONS FROM POINT SOURCES

Building 650 Source Storage Room

Following the closure of the Analytical Services Laboratory in Area 23 at Building 650, all of the standards, check sources, and tracer solutions were stored in a basement room until all items could be properly disposed. From an inventory of these radioactivity sources, only three of them, listed below with their curie (Ci) content assessed during calendar year (CY) 2002, are volatile and could become sources of air emissions.

Tritium (^{3}H) (as tritiated water)	3.0×10^{-4} Ci
Krypton-85 (^{85}Kr)	8.7×10^{-2} Ci
Iodine-129 (^{129}I)	5.4×10^{-7} Ci

All of the standards and solutions were maintained in accordance with 10 Code of Federal Regulations 835. No portion of these sources were released or consumed during CY 2007; therefore, no emission from these sources was estimated. However, about 11 microcuries of tritium gas from a pressurized tank at Building 650 were consumed during the calibration of analytical equipment.

Los Alamos National Laboratory Building CP-95A – Area 6
Lawrence Livermore National Laboratory Device Assembly Facility – Area 6

In previous years, the laboratories in these facilities maintained standards of radioactivity containing xenon-133 (^{133}Xe), iodine-131 (^{131}I), and ^{3}H. Due to the test moratorium that began in 1992, the need for standards was reduced. The use of the standards during the year did not result in any release to the atmosphere.

Building 11-102 – Area 11
Dense Plasma Focus Facility

In 2007, NTS operations began at the Dense Plasma Focus Facility, which was relocated from the NLVF to the NTS, Building 11-102. Operations at the NTS used the deuterium-tritium D(t,n)4He reaction. The following calculation of the total tritium emission is based upon the change in pressure in a tank of tritium gas used in the experiments:

Total emission = (920 Ci)(108 Torr/876 Torr) = 113 Ci ≈ 120 Ci released

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APPENDIX D
TRITIUM EMISSIONS ESTIMATED FROM AIR SAMPLING DATA

BACKGROUND INFORMATION

Environmental monitoring for tritium in atmospheric moisture was conducted at ten locations on the Nevada Test Site (NTS) until July 2001. Then the number of monitoring locations was increased to 14, and some of the locations were changed to conform to a change in strategy for demonstrating compliance with National Emission Standards for Hazardous Air Pollutants (see Compliance Assessment in Section III). There were four air samplers around the perimeter of the Area 5 Radioactive Waste Management Site (RWMS) where many curies (Ci) of tritium are buried at that facility; however, all four samplers were removed because they were too close to the sources for them to be used with the Clean Air Package 1988 computer program (CAP88-PC) software in estimating the tritium emissions. Instead, air samplers identified as U.S. Department of Defense (DoD) and Sugar Bunker North were added 1,590 meters (m) (5,216 feet [ft]) north and 970 m (3,182 ft) south, respectively, of the compound within the prevailing downwind sectors of the facility. Other air samplers were operated at the E Tunnel ponds area, near Sedan crater, and near Schooner crater. In November 2004, tritium samplers were installed at U-3bh N and U-3ah/at S near the Area 3 RWMS to monitor tritium emissions from waste disposal operations and vicinity. Figure 2.0 of this report shows the current NTS air sampling station locations.

SOURCE TERM ESTIMATES

Estimating the tritium emissions as tritiated water (HTO) from air sampling data required a CAP88-PC estimate of the air concentration at the location of each air sampler for a 1 Ci release from the center of each source location. The total annual emission was then calculated by dividing the annual average concentration of HTO measured at each sampling location by the predicted CAP88-PC concentration for a 1 Ci release.

Table D.1 lists the estimated emissions for each emission source location. Tritium emission from E Tunnel ponds was not estimated from air sampling data because the estimate from the total water pond influent and measured tritium concentrations, as described in Appendix B, was more conservative.

Table D.1 Tritium Emissions from Airborne Tritium Sampling Results during 2007

Emission Source	Air Sampler	Tritium Concentration (pCi/m^3)[(a)]	CAP88-PC Concentration for 1 Ci Emission (pCi/m^3)	Tritium Emission (Ci)[(b)]
Area 3 RWMS	BJY	0.854	0.0089	96[(c)]
	U-3BH North	0.719	0.0994	7.2
	U-3AH/AT South	1.012	0.359	2.8
Area 5 RWMS	DoD	0.442	0.114	3.9[(d)]
	Sugar Bunker North	0.641	0.564	1.1[(d)]
Area 10 Sedan	Sedan North	6.97	0.0274	250[(d)]
	Gate 700	0.483	0.0076	64[(d)]
Area 20 Schooner	Schooner	285	0.363	790[(e)]
	Gate 20-2P	0.383	0.00552	69

(a) pCi/m^3 = picocuries per cubic meter
(b) 1 Ci = 37 Gigabecquerels (GBq)
(c) Emission estimate likely biased high due to sampler potentially measuring tritium from other sources. Estimate still used for conservatism.
(d) The higher of the two emission estimates for each location was used for that location.
(e) Emission estimate likely biased high due to sampler being too close to the diffuse emission source. Alternative emission estimate based on Gate 20-2P sampling location considered more defensible and therefore used.

APPENDIX E
EMISSIONS OF AMERICIUM AND PLUTONIUM FROM LEGACY SITES BASED ON HISTORIC SOIL SURVEY DATA AND SOIL RE-SUSPENSION MODEL

BACKGROUND INFORMATION

Areas 1 through 12 and Areas 15 through 30 on the Nevada Test Site (NTS) contain diffuse sources of radionuclides. Historic soil surveys have identified the location of these sources on the NTS and provided estimates of the amounts of radionuclides which remain in the surface soils (U.S. Department of Energy [DOE], 1991; see Table 1.0). Due to occasional high winds, some contaminated soil becomes airborne. Results from the air samplers in these areas indicate that americium-241 (^{241}Am) and plutonium-239+240 ($^{239+240}$Pu) are routinely detected, but only in concentrations slightly above the minimum detectable concentration. The total emissions (in curies [Ci]) produced each year from all known soil legacy sites on the NTS is estimated with a mathematical re-suspension model. This appendix describes all the calculations involved in producing the emission estimates.

RE-SUSPENSION CALCULATIONS

These calculations are needed to estimate how much of the radionuclides in surface soils could actually become airborne (re-suspended) and therefore become an emission. A conservative estimate of americium and plutonium emissions from diffuse sources is obtained by the use of a re-suspension equation with parameters derived from actual studies at the NTS. In NUREG/CR-3332 (U.S. Nuclear Regulatory Commission, 1983), pages 5–30, an equation for calculating a suspension rate (fraction re-suspended per second) is given as follows:

$$S = K \times V_g$$

where: S = fractional re-suspension rate (curies per second [Ci/s]), or the fraction of the inventory re-suspended per second
K = re-suspension factor (per meter [m])
V_g = deposition velocity (meters per second [m/s])

The values of K and V_g used in this re-suspension equation are taken from DOE (1992). On page 75 of DOE (1992), values of K are given for the NTS. An average of the values is 2×10^{-10}/m. Ranges in V_g of 0.01 to 0.05 m/s, presented in DOE (1992), are used as conservative estimates. When these values are put into the above equation, S is between 2×10^{-12} and 1×10^{-11}/s. To be conservative, the higher fractional re-suspension rate of 1×10^{-11}/s is used. For example, the emission rate in picocuries (pCi)/s for $^{239+240}$Pu from Area 3 is calculated from the product of the $^{239+240}$Pu inventory (37 Ci from Table 1.0) and S as follows:

$$(37 \text{ Ci}) \times (1 \times 10^{-11}/\text{s}) \times (10^{12} \text{ pCi/Ci}) = 370 \text{ pCi/s}$$

Since 1 year (yr) = 3,600 s/hour x 24 hour/day x 365 days/yr = 3.15×10^7 s/yr, the annual emission rate becomes:

$$370 \text{ pCi/s} \times 3.15 \times 10^7 \text{ s/yr} = 1.17 \times 10^{10} \text{ pCi/yr or } 11.7 \text{ millicuries (mCi)/yr}$$

This method was used for calculating the ^{241}Am and $^{239+240}$Pu emissions from all other areas. The results are shown in Table E.1.

Table E.1 Calculated Emissions from Inventories[(a)] of Plutonium and Americium in NTS Areas

Inventory, Re-suspension Factors, and Calculated Emissions by Area								
Area	^{241}Am (Ci)	^{238}Pu (Ci)	$^{239+240}$Pu (Ci)	K (m^{-1})	Vg (m/s)	Emission of ^{241}Am (mCi/yr)	Emission of ^{238}Pu (mCi/yr)	Emission of $^{239+240}$Pu (mCi/yr)
1	4.2	6.5	24	2×10^{-10}	5×10^{-2}	1.32	2.05	7.57
2	2.9	8.6	22	2×10^{-10}	5×10^{-2}	0.91	2.71	6.94
3	4.6	3.1	37	2×10^{-10}	5×10^{-2}	1.45	0.98	11.67
4	6.6	13	40	2×10^{-10}	5×10^{-2}	2.08	4.10	12.61
5	0.6	0.1	4.8	2×10^{-10}	5×10^{-2}	0.19	0.03	1.51
6	1.7	3.3	8.4	2×10^{-10}	5×10^{-2}	0.54	1.04	2.65
7	2.2	0.6	16	2×10^{-10}	5×10^{-2}	0.69	0.19	5.05
8	17	8	110	2×10^{-10}	5×10^{-2}	5.36	2.52	34.69
9	4.2	2.2	89	2×10^{-10}	5×10^{-2}	1.32	0.69	28.07
10	19	19	110	2×10^{-10}	5×10^{-2}	5.99	5.99	34.69
11	3.3	0.5	29	2×10^{-10}	5×10^{-2}	1.04	0.16	9.15
12	5.7	8.5	39	2×10^{-10}	5×10^{-2}	1.80	2.68	12.30
15	8	7.8	63	2×10^{-10}	5×10^{-2}	2.52	2.46	19.87
16	0.7	1.5	3.7	2×10^{-10}	5×10^{-2}	0.22	0.47	1.17
17	2.8	4.5	18	2×10^{-10}	5×10^{-2}	0.88	1.42	5.68
18	19	5.6	100	2×10^{-10}	5×10^{-2}	5.99	1.77	31.54
19	21	32	140	2×10^{-10}	5×10^{-2}	6.62	10.09	44.15
20	23	30	41	2×10^{-10}	5×10^{-2}	7.25	9.46	12.93
30	3.2	4.5	14	2×10^{-10}	5×10^{-2}	1.01	1.42	4.42
TOTAL	150	160	910			47	50	290

(a) Radioactive inventories from Table 5 in DOE/NV/10845--02 (DOE, 1991)

As shown in Table E.1, the estimated total emissions of ^{241}Am, ^{238}Pu, and $^{239+240}$Pu from historic soil inventory data and from the re-suspension model were 47, 50, and 290 mCi/yr, respectively. These are shown in Table 2.0 (as 0.047, 0.050 and 0.29 Ci/yr), which summarizes all measured or computed emissions from the NTS in 2007.

OTHER ISOTOPES

The other isotopes that have been found in soil samples in the various areas on the NTS are cobalt-60 (^{60}Co), strontium-90 (^{90}Sr), cesium-137 (^{137}Cs), europium-152 (^{152}Eu), europium-154 (^{154}Eu), and europium-155 (^{155}Eu); however, their concentrations in air samples are below detection levels and collectively contribute less than 10 percent to the total dose from all radionuclide emissions calculated from re-suspension calculations, and therefore they have not been included in evaluations for National Emission Standards for Hazardous Air Pollutants compliance.

APPENDIX F
RADIONUCLIDE EMISSIONS FROM ENVIRONMENTAL RESTORATION, WASTE MANAGEMENT, RESEARCH, OR CONSTRUCTION PROJECTS

ENVIRONMENTAL CLEANUP PROJECTS

Disposal of Samples Stored in Building 26-2106

Certain radioactively contaminated soil, vegetation, and animal samples collected during the period of nuclear detonations at the Nevada Test Site (NTS) and in the South Pacific were stored in Building 26-2106. The samples were collected by several organizations at the NTS to assess the distribution of radioactive fallout and its effect upon the environment. As these samples were no longer of use, work was conducted to consolidate, characterize and dispose of these samples. As part of this plan, samples were fed into a shredder, which broke open the sample containers and deposited the soil and debris into B-25 boxes. Samples were collected and analyzed to characterize the radioactive and other hazardous components so that proper disposal can be determined. In order to determine potential offsite dose from dust emissions from the shredding process prior to collection of the characterization samples, the best available radionuclide concentration data in NTS soils were used to estimate the degree of radionuclide contamination of the soil samples in Building 26-2106. The parameters used in the calculation of the total weight of the soil samples and the total radioactive emissions are as follows:

Total number of samples: 80,000
Sample size: 1 gallon (gal) (conservative estimate as most samples were in 0.13–0.26 gal [0.5–1 liter] polyethylene bottles)
Soil density: 1.6 grams per cubic centimeter (g/cm^3)
Total weight of soil samples: 80,000 gal x 3785 cm^3/gal x 1.6 g/cm^3 = 4.84 x 10^8 g
Emission factor: 0.001 (for solid particulates as allowed by 40 CFR 61, Appendix D)
$^{239+240}Pu$ emission estimate = 0.00054 curies (Ci)
^{241}Am emission estimate = 0.00031 Ci

The CAP88-PC dose estimate, using wind blowing directly to nearest offsite residents, was 0.0067 millirem per year (mrem/yr) at Amargosa Valley (formerly called Lathrop Wells), 28.7 kilometers (km) (17.8 miles [mi]) southwest of the shredder.

CAU 300

Due to the removal and disposal of soil contaminated with radioactivity and/or hazardous chemicals in Areas 23, 25, and 26 (Corrective Action Unit [CAU] 300), an evaluation of the potential radiation doses to the offsite public resulting from soil re-suspension was conducted to determine whether the doses would be less than the limit of 0.1 mrem/yr, as specified by 40 CFR 61, Subpart H. The evaluation conservatively estimated the emission to air by taking the amount of material (assumed all soil) to be removed from near Buildings 25-3113A, 25-3901, 25-3124, and 26-2105 and maximum radionuclide concentrations measured at Building 25-3113A (overall highest of all CAU 300 locations) and applying an emission factor of 0.0128 kilograms of soil re-suspended per megagram of soil moved (kg particles/Mg soil moved). Potential radiation dose to the public was calculated with Clean Air Package 1988 (CAP88-PC), version 3.0, software. The following area and soil volume assumptions were used:

Area of emission source: 10 square meters
Total soil volume to be removed: 52 cubic meters (m^3)
Soil density was 1.5 cm^3/g

Table F.1 Estimated Radioactive Emissions Resulting from Contaminated Soil Removal and Haulage from CAU 300[(a)]

Estimated Radioactive Emissions Resulting from Contaminated Soil Removal and Haulage				
Analyte	Max. Concentration (pCi/g)[(b)]	Total Soil Moved (g)	Soil Re-Suspension Factor[(c)] (kg particles/Mg soil moved)	Radioactive Emissions (Ci)
Pu-239+240	0.73	7.80×10^{7}	0.0128	7.29×10^{-10}
Sr-90	295	7.80×10^{7}	0.0128	2.94×10^{-7}
U-234	37.7	7.80×10^{7}	0.0128	3.76×10^{-8}
U-235	2.35	7.80×10^{7}	0.0128	2.35×10^{-9}
U-238	1.23	7.80×10^{7}	0.0128	1.23×10^{-9}
Ac-228	2.22	7.80×10^{7}	0.0128	2.22×10^{-9}
Bi-214	1.38	7.80×10^{7}	0.0128	1.38×10^{-9}
Co-60	0.59	7.80×10^{7}	0.0128	$5. \times 10^{-10}$
Cs-137	348	7.80×10^{7}	0.0128	3.47×10^{-7}
Eu-152	8.2	7.80×10^{7}	0.0128	8.19×10^{-9}
Pb-212	2.11	7.80×10^{7}	0.0128	2.11×10^{-9}
Pb-214	1.45	7.80×10^{7}	0.0128	1.45×10^{-9}
Nb-94	4.32	7.80×10^{7}	0.0128	4.31×10^{-9}
Tl-208	0.75	7.80×10^{7}	0.0128	7.49×10^{-10}

(a) Radioactivity from Building 25-3113A Outfall soil and volume associated with soil removed from Buildings 25-3113A, 25-3901, 25-3124, and 26-2105
(b) pCi/g = picocurie(s) per gram
(c) From re-suspension model recommended in unpublished report *Methods for Estimating Fugitive Air Emissions of Radionuclides from Diffuse Sources at DOE Facilities*, September 3, 2004

The dose to the MEI offsite from this activity was calculated to be 4.0×10^{-8} mrem/yr at Amargosa Valley, 24 km (14.9 mi) south-southwest of the work location.

CAU 543

Due to the removal and disposal of materials contaminated with radioactivity and/or hazardous chemicals in Area 6 (former Decon Facility) and in Area 15 (EPA Farm), an evaluation of the potential radiation doses to the offsite public resulting from soil re-suspension was conducted to determine whether the doses would be less than the limit of 0.1 mrem/yr. This assessment was conducted using the following information:

Total soil volume to be removed: 280 m^3 (material listed in Appendix C of the CAU 543 Real Estate/Operations Permit [REOP])
Maximum radionuclide concentrations: listed in Appendix A, Table D.1-1 of the CAU 543 REOP
Soil density: 1.6 g/cm^3

Emission factor: 0.001 (for solid particulates as allowed by 40 CFR 61, Appendix D)
Shortest distance to populated offsite location: 46 km (28.6 mi) between Decon Facility and Amargosa Valley.
Wind blowing directly at offsite location, 11-16 knots

The emission of each radionuclide was calculated from these conservative estimates shown in Table F.2.

Table F.2 Estimated Radioactive Emissions Resulting from Contaminated Soil and Sludge Removal at sites within CAU 543

Analyte	Max. Concentration (pCi/g)	Total Removed (g)	Emission Factor[(a)] (dimensionless)	Radioactive Emissions (Ci)
Pu-238	8800	4.48×10^{8}	1.0×10^{-3}	3.94×10^{-3}
Pu-239+240	54	4.48×10^{8}	1.0×10^{-3}	2.42×10^{-5}
Sr-90	1.37	4.48×10^{8}	1.0×10^{-3}	6.14×10^{-7}
U-234	13.3	4.48×10^{8}	1.0×10^{-3}	5.96×10^{-6}
U-235	0.174	4.48×10^{8}	1.0×10^{-3}	7.80×10^{-8}
U-238	3.51	4.48×10^{8}	1.0×10^{-3}	1.57×10^{-6}
Ac-228	3.51	4.48×10^{8}	1.0×10^{-3}	1.57×10^{-6}
Bi-214	1.46	4.48×10^{8}	1.0×10^{-3}	6.54×10^{-7}
Co-60	2.09	4.48×10^{8}	1.0×10^{-3}	9.36×10^{-7}
Cs-137	65.6	4.48×10^{8}	1.0×10^{-3}	2.94×10^{-5}
Pb-212	3.29	4.48×10^{8}	1.0×10^{-3}	1.47×10^{-6}
Pb-214	1.86	4.48×10^{8}	1.0×10^{-3}	8.33×10^{-7}
Tl-208	1.02	4.48×10^{8}	1.0×10^{-3}	4.57×10^{-7}

(a) 40 CFR 61 Appendix D, 2, b, iii

Plutonium is the dominant contributor to dose so only the plutonium (^{238}Pu and $^{239+240}$Pu) emission estimates were used. The CAP88-PC dose estimate at 46 km distance was 0.00067 mrem/yr, or about 150 times lower than 0.1 mrem/yr.

Borehole Management Project

On April 30, 2007, the Borehole Management Project site preparation crew was preparing to gain access to the wellhead at borehole U9z PS#2 when an emission of radioactivity occurred that led to some level of internal exposure to workers at the location. The emission occurred approximately 1:30–2:00 pm. For conservatism, all alpha activity was assumed to be ^{239}Pu. This calculation estimates the amount of ^{239}Pu potentially emitted to air from this activity.

Two air samplers were in operation during the emission. Both samplers were very close at 46 centimeters (18 inches) and 2 m (6 feet), which makes comparisons with modeled results questionable due to the high uncertainty in wind patterns over such sort distances. To minimize this uncertainty, only the result from the sampler placed 2 m away was used. The ^{239}Pu concentration measured at the air sampler 2 m from the emission was divided by the ^{239}Pu concentration determined from CAP88-PC for a 1 Ci emission. A 1 Ci ^{239}Pu emission was modeled using CAP88-PC (version 3.0) with the following input parameters (all weather conditions were based on April 30, 2007 measurements taken at the Meteorological Data Acquisition [MEDA] 9 meteorological station):

Wind: 11–16 knots blowing 50 percent of the time towards the north-northwest and 50 percent of the time toward the north. Because the emission took place in a crater, a 1 Ci emission was

also modeled using a reduced wind speed (7 – 10 knots), also blowing 50 percent of the time towards the north-northwest and 50 percent of the time toward the north.
Average temperature: 28 degrees Celsius
Precipitation: 0 cm
Mixing height: 1,000 m
Humidity: 3 g/m^3
Distance between borehole and sampler: 2 m
Emission source: 1 Ci ^{239}Pu
Source height: 0 m (emission was at approximately the same height as the air sample: CAP88 air concentrations are defined as a ground level concentration, so the emission height was considered to be at ground level).
Source diameter: 0.1 m
Zero plume rise

Based on analysis of the filter from the sampler placed 2 m away, the air concentration was 4.11×10^2 pCi/m^3. Average modeled air concentrations from a 1 Ci emission was 1.38×10^4 pCi/m^3. Scaling the air concentrations resulted in the following estimated emission due to ^{239}Pu:

$$(4.11 \times 10^2 \text{ pCi/m}^3)/[(1.38 \times 10^4 \text{ pCi/m}^3)/(1 \text{ Ci emission})] = 0.03 \text{ Ci}$$

WASTE MANAGEMENT PROJECTS

Repackaging Oversized Waste Boxes

Transuranic waste was shipped to the NTS from the Lawrence Livermore National Laboratory (LLNL) through the early 1980s in 58 oversized boxes. These boxes could not be shipped off of the NTS under current shipping regulations, so they required examination and repackaging. This is conducted at the Area 5 RWMS, Visual Examination and Repackaging Building (VERB). The objective of this calculation was to ensure the airborne radioactive emissions from the examination and repackaging operations are in compliance with the National Emission Standards for Air Pollutants (NESHAP), 40 CFR 61, Subpart H. To do this, an assessment of the potential radiation dose to the offsite public from the airborne emissions was made.

The radionuclide inventory in the boxes was obtained from In Situ Object Counting System examination. An emission factor of 1×10^{-6} (40 CFR 61 Appendix D, 2, b, iii) was applied to the radionuclide inventory to determine the potential air emission (Table F.3).

The radionuclide emissions were input to CAP88-PC, Version 3.0 using wind conditions for Area 5 during 2006 (MEDA 13 meteorological station), Based on this assessment, the effective dose equivalent to the MEI offsite is 7.7×10^{-5} mrem/yr at Crystal, 44.47 km (27.6 mi) south-southwest of the VERB.

Table F.3 Total Box Inventory & Air Emission Estimate

Analyte	Total Ci	Total Emission (Ci) (Total x 1 x 10^{-6} Emission Factor)[(a)]
Pu-238	1.70	1.70×10^{-6}
Pu-239	2.58×10^{1}	2.58×10^{-5}
Pu-240	6.34	6.34×10^{-6}
Pu-241	1.83×10^{2}	1.83×10^{-4}
Pu-242	8.74×10^{-4}	8.74×10^{-10}
Am-241	3.01×10^{1}	3.01×10^{-5}
Np-237	1.39×10^{-3}	1.39×10^{-9}
Co-60	9.52×10^{-6}	9.52×10^{-12}
Am-243	2.09×10^{-2}	2.09×10^{-8}
Ra-226	2.49×10^{-4}	2.49×10^{-10}
Ac-227	5.34×10^{-3}	5.34×10^{-9}
Pa-231	3.95 x 10-3	3.95 x 10-9
Na-22	9.86 x 10-5	9.86 x 10-11
Cs-137	6.87 x 10-4	6.87 x 10-10
U-235	4.77 x 10-5	4.77 x 10-11
U-238	1.27 x 10-3	1.27 x 10-9
Th-229	5.12 x 10-3	5.12 x 10-9
U-232	1.33 x 10-2	1.33 x 10-8
Cm-243	6.88 x 10-3	6.88 x 10-9
Cm-245	3.00 x 10-3	3.00 x 10-9
Cm-244	4.44 x 101	4.44 x 10-5
Cf-249	2.00 x 10-3	2.00 x 10-9
Eu-154	3.03 x 10-6	3.03 x 10-12
U-233	9.93 x 10-1	9.93 x 10-7
Eu-152	2.23 x 10-6	2.23 x 10-12

[(a)] 40 CFR 61 Appendix D, 2, b, iii

RESEARCH PROJECTS

Soil Particle Size Distribution

Soil samples collected by LLNL from nine sites where past nuclear tests were conducted (Small Boy [Area 5 and Nellis Range], Little Feller I [Area 18], Little Feller II [Area 18], Palanquin [Area 20], Cabriolet [Area 20], Schooner [Area 20], Sedan [Area 10], Johnnie Boy [Area 18], and Danny Boy [Area 18]) were analyzed for their grain size distribution in Bunker 06-806. The grain-size analysis was conducted in a containment tent equipped with a high-efficiency particulate air filter, all within the Bunker to minimize any contamination of the outside environment.

Each sample (175 total) was collected in a 1-liter plastic bottle. In addition, LLNL provided two 55-gallon drums of previously collected soil samples, which are also to be analyzed for their grain-size distribution with the above mentioned 1-liter samples.

To determine whether the modification of the Bunker facility for this project is in compliance with NESHAP, one must determine whether the potential emissions from the Bunker could result in a radiation dose equal to or greater than 0.1 mrem/yr to the MEI offsite.

Since the radioactive content of the soil samples collected from the nine nuclear test sites listed above is not known, estimated radioactivity concentrations in surface soil at these sites was based on sampling from the Radionuclide Inventory and Distribution Program (U.S. Department of Energy, 1991). The radioactivity for each radionuclide in the total samples collected at each location was then calculated (number of samples x soil concentration per radionuclide in pCi/g x 1,000 cm^3/sample x 1.5 g/cm^3 x 1 Ci/1.0 x 10^6 pCi). The radioactivity for each radionuclide and location was summed and assumed to be $^{239+240}Pu$, the most hazardous radionuclide, resulting in a total of 48.6 microcuries (µCi). Likewise for the samples in the two 55-gallon drums, the same assumption was applied, resulting in a total of 6.74 µCi for Drum #1 and 3.70 µCi for Drum #2. The radioactivity in all samples, assumed to be $^{239+240}Pu$, was then summed: 48.6 + 6.74 + 3.70 = 59.0 µCi.

The distance between the Bunker and the nearest offsite populated location was 37 km (23 mi) south-southeast of the Bunker. The 59.0 µCi of $^{239+240}Pu$ in soil potentially emitted from this activity is about ten times less than emissions from Building 21-2106 (see above) and, therefore would also result in an offsite dose much less than 0.1 mrem/yr.

CONSTRUCTION PROJECTS

No construction projects conducted in 2007 resulted in an emission of radionuclides to air.

APPENDIX G
IDENTIFICATION AND JUSTIFICATION FOR THE DEVELOPMENT OF METEOROLOGICAL DATA USED AS INPUT TO CLEAN AIR PACKAGE 1988 (CAP88-PC)

SITE CHARACTERISTICS

The Nevada Test Site (NTS) is located in southern Nevada, approximately 105 kilometers (km) (65 miles [mi]) northwest of Las Vegas, Nevada, and encompasses an approximate rectangular area of 3,561 square kilometers (km^2) (1,375 square miles [mi^2]). Topography is complex with generally north-south oriented ridges and valleys typical of Nevada. Terrain elevations range from almost 823 meters (m) (2,700 feet [ft]) in the extreme southwest corner of the NTS (Area 25) to almost 2,347 m (7,700 ft) on Rainier Mesa in the northern part of the NTS (Area 12).

In general, terrain slopes gently into broad valleys. In the few areas where steep canyons or cliffs exist, adequate wind and temperature data have been collected and analyzed to provide thorough documentation of the existence of typical up-slope and down-slope wind regimes as a function of time of day.

Meteorological support, observations, and climatological services for the NTS are provided to the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) by the Air Resources Laboratory, Special Operations and Research Division (ARL/SORD). The ARL/SORD is a National Oceanic and Atmospheric Administration (NOAA) office and supports NNSA/NSO programs under the authority of an Interagency Agreement between NOAA and NNSA/NSO.

An arid climate exists over the NTS. Annual precipitation ranges from 12.4 centimeters per year (cm/yr) (4.9 inches/year [in./yr]) at Station No. 5, to 16.8 cm/yr (6.6 in./yr) at Yucca Flat (Station No. 6), to 14.7 cm/yr (5.8 in./yr) at Desert Rock, to 32.5 cm/yr (12.8 in./yr) on Rainier Mesa (Station No. 12).

METEOROLOGICAL OBSERVATIONS

The ARL/SORD manages, operates, and maintains a meteorological monitoring program that is designed and used to support the NNSA/NSO authorized activities on the NTS. This vital program consists of many meteorological monitoring systems that have been brought together under the Meteorological Integrated Data Network (MIDNET). The MIDNET includes a Meteorological Data Acquisition (MEDA) network of approximately 30 mobile meteorological towers located primarily on the NTS (Figure G.1). MIDNET has been operated on the NTS for more than 40 years, has undergone several modernizations and upgrades, and serves as a solid basis for deriving climatological information.

The MIDNET consists of communications systems, local area networks, upper-air sounding stations, and surface-based instrumentation used to measure wind direction and speed, temperature, relative humidity, pressure, and precipitation. Routine and special surface observations are collected by trained ARL/SORD personnel 16 hours per day, Monday through Friday at the Desert Rock Meteorological Observatory (DRA; elevation 1,007 m [3,304 ft]) located 4.8 km (3 mi) southwest of Mercury, Nevada (Station No. 23) (Figure G.1). Upper-air observations (radiosondes) are taken twice daily from DRA. DRA has been in operation since May 1978.

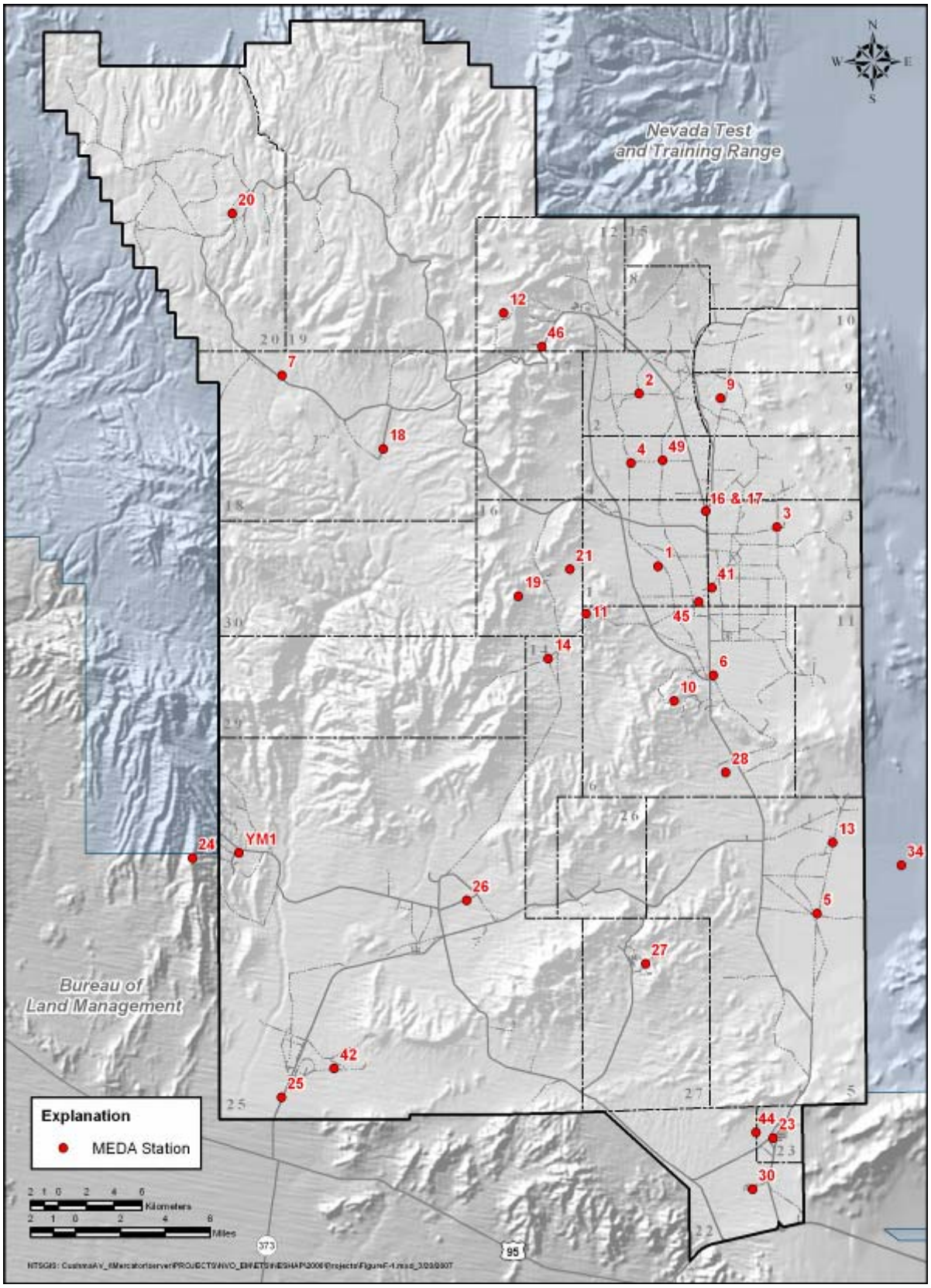

Figure G.1 Locations of MEDA Stations on the NTS in 2007

DRA was built to replace a similar observatory that was located at the Yucca Flat Meteorological Observatory (UCC; elevation 3,924 ft, Station No. 6) from January 1962 through mid-May 1978. Consequently, surface and upper-air observations are also available from UCC for 1962-1978.

A key component of the MIDNET system is the MEDA. A MEDA station consists of an enclosed trailer, a portable 10 m (32.8 ft) tower, a microprocessor, and a microwave radio transmitter. Wind speed and direction sensors are located on tower tops or booms oriented into the prevailing wind direction and at a minimum distance of two tower widths from the tower. Wind sensors are located 10 m above the ground.

Wind and temperature data have been collected on the NTS for more than 40 years. These and other meteorological data have been compiled into a comprehensive climatological database for the NTS. The MEDA data are especially useful in assessing boundary layer flow regimes on the NTS. MEDA station distribution and density (Figure G.1) are sufficient to document individual basin flow regimes and potential inter-basin air exchanges.

Ambient temperature and relative humidity sensors are located at 3 m (9.8 ft) above ground level. A total of 30 primary MEDA stations are located on or around the NTS (Figure G.1) to ensure that meteorological conditions are thoroughly documented for the complex terrain environment found on the NTS.

Wind direction is measured to two degrees of azimuth, and wind speed is accurate to 0.3 miles per hour. Wind data are collected as 15 minute averages and are transmitted via microwave to a central processor every 15 minutes. These data are checked operationally by the duty forecaster, and quality control is assured by the ARL/SORD climatologist. Plotted wind products are generated every 15 minutes for operational use. The data are stored and archived for climatological purposes.

MEDA temperature is accurate to 0.36 degrees Fahrenheit (°F) between -38°F and 140°F (absolute range for the NTS is -20°F to 115°F). Temperature measurements are instantaneous and are taken every 15 minutes at all MEDA stations. These data are also transmitted via microwave to a computer for processing, displaying, and archiving.

To utilize the most representative meteorological data available for NTS sources, cloud observations from DRA were melded with the concomitant MEDA winds from Mercury and Pahute Mesa. Similarly, the cloud observations from UCC were melded with MEDA wind data from Yucca and Frenchman Flats. The straight-line distance from DRA to Mercury is 4.8 km (3 mi); from UCC to Frenchman Flat is 19.3 km (12 mi); and from DRA to Pahute Mesa is 64.4 km (40 mi).

Cloud cover observations needed as input to the Stability Array (STAR) program are available from DRA (1978–present) and from UCC (1962–1978). Based on the available data, the cloud cover climatology from DRA and UCC are quite compatible. For example, UCC experiences 192 clear days annually, while DRA has 191 days. In addition, the average annual sky cover from sunrise to sunset for both stations is 3.9 tenths daily. The total number of cloudy days for UCC is 81 days and 82 days for DRA, annually. Therefore, the cloud cover observations from DRA and UCC can be considered as representative for most of the NTS.

APPLICATION TO CAP88-PC INPUT

Based on the above considerations and on the limitations of the Clean Air Package 1988 computer program (CAP88-PC), the cloud cover data from DRA were considered to be representative of Pahute Mesa. Therefore, atmospheric soundings and cloud cover observations from DRA were melded with MEDA surface wind data from Pahute Mesa for input to the STAR program to provide the very best data for calculating transport and dispersion processes. For sources in Yucca Flat and Frenchman Flat, the cloud cover data from UCC were considered to be the most representative. Yucca Flat and Frenchman Flat are adjoining valleys of similar soil and vegetation types and similar meteorological and climatological conditions.

For sources at Mercury, the cloud observations from DRA are representative. DRA is only 4.8 km (3 mi) from Mercury.

The STAR file is a matrix that includes seven Pasquill stability categories (A through G), six wind speed categories, and 16 wind sectors from wind roses calculated for each specified MEDA station on the NTS. The STAR files are used by a CAP88-PC utility program to create WIND files which are used by CAP88-PC in calculating diffusion calculations. Beginning in 2002, only weather data for the current year were used in creating the STAR files for the CAP88-PC calculations. Calendar year 2007 data from the MEDA stations for the NTS areas were used by ARL/SORD personnel to prepare the following STAR files:

STAR File	NTS Area
meda09.str	10
meda13.str	5
meda17.str	3
meda20.str	20

APPENDIX H
SUPPLEMENTAL INFORMATION

COLLECTIVE EFFECTIVE DOSE EQUIVALENT

As discussed in Section III, the U.S. Environmental Protection Agency has approved the use of critical receptor monitoring locations on the Nevada Test Site (NTS) to demonstrate National Emission Standards for Hazardous Air Pollutants (NESHAP) compliance in lieu of using the Clean Air Package 1988 computer software (CAP88-PC) to calculate the radiation doses received by offsite residents within 80 kilometers (km) (50 miles [mi]) of the NTS emission sources. Since the U.S. Department of Energy (DOE) agreed that there is little benefit in doing CAP88-PC calculations just for the collective effective dose equivalent (CEDE) (DOE, 2004a), this calculation was not performed for calendar year 2007. As shown in Figure H.1, the CEDE has been consistently below 0.6 person-rem [roentgen equivalent man] per year (yr) for the years 1992 to 2004, indicating that it is unlikely that the CEDE will exceed 1 person-rem/yr. However, if operations at the NTS change whereby this is exceeded, this change will be reconsidered.

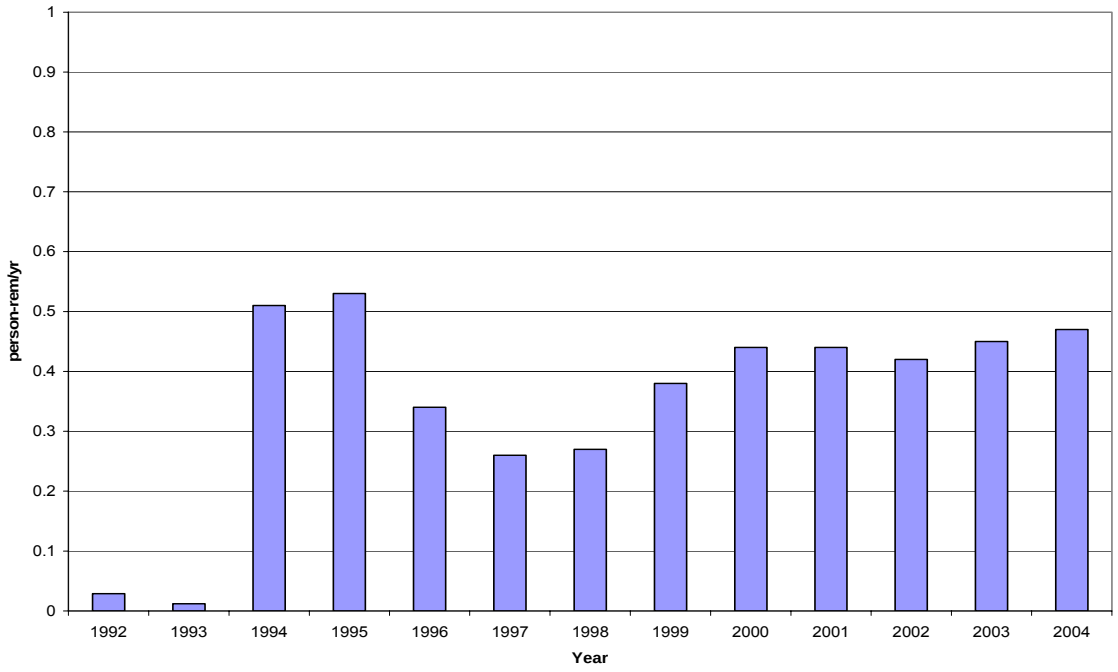

Figure H.1 CEDE to Populations within 80 km (50 mi) of Emission Sources

ESTIMATING TRITIUM EMISSIONS FROM SCHOONER AND SEDAN

Prior to 2002, the areas of diffuse tritium emissions from the Sedan and Schooner sites were assumed to be the sizes of their craters. From the measurement of tritium in vegetation samples collected in 2002 and 2004 at these sites, the areas of emissions appeared to be much larger. Current estimates for these areas are 3.8 x 10^6 square meters (m^2) for Sedan and 3.6 x 10^6 m^2 for Schooner. As this places the Schooner and Sedan air sampling locations within the source term area, the CAP88-PC concentration estimates at these sampler locations for a 1 curie per year (Ci/yr) release have high uncertainty (Figure H.2).

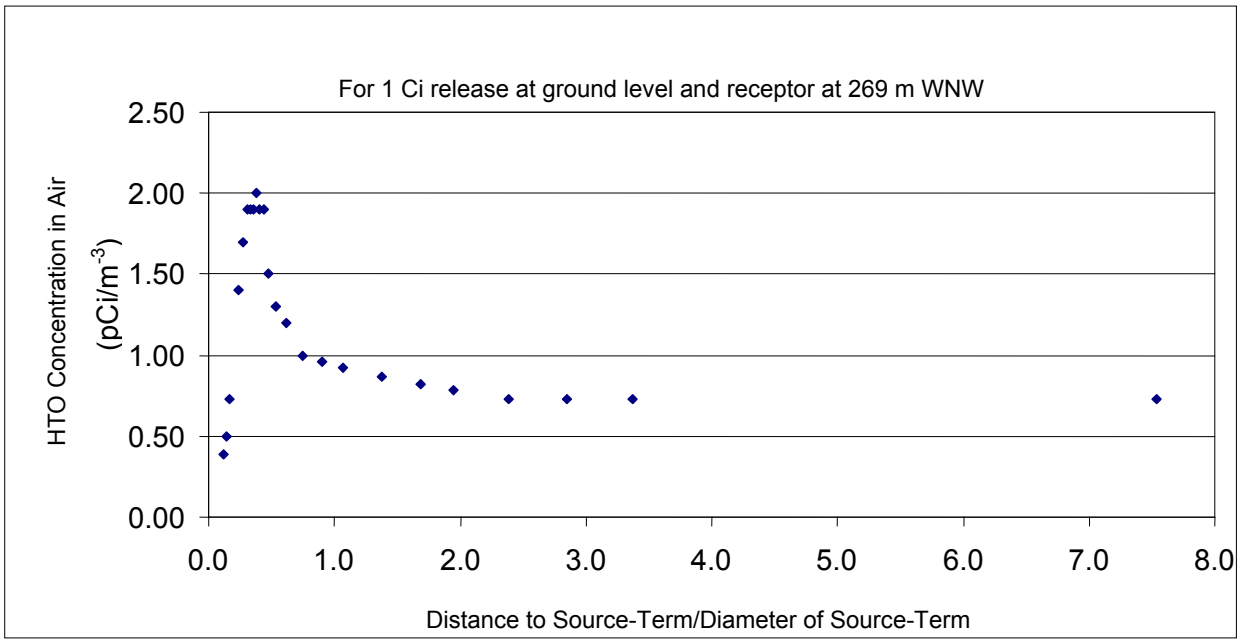

Figure H.2 CAP88-PC Predicted Air Concentration versus Ratio of Distance-to-Source/Diameter of Source

According to CAP88-PC documentation, the software estimates for area sources is reliable only for locations where the ratio (distance between the sampling location and source) / (source diameter) is greater than about 1.3. At a ratio greater than 2.5, the source is assumed to be a point source instead of an area source. To increase the reliability of tritium emission estimates, air samplers at further distances from the center of the source terms are included in making the release estimates, such as the air sampler positioned at Gate 20-2P, which is 4,790 m south-southeast of the Schooner crater. At this distance, area source is treated by CAP88-PC as a point source (ratio of 13). See Appendix D for a description of the method and results.

COMPLIANCE WITH SUBPARTS Q AND T, Title 40 Code of Federal Regulations 61

The NTS is regulated by Subpart H (National Emission Standards for Emissions of Radionuclides Other Than Radon from DOE Facilities), but not Q (National Emission Standards for Radon Emissions from DOE Facilities) or T (National Emission Standards for Radon Emissions from the Disposal of Uranium Mill Tailings). However, National Security Technologies, LLC (NSTec), includes Subpart Q in its Work Smart Standards. Therefore, radon flux measurements were made during this report period at the Area 3 and Area 5 Radioactive Waste Management Sites (RWMSs) to confirm inventory records that only trace amounts of

radium were disposed of in these areas and to make sure that the radon fluxes are well below the standard of 20 picocuries per square meter per second ($pCi/m^2/s$) required by Subpart Q. The results of the most recent study (NSTec, 2008) showed that the airborne concentrations of radon and the flux measurements of radon were both at background levels. An assessment of the potential risks posed by the Area 5 RWMS to the public projected that the in-growth of radon-222 (^{222}Rn) from the decay of thorium-230 (^{230}Th) in thorium wastes would not exceed the standard for approximately 30,000 years (Shott et al., 1998).

NON-DISPOSAL/NON-STORAGE SOURCES OF RADON EMISSIONS

None of these sources exist on the NTS.

QUALITY ASSURANCE PROGRAM FOR NESHAP COMPLIANCE

The quality assurance program for samples collected and analyzed for NESHAP compliance is documented in an environmental monitoring plan (DOE, 2003). The applicable requirements of 40 CFR 61, Appendix B, Method 114, "Test Methods for Measuring Radionuclide Emissions from Stationary Sources" (U.S. Environmental Protection Agency, 2001) and of DOE Order 414.1B, "Quality Assurance" (DOE, 2004b), have been implemented in this plan.

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