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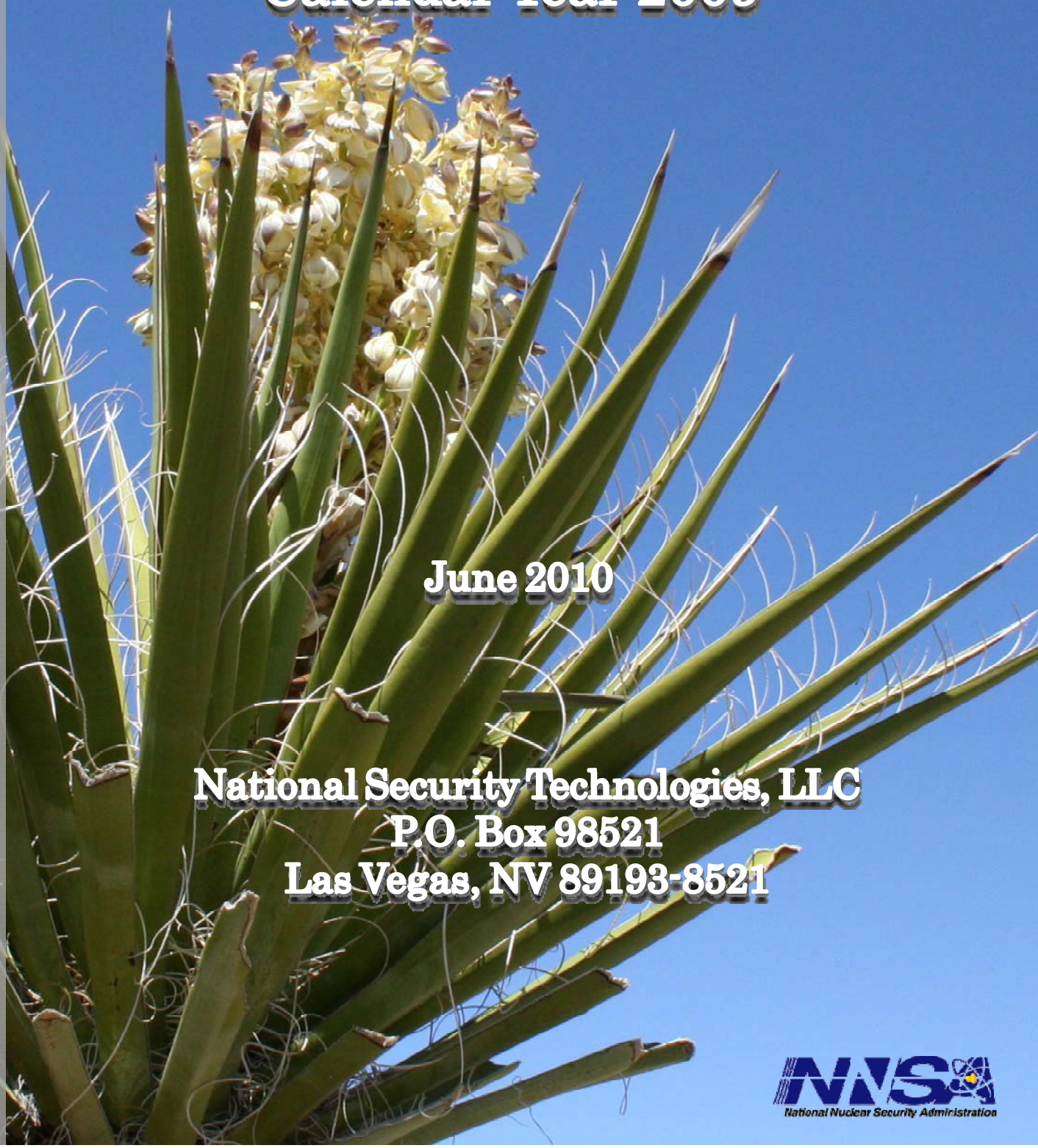
DOE/NV/25946--1008

Nevada Test Site & North Las Vegas Facility

National Emission Standards for Hazardous Air Pollutants – Radionuclide Emissions Calendar Year 2009



June 2010

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National Emission Standards for Hazardous Air Pollutants –

Radionuclide Emissions Calendar Year 2009

June 2010

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Prepared for:
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National Nuclear Security Administration
Nevada Site Office

Prepared by:
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EXECUTIVE SUMMARY

2009 RADIOLOGICAL DOSE TO THE PUBLIC BELOW FEDERAL STANDARD

The U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office operates the Nevada Test Site (NTS) and North Las Vegas Facility (NLVF). From 1951 through 1992, the NTS was the continental testing location for U.S. nuclear weapons. The release of radionuclides from NTS activities has been monitored since the initiation of atmospheric testing. Limitation to underground detonations after 1962 greatly reduced radiation exposure to the public surrounding the NTS. After nuclear testing ended in 1992, NTS radiation monitoring focused on detecting airborne radionuclides from historically contaminated soils. These radionuclides are derived from re-suspension of soil (primarily by wind) and emission of tritium-contaminated soil moisture through evapotranspiration. Low amounts of tritium were also emitted to air at the NLVF, an NTS support complex in North Las Vegas.

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) (CFR, 2008a) limits the release of radioactivity from a U.S. Department of Energy facility to 10 millirem per year (mrem/yr) effective dose equivalent to any member of the public. This limit does not include radiation not related to NTS activities. Unrelated doses could come from naturally occurring radioactive elements or from sources such as medically or commercially used radionuclides.

The NTS demonstrates compliance with the NESHAP limit by using environmental measurements of radionuclide air concentrations at critical receptor locations (EPA and DOE, 1995). This method was approved by the U.S. Environmental Protection Agency for use on the NTS in 2001(EPA, 2001a) and has been the sole method used since 2005. Six locations on the NTS have been established to act as critical receptor locations to demonstrate compliance with the NESHAP limit. These locations are actually pseudo-critical receptor stations, because no member of the public actually resides at these onsite locations. Compliance is demonstrated if the measured annual average concentration of each detected radionuclide at each of these locations is less than the NESHAP Concentration Levels (CLs) for Environmental Compliance listed in 40 CFR 61, Appendix E, Table 2 (CFR, 2008a). At any one location, 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.

NESHAP Compliance for 2009

NTS: Demonstrated by the Sum of Fractions at Each Critical Receptor Sampler Being Less Than 1.0			
Included Radionuclides	**NTS Operations Area**	**Critical Receptor Location**	**Sum of Fractions of Compliance Levels (CLs)**
^{241}Am, ^{238}Pu, $^{239+240}$Pu, ^{3}H	6	Yucca	0.005
	10	Gate 700 S	0.005
	16	Substation 3545	0.002
	20	Schooner	0.169
	23	Mercury	0.004
	25	Gate 510	0.001
NLVF: Demonstrated by the Highest Potential Offsite Dose Being Less Than 10 mrem/yr			
Estimated offsite dose from NLVF = 0.000044 mrem/yr			

In 2009, the potential dose from radiological emissions to air, resulting from both current and past NTS activities, at onsite compliance monitoring stations was a maximum of 1.69 mrem/yr, well below the 10 mrem/yr dose limit. Air sampling data collected at all six critical receptor stations had average concentrations of radioactivity that were a fraction of the CL values listed in Table 2 in Appendix E of 40 CFR 61 (CFR, 2008a). Concentrations ranged from less than 1 percent to a maximum of 17 percent of the allowed NESHAP limit. Because the nearest member of the public resides approximately 20 kilometers from potential release points on the NTS, concentrations at this location would be only a small fraction of that measured on the NTS. The potential dose to the public from NLVF emissions was also very low at 0.000044 mrem/yr, 230,000 times lower than the 10 mrem/yr limit.

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List of Acronyms and Abbreviations

Am	americium
ARL/SORD	Air Resources Laboratory, Special Operations and Research Division
BEEF	Big Explosives Experimental Facility
°C	degrees Celsius
CAP88-PC	Clean Air Package 1988 (EPA software program for estimating doses)
CAS	Corrective Action Site
CEDE	collective effective dose equivalent
CEF	Criticality Experiments Facility
CFR	Code of Federal Regulations
Ci	curie(s)
CL	Concentration Level
cm	centimeter(s)
cm/yr	centimeter(s) per year
Co	cobalt
Cs	cesium
CY	calendar year
DAF	Device Assembly Facility
DOE	U.S. Department of Energy
DRA	Desert Rock Meteorological Observatory
DU	depleted uranium
E	east
E-MAD	Engine, Maintenance, Assembly, and Disassembly
EDE	effective dose equivalent
EPA	U.S. Environmental Protection Agency
Eu	europium
ft^3/min	cubic feet per minute
g	gram(s)
g/cm^3	grams per cubic centimeter
^3H	tritium
HEPA	high-efficiency particulate air
HEST	High-Explosive Simulation Test
HTO	tritiated water
JASPER	Joint Actinide Shock Physics Experimental Research
kg	kilograms
km	kilometer(s)
km^2	square kilometers
Kr	krypton
L	liter(s)
LLW	low-level waste
m	meter(s)
m^2	square meter(s)
mCi	millicurie(s)
mCi/yr	millicurie(s)/year
MEDA	Meteorological Data Acquisition
MEI	maximally exposed individual
MIDNET	Meteorological Integrated Data Network
MLLW	mixed low-level waste
mrem/yr	millirem per year
m/s	meter(s) per second

List of Acronyms and Abbreviations (continued)

N	north
NAD	North American Datum
NESHAP	National Emission Standards for Hazardous Air Pollutants
NLVF	North Las Vegas Facility
NNSA/NSO	National Nuclear Security Administration Nevada Site Office
NOAA	National Oceanic and Atmospheric Administration
NPTEC	Nonproliferation Test and Evaluation Complex
NTS	Nevada Test Site
NTTR	Nevada Test and Training Range
Ops	Operations
pCi/L	picocurie(s) per liter
pCi/m^3	picocurie(s) per cubic meter
PM10	particulate matter ≤ 10 micron
Pu	plutonium
R-MAD	Reactor Maintenance, Assembly, and Disassembly
RAMATROL	Radioactive Materials Control
rem	roentgen equivalent man
RIDP	Radionuclide Inventory and Distribution Program
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
s	second(s)
S	south
SNM	special nuclear material
Sr	strontium
STAR	Stability Array (grouping of meteorological data)
TNT	trinitrotoluene
TRU	transuranic (nuclides with atomic numbers greater than uranium)
UCC	Yucca Flat Meteorological Observatory
UGTA	Underground Test Area
VERB	Visual Examination and Repackaging Building
W	west
yr	year(s)

Report Information

U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office
Air Emissions Annual Report
(under Subpart H, Title 40 Code of Federal Regulations [CFR] 61.94)
Calendar Year (CY) 2009

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. The test site is also an operational site for environmental restoration, low-level radioactive waste management, and groundwater characterization activities. Located in Nye County, Nevada, the site's southeast corner is about 105 kilometers (km) northwest of the major population center, Las Vegas, Nevada. The NTS covers about 3,561 square kilometers (km^2), an area larger than Rhode Island. Its size is 46 to 56 km east to west and 64 to 88 km 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 between the NTS and public lands (Figure 1). The NTS is characterized by desert valley and Great Basin mountain topography, with a climate, flora, and fauna typical of the southwest deserts. The vast majority of the area within 80 km of the NTS boundary has no human inhabitants (Figure 1). Higher population densities to the south and southwest drive the overall average population density up to about 1.2 person/km^2. The nearest populated location to the NTS boundary is Amargosa Valley, 3.4 km south of the southwest corner of the NTS. Two mining operations are also relatively near the boundaries of the NTS: the American Silica mine, 2.7 km east from the southeast edge of the NTS, and the Cinder Cone Pit mine, 5.5 km west of the southwest corner of the NTS. There are two dairies within 80 km of the NTS, one in Amargosa Center (center of Amargosa Valley, which is labeled Amargosa Center on maps in this report) at a distance of about 16.1 km from the boundary and one in Pahrump, 41.8 km south of the NTS. Agriculture around the NTS is sparse and consists primarily of alfalfa fields. These are found primarily in Amargosa Center, Pahrump, Penoyer Farm, Reed's Ranch, and ranging from Alamo to Hiko.

The North Las Vegas Facility (NLVF) is a fenced complex composed of 31 buildings that house much of the NTS project management, diagnostic development and testing, design, engineering, and procurement. The 80-acre facility is located along Losee Road in the city of North Las Vegas. The facility is buffered on the north, south, and east by general industrial zoning. The western border separates the property from fully developed, single-family residential zoned property.

SOURCE DESCRIPTION

In 1950, the NTS was established as the primary location for testing the nation's nuclear explosive devices. Such testing took place from 1951 to 1992. Historical testing 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). No nuclear tests have been conducted since September 23, 1992 (DOE, 2000). The environmental legacy of nuclear weapons and other testing on the NTS is the predominant source of radionuclides that are released into the air. They are characterized as non-point (diffuse) sources and include (1) delineated areas of radioactively contaminated surface soils, (2) contaminated groundwater that is pumped or flows naturally to the surface, (3) radioactive waste storage and burial sites, and (4) radiologically contaminated structures and materials being decommissioned, demolished, and/or managed.

Surface soils contaminated with plutonium (Pu), americium (Am), tritium (^3H), and fission and activation products from past nuclear device safety, atmospheric, or cratering tests that used nuclear explosives 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. In 1981, the DOE began a project known as the Radionuclide Inventory and Distribution Program. After five years of

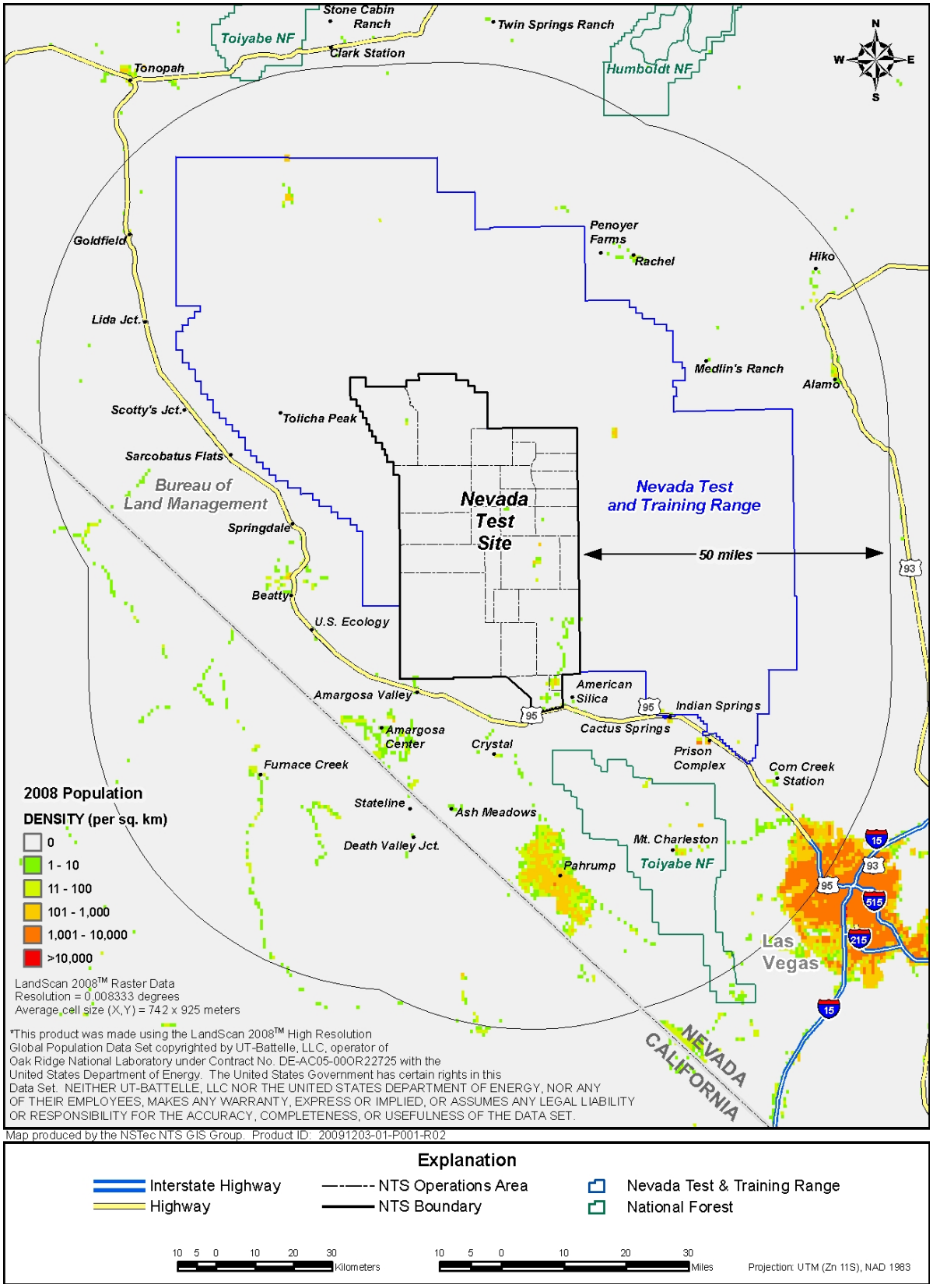

Figure 1. NTS and Surrounding Populated Area

field work and three years of data analysis, the result was an inventory and distribution of radionuclides in the soil in all parts of the NTS affected by NTS operations (DOE, 1991) (Table 1). The inventory is an estimate of the curies (Ci) of ^{241}Am, ^{238}Pu, and $^{249+240}$Pu in surface soil within each NTS Operations (Ops) Area. Other isotopes, such as 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) are also known to be in soil in various areas on the NTS, 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. Therefore, they have not been included in evaluations for National Emission Standards for Hazardous Air Pollutants (NESHAP) compliance. Figure 2 shows areas of elevated exposure rates due to radionuclides in NTS soils as measured by an aerial survey conducted in 1994 (Hendricks and Riedhauser, 1999).

Table 1. Inventory of ^{241}Am, ^{238}Pu, and $^{239+240}$Pu in Surface Soil[(a)] at the NTS

NTS Ops Area Studied	Study Site Area in square miles / Percent of Total	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 centimeters (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.

Collectively these diffuse NTS sources have air emissions with potential to result in an effective dose equivalent (EDE) exceeding 0.1 millirem per year (mrem/yr) which is greater than 1% of the standard (Grossman, 2005). Per requirements set forth in 40 CFR Section 61.93(b) (EPA and DOE, 1995), these are considered a major source requiring continuous monitoring (termed monitored source in this report). Sources that result in a potential EDE less than 0.1 millirem per year (mrem/yr) are considered minor release points (EPA and DOE, 1995).

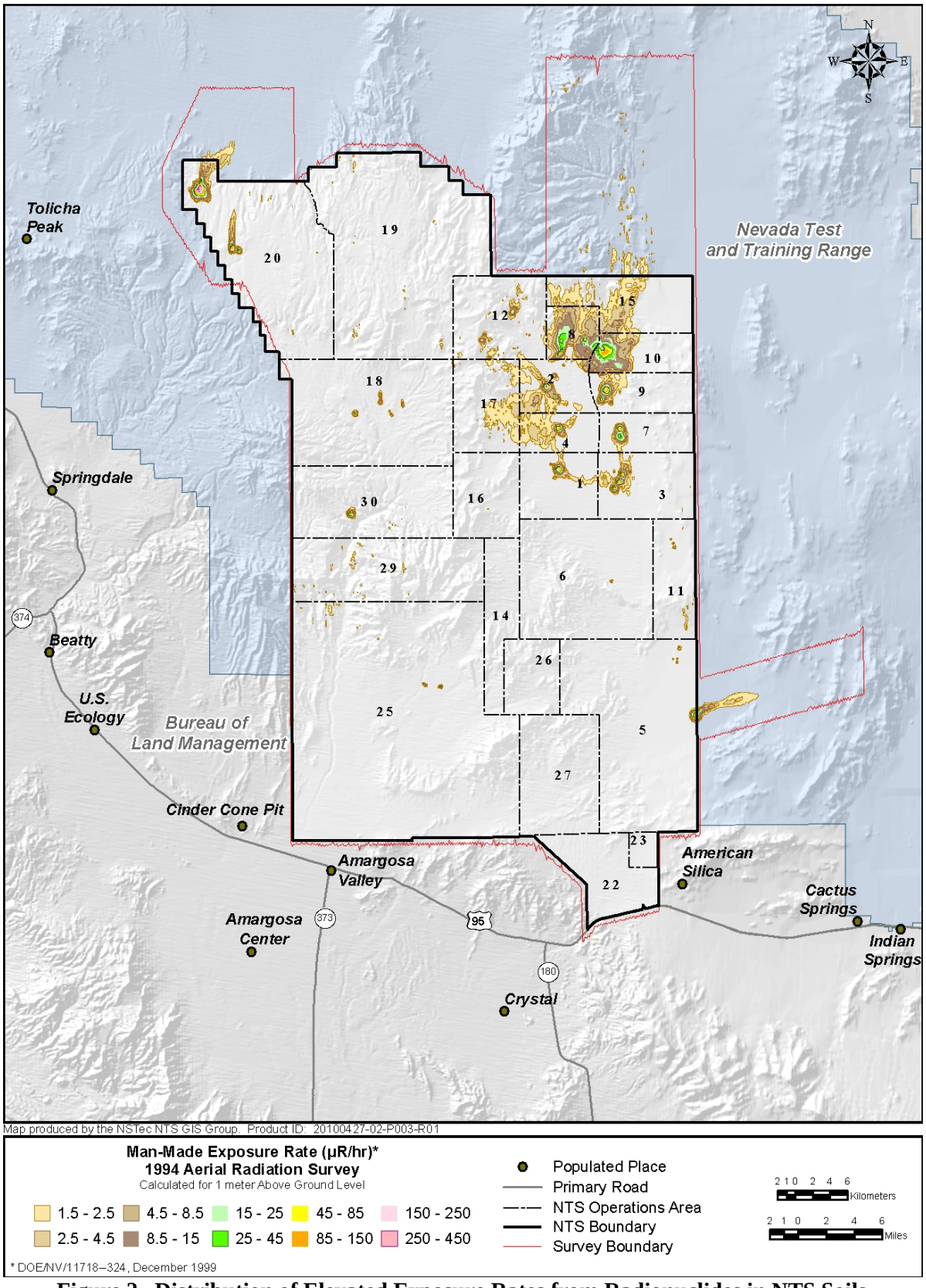

Figure 2. Distribution of Elevated Exposure Rates from Radionuclides in NTS Soils

Current missions of the NTS include (1) conducting high-hazard operations in support of defense-related nuclear and national security experiments; (2) providing support for homeland security activities, national security, and nonproliferation technology development and research; (3) characterizing and remediating the environmental legacy of past nuclear testing; and (4) managing and disposing radioactive wastes. A few programs and experiments at the NTS use or handle radioactive materials in facilities. In all such facilities, radioactive materials are controlled in accordance with Title 10 Code of Federal Regulations (CFR) Part 835, "Occupational Radiation Protection" (CFR, 2008b). Facilities that have unsealed radioactive material are potential point sources for radiological air emissions. The primary facilities for the major NNSA/NSO missions are shown in Figure 3.

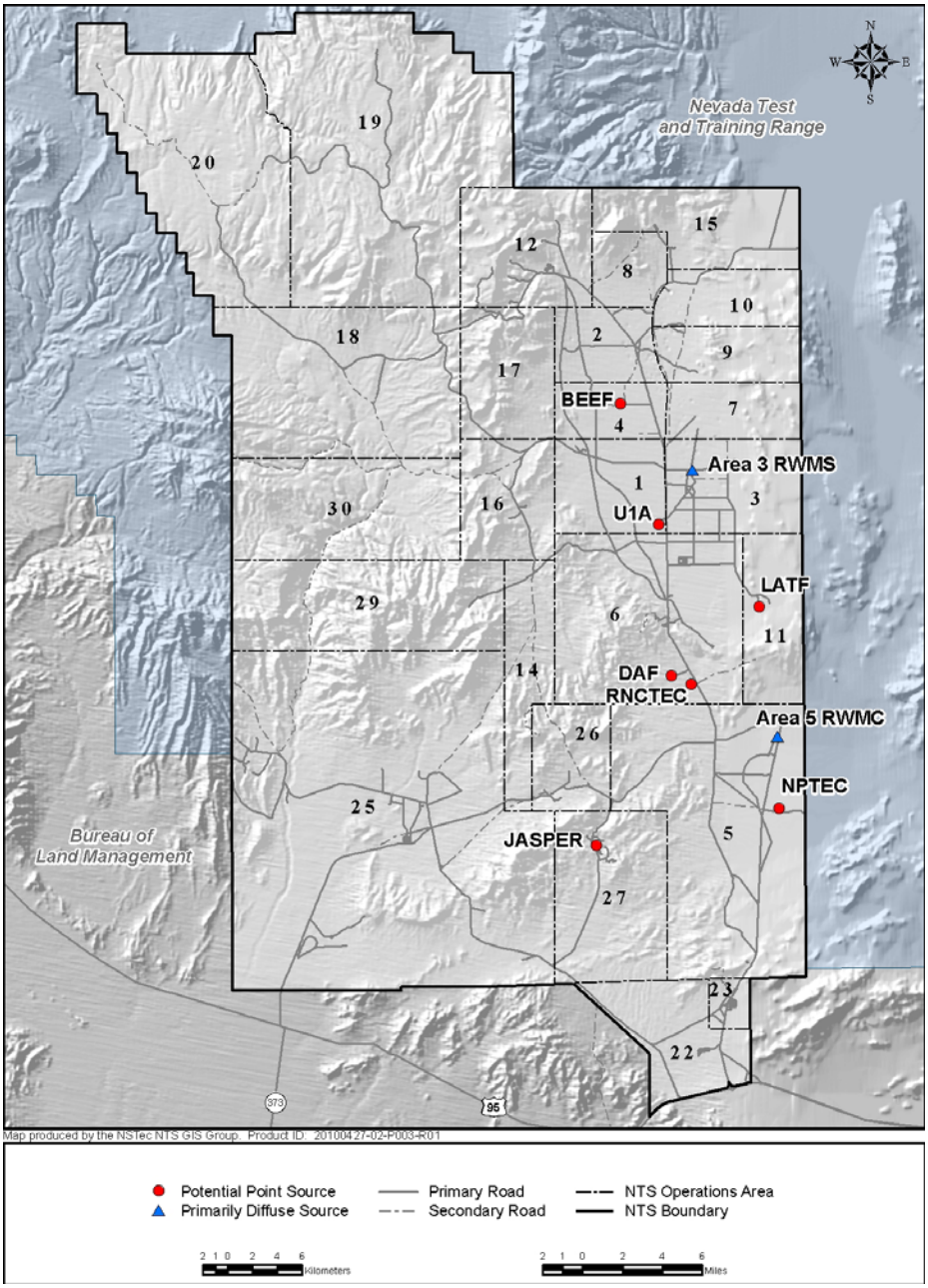

Figure 3. Primary Facilities for Key NNSA/NSO Missions

Radioactive emissions are not produced from each of these facilities in a given year, but all have the potential for radioactive emissions. During calendar year (CY) 2009, only the Area 3 Radioactive Waste Management Site (RWMS) and the Area 5 Radioactive Waste Management Complex (RWMC) had measurable emissions. Because of the low amounts and low potential for releases from facilities, all but one are considered a minor release point. The one exception is the Joint Actinide Shock Physics Experimental Research (JASPER) facility in Building 5100 in Area 27. Beginning in 2003, experimentation began at the JASPER facility using special nuclear material (SNM) and other actinide materials as targets. As required by U.S. Environmental Protection Agency (EPA) Region IX, a stack monitoring system was installed downstream of high-efficiency particulate air (HEPA) filters to ensure that the emissions are in conformance with the NESHAP. No man-made radionuclides were detected during stack monitoring from January through September 2009. The JASPER system was then disassembled for repairs, and there were no operations or stack monitoring from October through December 2009. The facility will be reassembled during 2010 and will be monitored upon resumption of operations. No continuous monitoring is required at other point source facilities on the NTS.

There are also facilities with laboratories where potentially contaminated environmental samples are processed or analyzed (Occupational Medicine and Radiological Control Building 23-650 and the Environmental Protection and Technical Services Building 23-652, both in Mercury [Area 23]). With environmental samples, the concentrations are generally low, and therefore the potential emissions are negligible. However, there is handling and distillation of radioactive materials in the laboratory in Building 23-652, so it is considered a potential source.

All locations from which radionuclides were known to be released to air in CY 2009 are listed in Table A.1 (Appendix A), and all locations with the potential to have unsealed radioactive material but had no known emissions in CY 2009 are listed in Table A.2.

SECTION II
AIR EMISSIONS DATA

Locations where radionuclides were released to the atmosphere during CY 2009 are listed in Table 2. These locations are also displayed in Figure 4. Releases for the year are grouped into five general categories: (1) legacy weapon test and plowshare soil contamination sites, (2) groundwater characterization or remediation activities, (3) radioactive waste management, (4) support facility operations, and (5) emanation from contaminated building materials. Note that the one monitored point source, the JASPER facility, is not part of the list for emission points during CY 2009. This is because stack monitoring detected no measurable radionuclide emissions during 2009, and therefore there is no emission to report. Descriptions of CY 2009 emission sources by category are described below.

Legacy Weapon Test and Plowshare Soil Contamination Sites

Three general soil contamination locations are listed for emission sources in this category. Two of them, Sedan and Schooner, are craters from the Plowshare program, which used nuclear devices to demonstrate their ability to excavate large amounts of earth. They are specifically listed separately from other test locations because they dominate the NTS for ^{3}H emissions. The derivation of ^{3}H emission estimates from these locations is described in Appendix B. The third general location is a grouping of all nuclear weapon and plowshare test locations from all areas on the NTS. This grouping is used to report Pu and ^{241}Am emissions, the derivation of which is described in Appendix C.

Groundwater Characterization or Remediation Activities

Groundwater containing radionuclides associated with legacy contamination can be brought to the surface through either groundwater flow through fissures and man-made tunnels or through active pumping.

One Environmental Restoration project location, the E Tunnel ponds, consists of water contaminated from historic nuclear weapons testing in the E Tunnels, which flows into collection ponds. The only radiological contaminant that produces a measurable air emission is ^{3}H evaporating as tritiated water (HTO). Calculation of this emission source for CY 2009 is described in Appendix D.

The Underground Test Area (UGTA) Sub-Project has the task of characterizing the aquifers at sites of past underground nuclear tests. To characterize the groundwater regime, suitable wells are being drilled and existing wells re-completed and sampled as determined by hydrologists. During these drilling and sampling operations, water is pumped to the surface. This water is then available for evaporation. Again, the only contaminant producing a measurable air emission from this evaporating water is ^{3}H as HTO. During CY 2009, water containing ^{3}H was pumped from Wells ER-20-7, ER-20-8, ER-20-8 #2, and ER-EC-11 (Figure 4). Calculations of the ^{3}H emissions from these sources are described in Appendix D.

At the NLVF, parts of the Building A-01 basement were contaminated with ^{3}H in 1995. This affected a vacant radiation source well that had since been filling with water due to the soil bottom in the well and a rise in groundwater. This source well was sealed in 2001 and a pump was installed to remove the residual ^{3}H contaminated water. The State of Nevada approved the disposal of this water by using it in evaporative coolers outside the north side of Building A-01 and by disposing of it in the Area 5 and Area 23 Sewage Lagoons at the NTS when the evaporative coolers were not effective. Calculation of ^{3}H emissions from the evaporative coolers and the NTS sewage lagoons during CY 2009 are described in Appendix D.

Radioactive Waste Management

The Area 3 RWMS and the Area 5 RWMC are used for the disposal of packaged, dry, low-level waste (LLW) in pits and trenches. The Area 5 RWMC also has facilities for waste examination and repackaging activities, 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. The only radioactive emission detected by the various types of samplers located downwind of these sites and attributed to site operations was ^{3}H as HTO in atmospheric moisture. The calculation of the ^{3}H source term for these emissions in CY 2009 is described in Appendix B.

Support Facility Operations

Facilities with laboratories as described at the end of Section I above have the potential to emit low quantities of radionuclides from contaminated environmental samples when they are handled or from the preparation of ^{3}H standards that are used for quality assurance purposes. Also, the Radiological Control Department has responsibilities to conduct receipt surveys of any radioactive materials arriving at the NTS. If packaging is damaged, materials must be handled during repackaging, which creates the potential for low levels of air emissions. These activities generally take place at Radioactive Materials Control (RAMATROL), Building 23-180.

Emanation from Building Materials

The 1995 ^{3}H contamination of the NLVF Building A-01 basement mentioned above also resulted in contamination of the basement building materials. Emanation of HTO from these building materials has persisted at continually decreasing levels. These emissions are exhausted from the building through the ventilation system. A description of the incident and the potential EDE for offsite exposure during CY 2009 are presented in Appendix E.

Each potential source of NTS emissions for CY 2009 was characterized by one of the following methods:

- measuring the radionuclide inventory in laboratories and identifying losses of radionuclides that were released to the environment;
- measuring the HTO concentrations in liquid effluents discharged to the surface and assuming that all the effluent evaporates over the course of the year to become an air emission;
- using re-suspension calculations; and
- using a combination of environmental measurements and the Clean Air Package 1988 (CAP88-PC) air dispersion model (EPA, 2006) to calculate the emissions.

In accordance with 40 CFR 61.93 (b)(4)(ii) (CFR, 2008a), no credit was taken for pollution control equipment in determining air emissions.

Distances and directions from all CY 2009 emission sources to nearest offsite locations of interest are listed in Table 2. Distances ranged from 6 to 80 km from NTS emission sources and from 0.1 to 0.85 km from NLVF emission sources. The source type, emission control, and description of the nature of each emission are listed in Table A.1 (Appendix A).

A summary of the CY 2009 emissions for NESHAP reporting by source is shown in Table 3. A summary of the NTS total CY 2009 emissions for NESHAP reporting by radionuclide is shown in Table 4. A summary of the NLVF total CY 2009 emissions is provided in Table 5. The source type, emission control, and description of the nature of each emission are listed in Table A.1 (Appendix A). Appendices B through E describe the methods used to determine the CY 2009 emissions.

Table 2. CY 2009 Radionuclide Emission Locations and Distance to Offsite Locations

	Distance [a] and Direction[b] to Nearest Offsite Locations		
Emission Source	**Offsite Residence**	**Offsite Business / Office**	**Offsite School**
Legacy Weapon Test and Plowshare Crater Locations			
Sedan, Area 10	52 km ENE (Medlin's Ranch)	59 km NNE (Rachel)	80 km ENE (Alamo)
Schooner, Area 20	37 km WSW (Sarcobatus Flat)	21 km WSW (Tolicha Peak)	56 km SSW (Beatty)
Grouped Area Sources – All NTS Ops Areas	Various locations ranging from 20 to 60 km from offsite locations		
Groundwater Characterization or Remediation Activities			
Environmental Restoration Projects			
E-Tunnel Ponds, Area 12	53 km WSW (Springdale)	55 km WNW (Tolicha Peak)	62 km SW (Beatty)
UGTA Sub-Project			
Well ER-20-7, Area 20	31 km SW (Springdale)	29 km WNW (Tolicha Peak)	46 km SSW (Beatty)
Well ER-20-8, Area 20	30 km SW (Springdale)	30 km WNW (Tolicha Peak)	44 km SW (Beatty)
Well ER-20-8 #2, Area 20	30 km SW (Springdale)	30 km WNW (Tolicha Peak)	44 km SW (Beatty)
Well ER-EC-11, NTTR	30 km SW (Springdale)	28 km WNW (Tolicha Peak)	44 km SSW (Beatty)
NLVF Groundwater Control			
NLVF, evaporative coolers, north side of A-01	0.6 km W (N Las Vegas)[c]	0.1 km (at north fence of NLVF)	0.85 km W (N Las Vegas)
Area 23 Sewage Lagoon (closer to populated offsite locations than the Area 5 Sewage Lagoon)	23 km SW (Crystal)	7 km ESE (American Silica)	32 km ESE (Indian Springs)
Radioactive Waste Management			
Area 3 RWMS	56 km SW (Amargosa Valley)	48 km S (American Silica)	61 km SSE (Indian Springs)
Area 5 RWMC	36 km SE (Cactus Springs)	26 km S (American Silica)	40 km SE (Indian Springs)
Support Facility Operations			
Buildings 23-650 and 23-652, Area 23	24 km SW (Crystal)	6 km SE (American Silica)	30 km ESE (Indian Springs)
RAMATROL, Building 23-180, Area 23	25 km SW (Crystal)	7 km SE (American Silica)	31 km ESE (Indian Springs)
Emanation from Building Materials			
Building A-01, basement ventilation, NLVF	0.6 km W (N Las Vegas)	0.1 km (at north fence of NLVF)	0.85 km W (N Las Vegas)

(a) Distance is shown in km. For miles, multiply by 0.62.
(b) N=north, S=south, E=east, W=west in all direction combinations shown
(c) City of North Las Vegas

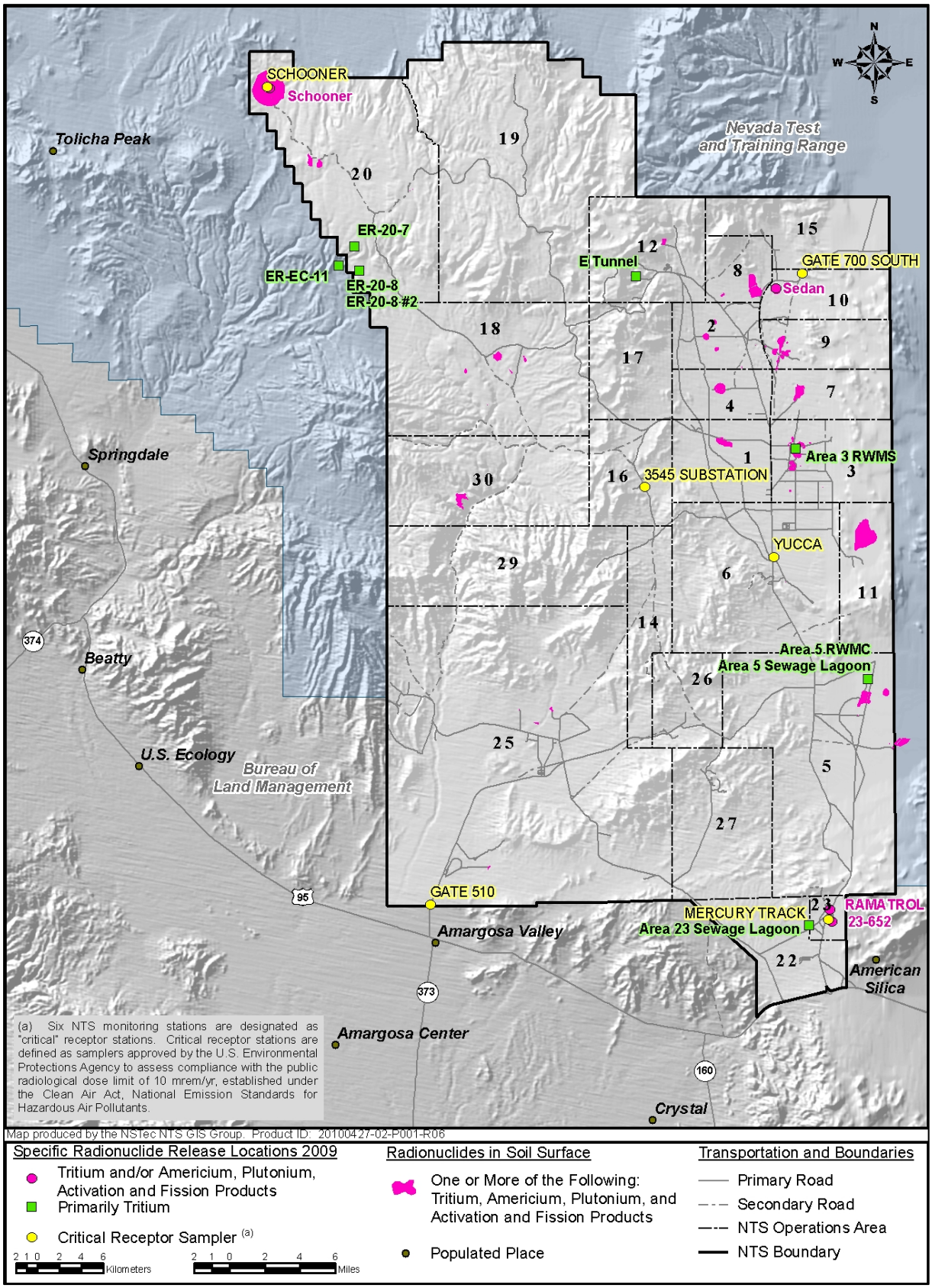

Figure 4. Sources of Radiological Air Emissions on the NTS in CY 2009

Table 3. Summary of CY 2009 Air Emissions Data by Source

Emission Source [a]	Type of Emissions Control	Nuclide	Annual Quantity (Ci)
Legacy Weapon Test and Plowshare Crater Locations			
Sedan	None	^{3}H[b]	22
Schooner	None	^{3}H[b]	83
Grouped Area Sources – All NTS Ops Areas	None	^{241}Am[c]	0.047
Grouped Area Sources – All NTS Ops Areas	None	^{238}Pu[c]	0.050
Grouped Area Sources – All NTS Ops Areas	None	$^{239+240}Pu$[c]	0.29
Groundwater Characterization or Remediation Activities			
Environmental Restoration Projects			
E-Tunnel, Corrective Action Site 12-59-01	None	^{3}H[d]	7.9
UGTA Sub-Project			
Well ER-20-7	None	^{3}H[d]	27.5
Well ER-20-8	None	^{3}H[d]	0.0010
Well ER-20-8 #2	None	^{3}H[d]	0.0058
Well ER-EC-11, NTTR	None	^{3}H[d]	0.060
NLVF Groundwater Control			
NLVF, evaporative coolers, north side of A-01	None	^{3}H[d]	0.00053
NTS sewage lagoons	None	^{3}H[d]	0.00036
Radioactive Waste Management			
Area 3 RWMS	Soil cover over waste	^{3}H[b]	30
Area 5 RWMC	Soil cover over waste, HEPA filtration on the VERB	^{3}H[b]	2.8
Support Facility Operations			
Buildings 23-650 and 23-652	None	^{3}H	negligible
RAMATROL, Building 23-180	None	various	negligible
Emanation from Building Materials			
Building A-01, basement ventilation, NLVF	None	^{3}H[e]	0.0081

(a) All locations are on the NTS except for well ER-EC-11 and Building A-01.
(b) Emission based on environmental surveillance results and CAP88-PC software.
(c) Sum of emissions estimated from re-suspension model; see Table C.1 for individual area estimates.
(d) Emission based on HTO discharged into containment pond(s), onto the ground, or through evaporators.
(e) Based on air concentrations and ventilation system flow rate.

Table 4. Total Estimated NTS Emissions for CY 2009

Radionuclides [(a)]	Total Quantity (Ci)
^{3}H	173
^{241}Am	0.047
^{238}Pu	0.050
$^{239+240}Pu$	0.29

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

(a) Radionuclides contributing ≥ 10 percent of the potential EDE or that were commonly detected in air samples.

Table 5. Total Estimated NLVF Emissions for CY 2009

Radionuclide	Total Quantity (Ci)
^{3}H	0.0087

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, 2001a) and has been the sole method used to demonstrate compliance since 2005. The six approved critical receptor locations are listed below and displayed in Figure 5 along with the entire NTS air sampling network.

- 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. 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 six locations is less than the NESHAP Concentration Levels (CLs) 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 6). 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 CY 2009 air sampling results from the six compliance stations are presented in Table 6.

COMPLIANCE ASSESSMENT

Table 6 lists the average concentrations of detected radionuclides and their fraction of the NESHAP compliance level for each of the six NTS critical receptor stations. The concentration average for each detected man-made radionuclide was below 1 percent of the CLs except for the ^{3}H average at the Schooner sampler station, which was about 17 percent of the CL. The average concentration of ^{3}H 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 6). At the Schooner station, the highest sum of the fractions of measured annual concentrations divided by the NESHAP CL for each radionuclide was 0.169, well below 1.0 and therefore in compliance with NESHAP. Figure 7 displays the sum of fraction results for the Schooner station from 2001 to 2009. Scaling this 0.169 sum of fractions for the Schooner station to the 10 mrem/yr limit gives an estimated EDE of 1.7 mrem/yr from air emissions for a hypothetical individual living year-round at this station. The maximally exposed individual (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.

No one resides at Schooner or along the borders near the air sampling stations. The dose at offsite populated locations 20–80 km from the Schooner station would be much lower due to wind dispersion, and likely much less than 1 mrem/yr. For comparison, MEI dose estimates made using CAP88-PC software from 1992 through 2004 are displayed in Figure 8.

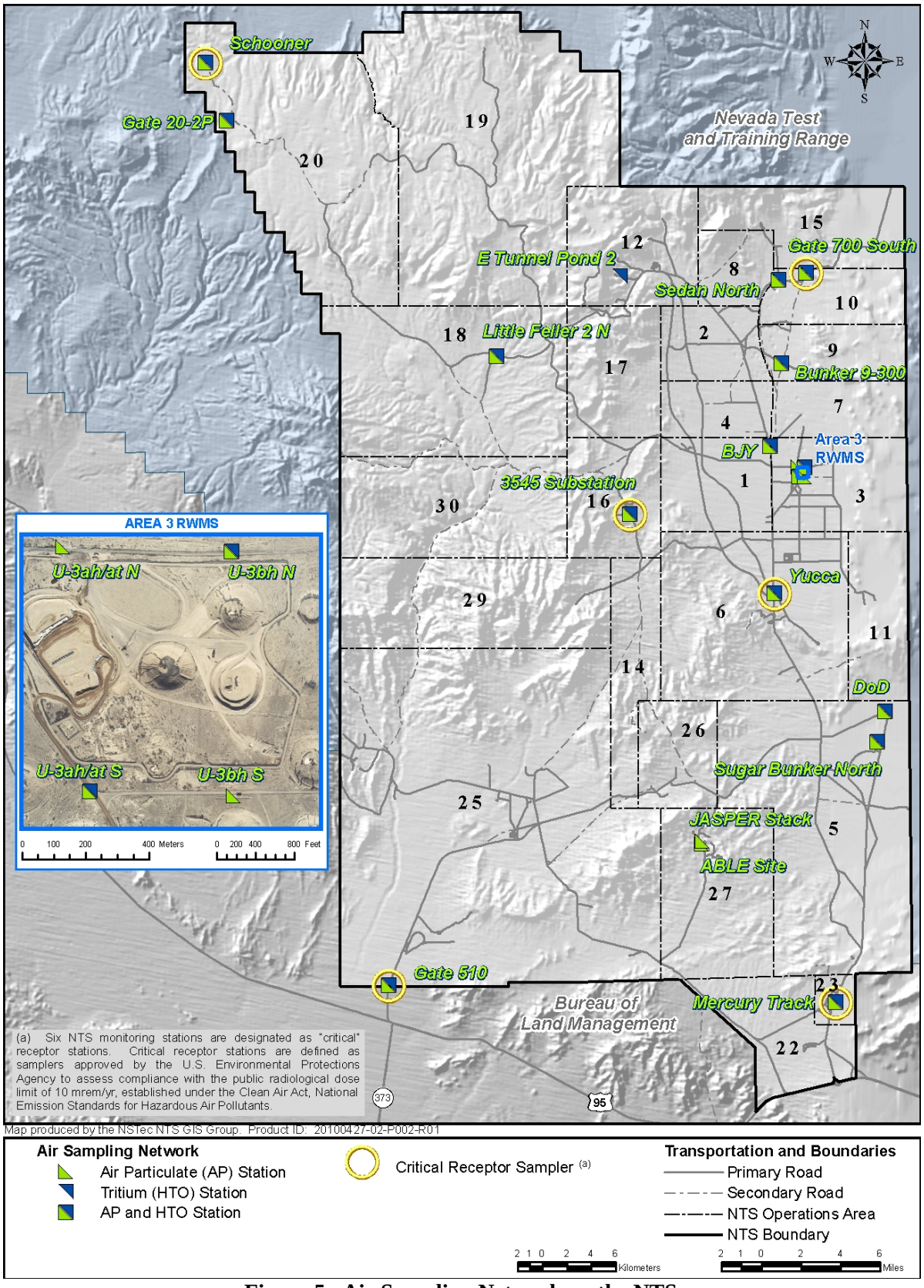

Figure 5. Air Sampling Network on the NTS

Table 6. Average Radionuclide Concentrations at NTS Critical Receptor Stations and Fraction of Concentration Level (CL), CY 2009

Location	Radionuclide	Average Concentration in Air (pCi/m^3)[(a)]	CL[(b)] (pCi/m^3)	Average Concentration as Fraction of CL
Yucca	^{3}H	0.23×10^{-0}	1500	0.0002
Gate 700		0.21×10^{-0}		0.0001
Substation 3545		0.07×10^{-0}		0.00005
Schooner		249.60×10^{-0}		0.1664
Mercury		0.16×10^{-0}		0.0001
Gate 510		0.06×10^{-0}		0.00004
Yucca	^{241}Am	0.75×10^{-6}	0.0019	0.0004
Gate 700		1.21×10^{-6}		0.0006
Substation 3545		0.78×10^{-6}		0.0004
Schooner		1.59×10^{-6}		0.0008
Mercury		1.43×10^{-6}		0.0008
Gate 510		0.44×10^{-6}		0.0002
Yucca	^{238}Pu	0.95×10^{-6}	0.0021	0.0005
Gate 700		0.60×10^{-6}		0.0003
Substation 3545		-0.02×10^{-6}		0.0000 (rounded negative number up to zero)
Schooner		1.22×10^{-6}		0.0006
Mercury		0.12×10^{-6}		0.0001
Gate 510		0.52×10^{-6}		0.0002
Yucca	$^{239+240}Pu$	7.04×10^{-6}	0.0020	0.0035
Gate 700		7.55×10^{-6}		0.0038
Substation 3545		2.29×10^{-6}		0.0011
Schooner		1.94×10^{-6}		0.0010
Mercury		6.58×10^{-6}		0.0033
Gate 510		1.42×10^{-6}		0.0007
Yucca	Sum of Fractions by Location			0.005
Gate 700				0.005
Substation 3545				0.002
Schooner				0.169
Mercury				0.004
Gate 510				0.001

(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) (CFR, 2008a)

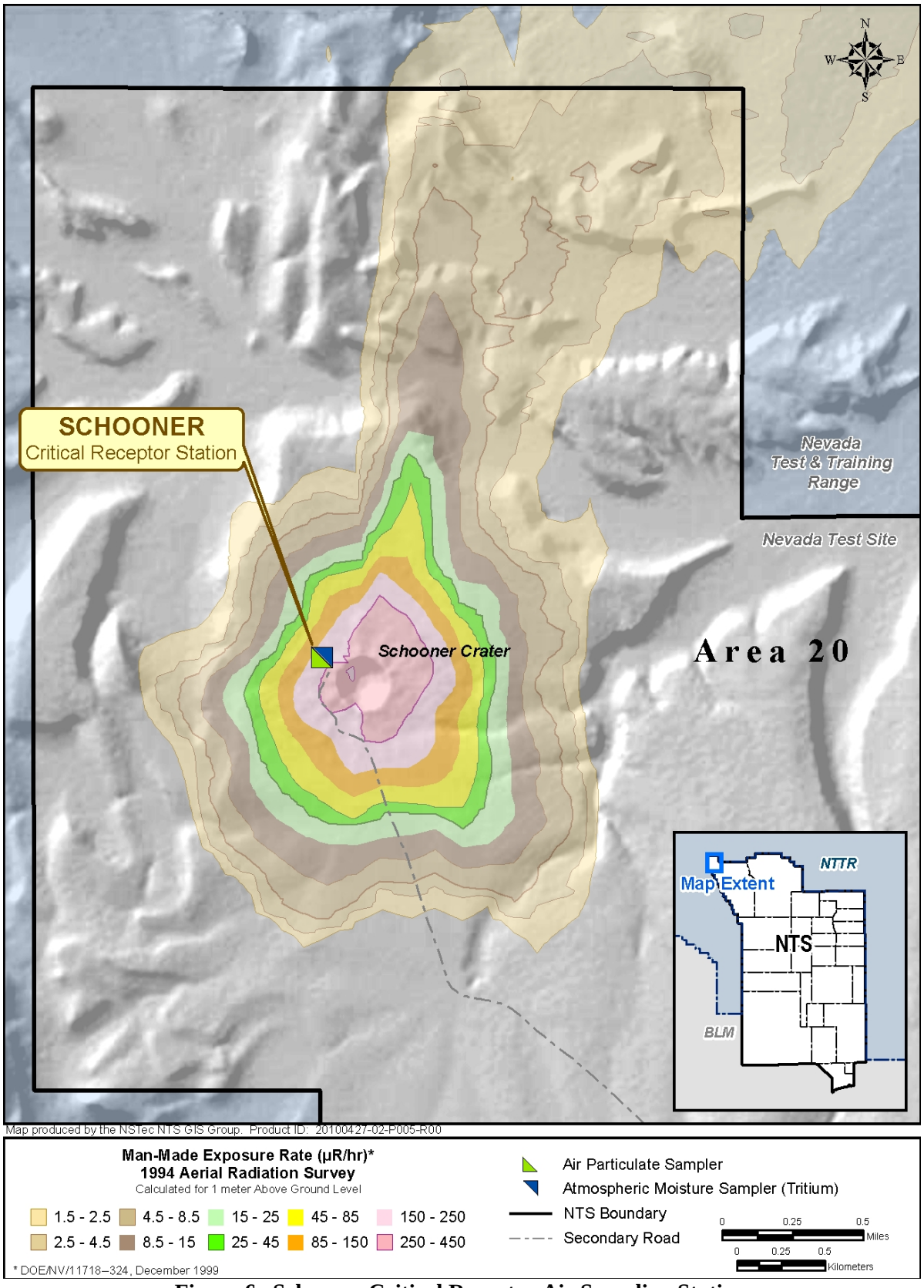

Figure 6. Schooner Critical Receptor Air Sampling Station

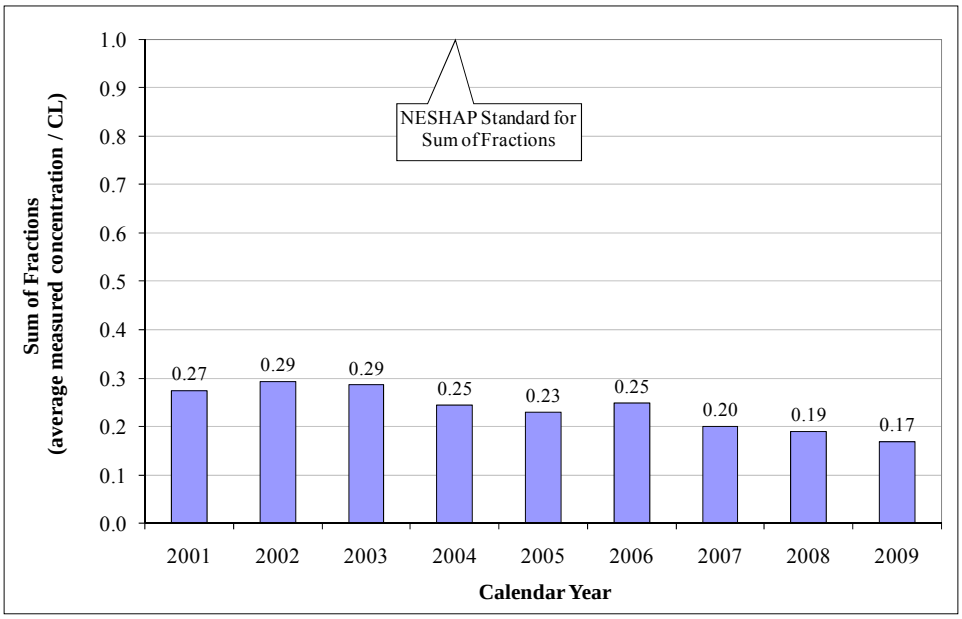

Figure 7. Sum of Fractions (Annual Average Radionuclide Concentrations Divided by CLs) for the Schooner Critical Receptor Location, CY 2001 to CY 2009

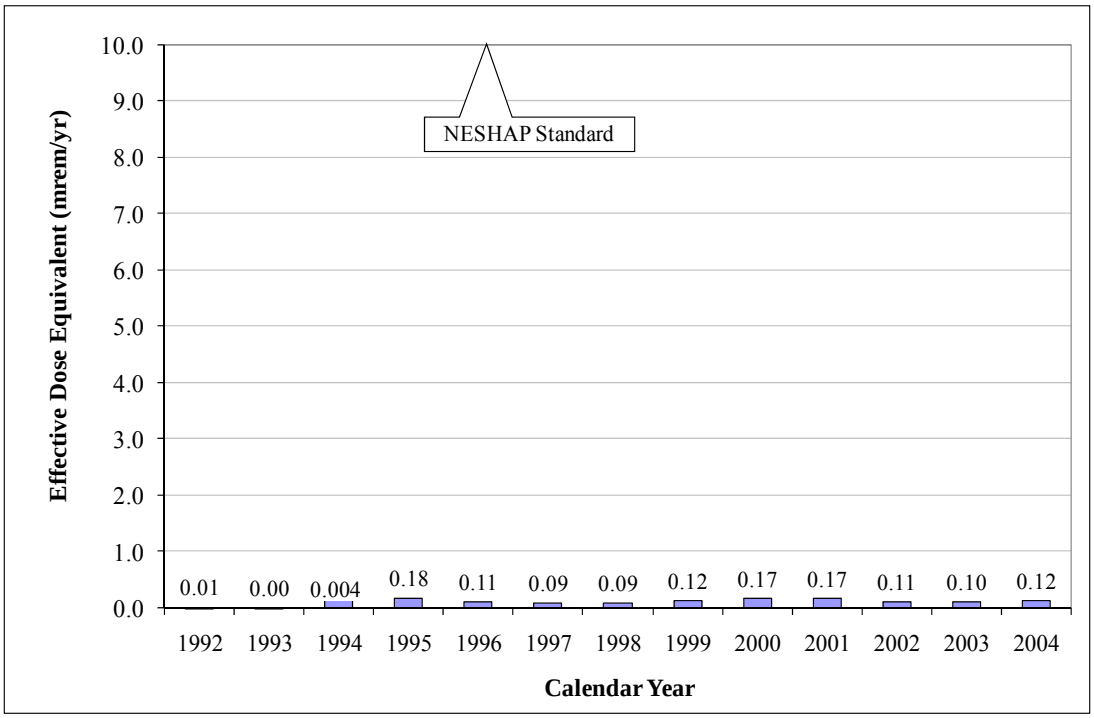

Figure 8. Effective Dose Equivalent to Offsite MEI prior to use of Onsite Critical Receptor Stations

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SECTION IV
ADDITIONAL INFORMATION

NEW CONSTRUCTION/MODIFICATION OR PERIODIC CONFIRMATORY MEASUREMENT ACTIVITIES AT THE NTS

During CY 2009, NESHAP evaluations were completed for the use of explosives during activities conducted by the Nonproliferation Test and Evaluation Complex (NPTEC) at Port Gaston (Area 26), near Test Cell C (Area 25), and the High-Explosive Simulation Test (HEST) site (Area 14). NESHAP evaluations were also conducted for Environmental Restoration planned demolition of the Engine Maintenance, Assembly, and Disassembly (E-MAD) (Area 25), Reactor Maintenance, Assembly, and Disassembly (R-MAD) (Area 25), and the Pluto Disassembly Facility (Area 26). These evaluations were completed in order to determine if these projects have the potential to release airborne radionuclides that would expose the public to a dose equal to or greater than 0.1 mrem/yr. For any project or facility with this potential, the EPA requires approval prior to operation and point-source operational monitoring. Summaries of these assessments are provided in Table 7 below. See Appendix F for a more detailed description of the dose evaluations.

Table 7. Summary of CAP88-PC Dose Evaluations

Location	Distance to Nearest NTS Boundary (km)	CAP88-PC Predicted Dose (mrem/yr)
Port Gaston	14.5	4.3×10^{-8}
Test Cell C	17.5	3.4×10^{-7}
HEST	22.5	1.2×10^{-8}
E-MAD	12.7	1.9×10^{-4}
R-MAD	15.9	6.3×10^{-10}
Pluto	15.8	$<6.3 \times 10^{-10}$

As shown in Table 7, the predicted radiation dose at the nearest NTS boundary for each location was a small fraction of the 0.1 mrem/yr level specified in 40 CFR 61.96. It was therefore concluded that these activities constituted minor sources and did not require regulatory approval or specific monitoring. The critical receptor air sampling station for demonstrating compliance with 40 CFR §61.92, Gate 510, is located closer to these activities than the nearest offsite resident in Amargosa Valley and in the same general direction.

Periodic confirmatory measurements are required by 40 CFR Section 61.93 (b) (4) (i) (CFR, 2008a) to ensure an emission source is still a minor source. The only periodic confirmatory measurement made during CY 2009 was that for ^{3}H emissions from Building A-01 at the North Las Vegas Facility. This is summarized in Appendix E.

UNPLANNED RELEASES DURING CY 2009

No unplanned releases occurred during CY 2009.

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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, Manager, NNSA/NSO

Signature: Stephen A Mellington Date: 6/15/10

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APPENDICES

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Appendix A

Potential National Emission Standards for Hazardous Air Pollutants (NESHAP) Sources

Table A.1 Locations from which radionuclides were released to air in calendar year (CY) 2009

Facility or Area	Type	Potential Air Source Term	Handling/ Processing	Nature of Emissions	Source	Effluent Controls	Release Amount / NESHAP Evaluation
Legacy Weapon Test and Plowshare Crater Locations							
Sedan Crater (Plowshare)	Diffuse	Tritium (^{3}H) as tritiated water (HTO), americium (Am), plutonium (Pu), activation and fission products	None	^{3}H as HTO through evaporation from soil or transpiration from plants and suspension of contaminated soil by wind	Minor [a]	None	• 22 curies (Ci) ^{3}H (Appendix B) • Nevada Test Site (NTS) compliance demonstrated with critical receptor location sample results (Gate 700 S sampler - closest)
Schooner Crater (Plowshare)	Diffuse	^{3}H as HTO, americium, plutonium, activation and fission products	None	^{3}H as HTO through evaporation from soil or transpiration from plants and suspension of contaminated soil by wind	Minor [a]	None	• 83 Ci ^{3}H (Appendix B) • NTS compliance demonstrated with critical receptor location sample results (Schooner sampler - closest)
Grouped Area Sources – All NTS Areas	Diffuse	Am, Pu, activation and fission products (^{3}H as HTO as well but the vast majority emitted from Sedan and Schooner – see above)	None	Wind causing suspension of soil containing small amounts of historical fallout / legacy radioactive materials	Monitored [b,c]	None	• Majority of ^{3}H emitted from Sedan and Schooner Craters (listed above) • 0.047 Ci ^{241}Am • 0.05 Ci ^{238}Pu • 0.29 Ci $^{239+240}$Pu (Appendix C) • NTS compliance demonstrated with all critical receptor locations (Table 6)

Table A.1 (continued) Locations from which radionuclides were released to air, CY 2009

Facility or Area	Type	Potential Air Source Term	Handling/ Processing	Nature of Emissions	Source	Effluent Controls	Release Amount / NESHAP Evaluation
Area 3 RWMS and surrounding area							
Cells U3ah/at and U3bh	Diffuse	Bulk low-level waste (LLW)	Subsurface burial of waste (no active burial during CY 2009)	^{3}H as HTO through evaporation from soil or transpiration from plants	Minor [a]	Soil cover	• 30 Ci, 2009 (Appendix B) • NTS compliance demonstrated with critical receptor location sample results (Yucca sampler - closest)
Closed cells U3ax/bl	Diffuse	Bulk LLW	Closed subsurface burial site	^{3}H as HTO through evaporation from soil or transpiration from plants	Minor [a]	Soil cover	
Area 5 RWMC							
Visual Examination and Repackaging Building (VERB), 05-32	Point	LLW, mixed LLW (MLLW) and transuranic (TRU) waste	Unpacking, classification, and repacking of wastes	^{3}H as HTO in atmospheric moisture and suspension of radioactive materials from waste during handling	Minor [a]	HEPA filtration	• 2.8 Ci ^{3}H from entire Area 5 RWMC (Appendix B) • 7.7 x 10^{-5} mrem/yr to the maximally exposed individual (MEI) from VERB operations estimated in 2007 [d] • NTS compliance demonstrated with critical receptor location sample results (Yucca and Mercury Track samplers - closest)
TRU Pad Cover Bldg, 05-24	Point	LLW and MLLW	Unpacking, classification, and repacking of wastes	Suspension of radioactive materials from waste during handling	Minor [a]	None	
Area 5 RWMS active cells (P03, P06, P12-P17), H-1	Diffuse	LLW and MLLW	Subsurface burial of waste	Evaporation from soil or transpiration from plants of ^{3}H as HTO	Minor [a]	Soil cover	
Area 5 Waste Management Site - 23 closed disposal cells, 13 inactive or closed Greater Confinement Disposal boreholes	Diffuse	LLW, MLLW, and TRU waste	Maintenance of closed cells and boreholes where wastes have been buried	Evaporation from soil or transpiration from plants of ^{3}H as HTO	Minor [a]	Soil cover	

Table A.1 (continued) Locations from which radionuclides were released to air, CY 2009

Facility or Area	Type	Potential Air Source Term	Handling/ Processing	Nature of Emissions	Source	Effluent Controls	Release Amount / NESHAP Evaluation
Environmental Restoration Projects							
E-Tunnels, Corrective Action Site 12-59-01	Diffuse	^{3}H in groundwater flowing from fissures in historic nuclear tests tunnel system	Controlled drainage and containment of groundwater from the tunnel in a series of earthen ponds	^{3}H as HTO through evaporation from soil or transpiration from plants	Minor [a]	None	• 7.9 Ci, 2009 (Appendix D) • NTS compliance demonstrated with critical receptor location sample results (Gate 700 S sampler - closest)
UGTA Sub-Project							
Area 20							
Well ER-20-7	Diffuse	^{3}H as HTO	Groundwater from wells at sites of past underground nuclear tests is pumped to the surface	Evaporation of ^{3}H as HTO	Minor [a]	None	27.5 Ci, 2009 (Appendix D) NTS compliance demonstrated with critical receptor location sample results (Schooner sampler - closest)
Well ER-20-8	Diffuse	^{3}H as HTO		Evaporation of ^{3}H as HTO	Minor [a]	None	0.0010 Ci, 2009 (Appendix D)
Well ER-20-8 #2	Diffuse	^{3}H as HTO		Evaporation of ^{3}H as HTO	Minor [a]	None	0.0058 Ci, 2009 (Appendix D)
Offsite, west of Area 20							
Well ER-EC-11	Diffuse	^{3}H as HTO		Evaporation of ^{3}H as HTO	Minor [a]	None	0.060 Ci, 2009 (Appendix D)
Support Facility Operations							
Occupational Medicine and Radiological Control Building 23-650; Environmental Protection and Technical Services Building 23-652	Point	^{3}H as HTO, fission products, americium and plutonium in environmental samples	Distilling or handling samples to prepare for submission to analytical laboratories	^{3}H emission during distillation or enrichment of samples and preparation of standards	Minor [a]	None	• 1.8 x 10^{-9} mrem/yr from estimated releases, 2004[e] • NTS compliance demonstrated with critical receptor location sample results (Mercury Track sampler - closest)
RAMATROL, Building 23-180, Source Storage and Counting Equipment	Point	Radioactive sources and materials received and those waiting disposal	Storage, shipment, receipt, opening, and surveying of packages containing radioactive materials	Aerosolized radioactive material	Minor [a]	None	Negligible release - NTS compliance demonstrated with critical receptor location sample results (Mercury Track sampler - closest)

Table A.1 (continued) Locations from which radionuclides were released to air, CY 2009

Facility or Area	Type	Potential Air Source Term	Handling/ Processing	Nature of Emissions	Source	Effluent Controls	Release Amount / NESHAP Evaluation
NLVF Groundwater Control (for Weapons Test Program)							
NLVF, Building A-01	Point	Parts of the basement were contaminated with ^{3}H in 1995 including a vacant radiation source well	Air flow through building ventilation system	^{3}H as HTO through emanation from building materials into the air and exhausted from the building through the ventilation system	Minor [a]	None	• 0.00812 Ci emission from building ventilation, 2009 • 0.00053 Ci from evaporation of pumped groundwater, 2009 • 4.4 x 10^{-5} mrem/yr to MEI, 2009 (Appendix E)
NLVF, evaporative coolers, north side of A-01	Point	^{3}H in groundwater pumped from NLVF Building A-01 source well	^{3}H contaminated water removed from source well. Water is stored in holding tanks until disposed by putting it through evaporative coolers (State-approved method)	^{3}H as HTO through evaporation	Minor [a]	None	
Area 5 and Area 23 Sewage Lagoons	Diffuse	^{3}H in groundwater pumped from NLVF Building A-01 source well	Groundwater is transported via truck and released into the sewage lagoons, as approved by the State, when the evaporative coolers are not effective or are not used	^{3}H as HTO through evaporation	Minor [a]	None	• 0.00036 Ci, 2009 (Appendix D) • NTS compliance demonstrated with critical receptor location sample results (Mercury Track closest sampler)

[a] Minor source has a potential release resulting in a dose of <0.1 mrem/yr to the MEI
[b] Monitored source has a potential to release resulting in a dose of ≥0.1 mrem/yr to the MEI
[c] The NTS Air Sampling Network, including the critical receptor sampling stations, monitor radionuclides in air from wide-area diffuse emissions on the NTS.
[d] NESHAP dose evaluation for potential release from the VERB as reported in Grossman and Warren (2008).
[e] NESHAP dose evaluation for potential release from 23-652 as reported in Grossman (2005).

Table A.2 Locations with potential to have unsealed radioactive material but had no known emissions in CY 2009

Facility or Area	Radioactive Material	Handling/Processing
Area 5 RWMS		
Drum Holding Pad, 05-T00016	Low-level waste (LLW), mixed LLW (MLLW), and transuranic (TRU) waste	Temporary storage of waste containers during processing
Drum Holding Pad, H-2	LLW, MLLW, and TRU waste	Temporary storage of waste containers during processing
Thermal Conditioning Unit, 05-7842652	LLW, MLLW, and TRU waste	Holding of sealed waste containers in a thermo stabilizer
Sprung Instant Structure, 05-B107019	LLW, MLLW, and TRU waste	Waste characterization
Real Time Radiography, 05-6	LLW, MLLW, and TRU waste	Characterization of waste in sealed containers
Sealand Storage West of 5-32	LLW	Storage in sealed containers awaiting disposal
Sealand Storage East of 5-32	LLW	Storage in sealed containers awaiting disposal
High Explosives Facilities		
Control Building, 27-5320	Legacy materials including shielding, cobalt source from radiograph unit, LLW from previous testing	Stored awaiting characterization, excess, and/or disposal
Big Explosives Experimental Facility (BEEF)	Depleted uranium (DU)	Storage and use in testing
JASPER		
Transport Vehicle Garage, 27-5110	Used Primary Target Chambers (a TRU waste) inside a standard waste box	Stored until waste box is filled, then transported to Area 5 RWMS for management
Able Site Assembly, 27-5100 [a]	Actinide materials	Conduct of shock physics experiments
U1a		
U1a Underground Complex	Actinide materials	Conduct of subcritical experiments
Criticality Experiments Facility (CEF)		
CEF Warehouse, 06-911	Primarily depleted, natural, and low enriched uranium, thorium	Storage
Device Assembly Facility (DAF)		
DAF, Area 6	Actinide materials	Nuclear material handling and measurement operations in support of underground test readiness, subcritical programs, disposition of materials, storage and experimentation
06/Outside DAF - Connex #s 043509 & 043510, 06-ASP	Legacy radioactive materials	Stored awaiting disposition
06/CP-50 Yard Container # 056824, 06-CP	Legacy radioactive materials	Stored awaiting disposition
06/Sea Land outside Bldg 500, 06-DAF	Gloves, tyveks and kimwipes used to clean radiological material during measurements and repack operations in DAF project buildings	Stored for pickup and disposal onsite

Table A.2 Locations with potential to have unsealed radioactive material but had no known emissions in CY 2009 (continued)

Facility or Area	Radioactive Material	Handling/Processing
Radiological/Nuclear Countermeasures Test and Evaluation Complex		
Active Interrogation Building, 06-332	Various radionuclides for sensor testing / development	Storage and use for evaluating arrays of monitors, portals, and other sensor arrangements
Dense Plasma Focus (Los Alamos Technical Facility).		
Storage Bunker, 11-101	Radioactive materials recovered from offsite	Staging of radioactive sources and materials until they can be sent for final disposition
Assembly Building, 11-102	Deuterium-^{3}H gas mix	Conducting experiments that produce a neutron flux using a deuterium-^{3}H reaction
Nonproliferation Test and Evaluation Complex		
Port Gaston blast pad	Soils potentially containing legacy fallout fission and activation products or actinides	Conduct experiments with conventional explosives over bare soil.
Test Cell C blast pad	Soils potentially containing legacy fallout fission and activation products or actinides	Conduct experiments with conventional explosives over bare soil.
High-explosive Simulation Test blast pad	Soils potentially containing legacy fallout fission and activation products or actinides	Conduct experiments with conventional explosives over bare soil.
Environmental Restoration Projects		
25/Trailer B 103318	Samples and standards potentially containing ^{3}H, fission and activation products, or actinides	Screening of samples for radioactivity
Maintenance, Assembly, and Disassembly Building, 25-3900	Building materials potentially containing fission and activation products or actinides	Characterization of building for planned demolition.
Reactor Maintenance, Assembly, and Disassembly Facility, 25-3110	Building materials potentially containing fission and activation products or actinides	Characterization of building for planned demolition.
Pluto Disassembly Building, 26-2201	Building materials potentially containing fission and activation products or actinides	Characterization of building for planned demolition.
Site Operations - Support Facilities		
Area 6 - Manitowoc Crane Area - SE Corner	Crane test weights with possible internal legacy contamination	Stored awaiting disposition
Area 6 - Manitowoc Crane Area - NE Corner	Crane test weights with possible internal legacy contamination	Stored awaiting disposition
Area 6 - Tower Yard	Legacy radioactive crane test weights with possible internal contamination	Stored awaiting disposition
06/Equipment Yard East	Legacy mud pump with possible internal contamination	Stored awaiting disposition
06/Equipment Yard West	Legacy post shot drill rigs, structures, and other equipment with possible internal contamination	Stored awaiting disposition

Table A.2 Locations with potential to have unsealed radioactive material but had no known emissions in CY 2009 (continued)

Facility or Area	Radioactive Material	Handling/Processing
Site Operations - Support Facilities (continued)		
06/Bldg 6-623	Legacy contaminated magnets	Stored awaiting disposition
6-623 Construction Yard, 06-040	Legacy contaminated steel targets	Stored awaiting disposition
U19ad Temporary Area	^{3}H, fission and activation products, or actinides in waste	Storage
Joint Nevada Test Site Program Office		
Los Alamos National Laboratory Building CP-95A, Area 6	Miscellaneous solid radioactive wastes that were removed by Waste Generator Services in 2009 for closure of CP-95A	Storage
Detonator Bunker, 06-CP-111	Legacy contaminated material and 55 gallon drums of anti-Cs	Stored awaiting removal and disposition
Lawrence Livermore National Laboratory Core Library, 12-830	Radioactive core samples	Storage of samples
Special Projects		
01/Condition Release Storage Yard East, Area 1 Subdock	Legacy post shot, slant hole drill rig, and associated equipment with possible internal contamination	Storage
01/Condition Release Storage Yard West, Area 1 Subdock	Legacy drilling pipe and miscellaneous drilling equipment, mobile conveyor system, and storage transportainer with possible internal contamination	Storage
01/Post Shot Drill Rig (Readiness)	Legacy post shot drill rig parts with possible internal contamination	Storage
01/Railcar #8 (202044)	Solids legacy materials with possible internal contamination	Storage
01-121/Connex # 295145	Stored depleted uranium bucket sealed in plastic bags	Storage
06-806	Contaminated soil samples	Storage
Defense Facilities and Nuclear Operations		
G-Tunnel Complex	Equipment containing radioactive material	In operational ready mode to support research and testing
G-Tunnel, Connex #9127908	Piece of machine equipment which was exposed to beryllium	Stored awaiting disposition
Defense Facilities and Nuclear Operations Container Packaging Center, 23-128	LLW	Disassembly and assembly of Department of Transportation Type A and B shipping containers

Table A.2 Locations with potential to have unsealed radioactive material but had no known emissions in CY 2009 (continued)

Facility or Area	Radioactive Material	Handling/Processing
Radiological Operations		
Occupational Medicine and Radiological Control, 23-650, Rm 36	Sealed sources and historical radioactive sources and samples. Volatile radioactive sources: ^{3}H: 3.0 x 10^{-4} Ci (as HTO) Krypton-85: 8.7 x 10^{-2} Ci Iodine-129: 5.4 x 10^{-7} Ci RadCon produces <5 gallons of low-level, compactable radio-active waste kept in Room 35/36 which is then transferred to RAMATROL Building 23-180	Temporary storage of low-level radiological waste products, storage of sealed radioactive sources for instrument calibrations and measurement, and tools necessary to perform contamination measurement of material and components entering and departing the NTS
722003 Office Trailer, 23-722003	Solid and liquid environmental samples	Staging of radioactive sources and materials from offsite until they can be sent for disposal, repackaging of drums containing radioactive material

[a] EPA-required stack monitoring detected no measurable radionuclide emissions in 2009. The effluent system was disassembled for repairs and did not operate at the end of the year. Therefore, no stack monitoring occurred October–December 2009.

Appendix B

Tritium Emissions Estimated from Air Sampling Data

BACKGROUND INFORMATION

Diffuse emissions of tritiated water (HTO) from the Nevada Test Site (NTS) include evaporation from containment ponds, evapotranspiration of soil moisture diffusing through waste covers at the Area 3 and Area 5 Radioactive Waste Management Sites (RWMSs), and evapotranspiration of HTO from soil contaminated by atmospheric, or near surface, nuclear weapon testing. Locations that make up the majority of diffuse tritium (^{3}H) emissions on the NTS are the Schooner and Sedan nuclear test areas, the Area 3 and Area 5 RWMSs, and the containment ponds at E Tunnel. Emissions from the E Tunnel ponds were not estimated from air sampling data because the total volume of water and ^{3}H concentration of the water was known, allowing for an estimate described in Appendix D. For the remaining sites listed, emissions were estimated by scaling concentrations of ^{3}H in air predicted by a modeled unit release to those measured at nearby sampling stations.

There are 19 sampling stations referred to as environmental samplers on the NTS. They include three stations that have exclusively low-volume air particulate samplers, one that has exclusively a HTO sampler, and 15 that have both air particulate and HTO samplers – 6 of which are designated as critical receptor locations. They are located throughout the NTS in or near the highest diffuse radiation sources. Figure 5 of this report shows the current NTS air sampling station locations and Table B-1 lists the samplers near the major diffuse ^{3}H emission locations.

SOURCE TERM ESTIMATES

For each major ^{3}H emission location, the Clean Air Package 1988 (CAP88-PC) model was used to estimate the ^{3}H concentration that would be expected at nearby air samplers if one curie (Ci) of ^{3}H were released from the center of the source location. The total annual emission from each source was then calculated by dividing the annual average concentration of ^{3}H measured at each sampling location by the predicted CAP88-PC concentration for a 1 Ci release. Table B.1 lists the estimated emissions for each source location.

Table B.1 ^{3}H Emissions from CY 2009 Air Sampling Results

Emission Source	Air Sampler	^{3}H Concentration (pCi/m^3)[(a)]	CAP88-PC Concentration for 1 Ci Emission (pCi/m^3)	^{3}H Emission (Ci)
Area 3 RWMS	BJY	0.55	0.0186	30[(b)]
	U-3bh N	0.43	0.585	0.74
	U-3ah/at S	0.73	0.242	3.0
Area 5 RWMS	DoD	0.31	0.11	2.8[(c)]
	Sugar Bunker North	0.80	0.458	1.8[(c)]
Area 10 Sedan	Sedan North	5.04	0.262	19[(c)]
	Gate 700	0.21	0.00952	22[(c)]
Area 20 Schooner	Schooner[(d)]	250	0.435	575[(e)]
	Gate 20-2P	0.35	0.00436	83

(a) pCi/m^3 = picocuries per cubic meter
(b) Diffuse emissions of ^{3}H from nearby atmospheric nuclear weapons test locations likely elevated the annual average concentrations of ^{3}H measured at the BJY sampler. It is probable that this resulted in the emission estimate for the Area 3 RWMS to be high. Estimate still used for conservatism.
(c) The higher of the two emission estimates for each location was used for that location.
(d) Critical Receptor Station
(e) Emission estimate likely biased high due to sampler being too close to the diffuse emission source (see Appendix H). The alternative emission estimate, based on the Gate 20-2P sampling location, is considered more defensible and was therefore used.

Appendix C

Emissions of Americium and Plutonium from Diffuse Legacy Sites Based on Historic Soil Survey Data and Soil Re-suspension Model

BACKGROUND INFORMATION

Operations (Ops) Areas 1 through 12 and 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 that remain in the surface soils (U.S. Department of Energy [DOE], 1991; see Table 1.0 of this report). 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 (per second), 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} per second (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 one year (yr) = 3,600 s/hour x 24 hours/day x 365 days/yr = 3.15×10^7 s/yr, the annual emission rate becomes:

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

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

Table C.1 Calculated Emissions from Inventories[(a)] of ^{238}Pu, $^{239+240}$Pu, and ^{241}Am in NTS Ops Areas

Inventory, Re-suspension Factors, and Calculated Emissions by NTS Ops Area								
NTS Ops 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}	0.5	1.32	2.05	7.57
2	2.9	8.6	22	2×10^{-10}	0.5	0.91	2.71	6.94
3	4.6	3.1	37	2×10^{-10}	0.5	1.45	0.98	11.67
4	6.6	13	40	2×10^{-10}	0.5	2.08	4.10	12.61
5	0.6	0.1	4.8	2×10^{-10}	0.5	0.19	0.03	1.51
6	1.7	3.3	8.4	2×10^{-10}	0.5	0.54	1.04	2.65
7	2.2	0.6	16	2×10^{-10}	0.5	0.69	0.19	5.05
8	17	8	110	2×10^{-10}	0.5	5.36	2.52	34.69
9	4.2	2.2	89	2×10^{-10}	0.5	1.32	0.69	28.07
10	19	19	110	2×10^{-10}	0.5	5.99	5.99	34.69
11	3.3	0.5	29	2×10^{-10}	0.5	1.04	0.16	9.15
12	5.7	8.5	39	2×10^{-10}	0.5	1.80	2.68	12.30
15	8	7.8	63	2×10^{-10}	0.5	2.52	2.46	19.87
16	0.7	1.5	3.7	2×10^{-10}	0.5	0.22	0.47	1.17
17	2.8	4.5	18	2×10^{-10}	0.5	0.88	1.42	5.68
18	19	5.6	100	2×10^{-10}	0.5	5.99	1.77	31.54
19	21	32	140	2×10^{-10}	0.5	6.62	10.09	44.15
20	23	30	41	2×10^{-10}	0.5	7.25	9.46	12.93
30	3.2	4.5	14	2×10^{-10}	0.5	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 C.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 3 of this report (as 0.047, 0.050 and 0.29 Ci/yr), which summarizes all measured or computed emissions from the NTS in calendar year 2009. The spatial relation between these diffuse emission locations and the critical receptor stations can be seen in Figure 4.

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 D

Calculation of Tritium Emissions from Contaminated Groundwater Discharges

During calendar year (CY) 2009, the air emissions of tritium (^3H) as tritiated water (HTO) from contaminated groundwater sources were conservatively estimated. They were computed as the product of the volume of water (in liters [L]) either pumped or naturally emerging to the surface and the ^3H concentration (as picocuries per liter [pCi/L]) measured in that water using the following formula. It was assumed that all of the HTO evaporated.

$$Water\ Concentration\ \left(\frac{pCi}{L}\right)\ x\ Water\ Volume\ (L)\ x\ \frac{1\ x\ 10^{-12}\ Ci}{pCi}$$

Water flow from the E Tunnel is measured monthly, and ^3H concentration in the water is measured annually in support of Water Pollution Control Permit NEV 96021.

The volume of water discharged into the Area 5 and Area 23 Sewage Lagoons on the Nevada Test Site is measured as it is removed from the basement of Building A-01 at the North Las Vegas Facility. Samples of the water were collected twice during CY 2009 to determine the ^3H concentration.

Water from the wells listed in Table D.1 is purge water from Underground Test Area Sub-Project sampling activities. The volume of water purged from each well is calculated by pump rates multiplied by time, and the ^3H concentrations of the well water are determined by either Los Alamos National Laboratory or Lawrence Livermore National Laboratory.

Table D.1 lists the values used to make emission estimates.

Table D.1 Concentrations of ^3H in Water, Water Volumes, and Estimated ^3H Emissions from Contaminated Groundwater Brought to the Surface

Location	^3H Concentration (pCi/L)	Water Volume (L)	^3H Emission (Ci)
E Tunnel Ponds	5.27×10^5	1.49×10^7	7.9
Area 5 and Area 23 Sewage Lagoons	9.03×10^2	4.02×10^5	0.00036
Building A-01, evaporative coolers, NLVF	9.03×10^2	5.83×10^5	0.00053
Well ER-20-7	9.18×10^6	3.00×10^6	27.5
Well ER-20-8	5.35×10^2	1.89×10^6	0.0010
Well ER-20-8 #2	5.35×10^2	3.91×10^5	0.0002
Well ER-EC-11	4.72×10^3	1.28×10^7	0.0603
Well ER-20-8 #2[(a)]	8.05×10^2	6.90×10^6	0.0056

(a) Second time well was pumped (well was pumped and sampled twice during 2009). Concentration used was the average of 730 and 880 pCi/L

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Appendix E

Potential Radionuclide Emissions and Dose from Point Sources

The only dose evaluations made for point source releases during calendar year (CY) 2009 was that for Building A-01 at the North Las Vegas Facility (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 (^{3}H)-aluminum foils was opened in Building A-01 at NLVF and emitted at least one curie (Ci) of ^{3}H into a basement area used as a fixed radiation source range. Environmental surveillance began on the day notification of the ^{3}H leak occurred. Environmental atmospheric moisture samplers were installed at three locations outside the facility to monitor for tritiated water (HTO) in air. Later, an atmospheric moisture sampler was installed in the basement and operated continuously so that progress on cleanup of the spill could be monitored. After cleanup, the environmental samplers were removed, but the basement air sampler continued operation through January 5, 1998, at which time samples were collected one to four times annually. From 1995 to the present, results and the effective dose equivalent (EDE) to the maximally exposed individual (MEI) offsite at the perimeter fence have been reported in the annual NESHAP reports.

During the years 1999 through 2009, air sampling for HTO in the basement was conducted intermittently. For CY 2009, the results of two atmospheric moisture samples were 500 picocuries per cubic meter (pCi/m^3) for the sample collected April 6 to April 13, 2009, and 1122 pCi/m^3 for the sample collected September 1 to September 8, 2009. The average of these sample results (811 pCi/m^3) was multiplied by the room ventilation rate (673 cubic feet per minute [ft^3/min]) to determine the total annual emission rate as shown below. The estimated total annual emission is expressed in millicuries per year (mCi/yr).

$$\frac{811\,pCi}{m^3}\times\frac{673\,ft^3}{\min}\times\frac{0.02832\,m^3}{ft^3}\times\frac{525{,}600\,\min}{yr}\times\frac{1\times10^{-9}\,mCi}{pCi}=\frac{8.12\,mCi}{yr}$$

An additional 0.53 mCi/yr of ^{3}H was released from Building A-01 by evaporating water from the radiation source well, resulting in a total emission of 8.7 mCi/yr.

Clean Air Package 1988 modeled dose estimates to the MEI from NLVF ^{3}H releases, 1995 to 2001, were used to develop a dose coefficient of 5.0 x 10^{-6} millirem per year per millicurie released ([mrem/yr]/mCi). This coefficient multiplied by the ^{3}H emission for CY 2009 gave the estimated EDE to the nearest member of the public outside the perimeter fence.

$$\frac{8.7\,mCi}{yr}\times\frac{5.0\times10^{-6}\,mrem}{mCi}=\frac{0.000044\,mrem}{yr}$$

A comparison of the past and current emission rates and radiation dose to the MEI are presented in Table E.1.

Table E.1. Comparison of ^{3}H Emission Rates from Building A-01, NLVF from 1995 to 2009

Year	Tritium Emission Rate (mCi/yr)	EDE to MEI (mrem/yr)
1995	123	0.00096
1996	52	0.00025
1997	110	0.00053
1998	16	0.00008
1999	301	0.0014
2000	370	0.0018
2001	200	0.00096
2002	(not sampled)	Not Estimated
2003	9.3	Not Estimated
2004	11	Not Estimated
2005	20	0.00010
2006	13.2	0.00007
2007	12.3	0.00006
2008	11.1	0.00006
2009	8.7	0.000044

Appendix F

Radionuclide Emissions from Environmental Restoration, Waste Management, Research, Construction Projects, and Periodic Confirmatory Measurements

During calendar year (CY) 2009, National Emission Standards for Hazardous Air Pollutants (NESHAP) evaluations were completed for three Environmental Restoration Program demolition projects planned to begin in CY 2010 and for three Nonproliferation Test and Evaluation project sites where conventional explosives are planned to be used over bare soil. These evaluations are summarized below.

ENVIRONMENTAL RESTORATION PROJECTS

E-MAD Demolition

The Environmental Restoration program plans a closure in place of the Engine Maintenance, Assembly, and Disassembly (E-MAD) facility located in Area 25 of the Nevada Test Site (NTS). This site contains radiologically impacted material. The plan is to demolish much of the facilities using traditional demolition techniques (e.g., heavy equipment). Explosive demolition work will be performed as well. During demolition activities, radionuclides associated with particulates will be suspended into the air and potentially available for transport off the NTS by wind.

The Clean Air Package 1988 (CAP88-PC) computer model, specifically version 3.0, was used for this assessment in accordance with Title 40 Code of Federal Regulations (CFR) Part 61.93. The Hotspot (version 2.06) computer model for short-term releases was also used for estimating the offsite radiation dose for comparison purposes.

Model Inputs

Distances to Potential Receptors

Release point (E-MAD): Latitude: 36.8065, Longitude 116.3048 (decimal degrees, North American Datum [NAD] 83). The distance to the nearest NTS boundary (12.7 kilometers [km]) was determined using ArcMap version 9.3 software. No one resides, or was stationed full-time, at the nearest NTS boundary. It was only used as a reference. The nearest offsite member of the public resided in Amargosa Valley, 20.3 km southwest of E-MAD.

Meteorological Data

Meteorological support, observations, and climatological services for the NTS are provided by the Air Resources Laboratory, Special Operations and Research Division (ARL/SORD), an office of the National Oceanic and Atmospheric Administration. ARL/SORD operates numerous Meteorological Data Acquisition (MEDA) stations throughout the NTS. MEDA station number 26, located in the eastern portion of Area 25 about 5 km east of E-MAD, was selected to provide the meteorological data representative of E-MAD. However, to ensure that potential offsite dose estimates are not underestimated, wind speed and stability maximizing air concentrations at the distance of the nearest offsite resident were used (wind speed of 4–6 knots, G stability). It was also conservatively assumed that the wind was blowing 100 percent of the time directly toward a populated location. Precipitation over the course of demolition activities was predicted to be 14.5 centimeters per year (cm/yr), which is the 1957–2008 annual average for Area 25 reported by ARL/SORD. The 1983–2000 average temperature in

Area 25 was 16.8 degrees Celsius (°C), and the mixing height (Height of Lid) was predicted to be 1,000 meters (m). The absolute humidity was assumed to be 5 grams per cubic meter (g/m^3).

Source Data

The area of the release was estimated to be the entire demolition site of 8,000 square meters (m^2) and the release height was estimated to be 15 m.

Plume rise was taken as that from the explosive demolition phase. This was estimated to be by momentum at an exit velocity of 4,000 meters per second (m/s). This is an approximation for large quantities of blasting agents (http://www.globalsecurity.org/military/systems/munitions/wxplosives-anfo.htm). Plume rise was assumed to be limited to 1,000 m for the CAP88-PC Height of Lid parameter.

The amount of explosives, 910 pounds trinitrotoluene (TNT) equivalent, were used for the Hotspot model (assumed to be the same as the maximum amount to be used at the Reactor Maintenance, Assembly, and Dissassembly [R-MAD] facility; see *R-MAD and Pluto Demolition* section below). The airborne fraction used in Hotspot was set to 0.3 of the total building radionuclide inventory.

The radioactive inventory of E-MAD was estimated during the facility hazard categorization process. The amounts of radionuclides released to air and used in CAP88-PC modeling were based on the equation for material handling during demolition in *Preferred Method to Estimate Radionuclide Emissions from Demolition*, listed in *Methods for Estimating Fugitive Air Emissions of Radionuclides from Diffuse Sources at DOE Facilities* (U. S. Environmental Protection Agency [EPA], 2004) and are listed in Table F.1.

Table F.1 Amount of Radioactive Air Emissions Potentially Released from the Demolition of the E-MAD Facility, Area 25.

Nuclide	E-MAD Inventory (Curies [Ci])[(a)]	Estimated Emissions (Ci)[(b)]
^{137}Cs	2.92×10^{-3}	2.63×10^{-5}
^{90}Sr	2.65×10^{-3}	2.39×10^{-5}
^{234}U	1.16×10^{-3}	1.04×10^{-5}
^{235}U	6.00×10^{-5}	5.40×10^{-7}
^{239}Pu	1.00×10^{-5}	9.00×10^{-8}

(a) used for Hotspot inventory (0.3 release fraction applied)

(b) used for CAP88-PC emission. An emission factor of 0.03 and a control efficiency of 70% (wetting) were used.

Food Source Scenario

It was assumed that intake would be based on a rural food source scenario. This is conservative as it assumes all food is derived regionally (none imported).

Results and Conclusion

With the conservative assumption that wind was blowing 100 percent of the time directly at the populated locations, both the CAP88-PC and Hotspot predicted doses at the nearest boundary were extremely low (1.9×10^{-4} millirems per year (mrem/yr) and 2.9×10^{-4} mrem/yr, respectively). These are more than 300 times lower than the 0.1 mrem/yr level specified in 40 CFR 61.96. It was therefore concluded that potential offsite doses from radionuclides suspended during demolition of E-MAD were minor and did not require specific monitoring or regulatory approval. The nearest critical receptor station for demonstrating compliance with 40 CFR § 61.92, Gate 510, is located about 3 km closer to E-MAD than the nearest offsite resident in Amargosa Valley and is in the same general direction.

R-MAD and Pluto Demolition

The Environmental Restoration program plans a closure in place of R-MAD, located in Area 25. The R-MAD Building (25-3110) will be demolished using traditional demolition techniques. The majority of the structure will be demolished using hydraulic hammer-equipped excavators. Explosive demolition will be completed for the high bay of R-MAD. During these activities, radionuclides associated with particulates will be suspended into the air and potentially available for transport off the NTS by wind.

Demolition of Building 2201 at the Pluto Disassembly Facility (Pluto) is also planned. Pluto is located north of Cane Spring Road in the southwestern portion of Area 26 of the NTS. The level of contamination at Pluto is much lower than that at R-MAD and decontamination efforts will be made such that the resulting building materials can be disposed of as sanitary waste. Therefore, a specific radionuclide NESHAP assessment was not be made for the Pluto facility, but was inferred from the results of the assessment for R-MAD.

The CAP88-PC version 3.0 computer model was used for this assessment in accordance with 40 CFR 61.93. The Hotspot (version 2.06) computer model for short-term releases was also used for estimating the offsite radiation dose for comparison purposes.

Model Inputs

Distances to Potential Receptors

Release point (R-MAD): Latitude: 36.816195, Longitude 116.239091 (decimal degrees, NAD 83). The distance to the nearest NTS boundary (15.9 km from R-MAD and 15.8 km from Pluto) was determined using ArcMap version 9.3 software. No one resides, or was stationed full-time, at the nearest NTS boundary. It was only used as a reference. The nearest offsite member of the public resided in Amargosa Valley, 24.2 km southwest of R-MAD.

Meteorological Data

ARL/SORD MEDA station number 26, located in the eastern portion of Area 25 about one km southwest of R-MAD, was used to obtain the meteorological data representative of R-MAD. The overall mode stability class of C was used for CAP88-PC modeling. The overall average wind speed was 7.3 knots but because CAP88-PC uses average wind speeds grouped in ranges, the wind speed range of 4–6 knots was used instead of the higher range of 7–10 knots in order to conservatively maximize deposition in the near offsite locations. It was also conservatively assumed that the wind was blowing 100 percent of the time directly toward a populated location. Precipitation over the course of demolition activities was predicted to be 14.5 cm/yr, which is the 1957–2008 annual average for Area 25 reported by ARL/SORD. The 1983–2000 average temperature in Area 25 was 16.8°C, and the Height of Lid was predicted to be 1,000 m. Absolute humidity was assumed to be 5 g/m^3.

Source Data

The area of the release was estimated to be the entire demolition site (3,500 m^2) and the release height used was equal to the roof height (19 m).

Plume rise was taken as that from the explosive demolition phase. This was estimated to be by momentum at an exit velocity of 4,000 m/s. This is an approximation for large quantities of blasting agents (http://www.globalsecurity.org/military/systems/munitions/wxplosives-anfo.htm). Plume rise was assumed to be limited to 1,000 m for the CAP88-PC Height of Lid parameter.

The amount of explosives, 910 pounds TNT equivalent, were used for the Hotspot model with an airborne fraction of 0.3.

The total amount of radioactivity predicted to be released to air is listed in Table F.2. Amounts of radionuclides used in CAP88-PC modeling were based on the equation *Preferred Method to Estimate*

Radionuclide Emissions from Demolition, listed in *Methods for Estimating Fugitive Air Emissions of Radionuclides from Diffuse Sources at DOE Facilities* (EPA, 2004).

Concentrations of radionuclides in building materials were estimated from Environmental Restoration program characterization data. Emission control measures will include wet spray (water) and geotextile material draped over structures to keep large pieces of material contained during explosive demolition.

Table F.2. Amount of Radioactive Air Emissions Potentially Released from the Demolition of the R-MAD Facility, Area 25.

Nuclide	R-MAD Inventory (Ci)[(a)]	Estimated Emissions (Ci)
^{137}Cs	4.01×10^{-4}	1.14×10^{-8}
^{60}Co	1.60×10^{-6}	4.53×10^{-11}
^{90}Sr	8.31×10^{-4}	2.36×10^{-8}
^{94}Nb	1.22×10^{-6}	3.45×10^{-11}
^{234}U	8.27×10^{-5}	2.35×10^{-9}
^{235}U	5.18×10^{-6}	1.47×10^{-10}
^{239}Pu	1.69×10^{-6}	4.78×10^{-11}

(a) used for CAP88-PC and Hotspot for emission

Food Source Scenario

It was assumed that intake would be based on a rural food source scenario. This is conservative as it assumes all food is derived regionally (none imported).

Results and Conclusion

Both the CAP88-PC and Hotspot predicted doses at the nearest boundary were extremely low (6.3×10^{-10} mrem/yr and 8.1×10^{-10} mrem/yr, respectively). These are more than 100-million times lower than the 0.1 mrem/yr level specified in 40 CFR 61.96. It was therefore concluded that potential offsite dose from radionuclides suspended during demolition of R-MAD were minor and did not require specific monitoring or regulatory approval. The nearest critical receptor station for demonstrating compliance with 40 CFR § 61.92, Gate 510, is located about 2.4 km closer to R-MAD than the nearest offsite resident in Amargosa Valley and is in the same general direction. It was also concluded that, because the potential radionuclide inventory at Pluto was a small fraction of that at R-MAD, the same conclusion could be made for demolition activities at the Pluto facility.

WASTE MANAGEMENT PROJECTS

No construction/modification activities took place at waste management facilities during CY 2009.

RESEARCH OR CONSTRUCTION PROJECTS

Use of Conventional Explosives Near Port Gaston

The Nonproliferation Test and Evaluation Complex (NPTEC), in support of several government agencies, conducted experiments using explosives near the Port Gaston facility in Area 26 of the NTS. Because the detonations were conducted over bare soil, any soil associated radionuclides could have been suspended into the air and potentially available for transport off of the NTS.

The CAP88-PC version 3.0 computer model was used to do a dose assessment in accordance with 40 CFR 61.93 prior to these activities being conducted. The Hotspot (version 2.06) computer model for short-term releases was also used for estimating the offsite radiation dose for comparison purposes.

CAP88 - PC Model Inputs

Distances to Potential Receptors

Release point: Latitude: 36.805833, Longitude 116.154000 (decimal degrees, NAD 83). The distance to the nearest NTS boundary (14.5 km) was determined using ArcMap version 9.2 software. No one resides, or was stationed full-time, at the nearest NTS boundary. It was only used as a reference. The nearest offsite member of the public resides in Amargosa Valley, 28.6 km southwest of Port Gaston. The second closest community is Crystal, 34.7 km south of Port Gaston.

Meteorological Data

ARL/SORD MEDA station number 26, located in the eastern portion of Area 25 was used to obtain the meteorological data that was representative of Port Gaston. In order to conservatively estimate the potential offsite dose, the lower wind speed range of 4–6 knots and the relatively calm stability class E were used for modeling. It was also assumed that the wind was blowing 100 percent of the time directly toward a populated location.

Precipitation during future activities was predicted to be 14.5 cm/yr which is the 1957–2008 annual average for Area 25 reported by ARL/SORD. The temperature was predicted to be 26.7°C. The Height of Lid was predicted to be 1,000 m, and the absolute humidity was assumed to be 5 g/m^3.

Source Data

The area of the release (soil suspended from the ground) was estimated to have a 20 m diameter (314 m^2 area) and a release height of zero.

Plume rise was estimated to be by momentum at an exit velocity of 4,000 m/s. This is an approximation for large quantities of blasting agents. Plume rise was assumed to be limited to 1,000 m for the CAP88-PC Height of Lid parameter.

For the Hotspot model, the amount of explosives used was 1,100 pounds TNT equivalent.

Soil suspension estimates were taken from modeling of explosive operations at the Big Explosives Experimental Facility (BEEF) for a previous project. The amount of soil (or particulate matter $\leq$ 10 micron [PM10]), emitted to air from a single 810 pound explosive detonation was estimated to be 731 grams (g) using the Combined Obscuration Model for Battlefield Induced Contaminants. Because the total amount of explosives predicted to be used at Port Gaston was greater than 810 pounds, this PM10 estimate was doubled then rounded up to 2,000 g for conservatism.

An aerial radiological survey conducted over the southwest corner of Area 26 in 1976 reported elevated radiation levels only over a test bunker located approximately 2.5 km northeast of Port Gaston. In 1984, soil samples were taken around this test bunker as part of the NTS Radionuclide Inventory and Distribution Program (RIDP). Aerial radiological surveys of Area 26 conducted in 1992 and 1994 did not detect any regions of anomalous radioactivity, and Environmental Restoration characterization data

showed radionuclide contamination in Area 26 to be predominately associated with building and structural materials. However, in order to make a conservative estimate of potential offsite dose, radionuclide concentrations from samples around the test bunker location reported by the RIDP were used and decay-corrected to the date operations were expected to begin (July 2009).

Concentrations of each nuclide were averaged and multiplied by 2,000 g of soil to obtain the amount of radioactivity potentially released to air (Table F.3). The Ci averages were then used as the emission source for modeling.

Table F.3. Total Activity Potentially Released to Air in Soil Suspended from Explosive Activities in Area 26.

	Radionuclide Activity per 2,000 g of Soil							
	^{60}Co	^{137}Cs	^{152}Eu	^{155}Eu	^{241}Am	^{90}Sr	^{238}Pu	$^{239+240}Pu$
Average pCi:	4.1	280.8	204.4	8.4	258.5	235.9	51.7	1680.3
Average Ci:	4.11×10^{-12}	2.81×10^{-10}	2.04×10^{-10}	8.40×10^{-12}	2.59×10^{-10}	2.36×10^{-10}	5.17×10^{-11}	1.68×10^{-09}

Food Source Scenario

It was assumed that intake would be based on a rural food source scenario. This is conservative as it assumes all food is derived regionally (none imported).

Results and Conclusion

Both CAP88-PC and HotSpot dose predictions were very low. The CAP88-PC predicted dose at the nearest boundary was 4.28×10^{-8} mrem/yr was over 2 million times lower than the 0.1 mrem/yr level specified in 40 CFR 61.96. It was therefore concluded that potential offsite doses from soil suspended during explosive detonations near Port Gaston were minor and did not require specific monitoring or regulatory approval. The critical receptor station, Gate 510, is located about 1.8 km closer to Port Gaston than the nearest offsite resident in Amargosa Valley and in the same general direction. This station is one of the stations used to demonstrate compliance with 40 CFR § 61.92.

Use of Conventional Explosives Near Test Cell C

The NPTEC, in support of several government agencies, plans to conduct experiments using explosives near the Test Cell C facility in Area 25 of the NTS. Because the detonations will be conducted over bare soil, any soil-associated radionuclides will be suspended into the air and potentially available for transport off of the NTS by wind. Experiments of this nature were not conducted at Test Cell C during CY 2009.

The CAP88-PC version 3.0 computer model was used to predict potential dose in accordance with 40 CFR 61.93. The Hotspot version 2.06 computer model for short-term releases was also used for estimating the offsite radiation dose for comparison purposes.

CAP88 - PC Model Inputs

Distances to Potential Receptors

Release point: Latitude: 36.833069, Longitude 116.274427 (decimal degrees, NAD 83). The distance to the nearest NTS boundary (17.5 km) was determined using ArcMap version 9.3 software. No one resides, or was stationed full-time, at the nearest NTS boundary. It was only used as a reference. The nearest offsite member of the public resided in Amargosa Valley, 23.6 km south-southwest of Test Cell C.

Meteorological Data

ARL/SORD MEDA station number 26, located in the eastern portion of Area 25 about 3 km southeast of Test Cell C, was used to obtain the meteorological data representative of Test Cell C. The overall mode stability class of C was used for CAP88-PC modeling. The overall average wind speed was 7.3 knots. The lower wind speed range of 4–6 knots was used as input for CAP88-PC in order to conservatively maximize deposition in the near offsite locations. It was also conservatively assumed that the wind was blowing 100 percent of the time directly toward a populated location.

Precipitation during future activities was predicted to be 14.5 cm/yr, which is the 1957–2008 annual average for Area 25 reported by ARL/SORD. The 1983–2000 average temperature in Area 25 was 16.8°C. The Height of Lid was predicted to be 1,000 m, and the absolute humidity was assumed to be 5 g/m^3.

Source Data

The area of the release (soil suspended from the ground) was estimated to have a 20 m diameter (314 m^2 area) and a release height of zero.

Plume rise was estimated to be by momentum at an exit velocity of 4,000 m/s. This is an approximation for large quantities of blasting agents. Plume rise was assumed to be limited to 1,000 m for the CAP88-PC Height of Lid parameter.

For the Hotspot model, 20,000 pounds of explosives, TNT equivalent, were used.

Soil suspension estimates were scaled from modeling of explosive operations at BEEF for a previous project. The amount of PM10 emitted to air from a single 810 pound explosive detonation was estimated to be 731 g using the Combined Obscuration Model for Battlefield Induced Contaminants. Because the total amount of explosives predicted to be used at Test Cell C was much higher than 810 pounds, this PM10 estimate was multiplied by 25 then rounded up to 20 kilograms (kg) for conservatism.

An aerial radiological survey conducted in 1994 located man-made radioactivity at Test Cell C. Data from insitu radionuclide measurements taken as part of the RIDP were used in this assessment. They were the maximum measurements taken 140 to 250 m away from Test Cell C, near the proposed blast pad. Radionuclide concentrations in soil were determined by decay correcting the RIDP values to the earliest date activities were expected to begin (January 1, 2010), converting areal measurements to concentrations in soil by using a soil density of 1.5 grams per cubic centimeter (g/cm^3), and by assuming that all nuclides were in the top 15 cm except actinides, which were assumed to all be in the top 7 cm of soil.

The maximum concentrations of each nuclide reported were multiplied by 20 kg of soil to obtain the amount of radioactivity potentially released to air (Table F.4). These values, in Ci, were then used as the emission source for modeling.

Food Source Scenario

It was assumed that intake would be based on a rural food source scenario. This is conservative as it assumes all food is derived regionally (none imported).

Table F.4. Annual Activity Potentially Released to Air in Soil Suspended by Explosive Activities Near Test Cell C, Area 25.

Nuclide	Maximum pCi/g	Radionuclide Activity per 20 kg of Soil (Ci)
^{60}Co	0.01	2.50×10^{-10}
^{137}Cs	0.43	8.57×10^{-9}
^{90}Sr	0.36	7.20×10^{-9}
^{152}Eu	0.27	5.44×10^{-9}
^{154}Eu	0.14	2.74×10^{-9}
^{155}Eu	0.02	3.53×10^{-10}
^{241}Am	0.77	1.53×10^{-8}
^{238}Pu	0.15	3.06×10^{-9}
$^{239+240}Pu$	4.98	9.96×10^{-8}

Results and Conclusion

Both the CAP88-PC and Hotspot predicted doses at the nearest boundary (3.4×10^{-7} mrem/yr and 1.3×10^{-6} mrem/yr, respectively) were over 70,000 times lower than the 0.1 mrem/yr level specified in 40 CFR 61.96. It was concluded that potential offsite dose from soil suspended during explosive detonations near Test Cell C was minor and did not require specific monitoring or regulatory approval. The critical receptor station, Gate 510, is located about 2.6 km closer to Test Cell C than the nearest offsite resident in Amargosa Valley and in the same general direction. This station is one of the stations used to demonstrate compliance with 40 CFR § 61.92.

Use of Conventional Explosives Near the HEST site

NPTEC plans to conduct experiments using explosives at the historically used High-Explosive Simulation Test (HEST) site in Area 14 of the NTS. Because the detonations are planned to be conducted over bare soil, any soil-associated radionuclides will be suspended into the air and potentially available for transport off of the NTS. Experiments of this nature were not conducted at the HEST site during CY 2009.

The CAP88-PC version 3.0 computer model was used to predict potential dose in accordance with 40 CFR 61.93. The Hotspot version 2.06 computer model for short-term releases was also used for estimating the offsite radiation dose for comparison purposes.

CAP88 - PC Model Inputs

Distances to Potential Receptors

Release point: Latitude: 36.971282, Longitude 116.180994 (decimal degrees, NAD 83). The distance to the nearest NTS boundary (22.5 km) was determined using ArcMap version 9.3 software. No one resides, or was stationed full-time, at the nearest NTS boundary. It is only used as a reference. The nearest offsite member of the public resided in Amargosa Valley, 41.6 km south-southwest of the HEST site.

Meteorological Data

ARL/SORD MEDA station number 14, located in the northern portion of Area 14 about 1 km south of the HEST site, was used to obtain the meteorological data representative of the HEST site. The overall mode stability class of C was used for CAP88-PC modeling. The overall average wind speed was 7.5 knots. The lower wind speed range of 4–6 knots was used as input for CAP88-PC in order to conservatively maximize deposition in the near offsite locations. It was also conservatively assumed that the wind was blowing 100 percent of the time directly toward a populated location.

Precipitation during future activities was predicted to be 23.1 cm/yr, which is the 1965–2008 annual average for Area 14 reported by ARL/SORD. The 1983–2000 average temperature in Area 14 was 13.9°C. The Height of Lid was predicted to be 1,000 m, and the absolute humidity was assumed to be 5 g/m^3.

Source Data

The area of the release (soil suspended from the ground) was estimated to have a 20 m diameter (314 m^2 area) and a release height of zero.

Plume rise was estimated to be by momentum at an exit velocity of 4,000 m/s. This is an approximation for large quantities of blasting agents. Plume rise was assumed to be limited to 1,000 m for the CAP88-PC Height of Lid parameter.

For the Hotspot model, 20,000 pounds of explosives, TNT equivalent, were used.

Soil suspension estimates were scaled from modeling of explosive operations at BEEF for a previous project. The amount of PM10 emitted to air from a single 810 pound explosive detonation was estimated to be 731 g using the Combined Obscuration Model for Battlefield Induced Contaminants. Because the total amount of explosives predicted to be used at the HEST site is about 25 times higher, this PM10 estimate was multiplied by 25 then rounded up to 20 kg for conservatism.

Three aerial radiological surveys have been conducted over Area 14. The 1970 survey covered the northern portion of Area 14. The 1992 and the 1994 surveys covered the entire Area 14. None of the surveys detected any radioactive anomalies. Environmental Restoration characterization, however, did detect very low levels of radionuclides in soil samples collected as part of Corrective Action Site CAS-14-23-01. Though detected, concentrations were low enough that they did not qualify as contaminants of concern from a cleanup perspective but were used in this assessment for predicting potential offsite dose.

The maximum concentration of each nuclide reported was multiplied by 20,000 g of soil to obtain the amount of radioactivity potentially released to air (Table F.5). These values, in Ci, were then used as the emission source for modeling.

Table F.5. Annual Activity Potentially Released to Air in Soil Suspended from Explosive Activities at the HEST Site, Area 14.

	^{137}Cs	^{234}U	^{238}U
Maximum pCi/g:	0.225	1.48	3.61
Radionuclide Activity per 20,000 g of soil (Ci):	4.50×10^{-9}	2.96×10^{-8}	7.22×10^{-8}

Food Source Scenario

It was assumed that intake would be based on a rural food source scenario. This is conservative as it assumes all food is derived regionally (none imported).

Results and Conclusion

Both the CAP88-PC and Hotspot predicted doses at the nearest boundary (1.2×10^{-8} mrem/yr and 6.4×10^{-8} mrem/yr, respectively) were over one million times lower than the 0.1 mrem/yr level specified in 40 CFR 61.96. It was therefore concluded that potential offsite doses from soil suspended during explosive detonations near the HEST site were minor and did not require specific monitoring or regulatory approval. The nearest critical receptor air sampling station for demonstrating compliance with 40 CFR §61.92, Gate 510, is located about 3.0 km closer to the HEST site than the nearest offsite resident in Amargosa Valley and in the same general direction.

PERIODIC CONFIRMATORY MEASUREMENTS

North Las Vegas Facility, Building A-01

See Appendix E

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Appendix G

Identification and Justification for the Development of Meteorological Data Used as Input to Clean Air Package 1988 (CAP88-PC)

Meteorological support, observations, and climatological services for the Nevada Test Site (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.

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). 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. 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.

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 meters [m]) located 4.8 kilometers (km) 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. DRA was built to replace a similar observatory that was located at the Yucca Flat Meteorological Observatory (UCC; elevation 1,196 m, 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 station. A MEDA station consists of an enclosed trailer, a portable 10 m 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 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

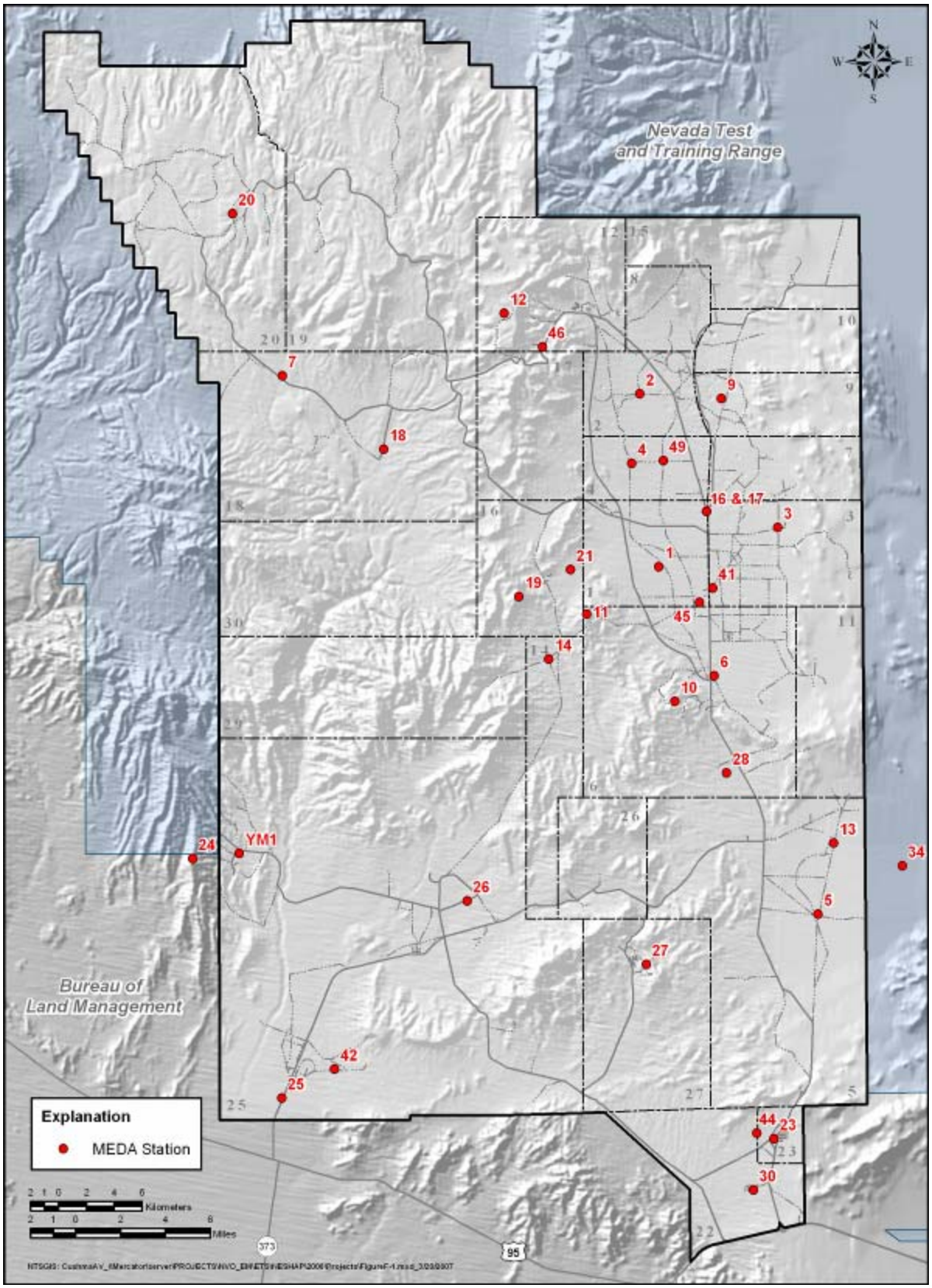

Figure G.1 Locations of MEDA Stations on the NTS in CY 2009

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 0.2 degrees Celsius (°C) between -39°C and 60°C (absolute range for the NTS is -29°C to 46°C). 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 use 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, from UCC to Frenchman Flat is 19.3 km, and from DRA to Pahute Mesa is 64.4 km.

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 0.39 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 (CAP88-PC) computer program, 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 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 that 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 2009 data from the MEDA stations for the NTS areas were used by ARL/SORD personnel to prepare the following STAR files listed in Table G.1.

Table G.1 Meteorological Data Acquisition System Locations Used to Create STAR Files for Use in Determining Radiological Emissions from the NTS (Appendix B).

STAR File	MEDA Station	MEDA Location (NTS Operations Area)	Area of Emission
meda09.str	MEDA09	9	10
meda13.str	MEDA13	5	5
meda20.str	MEDA20	20	20
meda49.str	MEDA49	4	3

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Appendix H

Supplemental Information

COLLECTIVE EFFECTIVE DOSE EQUIVALENT

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 (CAP88-PC) computer software to calculate the radiation doses received by offsite residents within 80 kilometers (km) of NTS emission sources (EPA, 2001a). 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, 2004), this calculation was not performed for calendar year 2009. 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 radionuclide emissions significantly increase, this change will be reconsidered and calculation of CEDE likely resumed.

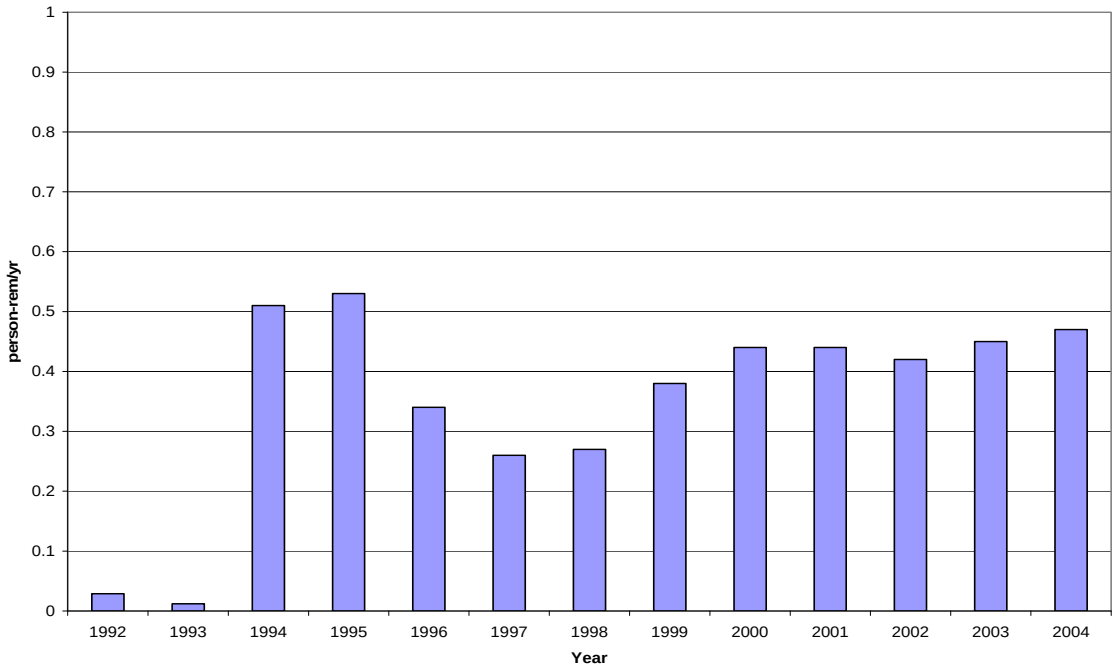

Figure H.1 CEDE to Populations within 80 km of Emission Sources

ESTIMATING TRITIUM EMISSIONS FROM SCHOONER AND SEDAN

Prior to 2002, the areas of diffuse tritium (^3H) emissions from the Sedan and Schooner sites were assumed to be the sizes of their craters. From the measurement of ^3H 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 3.8×10^6 square meters (m^2) for Sedan and 3.6×10^6 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 one curie per year (Ci/yr) release have high uncertainty (Figure H.2).

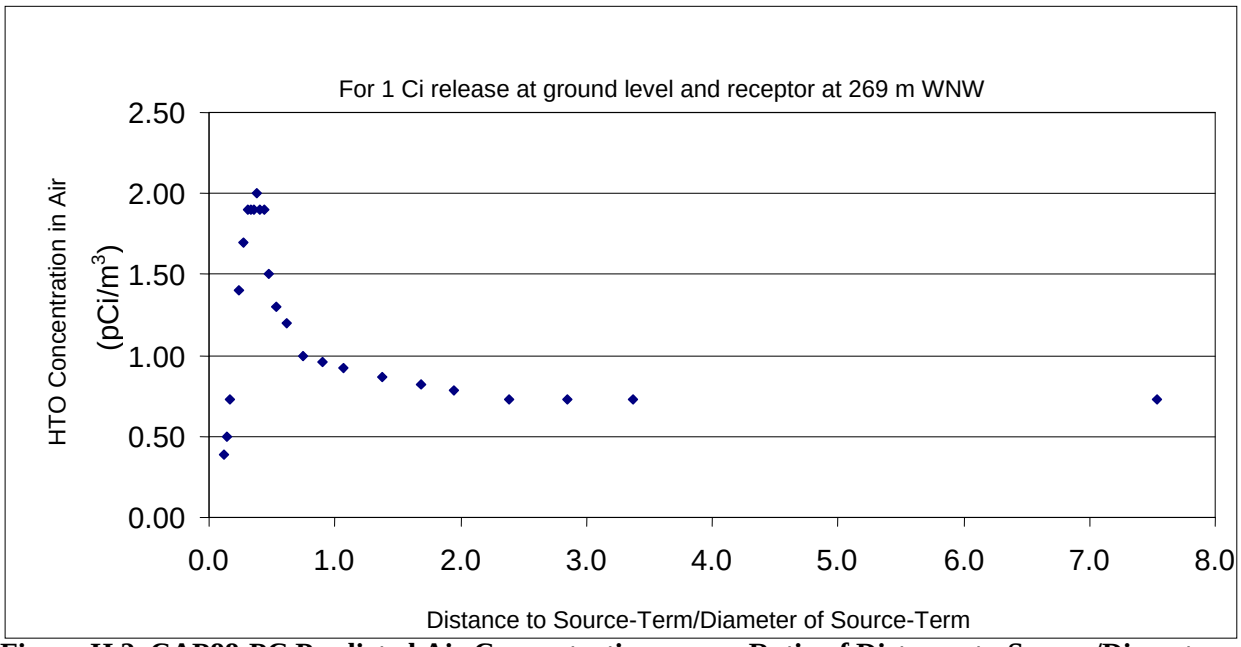

Figure H.2 CAP88-PC Predicted Air Concentration versus Ratio of Distance-to-Source/Diameter of Source

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 ^{3}H 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 meters 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 B for a description of the method and results.

COMPLIANCE WITH SUBPARTS Q AND T, Title 40 Code of Federal Regulations Part 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, U. S. Department of Energy Order 435.1, "Radioactive Waste Management" (DOE, 1999a) does include limits on radon flux from waste disposal facilities. 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 required by U.S. Department of Energy Manual 435.1-1, "Radioactive Waste Management Manual" (DOE, 1999b). The results of the most recent study (National Security Technologies, LLC, 2010) showed that the radon flux was not significantly different from 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 from the decay of thorium-230 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, 2001b), and of DOE O 414.1C, "Quality Assurance" (DOE, 2005) have been implemented in this plan.

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