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2010 LANL Radionuclide Air Emissions Report

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2010 LANL Radionuclide Air Emissions Report

David P. Fuehne

**U. S. Department of Energy Report
2010 LANL Radionuclide Air Emissions**

Site Name: Los Alamos National Laboratory
Location: County of Los Alamos, New Mexico

Operations Office Information:

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Compliance Assessment:

2010 Off-Site Effective Dose Equivalent: **0.33 mrem**

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Executive Summary

This report describes the reported dose from emissions of radionuclides at Los Alamos National Laboratory (LANL) for calendar year 2010. This report fulfills the requirements established by the National Emissions Standards for Hazardous Air Pollutants – Emissions of Radionuclides other than Radon from Department of Energy Facilities (Radionuclide NESHAP or Rad-NESHAP). This report is prepared by LANL’s Rad-NESHAP compliance team, which is part of the Environmental Protection Division. The information in this report is required under the Clean Air Act and is being reported to the U.S. Environmental Protection Agency (EPA). The highest effective dose equivalent (EDE) to an off-site member of the public was calculated using procedures specified by the EPA and described in this report. LANL’s EDE was 0.33 mrem for 2010. The annual limit established by the EPA is 10 mrem per year. All emissions are modeled to this single location, dubbed the Maximally Exposed Individual (MEI).

During calendar year 2010, LANL continuously monitored radionuclide emissions at 28 “major” release points, or stacks. The Laboratory estimates emissions from an additional 31 “minor” release points using radionuclide usage source terms in lieu of stack monitoring. Also, LANL uses a network of air samplers around the Laboratory perimeter to monitor ambient airborne levels of radionuclides. To provide data for dispersion modeling and dose assessment, LANL maintains and operates meteorological monitoring systems. From these measurement systems, a comprehensive evaluation is conducted to calculate the MEI dose for the Laboratory.

The MEI can be any member of the public at any off-site location where there is a residence, school, business, or office. In 2010, this MEI location was the southernmost building of 2201 Trinity Drive, the Los Alamos Lodge.* Since there are other receptors in the immediate area, all emissions were modeled to the adjacent Airnet Station 257. This station is called the Los Alamos (LA) Inn South station. The primary contributor to the off-site dose measured at this location was resuspension of legacy contamination on the hillside below the Airnet station. Other significant contributors to the reported off-site dose included the potential emissions from non-monitored (minor) emissions sources throughout the Laboratory and emissions of short-lived radioactive gases from the LANSCE accelerator facility. As discussed later in the report, the dose from remediation operations at Materials Disposal Area B (MDA-B) were considered for the MEI location, but measured air concentrations and associated off-site doses were less than the LA Inn South location. Doses reported to the EPA for the past 10 years are shown in Table E1.

* After a change in ownership, the Los Alamos Inn was renamed the Los Alamos Lodge. The Airnet station name of “LA Inn South” remains the same for consistency in tracking over the years.

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Table E1. Ten-Year Summary of Rad-NESHAP Dose Assessment for LANL

Year	EDE (mrem)	Highest EDE Location
2001	1.84	2470 East Road ("East Gate")
2002	1.69	2470 East Road ("East Gate")
2003	0.65	2470 East Road ("East Gate")
2004	1.68	2470 East Road ("East Gate")
2005	6.46	2470 East Road ("East Gate")
2006	0.47	Los Alamos Airport Terminal
2007	0.52	DP Road, Airnet Station 71/326
2008	0.55	2470 East Road ("East Gate")
2009	0.55	2470 East Road ("East Gate")
2010	0.33	2201 Trinity Drive, Airnet Station 257

2010 Significant Events

Several events that took place in 2010 are worth discussion in this Executive Summary.

Commencement of cleanup at Materials Disposal Area B. In February 2009, EPA Region 6 granted initial approval to start cleanup operations at Materials Disposal Area B (MDA-B). Subsequent work scope changes resulted in an update to this Pre-Construction approval, which was submitted in January 2010* and approved in February 2010. Initial operations began in February 2010. In June, large-scale excavation operations began. Other minor changes to the work scope necessitated communications with EPA Region 6 in October 2010 to address cleanup of residual contamination after a first cycle of excavation had been performed. Later communications in November addressed elevated emissions measurements on the network of air samplers surrounding MDA-B. In January 2011, minor scope changes were made in which much of the MDA-B excavated soil would be re-used at LANL, as long as the soil meets certain criteria for such on-site re-use. Ambient air emissions measurement operations at MDA-B are conducted according to the MDA-B Emissions Management Plan, including actions taken when elevated emissions are measured.

Cleanup work under the American Reinvestment and Recovery Act (ARRA). During CY2010, LANL performed demolition of legacy buildings at Technical Area 21 (TA-21) under the

* LA-UR-10-00015, "Update to Pre-Construction Application for the MDA-B Project." Submitted to EPA Region 6 on January 13, 2010. EPA approval granted February 18, 2010. Files are in the ENV-ES Rad-NESHAP records system.

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ARRA. Operations were described in a letter to EPA Region 6 in May 2010.* By the end of 2010, all legacy plutonium-handling buildings, designated “DP-West,” were torn down to the concrete foundation slab. The legacy tritium-handling buildings at DP-East were torn down as well, including below-grade removal of foundations and subsurface piping, etc. Starting in Fiscal Year 2012, planning will commence for the next phase of activities at TA-21, including remediation of other materials disposal areas (MDA-A and MDA-T), removal of subsurface material at DP-West, and demolition of remaining buildings. Rad-NESHAP compliance issues have been addressed, and air monitoring stations installed as needed to measure any air emissions from this work.

Addition of two new major point sources at TA-54. Two new waste processing lines were added at TA-54. TA-54 is the site of LANL’s low-level radiological waste disposal area, designated Materials Disposal Area G, or Area G. These waste processing lines allow for waste drum repackaging operations and other waste handling processes in preparation for the pending closure of Area G, currently scheduled for 2015. As described in the 2009 annual report, the design for these stacks and sampling systems was certified to meet ANSI/HPS N13.1-1999 design criteria using a half-scale model. Operations at TA-54 Building 412 began in June 2010, while operations in Building 231 commenced in September 2010. Emissions from these sources are included in this report.

Installation of new target at LANSCE. The primary beam target/moderator/reflector system was changed out at the LANSCE accelerator facility. One indirect result of that facility improvement was a dramatic reduction in radioactive gas emissions. Levels in 2010 were about one-fifth of levels measured in 2009. As a result, the MEI location was not the East Gate area for 2010.

Site visit by EPA Region 6. The Regional Health Physicist from EPA Region 6 visited LANL in November 2010. Focus areas were a walkaround of MDA-B cleanup operations and TA-21 D&D activities; the new TA-54 stacks; status of the Chemistry and Metallurgy Research-Replacement (CMRR) facilities; a tour of the Emergency Operations Center, and discussion about National Environmental Policy Act (NEPA) issues with the CMRR facilities. Since this visit was for status updates and information gathering and not a site inspection, no final report or similar summary was issued.

* Memo ENV-ES:10-0091, “Rad-NESHAP Status Update of Cleanup Activities at Los Alamos National Laboratory Technical Area 21.” David Janecky to George Brozowski. Technical report designated LA-UR-09-07922. Copies available in the ENV-ES records system.

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Changes to Radioactive Liquid Waste Treatment Facility. Several changes were made to operations at the TA-50 Building 1 Radioactive Liquid Waste Treatment Facility, the RLWTF. These changes were necessary to meet new NPDES* permit limits that went into effect in August 2010. These changes greatly reduced the volume of radioactive liquid waste (RLW) discharges from the RLWTF. After August, very little treated effluent was discharged through the permitted outfall; rather, other options were used. These included the use of open-air solar evaporative tanks at TA-53 and evaporation of treated RLW in small cooling towers at TA-50. Use of the cooling towers is described later in this report as a “0.1 mrem exemption” under 40CFR61.94(b)(8). In late 2010, a new evaporator was installed at TA-50 to process RLW; operations of that unit started in early 2011. For 2010 reporting, we have addressed the TA-50 cooling tower emissions as part of the Radioactive Materials Usage Survey, appropriate for this minor source. The TA-53 evaporative tanks are an existing LANL source, and emissions from these tanks are measured via the Airnet system of ambient air monitoring stations. The new evaporator at TA-50 will be included in the 2011 Radioactive Materials Usage Survey as a minor source.

Preparation for upgrades of TA-55 stack sampling systems. As part of the TA-55 Reinvestment Project (TRP), the stack sampling systems at LANL’s plutonium facility (PF) at TA-55 Building 4 are being upgraded. These upgrades will change the stack samplers from multi-point “rakes” in the rooftop stacks to single-point samplers, designed to meet state-of-the-art requirements of ANSI/HPS N13.1-1999. The rectangular stacks at PF-4 do not meet the ANSI standard requirements for use of single-point samplers, so the new sampling systems will be installed in the exhaust air ductwork in the basement of PF-4, upstream of the stack. Preliminary testing and proof-of-principle measurements were performed in late 2010 and early 2011, with all measurements indicating that the basement ductwork meets all ANSI standard criteria for sampler placement. The upgrade project was temporarily suspended during the federal budget Continuing Resolution, but final design is expected to take place in FY 2012, and construction in FY 2013. Once the new samplers are operational, the multi-point stack samplers currently in the PF-4 stacks will likely be turned off, following a short period of overlap to compare results between the two sampling methods.

* NPDES is the National Pollutant Discharge Elimination System, water quality discharge limits established by the federal Environmental Protection Agency.

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Abstract

The emissions of radionuclides from Department of Energy Facilities such as Los Alamos National Laboratory (LANL) are regulated by the Amendments to the Clean Air Act of 1990, National Emissions Standards for Hazardous Air Pollutants (40 CFR 61 Subpart H). These regulations established an annual dose limit of 10 mrem to the maximally exposed member of the public attributable to emissions of radionuclides. This document describes the emissions of radionuclides from LANL and the dose calculations resulting from these emissions for calendar year 2010. This report meets the reporting requirements established in the regulations.

Section I. Facility Information

61.94(b)(1) Name and Location of Facility

Los Alamos National Laboratory (LANL or the Laboratory) and the associated residential areas of Los Alamos and White Rock are located in Los Alamos County in north-central New Mexico, approximately 100 km (60 mi) north-northeast of Albuquerque and 40 km (25 mi) northwest of Santa Fe. Figure 1 illustrates the Laboratory's location with respect to the nation, state, and county.

61.94(b)(2) List of Radioactive Materials Used at LANL

Since the Laboratory's inception in 1943, its primary mission has been nuclear weapons research and development. Programs include weapons development, nonproliferation, magnetic and inertial fusion, nuclear fission, nuclear safeguards and security, and laser isotope separation. There is also basic research in the areas of physics, chemistry, engineering, and biology.

The primary facilities involved in the emissions of radioactivity are outlined in this section. The facility locations are designated by technical area and building and shown in Figure 2. For example, the facility designation TA-3-29 is Building 29 at Technical Area (TA) 3. Potential radionuclide release points are listed Table 1, with supporting information in later tables and in Section II of this report. Some of the sources described below are characterized as non-point (diffuse and fugitive) emissions. Off-site doses resulting from non-point emissions of radioactive particles and tritium oxide (tritiated water vapor or HTO) are measured and calculated using LANL's ambient air sampling network (Airnet).

Radioactive materials used at LANL include weapons-grade plutonium, heat-source plutonium, enriched uranium, depleted uranium, and tritium. Also, a variety of materials are generated through the process of activation; consequent emissions occur as gaseous mixed activation products (GMAP) and other particulate or vapor activation products (P/VAP).

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Figure 1. Location of Los Alamos National Laboratory.

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Figure 2. Los Alamos National Laboratory technical areas by number.

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The radionuclides emitted from point sources at LANL in calendar year 2010 are listed in Table 2. Tritium is released as either tritiated water vapor (called HTO) or elemental tritium gas (HT). Plutonium-239 can also contain Pu-240; the two isotopes are virtually indistinguishable by alpha spectroscopy, but have similar off-site dose conversions. GMAP emissions include ^{41}Ar , ^{11}C , ^{13}N , and ^{15}O . Various radionuclides such as $^{197\text{m}}\text{Hg}$, ^{68}Ge , and ^{76}Br make up the majority of the P/VAP emissions.

61.94(b)(3) Handling and Processing of Radioactive Materials at LANL Technical Areas

[Note – numerical superscript references in this and subsequent sections refer to external documents, listed at the end of this report.]

LANL technical areas and operations summaries are listed below. Additional descriptions of LANL technical areas can be found in the Annual Environmental Surveillance Report for LANL.¹ More thorough descriptions of LANL operations can be found in the Annual Site-Wide Environmental Impact Statement Yearbooks, the most recent being published in 2010.² A complete list of non-monitored sources and activities is found in the Radioactive Materials Usage Survey (RMUS), described in the next section.

The primary facilities responsible for radiological airborne emissions are as follows.

TA-3-29: The Chemistry and Metallurgy Research (CMR) facility conducts chemical and metallurgical research. The principal radionuclides used are isotopes of plutonium as well as other actinides. There are a variety of activities involving plutonium and uranium, which support many LANL and other U.S. Department of Energy (DOE) programs.

TA-3-66: This facility is used for a variety of nuclear materials work, primarily for dealing with metallic and ceramic items, including depleted uranium.

TA-3-102: This machine shop is used for the metalworking of radioactive materials, primarily depleted uranium. The facility only operated for part of 2010, and operations are planning to move to TA-3-141 over the next several years. Currently, TA-3-141 is a non-radiological facility.

TA-3-1698: This facility is designated as the Materials Science Laboratory. The building was designed to accommodate a wide variety of chemicals used in small amounts that are typical of many university and industrial labs conducting research in materials science. Small amounts of radioactive materials are used in experiments on materials properties (e.g., stress/strain measurements).

TA-15 and TA-36: These facilities conduct open-air explosive tests involving depleted uranium and weapons development testing. One building, TA-36-99, houses a “gas gun” focused explosive experiment that is ventilated through a non-monitored stack, starting in 2010.

TA-15-312: Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility: This facility conducts high-explosive-driven experiments to investigate weapons functions and behavior during nonnuclear tests using advanced radiography. Starting in 2007, explosive operations at DARHT are conducted in containment vessels. Use of these vessels virtually eliminates air emissions from these operations. Following testing, vessels undergo cleanout in building 15-534 and at times, repair in building 15-285. Both of these latter two buildings are non-monitored point sources, tracked in the RMUS.

TA-16-205 and -450: Weapons Engineering Tritium Facility (WETF): Buildings 205 and 450 were specifically designed and built to process tritium safely. The operations at WETF are divided into two categories: tritium processing and activities that support tritium processing. Examples of tritium-processing operations include the repackaging of tritium into smaller quantities and the packaging of tritium and other gases to user-specified pressures. Other operations include reacting tritium with other materials to form compounds and analyzing the effects of tritium. WETF operations have historically been housed in building 205, while building 450 was built for other tritium activities. In 2007, expansion of WETF into building 450 began. As part of this expansion, exhaust ducts were reconfigured so that emissions from TA-16-205 were routed into the TA-16-450 ES-05 stack. Therefore, the TA-16-205 stack ES-04 is discontinued as a point source and TA-16-450 ES-05 will be the point source for both buildings. The older emissions sampling system for building 205 is located in the exhaust duct coming out of building 16-205, and remains operational and able to measure emissions from that building. The new stack sampling system in stack ES-05 was certified to measure emissions from building 450, whenever that portion of the complex becomes active. This system will also measure emissions from building 205 operations, but was not certified for these operations under ANSI/HPS N13.1-1999 criteria. As discussed in the 2009 emissions report, the ES-05 stack monitor experienced technical problems, and its operations were discontinued in June 2009. Reported emissions for 2010 are measured with the 16-205 duct monitor, but exhausted through and CAP88 modeled from the 16-450 ES-05 stack.

TA-21: Many of the facilities at this decommissioned radiochemistry site are undergoing decontamination and demolition. Some of these operations may contribute to diffuse emissions of uranium and plutonium into the air. The Executive Summary details the current operational state of TA-21. The tritium operations in TA-21 were relocated in 2006 to other LANL sites, primarily WETF. In

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2009, demolition of office and support buildings began. Radiological process buildings were demolished in 2010. The MDA-B legacy waste disposal site is also considered part of TA-21.

TA-41-4: This building was formerly used as a tritium-handling facility. The tritium sources were removed in 2002. Diffuse tritium emissions could result from residual tritium contamination and cleanup operations.

TA-48: The principal activities carried out in this facility are radiochemical separations supporting the medical radioisotope production program, the Yucca Mountain program, nuclear chemistry experiments, and geochemical and environmental research. These separations involve nCi to Ci (hot cell) amounts of radioactive materials and use a wide range of analytical chemical separation techniques, such as ion exchange, solvent extraction, mass spectroscopy, plasma emission spectroscopy, and ion chromatography. Besides the hot cell operations, the building also houses the Actinide Research Facility and includes the other radiochemical operations described above. Building 1 at TA-48 contains the majority of operations and three monitored stacks; smaller operations take place in other buildings around TA-48-1.

TA-50-1: This waste management site consists of an industrial low-level (radioactive) liquid waste treatment facility, RLWTF. The building has one monitored stack (ES-2) and other smaller point sources which are not monitored. The cooling towers mentioned in the executive summary had been used for non-radiological purposes in the past; they began operations to process RLW in 2010. The new evaporator will start radiological operations in 2011 and be tracked as a non-monitored source.

TA-50-37: Currently there are no operations involving radioactive material in this building; long term plans for future operations that involve the use of radioactive actinides have not come to fruition. The operating facility has authorized cessation of stack sampling operations at this location, which is planned for later in 2011.

TA-50-69: This waste management site consists of a waste characterization, reduction, and repackaging facility. There is one monitored stack and two non-monitored stacks at this building. A third non-monitored emissions point, the vacuum pump system discharge, was added for 2010 to ensure completeness of emissions accountability from this building. The vacuum pump system is described in the RMUS as source ID 50006999, and provides suction for the continuous air monitors, fixed air samplers, and the ES-3 stack sampling system. This pump discharges its exhaust directly into the ambient air, and is now considered a separate release point.

TA-53: This technical area houses the Los Alamos Neutron Science Center (LANSCE), a linear particle accelerator complex. There are two monitored stacks (on buildings TA-53-3 and TA-53-7) and

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several sources tracked in the non-monitored stacks program. The accelerator is used to conduct research in stockpile stewardship, radiobiology, materials science, and isotope production, among other areas. LANSCE consists of the Manuel Lujan Neutron Scattering Center, the Proton Storage Ring, the Weapons Neutron Research facilities, the Proton Radiography facility, and the high-intensity beam line (Line A). The facility accelerates protons and H⁻ ions to an energy of 800 MeV into target materials such as graphite and tungsten to produce neutrons and other subatomic particles. The design current of the accelerator is approximately 1000 microamperes, but most operations take place as beam currents of 120 microamperes or less. Airborne radioactive emissions result from proton beams and secondary particles passing through and activating air in target cells, beam stop, and surrounding areas, or activating water used in target cooling systems. The majority of the emissions are short-lived activation products such as ¹¹C, ¹³N, and ¹⁵O. Most of the activated air is vented through the main stacks; however, a fraction of the activated air becomes a fugitive emission from the target areas.

As a by-product of accelerator operations, cooling water can contain trace amounts of radionuclides. Two solar evaporative tanks were constructed and began operation in 1999 to evaporate this wastewater from the accelerator. Evaporation of water from these open-air tanks can result in a diffuse source of airborne tritium and other particulates. To support other Laboratory operations, these tanks can be used for evaporation of water from other LANL facilities. As described in the Executive Summary, radioactive liquid waste from TA-50 Building 1 is transported by truck from that facility to the TA-53 evaporative tanks. This happened extensively in late 2010 as surface discharges from the TA-50 RLWTF were minimized.

TA-54: This waste management site consists of active and inactive shallow land burial sites for solid waste and is the primary storage area for mixed and transuranic radioactive waste. Waste characterization and processing operations also take place at TA-54 to prepare waste for shipment to the Waste Isolation Pilot Plant (WIPP). Shipments of transuranic waste for disposal at WIPP began in 1999. Characterization work includes analysis of headspace gases and radiography of waste drum contents; processing includes sorting, segregating, size-reduction, and repackaging of waste.

MDA G at TA-54 is also a known source of diffuse emissions of tritium vapor and direct radiation from above-ground storage of radioactive waste. Resuspension of soil contaminated with low levels of plutonium/ameridium has also created a diffuse source. Point sources at TA-54 include operations involving characterization, manipulation, or repackaging of waste containers. Two new monitored point sources came on-line in 2010, at Building 412 and Dome 231. These two new sources are waste processing facilities, preparing waste shipments for off-site disposal.

TA-55: Building 4 of the Plutonium Facility (PF-4) provides a pit manufacturing capability and continues the role providing the capability for research and development applications in chemical and metallurgical processes for recovering, purifying, and converting plutonium and other actinides.³ A wide range of activities (e.g., the heating, dissolution, forming, and welding of special nuclear materials) is also conducted. Additional activities include investigating the means to safely ship, receive, handle, and store nuclear materials and to manage wastes and residues from TA-55. Limited-scope tritium operations also take place in certain areas of TA-55. Building 2 of TA-55 houses associated support facilities for operations in PF-4, including the radiological sample analysis laboratory. Operations from this laboratory are tracked as part of LANL's non-monitored source program.

Section II. Air Emissions Data

61.94(b)(4) Point Sources

Monitored and unmonitored release points at LANL are listed in Table 1. The point sources are identified using an eight-digit identification number for each exhaust stack (StackID); the first two digits represent the LANL technical area, the next four the building, and the last two digits the stack number. Also listed in Table 1 are type, number, and efficiency of the effluent controls used on the release points. More information on effluent controls systems appear below.

In addition to the 26 monitored ("major") point sources, 31 unmonitored ("minor") release points in 15 LANL buildings are included in Table 1. Under 40 CFR 61.93(b)(4)(i), sampling of these minor release points is not required because each release point has a potential effective dose equivalent (PEDE) of less than 0.1 mrem/yr at the critical receptor. However, in order to verify that emissions from unmonitored point sources remain low, LANL conducts periodic confirmatory measurements in the form of the annual *Radioactive Materials Usage Survey for Unmonitored Point Sources*.⁴ The purpose of this survey is to collect and analyze radioactive materials usage and process information for the unmonitored point sources at LANL. In alternate years, the survey is expanded to review monitored sources and ensure proper emissions monitoring is taking place at these facilities.

The distance between each of the release points and the nearest receptor is provided in Table 1. The nearest receptor can be a residence, school, business, or office. In this report, the nearest receptor is defined as the public receptor most impacted by a given release point; that is, the air dispersion pattern is taken into account to determine the nearest or most critical receptor location.

In compliance with Appendix D to 40 CFR 61, we have used data collected from the facilities in conjunction with engineering calculations and other methods to develop conservative emissions estimates

from unmonitored point sources. Estimated PEDEs are calculated by modeling these emissions estimates using the U.S. Environmental Protection Agency (EPA)-approved CAP88 dose modeling software. A comprehensive survey of all of LANL's monitored and unmonitored point sources is conducted annually or biannually, depending on the magnitude of potential emissions. The Laboratory has established administrative requirements to evaluate all potentially new sources. These requirements are established for the review of new Laboratory activities and projects, ensuring that air quality regulatory requirements will be met before the activity or project begins.⁵

Non-point Sources

There are a variety of non-point sources within the 111 km² of land (43 square miles) occupied by LANL. Non-point sources can occur as diffuse or large-area sources, or as leaks or fugitive emissions from facilities. Examples of non-point sources of airborne radionuclides include surface impoundments, evaporative tanks and basins, shallow land burial sites, open burn sites, live firing sites, outfalls, container storage areas, unvented buildings, waste treatment areas, solid waste management units, and tanks. Additionally, a building is considered a non-point source if there is no active process exhaust (e.g., no fume hood, glove box, etc.); no forced air exhaust to the environment; or is equipped with only standard heating/ventilating/air conditioning systems (e.g., occupational comfort cooling or heating).

LANL summarizes the potential impacts of non-point sources by analyzing and reporting air concentration measurements of significant radionuclides (other than activation products) collected at ambient air-sampling (Airnet) sites around the Laboratory and at locations of public receptors surrounding the Laboratory. The LANL Airnet system was approved for use in monitoring LANL's non-point radioactive air emission sources in 1996.⁶ Based on the original methodology approved by EPA, additional procedures were developed to identify when new Airnet stations were required to assure continued compliance with the Radionuclide NESHAP.^{7,8}

Radionuclide Emissions

Table 2 lists the radionuclides released from monitored point sources, along with the annual emissions in curies for each radionuclide. The point sources are identified using an eight-digit identification number for each exhaust stack: the first two digits represent the LANL technical area, the next four digits the building, and the last two digits the stack number. No detectable emissions are denoted as "none." Extensive notes appear at the end of the source term table. A map showing the general locations of the facilities continuously monitored for radionuclide emissions is shown in Figure 3.

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Figure 3. Location of facilities with continuously operated stack-sampling systems for airborne radionuclide emissions.

Pollution Controls

The most common type of filtration for emission control purposes at LANL is the high-efficiency particulate air (HEPA) filter, as noted in Table 1. HEPA filters are constructed of sub-micrometer glass fibers that are pressed and glued into a compact, paper-like, pleated media.

At LANL, each HEPA filter is tested at least once every 12 months. The nominal performance criteria for HEPA filter systems are a maximum penetration of 5×10^{-4} for one stage (99.95% removal) and maximum penetration of 2.5×10^{-7} for two stages in series (99.999925% removal). In these quoted values, filter penetration and percent removal are defined below.

$$\text{Penetration} = (\text{downstream concentration}) / (\text{upstream concentration})$$

$$\text{Removal} = 1 - (\text{penetration}) * 100\%$$

Note that in recent years, changes to HEPA filter testing methods and equipment at LANL have resulted in limitations in the ability to certify very high levels of aerosol removal. Therefore, LANL is now only certifying all filters at the “single stage” penetration & removal criteria, regardless of the number of filter bank stages installed at the facility. Table 1 lists the number of filter banks installed at the facility and the nominal removal efficiency, not the certified tested removal efficiency.

Other types of filters used in ventilation systems are Aerosol 95; RIGA-Flow 220, 221, and 222; and FARR 30/30. These units are typically used as prefilters in HEPA filtration systems. These filters are significantly less efficient than HEPA filters and are typically used for removing gross particulate matter larger than 5 μm .

The above-mentioned filters are only effective for particles. When the contaminant of concern is in the form of a gas or vapors, activated charcoal beds can be used. Charcoal beds collect the gas contaminant through an adsorption process in which the gas comes in contact with the charcoal and adheres directly to the surface of the charcoal. The charcoal can be coated with different types of materials to make the adsorption process more efficient for specific types of contaminants. Typically, charcoal beds achieve an efficiency of 98% capture.

Tritium effluent controls are generally composed of a catalytic reactor and a molecular sieve bed. Tritium-contaminated effluent is passed through a catalyst that converts HT into HTO. This HTO is then collected as water on a molecular sieve bed. This process can be repeated until the tritium level is at, or below, the desired level. The effluent is then vented through the stack.

A delay system is used to reduce some of the short-lived radionuclides generated by activation at LANSCE. Emissions from a concentrated source of activated gas (the off-gas system for the 1L target

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cooling loops) are directed into a long transport line. The transit time through this system allows short-lived gaseous radionuclides to decay before emission from the stack. This delay system is used to provide a reduction in radionuclide emissions from the 1L target area.

Compliance with Maintenance and Inspection Requirements under the Revised Rad-NESHAP

The 2003 revisions to Subpart H established several inspection and maintenance requirements for monitored stacks. These requirements are based on American National Standards Institute/Health Physics Society N13.1-1999, *Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities*. Annual visual inspection of particulate monitoring systems is a component of the Laboratory's program to comply with these requirements. In 2010, we performed stack inspections on 16 monitored stacks. We also performed combination cleaning operations and inspections on an additional 7 stacks. The two new stacks at TA-54 were inspected at the time of installation. For the one tritium stack at TA-16, the annual in-place performance test serves as the annual inspection, per EPA alternative method approval. Two of the monitored stacks do not meet Subpart H requirements for "major" sources and did not have inspections performed on them. This accounts for the 28 monitored stacks at LANL.

Of the 16 inspections performed in 2010, three stack sample systems required cleaning. One has already been addressed in early 2011, and two others will be addressed in the summer of 2011. In 2010, no radiological material was measured on inspection or cleaning equipment. Therefore, no additions to the source term are required from this pathway for 2010.

Section III. Dose Assessment

61.94(b)(7) Description of Dose Calculations

Effective dose equivalent (EDE or dose) calculations for point sources, unmonitored point sources, and non-point gaseous activation products from LANSCE were performed with the CAP88 code. Starting with the 2006 annual emissions report, LANL uses CAP88-PC version 3 to demonstrate compliance. Verification of the CAP88 code is performed by running the EPA test case before and after performing the dose calculations.

Development of Source Term

Tritium emissions

Tritium emissions from the Laboratory's tritium facilities are measured using a collection device known as a bubbler. This device enables the Laboratory to determine not only the total amount of tritium released but also if it is in the chemical form of elemental tritium (HT) or tritiated water vapor (HTO). The bubbler operates by pulling a continuous sample of air from the stack, which is then "bubbled" through three sequential vials containing ethylene glycol. The ethylene glycol collects the water vapor from the sample of air, including any tritium that is part of a water molecule (tritium oxide, or HTO). After bubbling through these three vials, essentially all the water vapor and associated HTO is removed from the air, leaving elemental tritium, or HT. The sample air stream is then passed through a palladium catalyst that converts the HT to HTO. The sample is pulled through three additional vials containing ethylene glycol, which collects the newly formed HTO. The amount of HTO and HT is determined by analyzing the ethylene glycol for the presence of tritium using liquid scintillation counting. Since different chemical forms are collected in different vials, the system will discriminate HTO vapor from HT gas, allowing separate dose assessment with CAP88-PC version 3. For conservatism, however, all tritium is modeled as vapor phase HTO.

Tritium emissions from LANSCE do not require monitoring under 40 CFR 61.93(b)(4)(i). The primary source for airborne tritium emissions at LANSCE is activation of water vapor in air and activation and subsequent evaporation of water in the cooling system of beam targets. Because of the low relative contribution of tritium to the off-site dose at LANSCE, formal monitoring for tritium was discontinued after July 2001. However, the tritium emissions for 2010 can be calculated based on the rate of generation measured in 2001, using representative parameters. Using these rate-of-generation calculations, the tritium emissions from LANSCE stacks in 2010 were calculated to be less than 24 Ci and resulted in less than 0.0075 mrem to the facility critical receptor.

Radioactive particulate emissions

Emissions of radioactive particulate matter, generated by operations at facilities such as the CMR facility (TA-3-29) and the Plutonium Facility (TA-55), are sampled using a glass-fiber filter. A continuous sample of stack air is pulled through the filter, where small particles of radioactive material are captured. These samples are analyzed weekly using gross alpha/beta counting and gamma spectroscopy to identify any increase in emissions and to identify short-lived radioactive materials. Every six months, LANL composites these stack samples for subsequent analysis at an off-site laboratory.

These composite samples are analyzed to determine the total activity of materials such as ^{234}U , ^{235}U , ^{238}U , ^{238}Pu , ^{239}Pu , and ^{241}Am . These data are then combined with estimates of sampling losses and stack and sample flows to calculate emissions. Short-lived progeny are assumed to be emitted in secular equilibrium with their long-lived parent nuclides. For example, we measure for the presence of ^{90}Sr and assume that an equal amount of the progeny ^{90}Y is emitted as well.

Vapor form emissions

Vapor emissions, generated by LANSCE operations and by hot-cell activities at TA-3-29 and TA-48, are sampled using a charcoal filter or canister. A continuous sample of stack air is pulled through a charcoal filter upon which vaporous emissions of radionuclides are adsorbed. The amount and identity of the radionuclide(s) present on the filter are determined through the use of gamma spectroscopy. This information is then used to calculate emissions. Examples of radionuclides of this type include ^{68}Ge and ^{76}Br .

Gaseous mixed activation products (GMAP)

GMAP emissions resulting from activities at LANSCE are measured using real-time monitoring data. A continuously-operating air flow-through ionization chamber is operated in series with a high-purity germanium detector and data acquisition system. A sample of stack air is pulled through the ionization chamber to measure the total amount of radioactivity in the sample, while specific radioisotopes are identified through the use of gamma spectroscopy and decay curve analysis with the HPGe system. This information is then used to calculate emissions. Radionuclides of this type include ^{11}C , ^{13}N , and ^{15}O .

Summary of Input Parameters

EDE to potential receptors was calculated for all radioactive air emissions from sampled LANL point sources. Input parameters for these point sources are provided in Table 3. The geographic locations of the release points, given in New Mexico State Plane coordinates, are provided in Table 4. The relationship of the highest receptor location to the individual release points are provided in Table 5. Other site-specific parameters and the sources of these data are provided in Table 6.

LANL operates an on-site network of meteorological monitoring towers. Data gathered by the towers are summarized and formatted for input to the CAP88 program. For 2010, data from three different towers were used for the air-dispersion modeling; the tower data that are most representative of

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the release point are applied. Copies of the meteorological data files used for the annual 2010 dose assessments are provided in Table 7. Note that due to the extent of the data in Table 7, that table has been moved to Appendix 1. There are three files included in Table 7, detailing wind speed and direction information from TA-6, TA-53, and TA-54 meteorology towers.

The Laboratory also enters population array data to the CAP88 program. The data file represents a 16-sector polar-type array, with 20 radial distances for each sector. Population arrays are developed for each release point using U.S. Census data. An example of the population array used for the LANSCE facility is provided in Table 8. For agricultural array input, LANL is currently using the default values in CAP88. Finally, the radionuclide inputs for the point sources monitored in 2010 are provided in Table 2.

Public Receptors

Compliance with the annual dose standard is determined by calculating the highest EDE to any member of the public at any off-site point where there is a residence, school, business, or office. The Laboratory routinely evaluates public areas to assure that any new residence, school, business, or office is identified for the EDE calculation. As per EPA guidance,⁹ personnel that work in leased space within the boundaries of the Laboratory are not considered members of the public for the EDE determination. Personnel of this type are considered to be subcontractors to DOE, similar to security guards and maintenance workers.

Point Source Emissions Modeling

The CAP88 version 3 program was used to calculate doses from both the monitored and unmonitored point sources at LANL. The CAP88 program uses on-site meteorological data to calculate atmospheric dispersion and transport of the radioactive effluents. CAP88 includes all radionuclides for which there are dose conversion factors in the EPA's Federal Guidance Reports.^{10, 11, 12} In 2010, only three monitored radionuclides were not included in CAP88 for the monitored stacks source term: ¹⁰C, ¹⁴O, and ¹⁶N. For ¹⁰C and ¹⁴O, ¹¹C was used as a surrogate, as described in the Laboratory procedure ENV-EAQ-512.¹³ CAP88 was used to calculate the ¹¹C dose, which was then adjusted for the number of curies emitted, the gamma energy emitted per decay, and the half life of the radionuclides. For ¹⁶N, ²⁸Al was used as the surrogate nuclide and the resulting dose was adjusted accordingly. The maximum dose from emissions of radionuclides not included in the CAP88 library was 5.78E-06 mrem (see Tables 12 and 13). This dose contribution is well below the criteria for individual nuclide monitoring, which is 10% of a

source's PEDE. Updates of "non-CAP88 nuclides" for monitored and non-monitored point sources will be described in an upcoming memo to EPA Region 6 later this summer.

LANSCE Diffuse / Fugitive Emission Modeling

Some of the GMAP created at the accelerator target cells or at other accelerator beam line locations migrate into room air and into the environment. These diffuse or fugitive sources are continuously monitored throughout the beam-operating period. In 2010, approximately 20 Ci of ^{11}C and 1 Ci of ^{41}Ar were released from LANSCE as fugitive emissions.¹⁴ These sources were modeled as area sources using CAP88, and the specific input parameters are provided in Table 9.

Environmental Data Used for Non-point Source Emission Estimation

The net annual average ambient concentration of airborne radionuclides measured at 26 air sampling stations (Figure 4) is calculated by subtracting an appropriate background concentration value.¹⁵ The net concentration at each air sampler is converted to the annual EDE using Table 2 of Appendix E of 40 CFR 61 and applying the valid assumption that each table value is equivalent to 10 mrem/yr from all appropriate exposure pathways (100% occupancy assumed at the respective location).¹⁶ Dose assessment results from each air sampler are given in Table 10. The operational performance and analytical completeness of each air sampler is provided in Table 11.

In addition to ambient air sampling, the project reviewed one non-point tritium release from TA-16, in which legacy waste equipment was inventoried and processed for disposal. This resulted in a small release of tritium, approximately 10 millicuries. Since the off-site dose impact from this release is less than 0.01 mrem and the emission was measured by ambient air monitoring stations, we are not including this release with the radioactive gas releases in Table 9.

LANSCE Monthly Assessments

The Laboratory evaluates and reports the dose from short-lived radioactive gases released from LANSCE exhaust stack 53000702 on a monthly basis. This is so we can track and trend the emissions and identify any issues that need addressing throughout the year. The monthly dose values are calculated using actual meteorology for the month and the resulting doses are shown in Table 12. For 2010 the Laboratory also evaluated this stack's total gaseous emissions for the year in a single CAP88 run and compared the results to the monthly values summed for the calendar year. The sum of monthly doses resulted in a dose of 0.0284 mrem, while the annual total single analysis resulted in a total of 0.0384 mrem. The values differ by about 30%. This difference is due to the annual meteorological file including

windy spring season, while the monthly files (starting in June 2010) do not include this season. The southerly spring winds cause higher calculated doses at East Gate (directly north of LANSCE) but lower doses when evaluating other receptors to the west of LANSCE. This issue is made moot by using the maximum value of either the annual evaluation or the sum of the monthly doses for EPA reported doses.

All doses were evaluated at the East Gate receptor location initially; additional receptors were added in later. For later receptors (the LA Inn South Airnet station and 278 DP Road), annual runs were performed and compared with sum of monthly runs as well. The difference between the annual evaluation and the sum of the monthly evaluations was about 30% for these other receptors. In all cases, the maximum of either the annual GMAP run or the sum of monthly GMAP runs was used for reporting purposes at each analyzed receptor location.

Aside from these monthly GMAP runs from 53000702, all other CAP88 assessments are performed using annual source term and annual meteorological inputs. This decision reflects the year-round sampling for PVAP nuclides, while GMAP is only measured during beam operations. The summary of off-site dose analyses from the LANSCE facility is contained in Table 12.

Highest EDE Determination

For most of the recent past, the maximally exposed individual (MEI) location has been at 2470 East Road, usually referred to as "East Gate." The dose was mostly a result of LANSCE emissions. Emissions reduction efforts in place at LANSCE since 2005 have resulted in low off-site doses. Emissions were further reduced by improvements made in the new beam Target/Moderator/Reflector System (TMRS) that was installed in early 2010. Because the LANSCE emissions are so low in recent years, the location of the MEI is not as readily apparent as in the past and requires more detailed evaluation, as follows.

We know that the dose from LANSCE emissions is a significant contributor at its facility critical receptor location (East Gate), but much less so at other possible MEI locations. To evaluate different MEI locations, we start by determining the LANSCE at East Gate. We modeled all LANSCE facility emissions to the East Gate location with CAP88. This totaled 0.0699 mrem. To this we added the dose contribution from air concentrations measured at the East Gate Airnet station (0.021 mrem, see Table 10) for a rounded total of 0.091 mrem. This value is the point of comparison for examining the dose at other Airnet locations as reported in Table 10. Airnet station locations with measured doses that exceed this value are subject to further consideration. Airnet measurements are summed with doses from the LANSCE facility emissions, modeled with CAP88 to these alternate locations. Recall that locations must be a school, business, residence, or office to be considered for the MEI.

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Two Airnet stations with relatively higher doses at MEI locations close to LANSCE were considered. The first location is Airnet station 257, called the LA Inn South station, representing the southernmost building at 2201 Trinity Drive, the Los Alamos Lodge.* The second location is Airnet station 317, adjacent to the MDA-B remediation project, representing a receptor at 278 DP Road. The Airnet dose at the LA Inn location is 0.174 millirem and the dose at the DP Road location is 0.133 millirem for 2010. The LANSCE facility doses at these locations were 0.00404 mrem at LA Inn South and 0.00781 mrem at DP Road. The rounded sums of the Airnet measured dose and the LANSCE facility dose at each location were 0.178 mrem at the LA Inn South location and 0.141 mrem at the DP Road location. The dose of 0.178 mrem at the LA Inn South location was highest so it is the MEI location for 2010 operations. To this total, we add (1) the doses modeled by CAP88 dose from all other LANL facilities to this location and (2) the sum of all non-monitored stack potential emissions as modeled by CAP88 to the individual facility receptors for these non-monitored stacks. Details are in the next section and in Table 13.

It should be noted that there were certain cases where locations with elevated Airnet station measurements were not considered for the location of the MEI. For 2010, these included stations 169, 329, 330, and 331, all along the sections of DP Road north of the MDA-B remediation operations. In these cases, there are no public receptors (business, school, residence, or office) near these Airnet stations; other Airnet stations better represent the air concentrations to which members of the public are exposed. These stations are not considered for the MEI location. Details can be found on the map in Figure 4; measured doses are shown in Table 10.

61.92 Compliance Assessment

The highest EDE to any member of the public at any off-site point where there is a residence, school, or business was 0.33 mrem for radionuclides released by LANL in 2010. This dose was calculated by adding up (1) the dose contributions for each of the point sources at LANL, modeled to the MEI location; (2) the diffuse/fugitive gaseous activation products from LANSCE; (3) the dose measured by the ambient air sampler in the vicinity of the public receptor location; and (4) the potential dose contribution of 0.143 mrem from unmonitored stacks. Because the emissions estimates from unmonitored stacks do not account for pollution control systems, the actual dose will be significantly less

* After a change in ownership, the Los Alamos Inn was renamed the Los Alamos Lodge. The Airnet station name remains the same for consistency in tracking over the years.

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for these point sources. Table 13 of this report provides the compliance assessment summary, broken down by stack.

The location of the off-site point of highest EDE for 2010 is 2201 Trinity Drive, at the southernmost building of the Los Alamos Lodge complex. For simplicity, CAP88 analyses were made to Airnet Station 257, which is dubbed the “Los Alamos Inn South” Airnet station and adjacent to this MEI location. Modeling doses to this Airnet location will uniformly represent a cluster of buildings at this location on the south side of Trinity Drive.

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Figure 4. Locations of air sampling stations used for non-point source emissions compliance.

Section IV. Construction and Modifications

61.94(b)(8) Constructions, Modifications, and 61.96 Activity Relocations

A brief description of construction and modifications that were completed in 2010 for which the requirement to apply for approval to construct or modify was waived under 61.96 is listed below:

Gas Gun Experiments

A series of plate impact experiments on uranium powders and alloys using the gas guns at TA-39-69 were conducted in 2010. These experiments were previously conducted at the firing point at TA-39-56 and were relocated indoors to take advantage of additional capabilities of the gas guns. Radioactive materials have been used in TA-39-69 previously, but not in the past 10 years. These experiments represent an expansion of existing work.

Gases from these experiments are vented through a HEPA filter and exit the building from a non-monitored point approximately 10 feet (3 meters) above ground. Emissions were conservatively estimated based on the maximum operating scope, the Appendix D release fraction for particulates, and a release height of 3 meters. With these parameters, CAP88 calculated a worst case uncontrolled dose of less than $2\text{E-}7$ mrem/yr. Based on actual material usage in 2010, potential emissions from actual operations were estimated at $4\text{E-}9$ mrem/yr. Potential emissions from these experiments are tracked in the RMUS. These experiments will continue in 2011.

Soil Vapor Extraction Operations

The soil vapor extraction (SVE) pilot study at TA-54, MDA G, discussed in the 2008 LANL Radionuclide Air Emissions report, was expanded in 2010. LANL is continuing to evaluate the viability of this technique to remove Volatile Organic Compounds from the subsurface plume at TA-54. Due to the presence of tritium in the soil pore gas, this operation is tracked as a potential radiological emission source. Initial emissions estimates for the 2010 work were conservatively calculated based on the highest concentration of tritium found in the pore gas in the area, 100% release of all tritium, and a full year of continuous operation of the extraction unit. With these parameters, CAP88 calculated a worst-case uncontrolled dose of less than $4.2\text{E-}3$ mrem/yr. Actual SVE operation in 2010 took place continuously at TA-54, MDA G, from May 9 through May 28, for a total of 480 hours. Based on the 480 hours of actual

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operation, the potential dose for 2010 was $2.3\text{E-}4$ mrem. While there are no current plans to use SVE at the Laboratory in 2011, this operation could be used in the future.

TA-50 Cooling Towers for Evaporation

Two small cooling towers, normally used to cool potable water for facility equipment, were used to evaporate treated effluent from the TA-50-1 Radiological Liquid Waste Treatment Facility (RLWTF). This represented a first time use of radioactive materials at these towers. Initial emissions estimates for such use of the cooling towers assumed maximum potential quantity of treated effluent produced in a year, concentration of radionuclides at the highest allowable concentrations, and 100% radioactive material released. Based on these conservative assumptions, CAP 88 calculated a worst-case off-site dose of less than 0.05 mrem/yr. In 2010, between September and December, 157,261 gallons of treated effluent was evaporated from these towers. Based on the actual amount of radioactive material in this treated effluent, the potential off-dose for 2010 was $2\text{E-}5$ mrem.

While there are no current plans to use these cooling towers in this manner in 2011, they could be used this way in the future. Any future emissions from these cooling towers will be treated as a point source and emissions will be tracked through RMUS.

Section V. Additional Information

This section is provided pursuant to DOE guidance and is not required by Subpart H reporting requirements.

Unplanned Releases

During 2010, the only instances of increased airborne emissions of radionuclides at the Laboratory were those at MDA-B. Such instances were addressed according to the MDA-B emissions management plan and communicated to EPA Region 6. No other instances of elevated emissions required reporting to the EPA. There were no instances of an unplanned event.

Environmental Monitoring

In addition to the Airnet monitors identified in this report, additional environmental monitoring stations are operated at LANL and include several environmental monitoring stations located near the LANSCE boundary inhabited by the public. Measurement systems at these stations include

thermoluminescent dosimeters, continuously operated air samplers, and in-situ high-pressure ion chambers. The combination of these measurement systems allows for monitoring of radionuclide air concentrations and the radiation exposure rate. Results for air sampling associated with NESHAP compliance are included in this document, while results for all monitoring data are published in the Annual Environmental Surveillance Report for DOE Order compliance. This can be found on the web at the following URL: <http://www.lanl.gov/environment/air/reports.shtml>

Other Supplemental Information

The following information is included for completeness, but not directly required under 40 CFR 61 Subpart H regulations.

- 80-km collective effective (population) dose equivalent for 2010 airborne releases: 0.218 person-rem
- Compliance with Subparts Q and T of 40 CFR 61—Radon-222 Emissions
These regulations apply to ^{222}Rn emissions from DOE storage/disposal facilities that contain by-product material. “By-product material” is the tailings or wastes produced by the extraction or concentration of uranium from ore. Although this regulation targets uranium mills, LANL has likely stored small amounts of by-product material used in experiments in the TA-54 low-level waste facility, MDA G; this practice makes the Laboratory subject to this regulation. Subject facilities cannot exceed an emissions rate of $20 \text{ pCi/m}^2 \text{ s}$ of ^{222}Rn . In 1993 and 1994, LANL conducted a study to characterize emissions from the MDA G disposal site.¹⁷ This study showed an average emission rate of $0.14 \text{ pCi/m}^2 \text{ s}$ for MDA G. The performance assessment for MDA G has determined that there will not be a significant increase in ^{222}Rn emissions in the future.¹⁸
- Potential to exceed 0.1 mrem from LANL sources of ^{222}Rn or ^{220}Rn emissions: not applicable at LANL.
- Status of compliance with EPA effluent monitoring requirements as of June 3, 1996: LANL is in compliance with these requirements.

Table 1. 40-61.94(b)(4-5) Release Point Data

Stack ID	Location TA-Bldg	Effluent Controls	# of Effluent Controls*	Control Efficiency*	Monitored Stack?	Nearest Receptor (m)	Receptor Direction
03001600	TA-03-16	None	0	0%		968	N
03002913	TA-03-29-1	unknown	0	0%		859	NNE
03002914	TA-03-29-2	HEPA	2*	99.95% each*	X	733	NE
03002915	TA-03-29-2	HEPA	2*	99.95% each*	X	734	NE
03002919	TA-03-29-3	Aerosol 95	1	80%	X	838	NNE
03002920	TA-03-29-3	Aerosol 95	1	80%	X	837	NNE
03002923	TA-03-29-4	FARR 30/30	1	20%	X	618	NNW
03002924	TA-03-29-4	FARR 30/30	1	20%	X	618	NNW
03002928	TA-03-29-5	HEPA	2*	99.95% each*	X	938	NE
03002929	TA-03-29-5	HEPA	2*	99.95% each*	X	939	NE
03002932	TA-03-29-7	HEPA	2*	99.95% each*	X	858	NNE
03002933	TA-03-29-7	HEPA	2*	99.95% each*	X	857	NNE
03002937	TA-03-29-V	HEPA	2*	99.95% each*	X	872	NE
03002944	TA-03-29-9	RIGA-Flow	1	80%	X	939	NNE
03002945	TA-03-29-9	RIGA-Flow	1	80%	X	941	NNE
03002946	TA-03-29-9	RIGA-Flow	1	80%	X	940	NNE
03003299	TA-03-32	unknown	0	0%		641	NNE
03003400	TA-03-34	none	0	0%		668	NNE
03003501	TA-03-35	HEPA	1	99.95%		683	NNE
03006601	TA-03-66	none	0	0%		695	N
03006602	TA-03-66	none	0	0%		709	N
03006603	TA-03-66	none	0	0%		708	N
03006604	TA-03-66	none	0	0%		708	N
03006605	TA-03-66	none	0	0%		714	N
03006606	TA-03-66	none	0	0%		670	N
03006626	TA-03-66	HEPA	1	99.95%		618	N
03006654	TA-03-66	HEPA	1	99.95%		665	N
03006699	TA-03-66	none	0	0%		669	N
03010222	TA-03-102	HEPA	1	99.95%	X	792	N
03010225	TA-03-102	HEPA	1	99.95%		772	N
03169800	TA-03-1698	none	0	0%		717	NNE
09002103	TA-09-21	none	0	0%		3044	NE

Table 1 (Continued) Release Point Data

Stack ID	Location TA-Bldg	Effluent Controls	# of Effluent Controls	Control Efficiency*	Monitored Stack?	Nearest Receptor (m)	Receptor Direction
15053401	TA-15-534	HEPA	1	99.95%		3282	NNE
16020299	TA-16-202	unknown	0	0%		1185	S
16045005	TA-16-450	none	0	0%	X	772	S
21000507	TA-21-5	HEPA	2*	99.95%		611	N
21015001	TA-21-150	HEPA	1	99.95%		595	N
21015505	TA-21-155	CR/MS	1	>99%		680	NNW
21020901	TA-21-209	CR/MS	1	>99%		712	NNW
21025704	TA-21-257	none	0	0%		601	N
35000200	TA-35-2	none	0	0%		1294	NNW
35021305	TA-35-213	none	0	0%		1010	N
36000104	TA-36-1	unknown	0	0%		5379	SE
41000104	TA-41-1	HEPA	2*	99.95%		28	N
41000417	TA-41-4	none	0	0%		60	N
43000100	TA-43-1	none	0	0%		122	NNE
46002499	TA-46-24	none	0	0%		2887	N
46003100	TA-46-31	none	0	0%		2792	N
46004106	TA-46-41	none	0	0%		2890	N
46015405	TA-46-154	none	0	0%		2769	N
46015899	TA-46-158	none	0	0%		3053	N
46020099	TA-46-200	none	0	0%		2743	N
48000107	TA-48-1	HEPA/Charco	2*	99.95%	X	754	NNE
48000111	TA-48-1	none	0	0%		874	NNE
48000115	TA-48-1	none	0	0%		764	NNE
48000135	TA-48-1	none	0	0%		797	NNE
48000145	TA-48-1	none	0	0%		893	NNE
48000154	TA-48-1	HEPA	2*	99.95%	X	756	NNE
48000160	TA-48-1	HEPA	1	99.95%	X	769	NNE
48000166	TA-48-1	HEPA	2*	99.95%		867	NNE
48000167	TA-48-1	HEPA	2*	99.95%		897	NNE
48000168	TA-48-1	none	0	0%		874	NNE
48004500	TA-48-45	none	0	0%		742	N

Table 1 (Continued)

Stack ID	Location TA-Bldg	Effluent Controls	# of Effluent Controls	Control Efficiency*	Monitored Stack?	Nearest Receptor (m)	Receptor Direction
50000102	TA-50-1	HEPA	1	99.95% each*	X	1185	N
50000299	TA-50-2	none	0	0%		1215	N
50003701	TA-50-37	HEPA	2*	99.95% each*	X	1171	N
50006901	TA-50-69	HEPA	1	99.95%		1199	N
50006902	TA-50-69	HEPA	1	99.95%		1188	N
50006903	TA-50-69	HEPA	2*	99.95% each*	X	1187	N
50006999	TA-50-69	unknown	0	0%		1190	N
53000116	TA-53-1	unknown	0	0%		1443	ENE
53000303	TA-53-3	HEPA	1	99.95%	X	806	NNE
53000702	TA-53-7	HEPA	1	99.95%	X	957	NNE
53000799	TA-53-7	None	0	0%		926	NNE
53001599	TA-53-15	none	0	0%		1096	NNE
53001899	TA-53-18	none	0	0%		1019	NNE
53098401	TA-53-984	none	0	0%		1049	NE
53109099	TA-53-	none	0	0%		1009	NNE
54023199	TA-54-231	HEPA	1	99.95%	X	1480	SE
54028101	TA-54-281	HEPA	1	99.95%		1922	ESE
54041299	TA-54-412	HEPA	1	99.95%	X	1660	SE
54100199	TA-54-	none	0	0%		4999	ESE
54100999	TA-54-	none	0	0%		4781	ESE
55000201	TA-55-2	none	0	0%		1111	NNE
55000415	TA-55-4	HEPA	4*	99.95% each*	X	1018	NNE
55000416	TA-55-4	HEPA	4*	99.95% each*	X	1091	NNE
59000100	TA-59-1	none	0	0%		1104	N

Notes:

* As described in the main text, LANL only tests HEPA filter banks down to 0.0005 penetration & 99.95% removal.

This table reports the actual number of installed HEPA bank stages and nominal removal efficiencies, not tested efficiencies.

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Table 2. 40-61.94(b)(7) User Supplied Data—Radionuclide Emissions

StackID	Nuclide	Emission (Ci)	StackID	Nuclide	Emission (Ci)
03002914	Am-241	3.70E-09	03002928	Pu-239	1.51E-07
03002914	Pu-238	7.09E-08	03002928	Th-230	8.00E-09
03002914	Pu-239	1.06E-08	03002929	Am-241	7.43E-09
03002914	Th-228	8.52E-09	03002929	Pu-238	8.68E-09
03002915	Am-241	3.91E-09	03002929	Th-230	2.28E-08
03002915	Th-228	1.04E-08	03002932	Am-241	3.08E-09
03002915	U-234	5.06E-08	03002932	Th-230	3.98E-08
03002915	U-238	5.38E-08	03002932	U-234	6.57E-08
03002915	Pa-234m (p)	5.38E-08	03002933	Am-241	2.35E-09
03002915	Th-234 (p)	5.38E-08	03002933	Np-237	2.50E-07
03002919	Am-241	6.09E-07	03002933	Sr-90	8.85E-09
03002919	Pu-238	4.18E-07	03002933	Y-90 (p)	8.85E-09
03002919	Pu-239	2.92E-06	03002933	U-238	4.66E-08
03002919	Sr-90	1.47E-08	03002933	Pa-234m (p)	4.66E-08
03002919	Y-90 (p)	1.47E-08	03002933	Th-234 (p)	4.66E-08
03002919	Th-228	1.29E-08	03002937	Am-241	5.83E-11
03002919	Th-230	1.11E-08	03002937	Sr-90	2.08E-10
03002919	U-238	8.03E-08	03002937	Y-90 (p)	2.08E-10
03002919	Pa-234m (p)	8.03E-08	03002937	U-234	6.04E-10
03002919	Th-234 (p)	8.03E-08	03002944	Am-241	1.82E-08
03002920	Am-241	1.53E-09	03002944	Sr-90	2.18E-08
03002920	Pu-239	3.30E-09	03002944	Y-90 (p)	2.18E-08
03002920	Sr-90	2.80E-08	03002944	Th-228	2.78E-08
03002920	Y-90 (p)	2.80E-08	03002944	U-238	4.89E-08
03002920	Th-228	4.07E-08	03002944	Pa-234m (p)	4.89E-08
03002920	Th-230	9.75E-09	03002944	Th-234 (p)	4.89E-08
03002923	Pu-238	5.90E-09	03002945	Am-241	7.35E-09
03002923	Sr-90	5.22E-08	03002945	Th-228	1.04E-08
03002923	Y-90 (p)	5.22E-08	03002945	U-238	4.28E-08
03002923	Th-230	1.86E-08	03002945	Pa-234m (p)	4.28E-08
03002923	U-234	7.43E-07	03002945	Th-234 (p)	4.28E-08
03002923	U-238	4.33E-08	03002946	Am-241	9.82E-09
03002923	Pa-234m (p)	4.33E-08	03002946	Sr-90	1.92E-08
03002923	Th-234 (p)	4.33E-08	03002946	Y-90 (p)	1.92E-08
03002924	Am-241	4.40E-08	03002946	Th-228	2.16E-08
03002924	Pu-238	2.58E-06	03002946	Th-230	2.03E-08
03002924	Pu-239	7.93E-08	03010222	Pu-239	6.90E-11
03002924	Sr-90	2.64E-08	03010222	Th-228	3.32E-10
03002924	Y-90 (p)	2.64E-08	03010222	Th-230	1.88E-10
03002924	Th-228	2.43E-07	03010222	U-234	2.59E-09
03002924	Th-230	4.97E-09	03010222	U-238	8.88E-10
03002924	U-234	5.76E-06	03010222	Pa-234m (p)	8.88E-10
03002924	U-235	3.07E-08	03010222	Th-234 (p)	8.88E-10
03002928	Am-241	2.86E-08	16045005	H-3(Gas)	6.11E+00
03002928	Pu-238	1.59E-06	16045005	H-3(HTO)	4.17E+01

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StackID	Nuclide	Emission (Ci)
48000107	As-74	1.02E-06
48000107	Br-77	1.90E-04
48000107	Ge-68	5.02E-03
48000107	Ga-68 (p)	5.02E-03
48000107	Se-75	1.04E-04
48000154	Sr-90	2.36E-09
48000154	Y-90 (p)	2.36E-09
48000154	Th-228	1.81E-09
48000154	Th-230	1.08E-09
48000154	U-234	7.57E-09
48000160	As-73	6.02E-07
48000160	Br-77	2.55E-06
48000160	Ga-68 (p)	1.90E-05
48000160	Ge-68	1.90E-05
48000160	Hg-197 (p)	2.85E-05
48000160	Hg-197m	2.85E-05
48000160	Se-75	6.81E-08
50000102	Am-241	3.79E-09
50000102	Th-228	4.85E-08
50000102	U-238	7.91E-08
50000102	Pa-234m (p)	7.91E-08
50000102	Th-234 (p)	7.91E-08
50003701	None	-
50006903	Am-241	7.77E-11
50006903	Pu-238	1.20E-08
50006903	Pu-239	3.86E-10
50006903	Th-228	1.60E-10
50006903	Th-230	3.28E-10
50006903	U-238	9.89E-10
50006903	Pa-234m (p)	9.89E-10
50006903	Th-234 (p)	9.89E-10
53000303	Ar-41	2.18E+00
53000303	C-11	5.22E+01
53000303	H-3(HTO)	1.86E+01
53000303	Be-7	1.06E-03
53000303	Br-76	3.37E-06
53000303	Br-77	9.30E-06
53000303	Br-82	8.18E-05
53000303	Co-60	7.34E-08
53000303	Ge-68	1.99E-06
53000303	Ga-68 (p)	1.99E-06
53000303	Na-24	3.71E-04
53000303	V-48	2.97E-06
53000702	Ar-41	1.53E+01
53000702	C-10	3.79E-01
53000702	C-11	6.41E+01

StackID	Nuclide	Emission (Ci)
53000702	N-13	3.04E+01
53000702	N-16	5.75E-01
53000702	O-14	5.47E-01
53000702	O-15	4.54E+01
53000702	H-3(HTO)	4.79E+00
53000702	As-73	6.88E-06
53000702	Br-76	3.27E-04
53000702	Br-77	3.87E-05
53000702	Br-82	2.67E-03
53000702	Hg-197 (p)	5.25E-04
53000702	Hg-197m	5.25E-04
53000702	Na-24	1.47E-05
53000702	Os-191	5.07E-06
53000702	Se-75	1.82E-05
54023199	Am-241	2.00E-10
54023199	Sr-90	7.08E-10
54023199	Y-90 (p)	7.08E-10
54041299	Am-241	5.78E-11
54041299	Pu-239	3.43E-10
54041299	Th-228	5.99E-10
55000415	Am-241	5.42E-10
55000415	Pu-238	7.11E-10
55000415	Pu-239	8.00E-10
55000415	Th-228	8.31E-09
55000415	U-234	1.29E-08
55000415	U-238	8.73E-09
55000415	Pa-234m (p)	8.73E-09
55000415	Th-234 (p)	8.73E-09
55000416	Am-241	1.51E-09
55000416	H-3(Gas)	9.94E+00
55000416	H-3(HTO)	6.22E+00
55000416	Pu-239	3.37E-10
55000416	Sr-90	1.34E-09
55000416	Y-90 (p)	1.34E-09
55000416	Th-228	1.16E-08
55000416	Th-230	2.68E-09
55000416	U-238	1.55E-08
55000416	Pa-234m (p)	1.55E-08
55000416	Th-234 (p)	1.55E-08

Non-Point (Diffuse) Sources		
53DIF1LS	Ar-41	3.20E-01
53DIF1LS	C-11	7.79E+00
53DIF3SY	Ar-41	4.90E-01
53DIF3SY	C-11	1.19E+01

See notes next page

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Table 2

Notes: Stacks at the Chemistry & Metallurgy Research (CMR) facility identified as 03002914 through 03002933 are recorded in the RADAIR database as N3002914 through N3002933, to indicate measurements made with the New sampling systems, effective 2001.

Starting in 2006, particulate emissions from TA-55 stacks 55000415 and 55000416 are measured from new sample systems, which consist of four independent sample systems on each stack. The four samplers are identified as 5500415A, -B, -C, and -D; and 5500416A, -B, -C, and -D. Stack emissions data reported in this table represent average emission values measured from these four samplers. In the RADAIR database, these average emissions are given the stack ID 5500415X and 5500416X, with the "X" indicating the calculated average value from the four samples. The emissions of tritium (H-3, both HT and HTO forms) from the ES-16 stack use a different sample system, and references remain unchanged in the database.

Radionuclides with the designator "(p)" are short-lived progeny in secular equilibrium with their parent radionuclide; e.g., Ga-68 (progeny) is in equilibrium with Ge-68 (parent).

The term "None" in the Nuclide column indicates that there were no detectable emissions from this source in 2010.

The non-point source at TA-18, designated StackID 18DIFFUS, is no longer reported. Criticality operations at TA-18 have not taken place for several years, and that capability no longer exists at TA-18.

Non-point emissions sources 53DIF3SY and 53DIF1LS are separated from the main source term table because they are addressed in different sections of the annual emissions report.

Stack 16045005 (ES-5) exhausts buildings TA-16-450 and TA-16-205. The ES-5 stack sampler was not operational, so reported emissions are measured by the 16020504 duct sampler. That sampler captures all emissions from the facility, as 16-450 operations have not commenced. A full explanation is in Attachment B.

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Table 3. 40-61.94(b)(7) User-Supplied Data—Monitored Stack Parameters

StackID	Height (m)	Diameter (m)	Exit Velocity (m/s)	Nearest Meteorological Tower
03002914	15.9	1.07	12.08	TA-6
03002915	15.9	1.05	10.59	TA-6
03002919	15.9	1.07	14.96	TA-6
03002920	15.9	1.07	24.17	TA-6
03002923	15.9	1.07	16.99	TA-6
03002924	15.9	1.06	19.18	TA-6
03002928	15.9	1.05	21.50	TA-6
03002929	15.9	1.07	24.19	TA-6
03002932	15.9	1.07	17.79	TA-6
03002933	15.9	1.06	25.87	TA-6
03002937	16.8	0.20	4.51	TA-6
03002944	16.5	1.52	9.02	TA-6
03002945	16.5	1.52	6.72	TA-6
03002946	16.5	1.88	6.33	TA-6
03010222	13.4	0.91	0.42	TA-6
16045005	18.3	1.18	15.64	TA-6
48000107	13.4	0.30	20.60	TA-6
48000154	13.1	0.91	5.20	TA-6
48000160	12.4	0.38	11.90	TA-6
50000102	15.5	1.82	11.87	TA-6
50003701	12.4	0.91	5.83	TA-6
50006903	10.5	0.31	7.37	TA-6
53000303	33.5	0.91	8.00	TA-53
53000702	13.1	0.91	8.14	TA-53
540023199	0.61	0.61	0 vertical 6.4 horizontal	TA-54
540041299	0.61	0.61	0 vertical 4.2 horizontal	TA-54
55000415	9.5	0.93	7.80	TA-6
55000416	9.5	0.94	10.45	TA-6

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**Table 4. 61.94(b)(7) User-Supplied Data—Monitored Stack Parameters—
NM State Plane Coordinates (NAD '83)**

StackID	Easting	Northing
03002914	1,619,176	1,772,806
03002915	1,619,171	1,772,805
03002919	1,619,252	1,772,350
03002920	1,619,257	1,772,352
03002923	1,618,691	1,772,719
03002924	1,618,686	1,772,718
03002928	1,618,774	1,772,265
03002929	1,618,767	1,772,265
03002932	1,619,268	1,772,267
03002933	1,619,272	1,772,269
03002937	1,618,966	1,772,397
03002944	1,618,987	1,772,121
03002945	1,618,977	1,772,120
03002946	1,618,982	1,772,121
03010222	1,618,354	1,772,074
16045005	1,609,426	1,760,910
48000107	1,623,591	1,770,693
48000154	1,623,744	1,770,650
48000160	1,623,613	1,770,638
50000102	1,626,157	1,769,086
50003701	1,625,757	1,769,111
50006903	1,625,579	1,769,065
53000303	1,638,133	1,771,546
53000702	1,638,057	1,771,054
54023199	1,644,758	1,757,255
54041299	1,644,568	1,757,946
55000415	1,624,870	1,769,742
55000416	1,624,675	1,769,550

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**Table 5. 40-61.94(b)(7) User-Supplied Data—Highest Off-Site Dose
Location for Monitored Release Points**

StackID	Associated Meteorological Tower	Distance to LANL Highest Dose Location (m)	Direction to LANL Highest Dose Location
03002914	TA-06	1,718	ENE
03002915	TA-06	1,720	ENE
03002919	TA-06	1,759	ENE
03002920	TA-06	1,757	ENE
03002923	TA-06	1,864	ENE
03002924	TA-06	1,866	ENE
03002928	TA-06	1,900	ENE
03002929	TA-06	1,902	ENE
03002932	TA-06	1,767	ENE
03002933	TA-06	1,765	ENE
03002937	TA-06	1,829	ENE
03002944	TA-06	1,863	ENE
03002945	TA-06	1,866	ENE
03002946	TA-06	1,865	ENE
03010222	TA-06	2,040	ENE
16045005	TA-06	6,272	NE
48000107	TA-06	1,363	N
48000154	TA-06	1,369	N
48000160	TA-06	1,379	N
50000102	TA-06	1,918	NNW
50003701	TA-06	1,879	NNW
50006903	TA-06	1,880	NNW
53000303	TA-53	4,347	WNW
53000702	TA-53	4,365	WNW
54023199	TA-54	8,270	NW
54041299	TA-54	8,089	NW
55000415	TA-06	1,643	N
55000416	TA-06	1,697	N

Table 6. 40-61.94(b)(7) User-Supplied Data—Other Input Parameters

Description	Value	Units	CAP88 Variable Name (source code/V0 identifiers)
Annual rainfall rate	45	cm/y	RR
Lid height	1600	m	LIPO
Annual ambient temperature	9	deg C	TA
Absolute humidity	5.5	g/m ³	
E-vertical temperature gradient	0.02	K/m	TG
F-vertical temperature gradient	0.035	K/m	TG
G-vertical temperature gradient	0.035	K/m	TG
Food supply fraction - local vegetables	1		F1V
Food supply fraction - vegetable regional	0		F2V
Food supply fraction - vegetable imported	0		F3V
Food supply fraction - meat local	1		F1B
Food supply fraction - meat regional	0		F2B
Food supply fraction - meat imported	0		F3B
Food supply fraction - milk local	1		F1M
Food supply fraction - milk regional	0		F2M
Food supply fraction - milk imported	0		F3M
Ground surface roughness factor	0.5		GSCFAC

Table 7: 40-61.94(b)(7) User-Supplied Data—Wind Frequency Arrays

Due to the extent of data reported in Table 7, this table has been moved to Appendix 1.

Table 8. 40-61.94(b)(7) User-Supplied Data—Population Array
Estimated 2002 Population within 80 km of Los Alamos National Laboratory (revised 2006)

Direction	Distances from LANSCE stack 53000702 (distances in kilometers)												
	0.0-0.8	0.8-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-10	10-20	20-30	30-40	40-50	50-60	60-80
N	0	0	0	157	184	183	0	15	96	1007	0	884	600
NNW	0	0	0	566	276	397	50	7	21	272	0	0	494
NW	0	0	0	312	647	786	1336	2	25	52	768	0	1078
WNW	0	0	0	38	959	1047	5063	0	33	38	0	0	3091
W	0	0	0	0	161	169	15	9	78	376	0	88	168
WSW	0	0	0	0	0	0	2	9	46	455	0	3054	0
SW	0	0	0	0	0	0	5	3	0	0	0	2591	0
SSW	0	0	0	0	0	0	36	4	1154	1563	3708	3000	65504
S	0	0	0	0	0	0	20	6	20	179	0	0	3960
SSE	0	0	0	0	0	0	765	46	365	6118	2990	0	0
SE	0	0	0	0	0	0	5764	1	1184	79362	8866	196	6
ESE	0	0	0	0	0	0	36	13	780	9397	0	721	2430
E	0	0	0	0	0	0	3	1720	4493	459	528	1	598
ENE	0	0	0	0	0	0	0	2336	4868	3878	174	1013	1752
NE	0	0	11	0	0	0	0	1229	15964	2692	1500	1494	3527
NNE	0	1	22	0	0	0	0	14	2562	448	3258	0	58

Table 9. 40-61.94(b)(7) User-Supplied Data—Modeling Parameters
for LANL Non-Point Sources

Source	Radionuclide	Emission (Ci)	Area of Source (m ³)	Distance to LANL Maximum Dose Location (m)	Direction to LANL Maximum Dose Location
TA-53 Beam Switchyard	⁴¹ Ar	4.90E-01	484	4,299	WNW
StackID = 53DIF3SY	¹¹ C	1.19E+01	484	4,299	WNW
TA-53-1L Service Area	⁴¹ Ar	3.20E-01	1.0	4,351	WNW
Stack ID = 53DIF1LS	¹¹ C	7.79E+00	1.0	4,351	WNW

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Table 10. Environmental Data—Compliance Stations

2010 Effective Dose Equivalent measured at air sampling locations around LANL (net millirem)										
New Site ID	Old Site ID	Site Name	H-3	Am-241	Pu-238	Pu-239	U-234	U-235	U-238	Total (mrem)
114	9	LA Airport Terminal Bldg	0.002	0.005	0.003	0.072	0.004	0.000	0.003	0.090
119	13	Rocket Park	0.001	0.013	-0.006	-0.002	0.002	0.001	0.002	0.011
121	14	Pajarito Acres	0.004	0.006	-0.001	-0.001	0.002	0.001	0.000	0.009
133	17	Bandelier Fire Lookout	-0.001	0.003	-0.004	-0.001	0.004	0.001	0.002	0.004
137	11	Well PM-1	-0.002	0.006	-0.004	-0.003	0.004	0.000	0.002	0.002
149	6	48th Street	0.001	0.002	-0.005	-0.002	0.000	0.001	0.005	0.003
151	12	Royal Crest Trailer Court	0.001	0.003	0.002	-0.001	0.002	0.001	0.004	0.012
157	10	Eastgate	0.006	0.004	0.002	-0.001	0.005	0.000	0.006	0.021
166	8	McDonalds	0.003	0.003	0.001	0.004	0.006	0.001	0.004	0.022
167	15	White Rock Fire Station	0.001	0.006	-0.001	-0.001	0.005	0.001	0.005	0.015
168	16	WR Nazarene Church	0.000	0.014	-0.004	-0.005	0.000	0.001	0.002	0.008
169	20	TA-21 Area B	0.009	0.011	0.012	0.059	0.023	0.003	0.021	0.137
172	32	LA County Landfill	0.000	0.005	0.008	0.001	0.032	0.003	0.032	0.080
206	90	Eastgate - Backup	0.001	0.006	0.000	-0.002	0.004	0.000	0.007	0.016
210	60	LA Canyon	0.000	0.001	0.000	0.005	0.003	0.001	0.003	0.012
211	61	Los Alamos Medical Center	0.000	0.002	0.000	-0.002	0.004	0.000	0.004	0.007
212	62	Crossroads Bible Church	0.007	0.003	0.003	0.005	0.013	0.001	0.013	0.046
213	63	Monte Rey South	-0.001	0.006	-0.006	-0.002	0.003	0.002	0.002	0.002
257	66	Los Alamos Inn - South	0.001	0.004	0.001	0.159	0.004	0.001	0.003	0.174
262	67	TA-3 Research Park	0.005	0.002	-0.001	-0.001	0.005	0.000	0.009	0.018
290	68	Los Alamos Airport Road	0.000	0.006	-0.001	0.011	0.008	0.001	0.006	0.032
291	18	DP Rd - West Entrance	0.003	0.007	0.002	0.035	0.023	0.002	0.020	0.092
307	24	TA-16	0.001	0.011	-0.002	0.008	0.002	0.002	0.002	0.023
317	42	A15 - West End	0.005	0.003	0.003	0.088	0.019	0.002	0.013	0.133
318	43	East Road Fire Station	0.002	0.002	-0.001	0.017	0.008	0.002	0.011	0.041
319	44	New Beginnings Church	0.002	0.008	0.003	0.007	0.015	0.001	0.015	0.051
320	46	HedgeRow East Rd.	-0.004	0.006	0.000	0.012	0.010	0.001	0.011	0.035
326	71	DP - Fire Station	0.002	0.004	0.002	0.047	0.021	0.003	0.019	0.097
327	72	DP - Ace	0.003	0.004	0.003	0.043	0.014	0.001	0.011	0.080
328	73	DP - Monitor	0.006	0.002	0.002	0.040	0.020	0.002	0.020	0.092
329	74	A15 - West Center	0.029	0.003	0.008	0.893	0.032	0.002	0.021	0.988
330	75	A15 - East Center	0.021	0.005	0.005	0.678	0.032	0.002	0.017	0.759
331	79	A15 - East End	0.009	0.006	0.015	0.104	0.031	0.002	0.027	0.194
344	19	Hilltop House	-0.002	0.007	0.001	0.007	0.016	0.002	0.016	0.047
345	21	Canyon School	-0.001	0.005	0.000	0.003	0.012	0.001	0.006	0.027
347	28	Airport Hangers	0.002	0.010	0.003	0.008	0.006	0.000	0.004	0.032
348	29	State Rd 502/Mid-Runway	0.004	0.021	0.000	0.003	0.008	0.001	0.006	0.043
Note 1: For cross-reference, both the three-digit "Master Site ID" (used since 2009) and older two-digit station ID are shown.										
Note 2: Stations 317 and 257 are reviewed further in the section on "Highest EDE Determination," above. Stations 169, 329, 330, and 331 are along DP Road in areas where there is no public receptor location; these stations are not considered for the MEI.										

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Table 11. Environmental Data—Compliance Stations

2010 Analytical Completeness and Air Sampler Operation Summary										
New Site ID	Old Site ID	Site Name	H-3	Am-241	Pu-238	Pu-239	U-234	U-235	U-238	Percent run time
114	9	LA Airport Terminal Bldg	99.5	100	100	100	100	100	100	100
119	13	Rocket Park	99.5	100	100	100	100	100	100	100
121	14	Pajarito Acres	99.4	100	100	100	100	100	100	100
133	17	Bandelier Fire Lookout	99.1	100	100	100	100	100	100	100
137	11	Well PM-1	99.6	100	100	100	100	100	100	100
149	6	48th Street	99.5	100	100	100	100	100	100	100
151	12	Royal Crest Trailer Court	99.6	100	100	100	100	100	100	100
157	10	Eastgate	99.4	100	100	100	100	100	100	100
166	8	McDonalds	98.6	100	96.2	100	100	100	100	100
167	15	White Rock Fire Station	99.6	100	100	100	100	100	100	100
168	16	WR Nazarene Church	99.5	100	100	100	100	100	100	100
169	20	TA-21 Area B	99.0	100	96.2	100	100	100	100	100
172	32	LA County Landfill	98.9	100	100	100	100	100	100	100
206	90	Eastgate - Backup	98.7	100	100	100	100	100	100	100
210	60	LA Canyon	99.6	100	100	100	100	100	100	100
211	61	Los Alamos Medical Center	99.0	100	100	100	100	100	100	100
212	62	Crossroads Bible Church	99.5	100	100	100	100	100	100	100
213	63	Monte Rey South	98.6	100	100	100	100	100	100	100
257	66	Los Alamos Inn - South	99.6	100	100	100	100	100	100	100
262	67	TA-3 Research Park	99.5	100	92.3	100	100	100	100	100
290	68	Los Alamos Airport Road	99.6	100	100	100	100	100	100	100
291	18	DP Rd - West Entrance	99.5	100	100	100	100	100	100	100
307	24	TA-16	99.5	100	100	100	100	100	100	100
317	42	A15 - West End	99.5	100	100	100	100	100	100	100
318	43	East Road Fire Station	100	100	100	100	100	100	100	100
319	44	New Beginnings Church	95.3	100	100	100	100	100	100	100
320	46	HedgeRow East Rd.	99.6	100	100	100	100	100	100	100
326	71	DP - Fire Station	99.6	100	100	100	100	100	100	100
327	72	DP - Ace	99.5	100	100	100	100	100	100	100
328	73	DP - Monitor	99.5	100	100	100	100	100	100	100
329	74	A15 - West Center	99.4	100	100	100	100	100	100	100
330	75	A15 - East Center	99.6	100	100	100	100	100	100	100
331	79	A15 - East End	99.5	100	100	100	100	100	100	100
344	19	Hilltop House	99.5	100	100	100	100	100	100	100
345	21	Canyon School	99.5	100	100	100	100	100	100	100
347	28	Airport Hangers	96.7	100	100	100	100	100	100	100
348	29	State Rd 502/Mid-Runway	99.5	100	100	100	100	100	100	100
Average Analytical Completeness			99.2% for tritium H-3			99.9% for particulate nuclides				

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Table 12. LANSCE Monthly Assessments, Comparison with Annual Analyses, and Facility Dose Summary

Description	StackID	Dose at East Gate Receptor	Dose at LA Inn South Receptor	Dose at 278 DP Road Receptor
LANSCE stack January GMAP	53000702	None	None	None
LANSCE stack February GMAP	53000702	None	None	None
LANSCE stack March GMAP	53000702	None	None	None
LANSCE stack April GMAP	53000702	None	None	None
LANSCE stack May GMAP	53000702	None	None	None
LANSCE stack June GMAP	53000702	2.13E-03	1.67E-04	3.18E-04
LANSCE stack July GMAP	53000702	4.35E-03	2.53E-04	5.01E-04
LANSCE stack August GMAP	53000702	4.23E-03	3.47E-04	6.74E-04
LANSCE stack September GMAP	53000702	3.51E-03	2.77E-04	5.46E-04
LANSCE stack October GMAP	53000702	4.61E-03	3.09E-04	6.17E-04
LANSCE stack November GMAP	53000702	4.03E-03	6.30E-04	1.20E-03
LANSCE stack December GMAP	53000702	5.51E-03	4.82E-04	9.20E-04
Sum of monthly GMAP runs for this stack	53000702	2.84E-02	2.47E-03	4.78E-03

GMAP single annual analysis for this stack	53000702	3.84E-02	1.87E-03	3.60E-03
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Difference, sum of monthly vs. annual analyses: 30.0% 27.5% 28.1%

To be conservative, the **maximum value** of the two above methods will be used for all further reporting of GMAP emissions from the main LANSCE stack 53000702. Values are highlighted above for each receptor location.

SUMMARY OF LANSCE FACILITY DOSE		Receptor Location.....		
		East Gate	LA Inn	278 DP Rd
LANSCE stack GMAP	53000303	8.72E-03	6.19E-04	1.12E-03
LANSCE stack PVAP	53000303	5.50E-03	3.90E-04	7.05E-04
LANSCE Non-CAP88 Radionuclides	53000303	0.00E+00	0.00E+00	0.00E+00
LANSCE stack GMAP (see above)	53000702	3.84E-02	2.47E-03	4.78E-03
LANSCE stack PVAP	53000702	3.04E-03	1.49E-04	2.85E-04
LANSCE Non-CAP88 Radionuclides	53000702	5.78E-06	2.82E-07	1.70E-05
LANSCE Diffuse/Fugitive Emissions – Beam Switchyard	53DIF3SY	9.77E-03	2.56E-04	5.58E-04
LANSCE Diffuse/Fugitive Emissions – 1L Service Area	53DIF1LS	4.43E-03	1.65E-04	3.47E-04

2010 LANSCE facility summary: 6.99E-02 4.04E-03 7.81E-03

GMAP = Gaseous Mixed Activation products; short-lived radioactive gases (e.g., C-11, O-15, Ar-41).
PVAP = Particulate & Vapor Activation Products (e.g., Na-24, Br-76).
Note: All CAP88 analyses above are annual assessments, with the exception of the monthly GMAP analyses for stack 53000702, as described.
Note: For completeness, the "Summary" portion of this table is reproduced in Table 13, next page, for both the East Gate receptor and the LA Inn South receptor.

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**Table 13. 40-61.92 Highest Effective Dose Equivalent Summary
All LANL Sources**

Description	StackID	Dose for Release Site Receptor	Dose at LA Inn South Receptor
CMR Stack – Wing 2	03002914	8.97E-06	3.94E-06
CMR Stack – Wing 2	03002915	1.96E-06	8.67E-07
CMR Stack – Wing 3	03002919	3.63E-04	1.62E-04
CMR Stack – Wing 3	03002920	3.24E-06	1.30E-06
CMR Stack – Wing 4	03002923	4.27E-06	2.54E-06
CMR Stack – Wing 4	03002924	1.87E-04	1.12E-04
CMR Stack – Wing 5	03002928	1.13E-04	5.50E-05
CMR Stack – Wing 5	03002929	1.32E-06	6.25E-07
CMR Stack – Wing 7	03002932	1.58E-06	6.99E-07
CMR Stack – Wing 7	03002933	9.21E-06	3.71E-06
CMR Stack – Vault	03002937	0.00E+00	0.00E+00
CMR Stack – Wing 9	03002944	3.24E-06	1.61E-06
CMR Stack – Wing 9	03002945	1.43E-06	7.34E-07
CMR Stack – Wing 9	03002946	2.57E-06	1.30E-06
Shops Addition Stack	03010222	1.91E-08	9.05E-09
WETF Stack – new	16045005	7.62E-03	1.57E-03
Radiochemistry Stack	48000107	1.14E-02	3.70E-03
Radiochemistry /non-CAP88 nuclides	48000107	None	None
Radiochemistry Stack	48000154	3.16E-07	9.77E-08
Radiochemistry Stack	48000160	4.55E-05	1.47E-05
Waste Management Stack	50000102	1.76E-06	6.46E-07
Waste Management Stack	50003701	none	none
Waste Management Stack	50006903	6.56E-07	2.20E-07
LANSCe-Stack – GMAP	53000303	8.72E-03	6.19E-04
LANSCe- Annual – Partic/Vapor	53000303	5.50E-03	3.90E-04
LANSCe Non-CAP88 radionuclides	53000303	0.00E+00	0.00E+00
LANSCe-Stack – GMAP (See Note below)	53000702	3.84E-02	2.47E-03
LANSCe- Annual – Partic/Vapor	53000702	3.04E-03	1.49E-04
LANSCe Non-CAP88 radionuclides	53000702	5.78E-06	2.82E-07
LANSCe Fugitive - Beam Switch Yard	53DIF3SY	9.77E-03	2.56E-04
LANSCe Fugitive - 1L Service Area	53DIF1LS	4.43E-03	1.65E-04
Waste Processing Stack	54023199	0.00E+00	0.00E+00
Waste Processing Stack	54041299	0.00E+00	0.00E+00
Plutonium Facility Stack	55000415	7.61E-07	2.67E-07
Plutonium Facility Stack	55000416	4.63E-03	1.73E-03
Unmonitored Stacks - No credit for controls	99000000	1.43E-01	1.43E-01
Air Sampler Net Dose @ this location	99000010	N/A	1.74E-01
Total maximally exposed individual dose (mrem)			0.328
Rounded total for reporting purposes (mrem)			0.33
Note 1: As described in Table 12, the reporting value for GMAP emissions from 53000702 is the maximum value of either the annual GMAP dose assessment or the sum of monthly GMAP dose assessments. Data for TA-53 stacks here is reproduced from Table 12.			

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61.94(b)(9) 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.

Signature: <signature on file> Date: 6/21/2011
Kevin W. Smith, Owner
Manager
Los Alamos Site Office
National Nuclear Security Administration
U.S. Department of Energy

Signature: <signature on file> Date: 6/20/2011
J. Chris Cantwell, Operator
Associate Director
Environment, Safety, Health and Quality Division
Los Alamos National Security, LLC
Los Alamos National Laboratory

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Appendix 1 – Meteorology Data

Due to the extent of data reported in Table 7, that table has been moved to this appendix.

Table 7: 40-61.94(b)(7) User-Supplied Data—Wind Frequency Arrays

Table 7a: CAP88 Input Data for 2010 TA-6 Meteorological Tower
(98.3% Data Completeness)

N	A	0.000640.000200.000000.000000.000000.000000
NNE	A	0.000780.000200.000030.000000.000000.000000
NE	A	0.001220.000320.000000.000000.000000.000000
ENE	A	0.002000.000550.000000.000000.000000.000000
E	A	0.002180.000670.000000.000000.000000.000000
ESE	A	0.002030.000730.000000.000000.000000.000000
SE	A	0.001420.000900.000000.000000.000000.000000
SSE	A	0.001250.000900.000000.000000.000000.000000
S	A	0.001040.000670.000000.000000.000000.000000
SSW	A	0.000700.000170.000000.000000.000000.000000
SW	A	0.000580.000320.000000.000000.000000.000000
WSW	A	0.000320.000150.000000.000000.000000.000000
W	A	0.000290.000230.000000.000000.000000.000000
WNW	A	0.000290.000170.000000.000000.000000.000000
NW	A	0.000460.000260.000060.000000.000000.000000
NNW	A	0.000350.000290.000000.000000.000000.000000
N	B	0.000230.000090.000000.000000.000000.000000
NNE	B	0.000350.000170.000000.000000.000000.000000
NE	B	0.000580.000460.000000.000000.000000.000000
ENE	B	0.000870.000810.000000.000000.000000.000000
E	B	0.001070.001020.000000.000000.000000.000000
ESE	B	0.001100.001510.000000.000000.000000.000000
SE	B	0.000930.001940.000000.000000.000000.000000
SSE	B	0.000610.001540.000000.000000.000000.000000
S	B	0.000380.001310.000000.000000.000000.000000
SSW	B	0.000120.000440.000000.000000.000000.000000
SW	B	0.000090.000320.000030.000000.000000.000000
WSW	B	0.000120.000200.000000.000000.000000.000000
W	B	0.000030.000170.000030.000000.000000.000000
WNW	B	0.000060.000090.000060.000000.000000.000000
NW	B	0.000090.000090.000150.000000.000000.000000
NNW	B	0.000120.000170.000030.000000.000000.000000
N	C	0.000230.000520.000030.000000.000000.000000
NNE	C	0.000520.000870.000000.000000.000000.000000
NE	C	0.000780.001600.000120.000000.000000.000000
ENE	C	0.002090.002670.000060.000000.000000.000000
E	C	0.002610.003890.000000.000000.000000.000000
ESE	C	0.001420.004320.000030.000000.000000.000000
SE	C	0.001540.006040.000060.000000.000000.000000
SSE	C	0.000810.007400.000350.000000.000000.000000
S	C	0.000640.005570.001310.000000.000000.000000
SSW	C	0.000410.002320.000840.000030.000000.000000
SW	C	0.000120.001310.000150.000000.000000.000000
WSW	C	0.000170.000670.000350.000000.000000.000000
W	C	0.000090.000610.000490.000030.000000.000000
WNW	C	0.000030.000520.000260.000000.000000.000000
NW	C	0.000200.000610.000440.000000.000000.000000
NNW	C	0.000060.000670.000090.000030.000000.000000
N	D	0.004560.005920.003020.000990.000060.00003

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Table 7a (continued)

NNE	D	0.004620.009140.005370.001540.000030.00000
NE	D	0.005810.010420.004090.000550.000000.00000
ENE	D	0.006330.008360.000960.000000.000000.00000
E	D	0.008130.008770.000520.000000.000000.00000
ESE	D	0.004670.009690.000640.000030.000000.00000
SE	D	0.004700.013670.002870.000030.000000.00000
SSE	D	0.004300.020780.016430.001740.000060.00000
S	D	0.004410.025170.036280.009000.000460.00003
SSW	D	0.005110.015790.024880.009960.002030.00015
SW	D	0.004410.011000.017150.011700.002380.00015
WSW	D	0.003690.008800.012080.011440.002350.00015
W	D	0.003340.008500.012680.011350.003340.00023
WNW	D	0.003250.008070.012970.009090.003980.00110
NW	D	0.003600.008880.012510.005170.001540.00110
NNW	D	0.004030.007200.004560.000930.000030.00000
N	E	0.000900.003110.001480.000000.000000.00000
NNE	E	0.001130.002960.001510.000000.000000.00000
NE	E	0.000580.001540.000380.000000.000000.00000
ENE	E	0.000520.000840.000090.000000.000000.00000
E	E	0.000580.000750.000000.000000.000000.00000
ESE	E	0.000610.000840.000090.000000.000000.00000
SE	E	0.000670.000960.000120.000000.000000.00000
SSE	E	0.001070.001860.000230.000000.000000.00000
S	E	0.000870.006410.001480.000000.000000.00000
SSW	E	0.001160.012570.003340.000000.000000.00000
SW	E	0.001360.009030.009430.000000.000000.00000
WSW	E	0.001190.003080.005220.000000.000000.00000
W	E	0.000900.002350.002210.000000.000000.00000
WNW	E	0.000840.003450.003190.000000.000000.00000
NW	E	0.000870.005780.008010.000000.000000.00000
NNW	E	0.001040.002700.001340.000000.000000.00000
N	F	0.007400.009200.000440.000000.000000.00000
NNE	F	0.004730.003400.000060.000000.000000.00000
NE	F	0.002960.000990.000000.000000.000000.00000
ENE	F	0.001770.000460.000000.000000.000000.00000
E	F	0.001510.000260.000000.000000.000000.00000
ESE	F	0.001770.000350.000000.000000.000000.00000
SE	F	0.001650.000960.000000.000000.000000.00000
SSE	F	0.002840.000840.000000.000000.000000.00000
S	F	0.002580.002380.000030.000000.000000.00000
SSW	F	0.004990.005780.000060.000000.000000.00000
SW	F	0.007550.016430.001360.000000.000000.00000
WSW	F	0.009720.028740.007400.000000.000000.00000
W	F	0.009960.031870.005080.000000.000000.00000
WNW	F	0.009060.024320.003890.000000.000000.00000
NW	F	0.009140.027980.002550.000000.000000.00000
NNW	F	0.009640.016280.000440.000000.000000.00000

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Table 7 (continued)

Table 7b: CAP88 Input Data for 2010 TA-53 Meteorological Tower
(100.0% Data Completeness)

N	A	0.000940.000230.000000.000000.000000.000000
NNE	A	0.001830.000510.000000.000000.000000.000000
NE	A	0.003050.000940.000000.000000.000000.000000
ENE	A	0.003800.001460.000000.000000.000000.000000
E	A	0.004140.002400.000000.000000.000000.000000
ESE	A	0.002450.001860.000000.000000.000000.000000
SE	A	0.002630.002170.000000.000000.000000.000000
SSE	A	0.002110.002000.000000.000000.000000.000000
S	A	0.001110.001340.000000.000000.000000.000000
SSW	A	0.000800.000600.000000.000000.000000.000000
SW	A	0.000430.000510.000000.000000.000000.000000
WSW	A	0.000370.000340.000000.000000.000000.000000
W	A	0.000200.000370.000000.000000.000000.000000
WNW	A	0.000140.000260.000000.000000.000000.000000
NW	A	0.000200.000260.000000.000000.000000.000000
NNW	A	0.000540.000140.000000.000000.000000.000000
N	B	0.000200.000290.000030.000000.000000.000000
NNE	B	0.000310.000540.000030.000000.000000.000000
NE	B	0.001000.001260.000000.000000.000000.000000
ENE	B	0.001540.002680.000030.000000.000000.000000
E	B	0.001230.002940.000000.000000.000000.000000
ESE	B	0.000660.002080.000000.000000.000000.000000
SE	B	0.000630.002230.000000.000000.000000.000000
SSE	B	0.000540.002280.000000.000000.000000.000000
S	B	0.000310.001770.000030.000000.000000.000000
SSW	B	0.000140.000800.000030.000000.000000.000000
SW	B	0.000200.000510.000000.000000.000000.000000
WSW	B	0.000060.000140.000000.000000.000000.000000
W	B	0.000060.000140.000000.000000.000000.000000
WNW	B	0.000000.000140.000000.000000.000000.000000
NW	B	0.000170.000140.000060.000000.000000.000000
NNW	B	0.000170.000140.000030.000000.000000.000000
N	C	0.000430.000460.000110.000030.000000.000000
NNE	C	0.001000.001170.000400.000000.000000.000000
NE	C	0.001340.003620.000680.000030.000000.000000
ENE	C	0.002250.005740.000370.000000.000000.000000
E	C	0.001910.006390.000060.000000.000000.000000
ESE	C	0.001340.005050.000030.000000.000000.000000
SE	C	0.000830.004650.000030.000000.000000.000000
SSE	C	0.000600.005450.000290.000000.000000.000000
S	C	0.000710.004990.000680.000000.000000.000000
SSW	C	0.000230.002940.000630.000000.000000.000000
SW	C	0.000030.001660.000370.000000.000000.000000
WSW	C	0.000090.000940.000770.000030.000000.000000
W	C	0.000030.000860.000710.000060.000000.000000
WNW	C	0.000060.000860.000430.000000.000000.000000
NW	C	0.000140.000490.000060.000000.000000.000000
NNW	C	0.000170.000510.000140.000000.000000.000000

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Table 7b (continued)

N	D	0.004970.006510.006140.003030.000060.00000
NNE	D	0.006680.009730.007910.003370.000200.00000
NE	D	0.006250.011560.005110.001110.000000.00000
ENE	D	0.005710.010270.002850.000140.000000.00000
E	D	0.005020.008590.001680.000030.000000.00000
ESE	D	0.003650.005940.000570.000000.000000.00000
SE	D	0.003570.006110.001460.000260.000000.00000
SSE	D	0.002770.010760.008960.002740.000910.00003
S	D	0.003600.017780.033740.016100.001370.00037
SSW	D	0.002540.014440.037160.025370.004400.00126
SW	D	0.001910.009330.020920.014300.002910.00023
WSW	D	0.001860.006590.014160.011560.002740.00020
W	D	0.002250.005110.012900.007530.001680.00009
WNW	D	0.002710.004940.010760.005450.001370.00003
NW	D	0.003140.004080.006110.003030.000830.00046
NNW	D	0.003620.004000.004080.002400.000430.00009
N	E	0.004000.007590.001660.000000.000000.00000
NNE	E	0.003450.006590.001510.000000.000000.00000
NE	E	0.002250.004280.001370.000000.000000.00000
ENE	E	0.001400.002110.000400.000000.000000.00000
E	E	0.001400.001970.000170.000000.000000.00000
ESE	E	0.001230.001310.000000.000000.000000.00000
SE	E	0.000940.001570.000200.000000.000000.00000
SSE	E	0.000740.002400.000740.000000.000000.00000
S	E	0.001080.005390.005110.000000.000000.00000
SSW	E	0.001110.010130.020720.000000.000000.00000
SW	E	0.001600.018490.017100.000000.000000.00000
WSW	E	0.000970.009330.013440.000000.000000.00000
W	E	0.001280.006590.008880.000000.000000.00000
WNW	E	0.002140.006710.006310.000000.000000.00000
NW	E	0.002970.004600.002540.000000.000000.00000
NNW	E	0.002850.005370.002510.000000.000000.00000
N	F	0.008310.003140.000060.000000.000000.00000
NNE	F	0.008650.002880.000030.000000.000000.00000
NE	F	0.007820.002110.000060.000000.000000.00000
ENE	F	0.005390.001400.000030.000000.000000.00000
E	F	0.004770.000970.000000.000000.000000.00000
ESE	F	0.004170.000660.000000.000000.000000.00000
SE	F	0.003250.001310.000060.000000.000000.00000
SSE	F	0.004020.002030.000110.000000.000000.00000
S	F	0.004990.004050.000200.000000.000000.00000
SSW	F	0.004820.008560.002430.000000.000000.00000
SW	F	0.004600.006940.001060.000000.000000.00000
WSW	F	0.004650.009020.003800.000000.000000.00000
W	F	0.004990.010820.005970.000000.000000.00000
WNW	F	0.004510.010330.001510.000000.000000.00000
NW	F	0.006710.005170.000830.000000.000000.00000
NNW	F	0.007110.003710.000430.000000.000000.00000

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Table 7 (continued)

Table 7c: CAP88 Input Data for 2010 TA-54 Meteorological Tower
(100.0% Data Completeness)

N	A	0.000800.000460.000030.000000.000000.000000
NNE	A	0.001030.000600.000000.000000.000000.000000
NE	A	0.002400.001260.000000.000000.000000.000000
ENE	A	0.004250.002080.000000.000000.000000.000000
E	A	0.005770.002830.000000.000000.000000.000000
ESE	A	0.005080.002710.000000.000000.000000.000000
SE	A	0.003740.002370.000000.000000.000000.000000
SSE	A	0.002850.001800.000000.000000.000000.000000
S	A	0.001680.001480.000000.000000.000000.000000
SSW	A	0.000710.001480.000000.000000.000000.000000
SW	A	0.000800.000570.000000.000000.000000.000000
WSW	A	0.000630.000430.000000.000000.000000.000000
W	A	0.000430.000230.000000.000000.000000.000000
WNW	A	0.000460.000200.000000.000000.000000.000000
NW	A	0.000430.000310.000000.000000.000000.000000
NNW	A	0.000510.000200.000000.000000.000000.000000
N	B	0.000110.000290.000000.000000.000000.000000
NNE	B	0.000340.000630.000000.000000.000000.000000
NE	B	0.000490.001140.000000.000000.000000.000000
ENE	B	0.001230.002570.000000.000000.000000.000000
E	B	0.001280.003000.000000.000000.000000.000000
ESE	B	0.000740.001460.000000.000000.000000.000000
SE	B	0.000260.001200.000000.000000.000000.000000
SSE	B	0.000290.001770.000000.000000.000000.000000
S	B	0.000310.001710.000000.000000.000000.000000
SSW	B	0.000200.001340.000060.000000.000000.000000
SW	B	0.000060.000630.000030.000000.000000.000000
WSW	B	0.000200.000430.000060.000000.000000.000000
W	B	0.000110.000310.000060.000000.000000.000000
WNW	B	0.000090.000290.000090.000000.000000.000000
NW	B	0.000060.000090.000030.000000.000000.000000
NNW	B	0.000110.000170.000000.000000.000000.000000
N	C	0.000170.000510.000140.000000.000000.000000
NNE	C	0.000660.002030.000200.000000.000000.000000
NE	C	0.001060.004570.000230.000000.000000.000000
ENE	C	0.001480.005770.000140.000000.000000.000000
E	C	0.001140.004280.000090.000000.000000.000000
ESE	C	0.000800.002510.000090.000000.000000.000000
SE	C	0.000660.002230.000090.000000.000000.000000
SSE	C	0.000540.003400.000260.000000.000000.000000
S	C	0.000340.005370.000860.000000.000000.000000
SSW	C	0.000230.004510.000770.000000.000000.000000
SW	C	0.000260.001200.000860.000000.000000.000000
WSW	C	0.000030.000910.000830.000000.000000.000000
W	C	0.000140.001200.001510.000060.000000.000000
WNW	C	0.000200.000660.001170.000060.000000.000000
NW	C	0.000230.000490.000400.000030.000000.000000
NNW	C	0.000200.000340.000030.000000.000000.000000

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Table 7c (continued)

N	D	0.005450.005940.002800.001370.000140.00000
NNE	D	0.005250.012700.011160.004250.000110.00003
NE	D	0.006140.015930.009110.001200.000060.00000
ENE	D	0.004000.008160.002000.000140.000000.00000
E	D	0.002830.004080.000430.000030.000000.00000
ESE	D	0.002170.001970.000170.000030.000000.00000
SE	D	0.001460.003000.000860.000140.000090.00000
SSE	D	0.001430.004800.003830.005310.001570.00031
S	D	0.001880.009050.021240.019100.004910.00069
SSW	D	0.002310.013760.044450.036910.008340.00257
SW	D	0.002770.011080.020300.015790.004050.00077
WSW	D	0.002140.006970.007910.006110.001340.00000
W	D	0.003910.005990.007850.004140.000310.00003
WNW	D	0.004220.005340.007740.002830.000230.00000
NW	D	0.005050.007510.004540.001430.000260.00003
NNW	D	0.005220.004650.002650.001200.000110.00000
N	E	0.003570.004940.001770.000000.000000.00000
NNE	E	0.002200.003430.001710.000000.000000.00000
NE	E	0.001600.002630.000740.000000.000000.00000
ENE	E	0.001080.001570.000230.000000.000000.00000
E	E	0.000940.000660.000090.000000.000000.00000
ESE	E	0.000880.000800.000030.000000.000000.00000
SE	E	0.000600.000910.000060.000000.000000.00000
SSE	E	0.000430.001770.000570.000000.000000.00000
S	E	0.000710.003510.003000.000000.000000.00000
SSW	E	0.001280.006770.013300.000000.000000.00000
SW	E	0.001460.010080.015040.000000.000000.00000
WSW	E	0.001940.007140.003400.000000.000000.00000
W	E	0.002540.011760.002740.000000.000000.00000
WNW	E	0.002910.011480.004080.000000.000000.00000
NW	E	0.004800.010700.002030.000000.000000.00000
NNW	E	0.004370.005970.000880.000000.000000.00000
N	F	0.007880.012360.000770.000000.000000.00000
NNE	F	0.005370.006250.000260.000000.000000.00000
NE	F	0.003400.002480.000060.000000.000000.00000
ENE	F	0.001860.001140.000000.000000.000000.00000
E	F	0.000660.000460.000000.000000.000000.00000
ESE	F	0.000880.000000.000000.000000.000000.00000
SE	F	0.000570.000340.000000.000000.000000.00000
SSE	F	0.000910.000490.000090.000000.000000.00000
S	F	0.001230.001710.000290.000000.000000.00000
SSW	F	0.002450.004450.001230.000000.000000.00000
SW	F	0.003200.016300.005620.000000.000000.00000
WSW	F	0.004220.019070.006710.000000.000000.00000
W	F	0.005970.020780.003970.000000.000000.00000
WNW	F	0.010280.017130.000370.000000.000000.00000
NW	F	0.012960.038360.001230.000000.000000.00000
NNW	F	0.009960.019700.001740.000000.000000.00000

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