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Environment

U.S. Department of Energy Report
1999 LANL Radionuclide Air Emissions

Los Alamos
NATIONAL LABORATORY

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Prepared by
Keith W. Jacobson

Los Alamos
NATIONAL LABORATORY
Los Alamos, New Mexico 87545

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Location: County of Los Alamos, New Mexico

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Compliance Assessment:

1999 EDE: 0.32 mrem

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LIST OF ACRONYMS

CAB	Citizens' Advisory Board
CMR	Chemistry and Metallurgy Research (building)
DOE	Department of Energy
EDE	effective dose equivalent
EPA	Environmental Protection Agency
ESIDNUM	exhaust stack identification number
FFCA	Federal Facilities Compliance Agreement
GMAP	gaseous mixed activation products
HEPA	high-efficiency particulate air (filter)
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LSC	liquid scintillation counting
ND	no detectable (emissions)
PEDE	potential effective dose equivalent
P/VAP	particulate/vapor activation products
TA	technical area (at Los Alamos National Laboratory)

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ABSTRACT

Presented is the Laboratory-wide certified report regarding radioactive effluents released into the air by Los Alamos National Laboratory (LANL) in 1999. This information 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. For 1999, the dose was 0.32 mrem.

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 (Fig. 1).

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, 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, and engineering that supports such programs.

The primary facilities involved in emissions of radioactivity are outlined in this section. The facility locations are designated by technical area and building. For example, the facility designation TA-3-29 is Building 29 at Technical Area 3 (see Fig. 2 showing the technical areas at LANL). Potential radionuclide release points are listed in tables that follow. Some of the sources described below are characterized as non-point. Beginning in 1995, air sampling results from LANL's air sampling network (AIRNET) were used, with EPA approval, to calculate off-site impacts due to diffuse and fugitive emissions of radioactive particles and tritium oxide from non-point sources.

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 activation products occur in particulate and vapor form (P/VAP).

The radionuclides emitted from point sources at LANL in the calendar year (CY) 1999 are listed in the tables that follow this text. Tritium is released as tritium oxide and elemental tritium. Plutonium contains traces of Am-241, a transformation product of Pu-241. Some of the uranium emissions are from open-air explosive tests involving depleted uranium. GMAP emissions include Ar-41, C-10, C-11, N-13, N-16, O-14, and O-15. Various radionuclides such as Ga-68, Ge-68, Br-82, and Hg-197 make up the majority of the P/VAP emissions.

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

The primary facilities responsible for radiological airborne emissions follow. Additional descriptions of LANL technical areas can be found in the annual site environmental report for LANL.

TA-3-29: Programs conducting chemical and metallurgical research are located in this facility. Principal radionuclides are isotopes of plutonium and uranium.

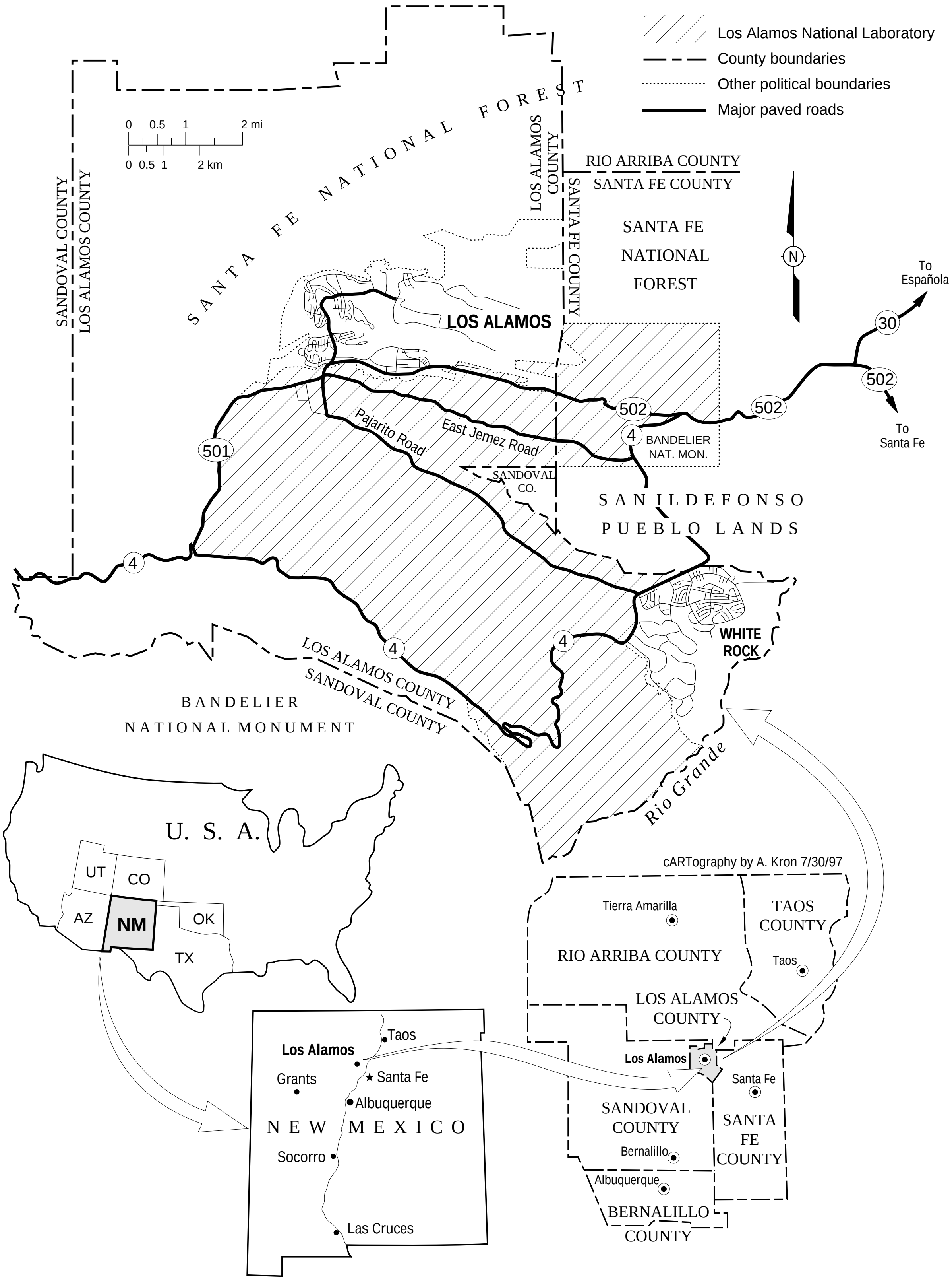

Figure 1. Location of Los Alamos National Laboratory.

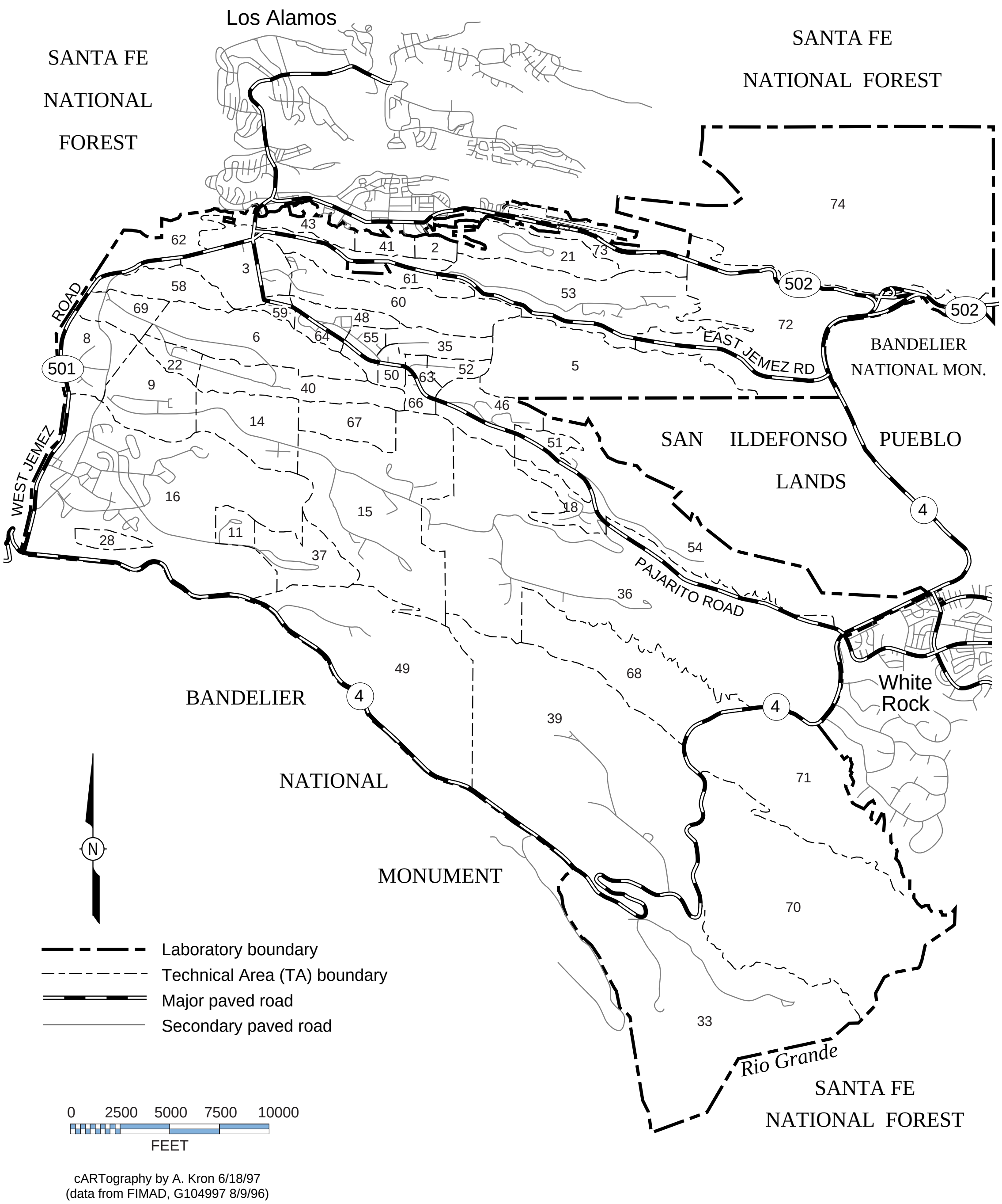

Figure 2. Los Alamos National Laboratory technical areas by number.

TA-3-35: The facility houses a 5,000-ton capacity press that has been used in the metalworking of radioactive materials.

TA-3-102: This machine shop is used for the metalworking of radioactive materials, primarily depleted uranium.

TA-15-PHERMEX and TA-36: These facilities conduct open-air explosive tests involving depleted uranium.

TA-16-205, TA-21-155, and **TA-21-209:** These facilities conduct operations involving tritium. Programs include testing of tritium control systems for the nuclear fusion program (TA-21-155), preparation of targets containing tritium for laser-fusion research, and the handling of tritium for defense programs. Tritium recovery operations from old equipment are being conducted at TA-21-209.

TA-18: This nuclear facility studies the behavior of critical assemblies of nuclear materials. Some of the assemblies are used as a source of fission neutrons for experimental purposes, resulting in a diffuse source of Ar-41 emissions.

TA-21: Many of the facilities at this decommissioned radiochemistry site are undergoing decontamination, demolition, and disposal. Some of these operations may contribute to diffuse releases of uranium and plutonium into the air.

TA-33-86 and TA-41-4: These buildings were formerly used as tritium-handling facilities. All accountable tritium has been removed, and current emissions primarily result from residual tritium contamination and cleanup operations.

TA-48-1: The principal activities carried out in this facility are radiochemical separations in support of 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.

TA-50-1: This waste management site consists of a low-level liquid waste treatment plant. Also, there is a wastewater outfall from TA-50-1 that results in a diffuse source of airborne tritium.

TA-50-37: This controlled air incinerator was decommissioned in 1996 and is no longer active. It has been remodeled to house the Radioactive Materials Research Operations Demonstration (RAMROD) project.

TA-50-69: This waste management site consists of a waste characterization and reduction facility.

TA-53: This technical area houses the Los Alamos Neutron Science Center (LANSCE), a linear particle accelerator complex. 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 facility, 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. The primary high-intensity beam line (Line A) and medical isotope production facility did not operate in 1999. Medium (100 microamp) intensity beam operations to the Proton Storage Ring (PSR) and the Manuel Lujan Neutron Scattering Center were conducted in January of 1999. Low-intensity beam (up to 10 microamps) operations to the PSR, the Weapons Neutron Research facility, and the Proton Radiography facility were conducted in January 1999 and May to December of 1999.

Airborne radioactive emissions result from the proton beams and secondary particles passing through and activating air in the target cells, beam stop, and surrounding areas. The majority of the emissions are short-lived activation products such as C-11, N-13, and O-15. 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. In addition, there are three wastewater lagoons at TA-53 that have received radioactive liquid effluents from the accelerator; however, none of these lagoons received wastewater in 1999, and the old lagoon facility is being remedied. Two new solar evaporative basins were constructed and began operation in 1999 to evaporate wastewater from the accelerator. Evaporation of water from these facilities can result in a diffuse source of airborne tritium.

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. Area G at TA-54 is a known source of diffuse emissions of tritium vapor. Resuspension of soil contaminated with low levels of plutonium/americium has also created a diffuse source.

TA-55-4: As discussed in the January 1999 *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, this plutonium facility is slated for a plutonium pit production mission as well as for continuing in its traditional role of housing research and development applications in chemical and metallurgical processes for recovering, purifying, and converting plutonium and other actinides.[1] A wide range of activities that include the heating, dissolution, forming, welding, etc., of special nuclear materials are conducted. Additional activities include the means to safely ship, receive, handle, and store nuclear materials, as well as manage the wastes and residues produced by TA-55 operations.

Section II. Air Emissions Data

61.94(b)(4) Point Sources

Sampled and unsampled point sources at LANL are listed in Table 1. Each entry is identified by technical area and building. Also listed in Table 1 are type, number, and efficiency of the effluent controls used on the release points. Each stage of the high-efficiency particulate air (HEPA) exhaust filters is tested at least once every 12 months. The performance criteria for HEPA filter systems are a maximum penetration of 5×10^{-4} for one stage and 2.5×10^{-7} for two stages in series, in which penetration equals concentration of aerosol downstream of the air cleaner divided by concentration upstream.

The distance between the point source and the nearest receptor is provided in Table 2. 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 critical receptor location. The distance to the nearest farm producing milk is 20 km east of the Laboratory's eastern boundary; the nearest farms producing meat and vegetables adjoin the Laboratory's eastern boundary, about 4 km from the main exhaust stack at LANSCE. More detailed agricultural information can be found in a supplemental LANL report.[2] At this time, LANL is not using this site-specific agricultural data in the CAP88 model; pre-programmed or default values for New Mexico are utilized for the number of beef and milk cattle and for agricultural productivity.

In addition to 31 monitored release points, approximately 40 unmonitored release points in more than 30 LANL buildings are included in Table 1. Under 40 CFR 61.93(b)(4)(i), sampling of these release points is not required because each release point has a potential effective dose equivalent 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 Radioactive Materials Usage Survey. The purpose of the Usage Survey is to collect and analyze radioactive materials usage and process information for the monitored and unmonitored point sources at LANL.

Guidance in Appendix D to 40 CFR 61, engineering calculations, and other methods are used to develop conservative emissions estimates from unmonitored point sources using the data collected from the facilities. Estimated potential effective dose equivalents (PEDEs) are calculated by modeling these emissions estimates using the EPA-approved CAP88 dose modeling software. A comprehensive survey of all of LANL's monitored and unmonitored point sources is conducted annually or biannually. Results of the 1999 Usage Survey can be found in the report *1999 Radioactive Materials Usage Survey for Point Sources*.[3] The Laboratory has established administrative requirements to evaluate all potential new sources. These requirements are established for the review of all new Laboratory activities and projects to ensure that air quality regulatory requirements will be met before the activity or project begins.[4]

Non-Point Sources

There are a variety of non-point sources within the 111 square kilometers of land 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, shallow land burial sites, open burn sites, firing sites, outfalls, container storage areas, unvented buildings, waste treatment areas, solid waste management units, and tanks. The Laboratory measures annual average ambient concentrations of important airborne radionuclides (other than activated gases) at a number of potential receptor locations as described below.

Beginning in 1995, LANL began summarizing the potential impacts of nonpoint sources by analyzing and reporting air concentration measurements collected at 17 ambient air-sampling sites around the Laboratory. Previously, LANL had estimated emissions from the most significant nonpoint sources and determined the impacts using EPA's dose assessment computer program. The Laboratory and EPA negotiated this new method of assessing non-point sources as part of a Federal Facility Compliance Agreement (FFCA).[5] Results of the air sampling analysis are provided in Section III of this report. There were no unexplained readings measured at the air sampling stations in 1999.

Radionuclide Emissions

Radionuclides released from sampled point sources, along with the annual release rate for each radionuclide, are documented in Table 9. The point sources are identified using an eight-digit identification number for each exhaust stack (ESIDNUM): the first two digits represent the LANL technical area, the next four digits the building area, and the last two digits the stack number. No detectable emissions are denoted as ND.

Pollution Controls

At Los Alamos National Laboratory the most common type of filtration, for emission control purposes, is the high efficiency particulate air (HEPA) filter. HEPA filters are constructed of sub-micrometer glass fibers that are pressed and glued into a compact, paper-like, pleated media. The paper media is folded alternately over corrugated separators and mounted into a metal or wood frame in eight standard sizes and airflow capacities. A Type I nuclear grade HEPA filter is capable of removing 99.97% of 0.3 μm particles at rated airflow. Other types of filters used in ventilation systems are Aerosol 95, RIGA-FLOW 220, and FARR 30/30. These units are typically used as pre-filters in HEPA filtration systems. These filters are significantly less efficient than HEPA filters and are typically used for collecting 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, activated charcoal beds are used. Charcoal beds collect the gas contaminant through an adsorption process in which the gas comes in contact with the charcoal and adheres to the surface of the charcoal. The charcoal can be coated with different types of materials to make the adsorption process more efficient for different types of contaminants. Typically charcoal beds can achieve an efficiency of 98% capture with a resident time of 0.25 seconds.

Tritium effluent controls are generally composed of a catalytic reactor and a molecular sieve bed (CR/MS). Tritium-contaminated effluent is passed through a catalyst that converts elemental tritium (HT) into tritium oxide (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.

Section III. Dose Assessment

61.94(b)(7) Description of Dose Calculations

Effective dose equivalent (or dose) calculations for point sources, unsampled point sources, and non-point gaseous activation products from LANSCE and TA-18 were performed with the mainframe CAP88 version of AIRDOS. This procedure included using PREPAR to prepare the input file to AIRDOS and using the DARTAB preprocessor to prepare the dose conversion factor input file for DARTAB. The calculations used dose conversion factors taken from the RADRISK database that was distributed along with the CAP88 programs.[6] Verification of the CAP88 code is performed regularly by running the EPA test cases originally distributed with the mainframe version.[7]

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 whether it is in the elemental (HT) or oxide (HTO) form. 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 the air sample is "bubbled" through these three vials, essentially all HTO is removed from the air, leaving elemental tritium or HT. The sample, containing the elemental tritium, is then passed through a palladium catalyst that converts the elemental tritium 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 (LSC). Although LANL's measurement device can distinguish the presence of HTO from HT, all emissions of tritium are assumed to be HTO for modeling the off-site dose. Because HTO contributes approximately 20,000 times more dose than an equivalent amount of HT, this is a conservative measure that further ensures that the dose to an off-site receptor is not underestimated.

Tritium emissions from LANSCE (which do not require monitoring under 40 CFR 61.93(b)(4)(i)) are determined using a silica gel sampler. A sample of stack air is pulled through a cartridge containing silica gel. The silica gel collects the water vapor from the air, including any HTO. The water is distilled from the sample, and the amount of HTO is determined by analyzing the water using LSC. Because the primary source for tritium at LANSCE is activated water, sampling for only HTO is appropriate. These results are also corrected using the absolute humidity measured in the stack.

Radioactive particle emissions

Emissions of radioactive particulate matter, generated by operations at facilities such as the Chemistry and Metallurgy Research (CMR) Building and 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 samples for subsequent analysis at an off-site Laboratory. These composite samples are analyzed to determine the total activity of materials such as uranium-234/235/238, plutonium-238/239/240, and americium-241. These data are then combined with estimates of sampling losses and stack and sample flows to calculate emissions. For the case of radionuclides that have short-lived daughters, LANL includes these progeny in the source term. For example, the analytical laboratory measures the parent radionuclide U-238, and its short-lived progeny (Th-234 and Pa-234m) are assumed to be in equilibrium with U-238.

Vapor form emissions

Vapor emissions, generated by LANSCE operations and by hot cell activities at CMR and TA-48, are sampled using a charcoal filter or canister. A continuous sample of stack air is pulled through a charcoal filter where 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. Radionuclides of this type include Ga-68, Ge-68, Br-82, and Hg-197.

Gaseous mixed activation products (GMAP)

GMAP emissions, resulting from activities at LANSCE, are measured using near real-time monitoring data. A sample of stack air is pulled through an ionization chamber that measures the total amount of radioactivity in the sample. Specific radioisotopes are identified through the use of gamma spectroscopy and decay curves. This information is then used to calculate emissions. Radionuclides of this type include C-11, N-13, and O-15.

Summary of input parameters

Effective dose equivalents to potential receptors were 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 NM State Plane coordinates, are provided in Table 4. The relationships of receptor locations to the individual release points are provided in Table 5. The nearest receptor location is different for each point source. However, because the majority of the yearly dose has historically been caused by LANSCE emissions, the LANSCE critical receptor location has historically been the maximum dose location for all Laboratory emissions. This location is a business office approximately 800 meters north-northeast of the LANSCE stack. Emissions and doses from LANSCE are calculated on a monthly basis during beam operations to ensure continued compliance with the 10 mrem/yr standard.

Other site-specific parameters and the source of these data are provided in Table 6. The LANL Air Quality Group 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 1999, data from four different towers were used for the air dispersion modeling; the tower data most representative of the release point is applied. Copies of the meteorological data files used for the 1999 dose assessment are provided in Table 7.

The Air Quality Group also inputs 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 US Census data, updated with annual projections. 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 1999 are provided in Table 9.

Public receptors

Compliance with the annual dose standard is determined by calculating the highest effective dose equivalent to any member of the public at any off-site point where there is a residence, school, business, or office. Late in the calendar year, a visual tour of the Laboratory vicinity was completed to identify new locations inhabited by the public; that is, new off-site public receptors that had not existed in the year previous to this assessment were identified. Many new businesses and residences were noted in the 1999 tour. For example, there are several new residences at the Royal Crest Trailer Park. One of these new residences became the nearest new off-site point for the TA-48 facility (in this report, the nearest off-site point is defined as the area of public habitation where the highest off-site dose occurs for a given emissions source). For the 1999 compliance assessment, LANL-wide doses were evaluated at the nearest off-site point for each monitored emissions stack, as well as at a number of additional key locations.

Point Source Emissions Modeling

The CAP88 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. There are a number of radionuclides monitored in LANL effluents that are not included in the dose factor database used by CAP88.[7] For the substantial GMAP effluents such as C-10, N-16, and O-14, LANL uses a revised set of CAP88 database files to which the required dose factors have been added. For other effluents such as Ga-68, Ge-68, Br-82, Hg-197, etc., LANL uses the CAP88 code to calculate environmental concentrations of these radionuclides at the receptor locations and then applies an appropriate dose factor to estimate dose.

LANSCE Fugitive Emission Modeling

Some of the gaseous mixed activation products (GMAP) created at the accelerator target cells migrate into room air and into the environment. These fugitive sources are continuously monitored throughout the beam-operating period. In 1999, approximately 17.1 Ci of C-11 and 0.7 Ci of Ar-41 were released from LANSCE as fugitive emissions. This source was modeled as an area source, using CAP88 and meteorological data coinciding with the LANSCE run cycle. Fugitive effluents were modeled from one area at LANSCE; additional source information is provided in Table 10.

TA-18 Non-Point Emission Modeling

This site consists of a variety of nuclear assemblies that are operated at near-critical conditions. During the near-critical operations, neutrons are generated that, in turn, activate argon atoms in the air surrounding the assembly. Operations conducted in 1999 were evaluated for their potential to create Ar-41 gas. In 1999, approximately 0.49 Ci of Ar-41 was generated and the dose evaluated with CAP88. Additional source information is provided in Table 10.

Radionuclides Not Included in CAP88

Some of the radionuclides detected in LANL air effluents are not included in the CAP88 library of exposure-to-dose conversion factors. As previously mentioned, LANL added dose coefficients to the CAP88 data files for three routinely emitted radionuclides: C-10, N-16, and O-14. Because of the unique emissions from LANSCE and other facilities, other radionuclides not included in CAP88 are emitted on an infrequent basis. Examples of such radionuclides detected in LANL air effluents during 1999 are included in Table 9 and are listed separately in Table 11.

To calculate the dose from these particular radionuclides, LANL uses several methods. LANL uses the mainframe version of CAP88 to calculate the air concentration at the receptor location of interest. In most cases the air concentration can be then converted into a dose by applying the conversions given in Table 2 of Appendix E of 40 CFR 61, which has a more extensive list of radionuclides than CAP88.[8] In some cases, LANL obtains exposure-to-dose conversion factors from other sources, such as EPA's Federal Guidance Reports.[9,10] Dose conversion factors used for radionuclides not included in CAP88 but found in LANL air effluents during 1999 are provided in Table 12.

At the LANL-wide maximum dose location for 1999, the total estimated dose arising from emissions of radionuclides not included in the CAP88 library was about 0.001 mrem. This number is included in the total annual dose. The LANL Air Quality Group has informed the Regional Office of the U.S. EPA of the various steps and methods used to calculate the doses from such radionuclides.[11]

Environmental Data

The net annual average ambient concentration of airborne radionuclides measured at 17 air sampling stations (Fig. 3) is calculated by subtracting an appropriate background concentration value. The net concentration is converted to an annual effective dose equivalent (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).[8] Results from each air sampler are given in Table 13. The operational performance of each air sampler is provided in Table 14.

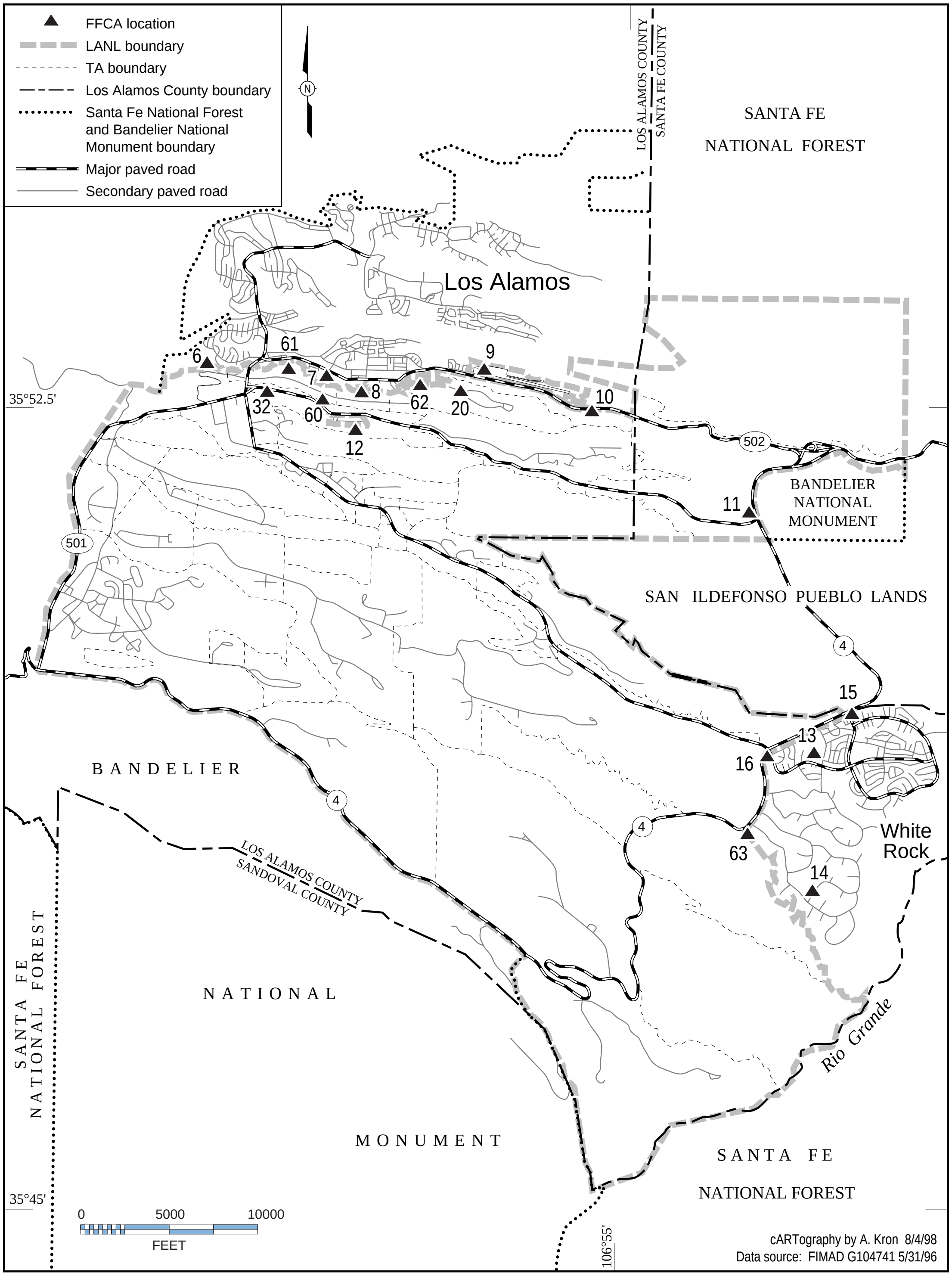

Figure 3. Locations of air sampling stations used for non-point source compliance.

LANSCE Monthly Assessments

The Air Quality Group evaluates the dose from short-lived radioactive gases released from LANSCE on a monthly basis. The monthly dose values are evaluated with the actual meteorology for the month and these doses are given in Table 15. The Air Quality Group also evaluates the annual LANSCE emissions with annual average meteorology and compares the results to the monthly values summed for the calendar year; the values for these two assessments were 1.16e-02 and 1.11e-02, respectively.

Highest EDE Determination

A major change to the procedure for determining the highest EDE was necessary for 1999 because of significantly reduced emissions from the LANSCE facility. Over the past nine years, the off-site EDE due to LANSCE operations has averaged about 5 mrem. For 1999, the highest off-site EDE from the LANSCE facility was 1.16e-02 mrem. The highest off-site EDE location for LANSCE effluents is a business office in the East Gate area (2470 East Gate Drive). Since the contribution from LANSCE for 1999 is greatly reduced, the location of the highest off-site dose is not as readily established as had been in the past.

In late 1999, LANL began working on a plan to ensure that the location of the highest public dose could be determined. This plan uses a multi-step approach, and the steps used were presented to the local Citizen's Advisory Board (CAB) for LANL for their review and comment. In addition, the Air Quality Group requested the CAB to identify additional locations of potential public interest that should be evaluated for off-site dose. Table 16 shows the locations identified by both LANL and the CAB for the purposes of finding the location of the highest off-site dose. Also shown in the table is the AIRNET sampling station that the Air Quality Group associated with the selected public receptor location. Some of the locations evaluated for the Los Alamos area are shown in Fig. 4. The 1999 LANL-wide doses at these various off-site locations are also provided in Table 16.

61.92 Compliance Assessment

The highest effective dose equivalent to any member of the public at any off-site point where there is a residence, school, or business office was 0.32 mrem for radioactive effluents released by LANL in 1999. This dose was calculated by adding up the doses for each of the point sources at LANL, the diffuse and fugitive gaseous activation products from LANSCE and TA-18, and the dose measured by the ambient air sampler in the vicinity of the public receptor location. The compliance assessment also includes a potential dose contribution of 0.11 mrem from unmonitored stacks. Because the emissions estimates do not account for pollution control systems, the actual dose will be significantly less for the unmonitored point sources. Also, this dose includes an approximate 0.001 mrem contribution from radionuclides not included in CAP88. Table 17 provides the compliance assessment summary. The location of the off-site point of highest EDE for 1999 was the County Landfill business office; this location is different from the location of previous years' assessments. Historically, the highest off-site EDE location was a business office in the East Gate area. Table 17 also lists the LANL-wide doses at this location.

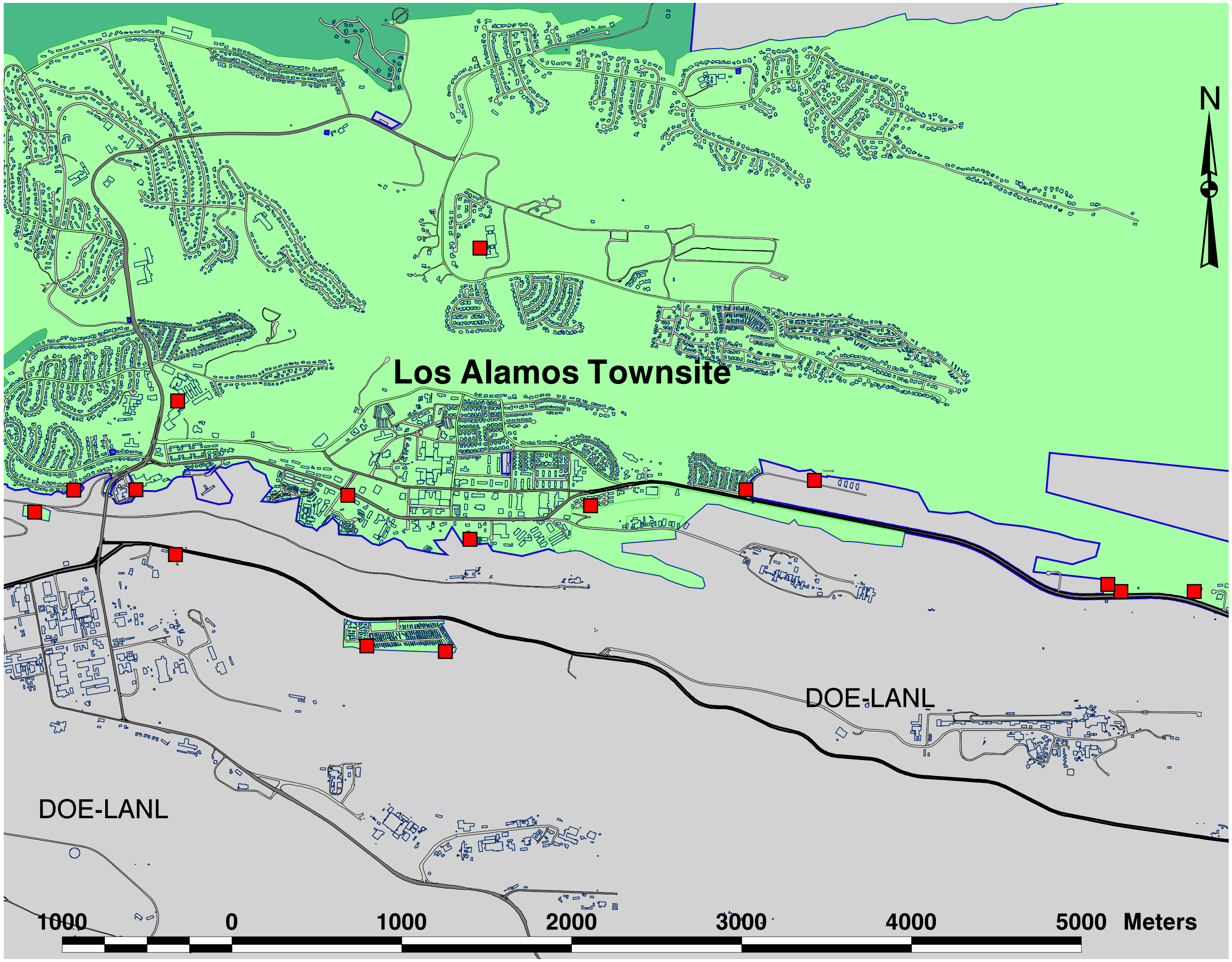

Figure 4. Locations in the Los Alamos townsite area evaluated for off-site dose.

Section IV. Constructions and Modifications

61.94(b)(8) Constructions and Modifications

A brief description of constructions and modifications that were completed and/or reviewed in 1999, but for which the requirement to apply for approval to construct or modify was waived under 61.96, is provided here. The Air Quality Group for LANL/DOE maintains the documentation developed to support the waiver.

Project #97-0104 Contaminated Records Storage Area

This project was previously reviewed in the *1997 LANL Radionuclide Air Emissions Report*. It is being included again because the Central Weapons Information Center began working with these potentially contaminated records in early 1999. Contaminated records will be stored in the Central Weapons Information Center. Potential contaminants include tritium, alpha contamination, gamma contamination, beryllium, lead, and high explosives residue. Potential contamination from the files is estimated based on typical levels of contamination in trash receptacles and bench tops at TA-21. The maximum level of contamination is estimated to be 0.04 Ci for 1000 boxes. In order to determine the applicability of NESHAP requirements, a dose assessment was calculated using CAP88-PC. Based on the modeling results, the potential effective dose equivalent at the nearest receptor is 0.02 mrem/yr and is well below the stack monitoring and construction approval threshold of 0.1 mrem/yr.

Project #99-0050 Volume Reduction Evaporator

The Volume Reduction Evaporator project involves the installation of evaporation equipment at TA-50-248. The equipment will consist of a 10 million Btu natural gas-fired boiler, a cooling tower, and an evaporation unit. Steam from the boiler will be used to heat the evaporation unit, and the cooling tower will be used to facilitate condensation functions of the evaporation unit.

The waste stream is not new and is not increasing in quantity or in radionuclide concentration. Therefore, the potential emissions from the waste treatment operations are not increasing. Changes to the waste treatment are being made to reduce the contaminants that are in the final liquid discharge.

The process involves the volume reduction of radionuclide-contaminated liquid effluent from reverse osmosis and electrodialysis reversal units at TA-50-1 by evaporation within a sealed evaporator/condenser unit. The radionuclide-contaminated evaporator bottoms from the evaporator/condenser unit will be pumped into a holding tank. Although the evaporator/condenser unit is a sealed source, the evaporator bottoms holding tank has an opening in the top of it to allow air to diffuse while the evaporator bottoms are pumped in.

Dose assessments were calculated using CAP88. Maximum operation of this unit will be no more than 150 days per year. In order to conduct a conservative emissions estimate, it is assumed that the unit operates 365 days per year. The average alpha radioactivity level in the concentrate for the calendar year 1999 was 0.017 Ci/yr. Using this information and Appendix D emission factors,[8] modeling indicates the maximum potential effective dose equivalent from the source at the nearest receptor is 0.003 mrem/yr. This is well below the monitoring and permitting threshold of 0.1 mrem/yr specified in the NESHAP. The start-up date for this operation was January 31, 2000.

Section V. Additional Information

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

Unplanned Releases

During 1999, the Laboratory had no instances of increased airborne emissions of radioactive materials that required reporting to the Environmental Protection Agency.

There were two instances of unplanned releases due to process problems. First, during the week of June 4, 1999, a small release of a radioactive form of silicon, Si-32, occurred at the Radiochemistry facility, TA-48. This release comprised 5 µCi and had a dose impact less than 0.001 mrem. The second unplanned release was noted during the week of June 25, 1999. An operation at the Chemistry and Metallurgy Research (CMR) facility resulted in a small release of a radioactive form of technetium, Tc-99. During an operation involving the heating of enriched uranium, any Tc-99 present in the sample is volatilized. Because of an equipment malfunction, this Tc-99 was released to the room and subsequently vented through the stack. This release comprised 50 µCi and had a dose impact less than 0.001 mrem.

Environmental Monitoring

The LANL Air Quality Group operates an extensive environmental monitoring network that includes several environmental monitoring stations located near the LANSCE boundary inhabited by the public. Measurement systems at these stations include LiF 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 are published here and results for all monitoring data are published in the Annual Site Environmental Surveillance Report for DOE Order compliance.

Other Supplemental Information

- Collective effective dose equivalent for 1999 airborne releases: 0.32 person-rem.
- Compliance with Subparts Q and T of 40 CFR 61 – Radon-222 Emissions.
  These regulations apply to Rn-222 emissions from DOE storage/disposal facilities that contain byproduct material. "Byproduct 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 byproduct material used in experiments in the TA-54 low-level waste facility, Area G, and this practice makes the Laboratory subject to this regulation. Subject facilities cannot exceed an emissions rate of 20 pCi/m^2 s of Rn-222. In 1993 and 1994, LANL conducted a study to characterize emissions from the Area G disposal site.[12] This study showed an average emission rate of 0.14 pCi/m^2 s for Area G. The performance assessment for Area G has determined that there will not be a significant increase in Rn-222 emissions in the future.[13]

- Potential to exceed 0.1 mrem from LANL sources of Rn-222 or Rn-220 emissions: not applicable at LANL.
- Status of compliance with EPA effluent monitoring requirements: As of June 3, 1996, LANL came into compliance with EPA effluent monitoring requirements.

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

ESIDNUM	Location	Control Description	Number of Effluent Controls	Control Efficiency	Monitored
03001608	TA-03-16	none	0	0%	☐
03001609	TA-03-16	none	0	0%	☐
03001614	TA-03-16	none	0	0%	☐
03001616	TA-03-16	none	0	0%	☐
03001621	TA-03-16	none	0	0%	☐
03001641	TA-03-16	none	0	0%	☐
03002913	TA-03-29-1	unkown	0	0%	☐
03002914	TA-03-29-2	HEPA	2	99.95% each	☑
03002915	TA-03-29-2	HEPA	2	99.95% each	☑
03002919	TA-03-29-3	Aerosol 95	1	80%	☑
03002920	TA-03-29-3	Aerosol 95	1	80%	☑
03002921	TA-03-29-3	none	0	0%	☐
03002923	TA-03-29-4	FARR 30/30	1	~ 20%	☑
03002924	TA-03-29-4	FARR 30/30	1	~ 20%	☑
03002928	TA-03-29-5	HEPA	2	99.95% each	☑
03002929	TA-03-29-5	HEPA	2	99.95% each	☑
03002932	TA-03-29-7	HEPA	2	99.95% each	☑
03002933	TA-03-29-7	HEPA	2	99.95% each	☑
03002937	TA-03-29-V	HEPA	2	99.95% each	☑
03002944	TA-03-29-9	RIGA-Flow 220	1	80%	☑
03002945	TA-03-29-9	RIGA-Flow 220	1	80%	☑
03002946	TA-03-29-9	RIGA-Flow 220	1	80%	☑
03003401	TA-03-34	none	0	0%	☐
03003435	TA-03-34	none	0	0%	☐
03003501	TA-03-35	HEPA	1	99.95%	☑
03003999	TA-3-39	none	0	0%	☐
03004025	TA-03-40	HEPA	1	99.95%	☐
03006601	TA-03-66	none	0	0%	☐
03006602	TA-03-66	none	0	0%	☐
03006603	TA-03-66	none	0	0%	☐
03006604	TA-03-66	none	0	0%	☐
03006605	TA-03-66	none	0	0%	☐

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

ESIDNUM	Location	Control Description	Number of Effluent Controls	Control Efficiency	Monitored
03006626	TA-03-66	HEPA	1	99.95%	☐
03006643	TA-03-66	none	0	0%	☐
03010222	TA-03-102	HEPA	1	99.95%	☑
03010225	TA-03-102	HEPA	1	99.95%	☐
03014110	TA-03-141	none	0	0%	☐
03169801	TA-03-1698	none	0	0%	☐
09002103	TA-09-21	none	0	0%	☐
09003201	TA-09-32	none	0	0%	☐
15044699	TA-15-446	none	0	0%	☐
16020504	TA-16-205	CR/MS	1	>99%	☑
16020599	TA-16-205	none	0	0%	☐
16024801	TA-16-248	none	0	0%	☐
18012701	TA-18-127	none	0	0%	☐
18016801	TA-18-168	none	0	0%	☐
21000507	TA-21-5	HEPA	2	99.95% each	☐
21002S00	TA-21-2S	HEPA	1	99.95%	☐
21015001	TA-21-150	HEPA	1	99.95%	☐
21015505	TA-21-155	CR/MS	1	>99%	☑
21020901	TA-21-209	CR/MS	1	>99%	☑
21021301	TA-21-213	none	0	0%	☐
21025704	TA-21-257	none	0	0%	☐
21041899	TA-21-418	none	0	0%	☐
33008606	TA-33-86	none	0	0%	☑
35021305	TA-35-213	none	0	0%	☐
35021308	TA-35-213	none	0	0%	☐
41000104	TA-41-1	HEPA	2	99.95% each	☐
41000417	TA-41-4	none	0	0%	☑
43000102	TA-43-1	none	0	0%	☐
43000109	TA-43-1	none	0	0%	☐
43000110	TA-43-1	none	0	0%	☐
43000112	TA-43-1	none	0	0%	☐
43000113	TA-43-1	none	0	0%	☐

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

ESIDNUM	Location	Control Description	Number of Effluent Controls	Control Efficiency	Monitored
43000134	TA-43-1	none	0	0%	☐
46002401	TA-46-24	none	0	0%	☐
46003101	TA-46-31	none	0	0%	☐
46003125	TA-46-31	none	0	0%	☐
46003141	TA-46-31	none	0	0%	☐
46004106	TA-46-41	none	0	0%	☐
46015405	TA-46-154	none	0	0%	☐
46015810	TA-46-158	none	0	0%	☐
48000107	TA-48-1	HEPA/Charcoal Bed	2	99.95% each	☑
48000111	TA-48-1	none	0	0%	☐
48000115	TA-48-1	none	0	0%	☐
48000135	TA-48-1	none	0	0%	☐
48000145	TA-48-1	none	0	0%	☐
48000154	TA-48-1	HEPA	2	99.95% each	☑
48000160	TA-48-1	HEPA	1	99.95%	☑
48000199	TA-48-1	HEPA	1	99.95%	
48004501	TA-48-45	none	0	0%	☐
50000102	TA-50-1	HEPA	1	99.95% each	☑
50000201	TA-50-2	none	0	0%	☐
50003701	TA-50-37	HEPA	2	99.95% each	☑
50006901	TA-50-69	HEPA	1	99.95%	☐
50006902	TA-50-69	HEPA	1	99.95%	☐
50006903	TA-50-69	HEPA	2	99.95% each	☑
50018500	TA-50-185	HEPA	1	99.95%	☐
53000303	TA-53-3	HEPA	1	99.95%	☑
53000702	TA-53-7	HEPA	1	99.95%	☑
53000799	TA-53-7	none	0	0%	☐
53036599	TA-53-365	none	0	0%	☐
53109010	TA-53-1090	none	0	0%	☐
54003300	TA-54-33	HEPA	1	99.95%	☐
54003601	TA-54-36	HEPA	1	99.95%	☐
54022601	TA-54-226	none	0	0%	☐

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

ESIDNUM	Location	Control Description	Number of Effluent Controls	Control Efficiency	Monitored
54028101	TA-54-281	HEPA	1	99.95%	☐
54100110	TA-54-1001	none	0	0%	☐
55000415	TA-55-4	HEPA	4	99.95% each	☑
55000416	TA-55-4	HEPA	4	99.95% each	☑
59000104	TA-59-1	none	0	0%	☐
59000114	TA-59-1	none	0	0%	☐
59000121	TA-59-1	none	0	0%	☐
59000122	TA-59-1	none	0	0%	☐
59000123	TA-59-1	none	0	0%	☐
59000124	TA-59-1	none	0	0%	☐
59000125	TA-59-1	none	0	0%	☐
59000126	TA-59-1	none	0	0%	☐
59000127	TA-59-1	none	0	0%	☐
59000130	TA-59-1	none	0	0%	☐

Table 2. 40-61.94(b)(6) Distances from Monitored Release Points to Nearest Receptor

ESIDNUM	Nearest Receptor (m)	Receptor Direction
03002914	731	NE
03002915	732	NE
03002919	836	NNE
03002920	835	NNE
03002923	845	NE
03002924	846	NE
03002928	936	NE
03002929	937	NE
03002932	856	NNE
03002933	855	NNE
03002937	870	NE
03002944	937	NNE
03002945	939	NNE
03002946	938	NNE
03003501	691	NNE
03010222	1060	NE
16020504	778	SSW
21015505	680	NNW
21020901	712	NNW
33008606	977	WSW
41000417	197	N
48000107	750	NNE
48000154	751	NNE
48000160	764	NNE
50000102	1183	N
50003701	1171	N
50006903	1186	N
53000303	800	NNE
53000702	944	NNE
55000415	1016	NNE
55000416	1089	NNE

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

ESIDNUM	Height (m)	Diameter (m)	Exit Velocity (m/s)
03002914	15.9	1.07	7.0
03002915	15.9	1.07	23.6
03002919	15.9	1.07	25.9
03002920	15.9	1.07	15.0
03002923	15.9	1.07	21.9
03002924	15.9	1.07	15.8
03002928	15.9	1.07	22.5
03002929	15.9	1.07	19.8
03002932	15.9	1.07	18.3
03002933	15.9	1.07	20.0
03002937	16.8	0.20	23.4
03002944	16.5	1.40	11.4
03002945	16.5	1.40	11.9
03002946	16.5	1.80	5.5
03003501	12.0	0.86	6.3
03010222	13.4	0.91	1.3
16020504	18.3	0.46	21.2
21015505	29.9	0.81	8.2
21020901	22.9	1.22	11.3
33008606	23.4	0.56	12.1
41000417	30.8	1.50	3.0
48000107	13.4	0.30	20.2
48000154	13.1	0.91	7.1
48000160	12.4	0.38	13.0
50000102	15.5	1.83	12.6
50003701	12.4	0.91	7.9
50006903	10.5	0.34	4.0
53000303	33.5	0.91	12.1
53000702	13.1	0.91	10.0
55000415	9.5	0.93	9.3
55000416	9.5	0.93	16.1

Table 4. 69.94(b)(7) User-Supplied Data—Monitored Stack Parameters —x and y coordinates

ESIDNUM	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
03003501	1,619,949	1,772,577
03010222	1,618,354	1,772,074
16020504	1,609,447	1,760,866
21015505	1,633,757	1,774,182
21020901	1,633,991	1,774,175
33008606	1,638,721	1,740,076
41000417	1,626,190	1,774,437
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	1,769,109
50006903	1,625,579	1,769,065
53000303	1,638,133	1,771,546
53000702	1,638,057	1,771,054
55000415	1,624,870	1,769,742
55000416	1,624,675	1,769,550

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

ESIDNUM	Distance to LANL Highest Dose Location (m)	Direction to LANL Highest Dose Location
03002914	731	NE
03002915	732	NE
03002919	836	NNE
03002920	835	NNE
03002923	845	NE
03002924	846	NE
03002928	936	NE
03002929	937	NE
03002932	856	NNE
03002933	855	NNE
03002937	870	NE
03002944	937	NNE
03002945	939	NNE
03002946	938	NNE
03003501	691	NNE
03010222	1,060	NE
16020504	5,425	NE
21015505	4,023	W
21020901	4,095	W
33008606	11,933	NNW
41000417	1,716	W
48000107	1,545	NW
48000154	1,582	NW
48000160	1,562	NW
50000102	2,428	NW
50003701	2,338	NW
50006903	2,312	NW
53000303	5,442	W
53000702	5,448	WNW
55000415	2,015	NW
55000416	2,022	NW

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

Description	Value	Units	CAP88 Variable Name	Reference
Annual rainfall rate	45.3	cm/y	RR	Bowen (1990)
Lid height	1525	m	LIPO	Holzworth (1972)
Annual median temp	281.9	K	TA	Bowen (1990)
E-vertical temperature gradient	0.02	K/m	TG	EPA (1995)
F-vertical temperature gradient	0.035	K/m	TG	EPA (1995)
G-vertical temperature gradient	0.035	K/m	TG	EPA (1995)
Food supply fraction - local vegetables	0.076		F1V	EPA (1989)
Food supply fraction - vegetable regional	0.924		F2V	EPA (1989)
Food supply fraction - vegetable imported	0		F3V	EPA (1989)
Food supply fraction - meat local	0.008		F1B	EPA (1989)
Food supply fraction - meat regional	0.992		F2B	EPA (1989)
Food supply fraction - meat imported	0		F3B	EPA (1989)
Food supply fraction - milk local	0		F1M	EPA (1989)
Food supply fraction - milk regional	1		F2M	EPA (1989)
Food supply fraction - milk imported	0		F3M	EPA (1989)
Ground surface roughness factor	0.5		GSCFAC	EPA (1989)

Brent M. Bowen, “Los Alamos Climatology,” Los Alamos National Laboratory report LA-11735-MS (1990).

George C. Holzworth, “Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution throughout the Contiguous United States,” U.S. Environmental Protection Agency Office of Air Programs report (1972).

U.S. Environmental Protection Agency, “User’s Guide for the Industrial Source Complex (ISC3) Dispersion Models Volume II - Description of Model Algorithms,” EPA-454/B-95-003b (1995).

U.S. Environmental Protection Agency, "Risk Assessments Methodology, Environmental Impact Statement, NESHAPS for Radionuclides, Background Information Document - Volume 1,” EPA/520/189-005 (1989).

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

CAP88 Input Data for 1999 TA-6 Meteorological Tower

```
 1  1  0.000950.000870.000060.000000.000000.00000
 1  2  0.001960.001270.000000.000000.000000.00000
 1  3  0.003870.001820.000030.000000.000000.00000
 1  4  0.007100.004880.000000.000000.000000.00000
 1  5  0.008860.006840.000000.000000.000000.00000
 1  6  0.007880.010270.000000.000000.000000.00000
 1  7  0.008860.013470.000140.000030.000000.00000
 1  8  0.006380.016700.000460.000000.000000.00000
 1  9  0.003870.008910.000120.000000.000000.00000
 1 10  0.002020.003640.000430.000000.000000.00000
 1 11  0.000750.001790.000290.000000.000000.00000
 1 12  0.000520.001150.000090.000000.000000.00000
 1 13  0.000550.000720.000030.000000.000000.00000
 1 14  0.000720.000580.000030.000000.000000.00000
 1 15  0.000580.000690.000200.000000.000000.00000
 1 16  0.000660.000690.000170.000000.000000.00000
 2  1  0.000200.000630.000260.000000.000000.00000
 2  2  0.000720.001240.000260.000000.000000.00000
 2  3  0.000750.002710.000170.000000.000000.00000
 2  4  0.001670.003840.000140.000000.000000.00000
 2  5  0.001500.004390.000060.000000.000000.00000
 2  6  0.001130.003060.000030.000000.000000.00000
 2  7  0.001210.003000.000090.000000.000000.00000
 2  8  0.001470.009200.001150.000060.000000.00000
 2  9  0.000950.010760.003430.000000.000000.00000
 2 10  0.000610.004900.004360.000030.000000.00000
 2 11  0.000260.001620.002220.000090.000000.00000
 2 12  0.000170.001100.001560.000030.000000.00000
 2 13  0.000200.000550.000260.000000.000000.00000
 2 14  0.000140.000490.000350.000000.000000.00000
 2 15  0.000090.000870.000780.000000.000000.00000
 2 16  0.000260.000980.000810.000030.000000.00000
 3  1  0.000490.001130.000520.000000.000000.00000
 3  2  0.001560.003660.001790.000060.000000.00000
 3  3  0.001380.006350.001790.000090.000000.00000
 3  4  0.001330.006320.000550.000000.000000.00000
 3  5  0.001730.004390.000230.000000.000000.00000
 3  6  0.001130.002020.000000.000000.000000.00000
 3  7  0.000750.000630.000060.000000.000000.00000
 3  8  0.001270.006170.001470.000030.000000.00000
 3  9  0.001670.018290.016360.000460.000000.00000
 3 10  0.001360.010650.013010.001040.000000.00000
 3 11  0.000610.004130.005110.000720.000000.00000
 3 12  0.000350.002740.006430.000660.000000.00000
 3 13  0.000400.001930.004820.000290.000000.00000
 3 14  0.000170.001330.003460.000170.000000.00000
 3 15  0.000140.002570.004530.000460.000000.00000
 3 16  0.000290.001270.000810.000090.000000.00000
 4  1  0.003750.006350.000460.000000.000000.00000
 4  2  0.004070.008340.002710.000870.000000.00000
 4  3  0.003000.005020.000840.000060.000000.00000
 4  4  0.003200.003230.000230.000000.000000.00000
```

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

(TA-6 data continued)

4	5	0.002830.001470.000030.000000.000000.00000
4	6	0.002830.000720.000030.000000.000000.00000
4	7	0.002570.000520.000060.000000.000000.00000
4	8	0.002860.002310.000350.000320.000000.00000
4	9	0.005710.009870.001700.000260.000000.00000
4	10	0.006350.023050.003810.002080.000060.00000
4	11	0.004530.026600.004820.001440.000260.00000
4	12	0.002940.015550.005160.001820.000230.00000
4	13	0.002310.007070.012610.006920.000780.00006
4	14	0.001790.006980.014800.010990.003980.00101
4	15	0.002390.010180.008630.002970.000870.00003
4	16	0.003090.008370.000870.000170.000000.00000
5	1	0.005400.002970.000000.000000.000000.00000
5	2	0.002910.001850.000000.000000.000000.00000
5	3	0.002160.000890.000000.000000.000000.00000
5	4	0.001180.000260.000000.000000.000000.00000
5	5	0.001010.000140.000000.000000.000000.00000
5	6	0.001070.000030.000000.000000.000000.00000
5	7	0.001330.000030.000000.000000.000000.00000
5	8	0.001880.000090.000000.000000.000000.00000
5	9	0.004210.001040.000000.000000.000000.00000
5	10	0.005190.004470.000000.000000.000000.00000
5	11	0.006200.011140.000000.000000.000000.00000
5	12	0.005450.021720.000200.000000.000000.00000
5	13	0.002970.020510.002080.000000.000000.00000
5	14	0.003290.013390.006260.000090.000000.00000
5	15	0.003400.029310.000630.000000.000000.00000
5	16	0.005250.011970.000000.000000.000000.00000
6	1	0.004730.001040.000000.000000.000000.00000
6	2	0.002770.000430.000000.000000.000000.00000
6	3	0.001330.000030.000000.000000.000000.00000
6	4	0.000920.000000.000000.000000.000000.00000
6	5	0.000690.000000.000000.000000.000000.00000
6	6	0.000630.000000.000000.000000.000000.00000
6	7	0.000810.000000.000000.000000.000000.00000
6	8	0.000870.000000.000000.000000.000000.00000
6	9	0.001880.000000.000000.000000.000000.00000
6	10	0.002940.000430.000000.000000.000000.00000
6	11	0.006150.002220.000000.000000.000000.00000
6	12	0.005890.009610.000000.000000.000000.00000
6	13	0.008420.035080.000140.000000.000000.00000
6	14	0.006720.042560.001640.000000.000000.00000
6	15	0.007590.017430.000000.000000.000000.00000
6	16	0.006780.004270.000000.000000.000000.00000

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

CAP88 Input Data for 1999 TA-49 Meteorological Tower

```
 1  1  0.000180.000030.000000.000000.000000.00000
 1  2  0.000290.000030.000000.000000.000000.00000
 1  3  0.000650.000120.000000.000000.000000.00000
 1  4  0.000880.000260.000000.000000.000000.00000
 1  5  0.002320.000210.000000.000000.000000.00000
 1  6  0.001760.000620.000000.000000.000000.00000
 1  7  0.001670.000650.000000.000000.000000.00000
 1  8  0.000910.000380.000000.000000.000000.00000
 1  9  0.000560.000290.000000.000000.000000.00000
 1 10  0.000350.000180.000000.000000.000000.00000
 1 11  0.000230.000000.000000.000000.000000.00000
 1 12  0.000210.000000.000000.000000.000000.00000
 1 13  0.000290.000030.000000.000000.000000.00000
 1 14  0.000090.000030.000000.000000.000000.00000
 1 15  0.000000.000030.000030.000000.000000.00000
 1 16  0.000090.000000.000000.000000.000000.00000
 2  1  0.000030.000030.000000.000000.000000.00000
 2  2  0.000090.000030.000000.000000.000000.00000
 2  3  0.000150.000150.000000.000000.000000.00000
 2  4  0.000620.000350.000000.000000.000000.00000
 2  5  0.000880.000940.000000.000000.000000.00000
 2  6  0.000680.000910.000000.000000.000000.00000
 2  7  0.000380.000820.000000.000000.000000.00000
 2  8  0.000350.000560.000000.000000.000000.00000
 2  9  0.000320.000560.000000.000000.000000.00000
 2 10  0.000120.000290.000000.000000.000000.00000
 2 11  0.000000.000180.000000.000000.000000.00000
 2 12  0.000030.000090.000000.000000.000000.00000
 2 13  0.000120.000000.000000.000000.000000.00000
 2 14  0.000030.000090.000000.000000.000000.00000
 2 15  0.000120.000030.000000.000000.000000.00000
 2 16  0.000030.000060.000000.000000.000000.00000
 3  1  0.000120.000090.000000.000000.000000.00000
 3  2  0.000180.000060.000000.000000.000000.00000
 3  3  0.000440.000320.000000.000000.000000.00000
 3  4  0.000730.000910.000000.000000.000000.00000
 3  5  0.001380.003960.000000.000000.000000.00000
 3  6  0.001060.004080.000000.000000.000000.00000
 3  7  0.000700.004790.000000.000000.000000.00000
 3  8  0.000530.002850.000030.000000.000000.00000
 3  9  0.000320.002550.000000.000000.000000.00000
 3 10  0.000380.001320.000000.000000.000000.00000
 3 11  0.000210.000530.000030.000000.000000.00000
 3 12  0.000150.000380.000030.000000.000000.00000
 3 13  0.000150.000350.000030.000000.000000.00000
 3 14  0.000210.000350.000060.000000.000000.00000
 3 15  0.000060.000230.000000.000000.000000.00000
 3 16  0.000150.000180.000030.000000.000000.00000
 4  1  0.000880.001350.001560.001140.000000.00000
 4  2  0.000940.001940.001060.002030.000090.00000
 4  3  0.001230.003350.000650.000970.000000.00000
 4  4  0.002000.006840.000440.000180.000000.00000
```

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

(TA-49 data continued)

4	5	0.001590.010510.000650.000030.000000.00000
4	6	0.001290.006810.000680.000000.000000.00000
4	7	0.000940.007980.000470.000500.000320.00003
4	8	0.001120.011390.002970.002320.000530.00023
4	9	0.001200.016090.009070.016350.001850.00003
4	10	0.001000.005990.005720.010540.002520.00044
4	11	0.000680.002520.003380.008430.001350.00073
4	12	0.000910.002380.004140.005340.000820.00012
4	13	0.001120.002990.006340.008220.001000.00023
4	14	0.000790.002320.008660.006610.001610.00012
4	15	0.000790.001470.004490.005340.001760.00018
4	16	0.000970.001320.002610.003380.000500.00012
5	1	0.002550.010360.008220.000210.000000.00000
5	2	0.001730.011040.006310.000290.000000.00000
5	3	0.002110.011800.008510.000560.000000.00000
5	4	0.001730.007490.004080.000090.000000.00000
5	5	0.001260.004400.001350.000030.000000.00000
5	6	0.000880.002260.000680.000030.000000.00000
5	7	0.001000.002550.000880.000090.000000.00000
5	8	0.001320.005550.008220.000620.000000.00000
5	9	0.001610.020780.049230.007020.000000.00000
5	10	0.002760.025100.026710.002910.000000.00000
5	11	0.001670.018820.015180.001000.000000.00000
5	12	0.001560.009160.008780.000560.000000.00000
5	13	0.001670.006870.008720.001230.000000.00000
5	14	0.001670.008190.011770.000730.000000.00000
5	15	0.002200.008510.008950.000560.000000.00000
5	16	0.002140.004700.004290.000380.000000.00000
6	1	0.008190.018850.004490.000000.000000.00000
6	2	0.006020.004290.000230.000000.000000.00000
6	3	0.003850.002640.000530.000000.000000.00000
6	4	0.002170.000590.000120.000000.000000.00000
6	5	0.001140.000380.000000.000000.000000.00000
6	6	0.001470.000350.000000.000000.000000.00000
6	7	0.001610.000790.000090.000000.000000.00000
6	8	0.001910.001170.000260.000000.000000.00000
6	9	0.002500.003460.000500.000000.000000.00000
6	10	0.003880.008370.000590.000000.000000.00000
6	11	0.004730.016670.001290.000000.000000.00000
6	12	0.004610.025420.005280.000000.000000.00000
6	13	0.004960.032640.011100.000000.000000.00000
6	14	0.005200.025220.017440.000000.000000.00000
6	15	0.006520.022870.007930.000000.000000.00000
6	16	0.006660.033440.020080.000060.000000.00000

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

CAP88 Input Data for 1999 TA-53 Meteorological Tower

1	1	0.001400.000140.000000.000000.000000.00000
1	2	0.002580.000460.000030.000000.000000.00000
1	3	0.005040.001550.000000.000000.000000.00000
1	4	0.008670.005270.000000.000000.000000.00000
1	5	0.007810.005640.000000.000000.000000.00000
1	6	0.005490.004610.000000.000000.000000.00000
1	7	0.003830.004210.000000.000000.000000.00000
1	8	0.002800.002520.000000.000000.000000.00000
1	9	0.001430.001970.000000.000000.000000.00000
1	10	0.000860.000660.000000.000000.000000.00000
1	11	0.000490.000600.000000.000000.000000.00000
1	12	0.000540.000490.000030.000000.000000.00000
1	13	0.000460.000400.000060.000000.000000.00000
1	14	0.000290.000340.000000.000000.000000.00000
1	15	0.000400.000370.000030.000000.000000.00000
1	16	0.000690.000290.000030.000000.000000.00000
2	1	0.000290.000230.000090.000000.000000.00000
2	2	0.000660.000260.000060.000000.000000.00000
2	3	0.000860.001570.000000.000000.000000.00000
2	4	0.001800.003810.000030.000000.000000.00000
2	5	0.001430.004550.000000.000000.000000.00000
2	6	0.000690.003090.000030.000000.000000.00000
2	7	0.000540.002980.000000.000000.000000.00000
2	8	0.000600.002690.000000.000000.000000.00000
2	9	0.000260.001750.000000.000000.000000.00000
2	10	0.000170.000920.000060.000000.000000.00000
2	11	0.000260.000430.000000.000000.000000.00000
2	12	0.000090.000430.000060.000000.000000.00000
2	13	0.000110.000600.000060.000000.000000.00000
2	14	0.000170.000340.000030.000000.000000.00000
2	15	0.000140.000230.000030.000000.000000.00000
2	16	0.000060.000200.000090.000000.000000.00000
3	1	0.000570.000800.000310.000000.000000.00000
3	2	0.000940.001600.000290.000030.000000.00000
3	3	0.001320.004520.000740.000030.000000.00000
3	4	0.001720.007300.000230.000000.000000.00000
3	5	0.001490.006440.000310.000000.000000.00000
3	6	0.001060.005690.000230.000000.000000.00000
3	7	0.000540.004840.000030.000000.000000.00000
3	8	0.000740.006730.000170.000000.000000.00000
3	9	0.000720.006150.001170.000030.000000.00000
3	10	0.000200.002660.001370.000030.000000.00000
3	11	0.000290.001090.000570.000030.000000.00000
3	12	0.000170.001060.001060.000000.000000.00000
3	13	0.000110.001630.002290.000060.000000.00000
3	14	0.000170.001630.001570.000000.000000.00000
3	15	0.000110.000720.000770.000060.000000.00000
3	16	0.000200.000570.000400.000000.000000.00000
4	1	0.005470.007870.007380.002720.000110.00000
4	2	0.004150.008990.006730.003610.000630.00000
4	3	0.003290.007980.004240.000600.000000.00000
4	4	0.002430.005950.002060.000030.000000.00000

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

(TA-53 data continued)

4	5	0.002260.004350.001030.000000.000000.00000
4	6	0.001720.003290.000540.000000.000000.00000
4	7	0.001800.004290.001120.000110.000030.00003
4	8	0.001920.010190.008010.002290.000600.00017
4	9	0.002170.015110.029390.012590.000490.00003
4	10	0.001830.012360.031620.013710.002350.00034
4	11	0.001830.014880.020030.007560.000830.00020
4	12	0.001720.006270.010450.006670.000720.00009
4	13	0.002260.005900.014800.005980.000630.00011
4	14	0.002630.005780.009840.004810.000720.00000
4	15	0.003520.004210.005350.003980.001000.00023
4	16	0.004890.004720.003660.001600.000310.00006
5	1	0.008530.011250.002060.000000.000000.00000
5	2	0.007670.010820.004410.000030.000000.00000
5	3	0.005010.005810.001950.000030.000000.00000
5	4	0.003290.002800.000290.000000.000000.00000
5	5	0.002720.001830.000000.000000.000000.00000
5	6	0.002260.001460.000000.000000.000000.00000
5	7	0.001800.001750.000110.000000.000000.00000
5	8	0.002090.003260.002800.000400.000000.00000
5	9	0.002460.009100.005410.000290.000000.00000
5	10	0.002920.022980.023120.000460.000000.00000
5	11	0.003030.028990.013510.000140.000000.00000
5	12	0.003060.021840.016050.000140.000000.00000
5	13	0.003580.022870.018460.000000.000000.00000
5	14	0.005040.018030.003150.000000.000000.00000
5	15	0.006980.009990.002580.000090.000000.00000
5	16	0.008040.010530.002660.000060.000000.00000
6	1	0.003660.001170.000000.000000.000000.00000
6	2	0.002950.001490.000060.000000.000000.00000
6	3	0.003550.000940.000000.000000.000000.00000
6	4	0.002580.000310.000000.000000.000000.00000
6	5	0.002060.000170.000000.000000.000000.00000
6	6	0.002030.000290.000000.000000.000000.00000
6	7	0.002200.000570.000030.000000.000000.00000
6	8	0.002600.001370.000000.000000.000000.00000
6	9	0.002720.002260.000140.000000.000000.00000
6	10	0.003210.003610.000260.000000.000000.00000
6	11	0.002350.001570.000000.000000.000000.00000
6	12	0.001720.004150.000830.000000.000000.00000
6	13	0.001430.003950.000890.000000.000000.00000
6	14	0.002030.004320.000230.000000.000000.00000
6	15	0.002150.000690.000000.000000.000000.00000
6	16	0.003580.000920.000030.000000.000000.00000

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

CAP88 Input Data for 1999 TA-54 Meteorological Tower

```
1  1  0.000950.000230.000000.000000.000000.00000
1  2  0.001230.000720.000000.000000.000000.00000
1  3  0.002750.001830.000000.000000.000000.00000
1  4  0.005900.004240.000000.000000.000000.00000
1  5  0.010200.008080.000060.000000.000000.00000
1  6  0.010430.006420.000000.000000.000000.00000
1  7  0.007220.003750.000000.000000.000000.00000
1  8  0.004330.003240.000000.000000.000000.00000
1  9  0.002440.002520.000000.000000.000000.00000
1 10  0.001430.000830.000000.000000.000000.00000
1 11  0.000690.000720.000030.000000.000000.00000
1 12  0.000690.000320.000000.000000.000000.00000
1 13  0.000660.000230.000000.000000.000000.00000
1 14  0.000370.000340.000030.000000.000000.00000
1 15  0.000400.000340.000000.000000.000000.00000
1 16  0.000600.000370.000000.000000.000000.00000
2  1  0.000090.000260.000000.000000.000000.00000
2  2  0.000260.000570.000000.000000.000000.00000
2  3  0.000540.001720.000000.000000.000000.00000
2  4  0.001550.003320.000030.000000.000000.00000
2  5  0.001180.002750.000060.000000.000000.00000
2  6  0.000970.001890.000030.000000.000000.00000
2  7  0.000720.002010.000000.000000.000000.00000
2  8  0.000430.002810.000030.000000.000000.00000
2  9  0.000260.002640.000000.000000.000000.00000
2 10  0.000230.001380.000030.000000.000000.00000
2 11  0.000140.000520.000000.000000.000000.00000
2 12  0.000000.000290.000030.000000.000000.00000
2 13  0.000030.000170.000030.000000.000000.00000
2 14  0.000030.000260.000110.000000.000000.00000
2 15  0.000060.000140.000000.000000.000000.00000
2 16  0.000060.000200.000000.000000.000000.00000
3  1  0.000290.000570.000030.000000.000000.00000
3  2  0.000400.001890.000060.000000.000000.00000
3  3  0.001150.005850.000260.000000.000000.00000
3  4  0.001060.004990.000600.000000.000000.00000
3  5  0.000720.002150.000090.000000.000000.00000
3  6  0.000720.001350.000110.000000.000000.00000
3  7  0.000520.001810.000030.000000.000000.00000
3  8  0.000540.004010.000490.000000.000000.00000
3  9  0.000520.007540.001030.000000.000000.00000
3 10  0.000320.005160.001090.000000.000000.00000
3 11  0.000060.001950.000340.000000.000000.00000
3 12  0.000230.000690.000540.000030.000000.00000
3 13  0.000290.001320.002180.000000.000000.00000
3 14  0.000140.001060.002440.000060.000000.00000
3 15  0.000170.000460.000660.000090.000000.00000
3 16  0.000340.000290.000200.000030.000000.00000
4  1  0.002090.002320.001980.001830.000060.00000
4  2  0.002090.007710.006020.002350.000340.00000
4  3  0.002750.012670.006880.000110.000000.00000
4  4  0.002060.004470.000890.000000.000000.00000
```

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

(TA-54 data continued)

4	5	0.001600.001180.000000.000000.000000.00000
4	6	0.001550.000230.000000.000030.000000.00000
4	7	0.001120.001290.000370.000090.000000.00000
4	8	0.001580.003300.004240.002410.000460.00000
4	9	0.001490.009570.019860.009430.000430.00000
4	10	0.001430.013500.041130.019690.002720.00023
4	11	0.001000.006100.011660.007740.001030.00020
4	12	0.001260.004590.006790.003470.000430.00000
4	13	0.001200.003960.009290.002440.000340.00000
4	14	0.001750.003810.008110.001810.000030.00000
4	15	0.001180.003120.005360.001810.000090.00000
4	16	0.001660.001810.001890.001180.000230.00000
5	1	0.006390.006760.003840.000140.000000.00000
5	2	0.003610.008540.005790.000200.000000.00000
5	3	0.003380.005300.001200.000000.000000.00000
5	4	0.002520.001600.000090.000000.000000.00000
5	5	0.001260.000230.000000.000000.000000.00000
5	6	0.000970.000000.000000.000000.000000.00000
5	7	0.000860.000400.000030.000000.000000.00000
5	8	0.001030.000830.000110.000000.000000.00000
5	9	0.001150.003870.001090.000060.000000.00000
5	10	0.001830.013960.019570.001400.000000.00000
5	11	0.002060.017830.022440.000370.000000.00000
5	12	0.002720.011550.002610.000000.000000.00000
5	13	0.003840.017020.001580.000000.000000.00000
5	14	0.006680.020350.001810.000000.000000.00000
5	15	0.008480.028570.001120.000000.000000.00000
5	16	0.011350.014100.001720.000090.000000.00000
6	1	0.007390.009090.000230.000000.000000.00000
6	2	0.006360.005850.000320.000000.000000.00000
6	3	0.003010.003380.000030.000000.000000.00000
6	4	0.001350.000370.000000.000000.000000.00000
6	5	0.000400.000000.000000.000000.000000.00000
6	6	0.000540.000000.000000.000000.000000.00000
6	7	0.000400.000030.000000.000000.000000.00000
6	8	0.000230.000110.000000.000000.000000.00000
6	9	0.000770.000630.000030.000000.000000.00000
6	10	0.001890.004160.000340.000000.000000.00000
6	11	0.002550.013700.002410.000000.000000.00000
6	12	0.003840.023300.004500.000000.000000.00000
6	13	0.008710.032440.002780.000000.000000.00000
6	14	0.016420.024620.000030.000000.000000.00000
6	15	0.015450.037520.000430.000000.000000.00000
6	16	0.010520.016050.001350.000000.000000.00000

Table 8. 40-61.94(b)(7) User-supplied Data—Population Array

Projected 1999 Population within 80 km of Los Alamos National Laboratory

	Distance from TA53 (km)														
Direction	**0.8-1.0**	**1.0-1.5**	**1.5-2.0**	**2.0-2.5**	**2.5-3.0**	**3.0-3.5**	**3.5-4.0**	**4.0-5.0**	**5.0-6.0**	**6.0-7.0**	**7.0-8.0**	**8.0-10**	**10-20**	**20-30**	**30-40**	**40-80**
N	6	17	55	26	51	80	92	137	0	0	0	0	17	107	1113	1647
NNW	5	16	47	227	166	88	254	274	20	0	0	0	8	23	306	546
NW	5	11	20	56	315	379	205	669	409	388	52	0	2	28	58	1194
WNW	0	6	9	15	67	207	808	1034	1843	2581	714	0	0	29	34	2888
W	0	0	3	8	13	17	94	161	16	0	0	0	8	71	321	156
WSW	0	8	10	10	7	6	3	0	0	0	0	1	8	40	444	2622
SW	0	9	4	0	0	0	0	0	0	0	1	3	3	0	0	2643
SSW	0	5	0	0	0	0	0	0	0	0	0	32	3	944	1410	65977
S	0	5	0	0	0	0	0	0	0	0	0	18	6	18	164	3695
SSE	0	6	0	0	0	0	0	0	0	331	216	308	52	320	5829	2805
SE	0	2	0	0	0	0	0	0	0	1527	3266	556	0	1064	75112	8463
ESE	0	0	0	0	0	1	0	0	0	0	0	10	12	723	8286	3094
E	0	0	0	0	0	0	0	0	0	0	1	0	1769	4215	410	546
ENE	1	0	0	0	0	0	0	0	0	0	0	0	2327	4805	4104	3332
NE	4	9	2	0	0	0	0	0	0	0	0	0	1441	16913	2988	6898
NNE	6	17	51	7	37	31	24	23	0	0	0	0	16	2791	458	1139

Table 9. 40-61.94(b)(7) User-Supplied Data—Radionuclide Emissions

ESIDNUM	Nuclide	Emission(Ci)
03002914	Th-230	9.54e-09
03002915	Pu-239	1.36e-08
03002915	U-238	1.57e-08
03002915	Th-234	1.57e-08
03002915	Pa-234m	1.57e-08
03002919	Am-241	2.37e-06
03002919	Pu-238	2.16e-06
03002919	Pu-239	1.80e-05
03002919	U-234	1.02e-08
03002920	Am-241	1.66e-07
03002920	Pu-238	1.51e-08
03002920	Pu-239	4.10e-07
03002923	Pu-239	3.20e-08
03002923	Tc-99	9.22e-04
03002923	Th-230	2.12e-08
03002923	U-238	9.01e-08
03002923	Th-234	9.01e-08
03002923	Pa-234m	9.01e-08
03002923	U-234	2.94e-06
03002923	U-235	9.74e-08
03002923	Th-231	9.74e-08
03002924	Am-241	1.33e-08
03002924	Pu-238	5.02e-08
03002924	Pu-239	3.23e-08
03002924	Th-228	1.16e-07
03002924	Th-230	3.36e-08
03002924	U-234	2.86e-06
03002924	U-235	4.06e-09
03002924	Th-231	4.06e-09
03002928	Pu-238	3.87e-08
03002928	U-234	1.68e-08
03002929	Am-241	2.36e-08
03002929	Pu-238	1.27e-08
03002929	Pu-239	2.42e-07
03002929	Th-230	2.56e-08
03002929	U-234	2.08e-08
03002932	None detected	None
03002933	U-234	1.59e-08
03002937	U-234	5.93e-10
03002944	U-234	2.16e-08

Table 9. 40-61.94(b)(7) User-Supplied Data—Radionuclide Emissions (continued)

ESIDNUM	Nuclide	Emission(Ci)
03002945	None detected	None
03002946	U-234	1.53e-08
03003501	Th-230	6.43e-09
03003501	U-235	4.55e-08
03003501	Th-231	4.55e-08
03003501	U-238	1.33e-08
03003501	Th-234	1.33e-08
03003501	Pa-234m	1.33e-08
03003501	U-234	1.18e-06
03010222	Th-228	2.52e-09
03010222	Th-230	7.80e-10
03010222	U-235	1.17e-08
03010222	Th-231	1.17e-08
03010222	Th-232	5.42e-10
03010222	U-238	1.33e-08
03010222	Th-234	1.33e-08
03010222	Pa-234m	1.33e-08
03010222	U-234	3.00e-07
16020504	H-3	1.37e+02
16020504	H-3	2.44e+01
21015505	H-3	1.69e+01
21015505	H-3	4.89e+01
21020901	H-3	3.28e+02
21020901	H-3	9.23e+01
33008606	H-3	2.28e+02
33008606	H-3	7.12e+02
41000417	H-3	1.11e+01
41000417	H-3	1.47e+00
48000107	As-73	1.83e-05
48000107	As-74	4.49e-05
48000107	Br-77	1.15e-05
48000107	Ga-68	1.71e-03
48000107	Ge-68	1.71e-03
48000107	Se-75	3.50e-04
48000154	None detected	None
48000160	Ga-68	1.54e-05
48000160	Ge-68	1.54e-05
48000160	P-32	5.07e-06
48000160	Si-32	5.07e-06
48000160	U-238	6.05e-10

Table 9. 40-61.94(b)(7) User-Supplied Data—Radionuclide Emissions (continued)

ESIDNUM	Nuclide	Emission(Ci)
48000160	Th-234	6.05e-10
48000160	Pa-234m	6.05e-10
50000102	Am-241	1.31e-07
50000102	Pu-238	3.38e-08
50000102	Pu-239	1.76e-08
50000102	Th-230	3.72e-08
50003701	U-238	2.30e-09
50003701	Th-234	2.30e-09
50003701	Pa-234m	2.30e-09
50003701	U-234	1.68e-08
50006903	Pu-238	9.94e-11
53000303	Ar-41	1.50e-01
53000303	C-11	4.11e+00
53000303	H-3	1.80e+00
53000702	Ar-41	1.29e+01
53000702	Br-76	2.32e-04
53000702	Br-82	6.27e-04
53000702	C-10	4.24e-02
53000702	C-11	2.62e+02
53000702	Co-60	3.97e-06
53000702	H-3	4.46e-01
53000702	Hg-197	1.60e-03
53000702	N-13	1.59e+00
53000702	N-16	1.50e-02
53000702	O-14	1.00e-01
53000702	O-15	1.89e+01
55000415	Am-241	5.39e-08
55000415	Pu-239	4.72e-08
55000415	U-238	2.99e-08
55000415	Th-234	2.99e-08
55000415	Pa-234m	2.99e-08
55000416	H-3	1.45e+00
55000416	H-3	3.09e-01
55000416	Pu-239	1.60e-08
55000416	U-238	2.14e-08
55000416	Th-234	2.14e-08
55000416	Pa-234m	2.14e-08
55000416	U-234	1.97e-08

Table 10. 40-61.94(b)(7) User-Supplied Data—Modeling Parameters for LANL Non-Point Sources

LANL Air Activation Sources

Source	Radionuclide	Emissions (Ci)	Area of Source (m^2)	Distance to LANL Maximum Dose Location (m)	Direction to LANL Maximum Dose Location
TA-53-Switchyard	Ar-41	0.7	484	5,420	W
	C-11	17.1	484	5,420	W
TA-18	Ar-41	0.49	31,400	5,865	NW

Table 11. 40-61.94(b)(7) User-Supplied Data—Radionuclides Not Included in CAP88

Source	ESIDNUM	Radionuclide	Emissions (Ci)	Dose at LANL Receptor (mrem)	Dose at Facility Receptor (mrem)
TA-48-1-7	48000107	As-73	1.83E-05	1.36E-07	1.45E-06
		As-74	4.49E-05	1.68E-06	1.82E-05
		Br-77	1.15E-05	2.26E-08	2.38E-07
		Ga-68	1.71E-03	1.54E-07	1.65E-06
		Ge-68	1.71E-03	7.00E-04	7.50E-03
		Se-75	3.50E-04	1.71E-04	1.88E-03
TA48-1-60	48000160	Ga-68	1.54E-05	1.43E-09	1.54E-08
		Ge-68	1.54E-05	6.50E-06	7.00E-05
		Si-32	5.07E-06	1.39E-05	1.52E-04
TA-53-7-2	53000702	Br-76	2.32e-04	3.17E-08	1.46E-06
		C-10*	4.24E-02	2.06E-22	1.58E-08
		Hg-197	1.60e-03	5.82E-07	2.75E-05
		N-16*	1.50E-02	0.00E-00	1.19E-12
		O-14*	1.00E-01	2.75E-11	1.75E-03

*As discussed in Section III of this report under the subheading “Radionuclides Not Included in CAP88,” the Air Quality group has added these radionuclides to the CAP88 database.

Table 12. 40-61.94(b)(7) User-Supplied Data—Supplemental Dose Factors

Radionuclide	Ci per m^3 per 10 mrem	Reference
As-73	1.10E-11	EPA (1989)
As-74	2.20E-12	EPA (1989)
Br-76	1.23E-10	LANL (2000)
Br-77	4.20E-11	EPA (1989)
C-10	1.13E-11	DOE/LANL (1998)
Ga-68	9.10E-10	LANL(2000)
Ge-68	2.00E-13	LANL(2000)
Hg-197	8.30E-11	EPA (1989)
N-16	3.43E-12	DOE/LANL (1998)
O-14	5.29E-12	DOE/LANL (1998)
Se-75	1.70E-13	EPA (1989)
Si-32	3.40E-14	LANL(2000)

Department of Energy, letter to Mr. George P. Brozowski, U.S. Environmental Protection Agency Region 6 from Mr. Steve Fong, DOE Los Alamos Area Office, Aug 18, 1998.

Los Alamos National Laboratory, internal memo to Mr. Scott Miller from Keith W. Jacobson, Air Quality Group memo ESH17:900-260, April 28, 2000.

U.S. Environmental Protection Agency, "National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities," Code of Federal Regulations, Title 40, Part 61.90, Table 2 of Appendix E to Subpart H (1989).

Table 13. FFCA Environmental Data

1999 Effective Dose Equivalent (net in mrem) at Air Sampling Locations Around LANL

Site # and Name		Am-241	H-3	Pu-238	Pu-239	U-234	U-235	U-238	Rounded Total
06	48th Street	0.008	0.004	0.000	0.002	0.000	0.001	0.000	0.02
07	Shell Station	0.006	0.008	0.002	0.034	0.038	0.003	0.033	0.12
08	LA McDonalds	0.006	0.016	-0.001	-0.001	0.005	0.000	0.006	0.03
09	Los Alamos Airport	0.005	0.023	0.000	0.006	0.003	0.001	0.004	0.04
10	East Gate	0.005	0.024	0.000	0.003	0.006	0.001	0.008	0.05
11	Well PM-1 (E. Jemez Road)	-0.002	0.012	0.001	0.003	0.002	0.001	0.001	0.02
12	Royal Crest Trailer Court	0.001	0.010	0.003	0.000	0.007	0.000	0.010	0.03
13	Rocket Park	0.004	0.022	0.001	0.000	0.003	0.001	0.003	0.03
14	Pajarito Acres	0.004	0.014	0.000	0.001	0.002	0.001	0.006	0.03
15	White Rock Fire Station	0.004	0.013	0.001	0.001	0.007	0.002	0.008	0.04
16	White Rock Nazarene Church	-0.001	0.022	0.000	0.002	0.004	0.001	0.004	0.03
20	TA-21 Area B	0.006	0.029	0.000	0.005	0.012	0.001	0.011	0.06
32	County Landfill	0.033	0.013	0.001	0.017	0.067	0.003	0.062	0.20
60	LA Canyon	0.004	0.009	0.001	0.003	0.007	0.002	0.006	0.03
61	LA Hospital	0.004	0.007	0.001	0.006	0.016	0.002	0.013	0.05
62	Crossroads Bible Church	0.002	0.012	0.001	0.001	0.003	0.001	0.004	0.02
63	Monte Rey South	0.002	0.014	0.002	0.002	0.004	0.001	0.007	0.03

Table 14. FFCA Analytical Completeness Summary—Air Sampler Operation

Site #	Site Name	% Run Time	Analysis	% Analytical Completeness
06	48th Street	99.8		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
07	Gulf/Exxon/Shell Station	98.9		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
08	McDonalds	100.3		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
09	Los Alamos Airport	100.1		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
10	Eastgate	99.8		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
11	Well PM-1 (E. Jemez Road)	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0

Table 14. FFCA Analytical Completeness Summary—Air Sampler Operation (continued)

Site #	Site Name	% Run	Analysis	% Analytical Completeness
12	Royal Crest Trailer Court	98.1		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
13	Rocket Park	99.8		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
14	Pajarito Acres	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
15	White Rock Fire Station	99.6		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
16	White Rock Nazarene Church	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
20	TA-21 Area B	98.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0

Table 14. FFCA Analytical Completeness Summary—Air Sampler Operation (continued)

Site #	Site Name	% Run	Analysis	% Analytical Completeness
32	County Landfill (TA-48)	99.8		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
60	LA Canyon	100.1		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
61	LA Hospital	100.3		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
62	Crossroads Bible Church	100.3		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0
63	Monte Rey South	100.0		
			Am-241	100.0
			H-3	100.0
			Pu-238	100.0
			Pu-239	100.0
			U-234	100.0
			U-235	100.0
			U-238	100.0

Table 15. LANSCE Monthly Assessments and Summary

Description	ESIDNUM	Dose at East Gate Receptor
LANSCE Stack-January	53000303	2.47E-04
LANSCE Stack-February	53000303	4.40E-06
LANSCE Stack-May	53000303	2.91E-04
LANSCE Stack-August	53000303	8.41E-06
LANSCE Stack-September	53000303	3.58E-05
LANSCE Stack-October	53000303	2.87E-05
LANSCE Stack-November	53000303	1.18E-05
LANSCE Stack-December	53000303	1.46E-05
LANSCE Stack-PVAP*	53000303	7.57E-05
LANSCE Stack-January	53000702	4.14E-02
LANSCE Stack-February	53000702	6.62E-05
LANSCE Stack-May	53000702	1.69E-02
LANSCE Stack-June	53000702	5.23E-03
LANSCE Stack-August	53000702	8.66E-03
LANSCE Stack-July	53000702	6.75E-03
LANSCE Stack-September	53000702	1.01E-02
LANSCE Stack-October	53000702	2.95E-03
LANSCE Stack-November	53000702	3.19E-03
LANSCE Stack-December	53000702	1.86E-03
LANSCE Stack-PVAP*	53000702	4.84E-05
LANSCE Non-CAP88 Radionuclides*	53000702	2.90E-05
LANSCE Fugitive Emissions*	53000303	1.31E-02
LANSCE Summary		**1.11E-01**

*Annual Value

Table 16. 40-61.92 Effective Dose Equivalent at Selected Public Locations

	Location	Easting	Northing	Nearest AIRNET Location Sampler Name	#	Selected By	LANL- Wide EDE*
1	Los Alamos High School	1,620,570	1,777,805	LA Hospital	61	CAB†	5.74E-02
2	Los Alamos Middle School	1,626,621	1,780,872	Barranca School‡	04	CAB	2.20E-02
3	White Rock Pinon School	1,651,290	1,754,437	Rocket Park	13	CAB	5.96E-02
4	Tsankawi Visitor Center	1,648,105	1,758,380	Well PM-1	11	CAB	3.76E-02
5	East Road Condos	1,628,580	1,775,750	Cross. Bible Church	62	CAB	2.98E-02
6	Royal Crest Trailer Court - West	1,624,256	1,773,065	Royal Crest Tlr. Crt.	12	CAB	4.13E-02
7	2470 East Gate (NNE sector)	1,638,825	1,774,097	East Gate	10	LANL	1.87E-01
8	County Landfill Office	1,620,569	1,774,763	County Landfill	32	LANL	2.10E-01
9	Los Alamos Shell	1,623,892	1,775,889	Shell Station	07	LANL	1.29E-01
10	Los Alamos Airport	1,632,902	1,776,247	Los Alamos Airport	09	LANL	6.98E-02
11	Residence on Nambe Loop	1,621,568	1,776,046	TA-21 Area B	20	LANL	6.94E-02
12	Los Alamos Hospital	1,619,848	1,776,089	LA Hospital	61	LANL	6.32E-02
13	White Rock Fire Station	1,653,579	1,756,630	WR Fire Station	15	LANL	6.32E-02
14	Business on Trinity Drive	1,626,228	1,775,088	LA McDonald's	08	LANL	4.19E-02
15	Bandelier Fire Lookout	1,635,700	1,739,005	Bandelier‡	17	LANL	6.49E-02
16	Residence on Monte Rey South	1,647,976	1,750,376	Monte Rey South	63	LANL	4.43E-02
17	Ponderosa Campground	1,608,575	1,758,460	TA-49‡	26	LANL	4.03E-02
18	Los Alamos Ice Rink	1,617,852	1,775,692	LA Canyon	61	LANL	3.71E-02
19	Residence on Fairway	1,618,602	1,776,052	48th Street	06	LANL	2.72E-02
20	San Ildefonso Pueblo	1,678,656	1,780,236	San Ildefonso‡	41	CAB	5.57E-02
21	Santa Clara Pueblo	1,688,500	1,808,360	Espanola‡	01	CAB	4.44E-02
22	Abiquiu	1,620,400	1,894,600	Espanola‡	01	CAB	4.38E-02
23	Residence at East Gate (N sector)	1,638,616	1,774,231	East Gate	10	LANL	1.54E-01
24	Business at East Gate (NE sector)	1,640,230	1,774,090	East Gate	10	LANL	1.40E-01
25	Royal Crest Trailer Court - East	1,625,778	1,772,955	Royal Crest Trl. Crt.	12	LANL	4.15E-02

*Note: To allow for more meaningful comparisons, these doses do not include the estimated contribution from unmonitored point sources.
†Citizens' Advisory Board
‡Note: These samplers are not part of the regular NESHAP compliance network for LANL.

Table 17. 40-61.92 Highest Effective Dose Equivalent Summary

ESIDNUM	Description	Dose for Release Site Receptor	Dose at LANL Receptor	Dose at East Gate Receptor
03002914	CMR Stack	1.59E-06	1.59E-06	1.64E-07
03002915	CMR Stack	2.52E-06	2.52E-06	3.74E-07
03002919	CMR Stack	2.99E-03	2.99E-03	4.55E-04
03002920	CMR Stack	1.10E-04	1.10E-04	1.50E-05
03002923	CMR Stack	1.60E-04	1.60E-04	2.49E-05
03002924	CMR Stack	1.95E-04	1.95E-04	2.75E-05
03002928	CMR Stack	4.81E-06	4.81E-06	8.26E-07
03002929	CMR Stack	3.84E-05	3.84E-05	6.39E-06
03002932	CMR Stack	0.00E+00	0.00E+00	0.00E+00
03002933	CMR Stack	8.56E-07	8.56E-07	1.27E-07
03002937	CMR Stack	4.62E-08	4.62E-08	5.32E-09
03002944	CMR Stack	1.14E-06	1.14E-06	1.77E-07
03002945	CMR Stack	0.00E+00	0.00E+00	0.00E+00
03002946	CMR Stack	9.06E-07	9.06E-07	1.33E-07
03003501	Press Building Stack	1.42E-04	1.42E-04	1.25E-05
03010222	Shops Addition Stack	2.63E-05	2.63E-05	2.95E-06
16020504	WETF Stack	6.35E-03	1.34E-03	7.60E-04
18000001	TA-18 Diffuse	2.85E-05	1.47E-06	2.85E-05
21015505	TSTA Stack	2.29E-03	3.04E-04	1.79E-03
21020901	TSFF Stack	1.64E-02	1.85E-03	1.33E-02
33008606	HP-Site Stack	2.08E-02	1.74E-03	3.68E-03
41000417	W-Site Stack	1.62E-03	1.15E-04	1.93E-04
48000107	Radiochemistry Stack/Non-CAP88 Radionuclides	9.40E-03	8.73E-04	9.28E-04
48000154	Radiochemistry Stack	0.00E+00	0.00E+00	0.00E+00
48000160	Radiochemistry Stack	7.99E-08	7.71E-09	7.70E-09
48000160	Radiochemistry Stack/Non-CAP88 Radionuclides	2.22E-04	2.04E-05	2.07E-05
50000102	Waste Management Stack	2.07E-05	2.23E-06	6.61E-06
50003701	Waste Management Stack	7.37E-07	8.52E-08	1.99E-07
50006903	Waste Management Stack	1.08E-08	1.22E-09	2.56E-09
53000303	LANSCE-Annual	7.96E-04	1.22E-05	7.96E-04
530003sy	LANSCE Fugitive-Switch Yard	1.31E-02	3.18E-05	1.31E-02

Table 17. 61.92 Highest Effective Dose Equivalent Summary (continued)

ESIDNUM	Description	Dose for Release Site Receptor	Dose at LANL Receptor	Dose at East Gate Receptor
53000702	LANSCE-Annual	1.02E-01	4.16E-04	1.02E-01
53000702	LANSCE Stack/Non-CAP88 Radionuclides	2.90E-05	6.14E-07	2.90E-05
55000415	Plutonium Facility Stack	2.37E-05	2.13E-06	3.72E-06
55000416	Plutonium Facility Stack	1.07E-04	1.25E-05	2.29E-05
99000000	Unmonitored Stacks-Gross	1.10E-01	1.10E-01	1.10E-01
99000010	Air-Sampler Net Dose	2.00E-01	2.00E-01	5.00E-02
	Total	**4.87E-01**	**3.20E-01**	**2.97E-01**

References

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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 USC., 001).

Signature: David A. Gurulé Date: 6/29/00

David A. Gurulé, P.E., Owner
Area Manager, Los Alamos Area Office
U.S. Department of Energy

Signature: Date: June 28, 2000

Dennis J. Erickson, Operator
Director, Environment, Safety and Health Division
Los Alamos National Laboratory

1998 LANL Radionuclide Emissions Report Errata as noted by J.C. Lochamy and K.W. Jacobson

Table 9:

The records beginning with "53DIFFUS" should not have been included on page 5 of Table 9, as they were correctly listed in Table 10.

Table 12:

The "rounded total" column in Table 12 included tritium doses from both the old and new methods for calculating tritium concentrations. Tritium doses for only the new method should have been included.

Table 16:

The dose for the "Unmonitored Stacks-gross" source is listed as 2.71e-2 on page 2 of Table 16, it should have read 2.71e-1.

certification statement:

The last word in the first paragraph of the Certification Statement should read "1001", not "001"

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