LA-13353-ENV

U.S. Department of Energy Report
1996 LANL Radionuclide Air Emissions

Los Alamos
NATIONAL LABORATORY

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Prepared by
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Compliance Assessment:

1996 EDE: 1.93 mrem

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LIST OF ACRONYMS

DOE	Department of Energy
EDE	effective dose equivalent
EPA	Environmental Protection Agency
ES	exhaust stack (identification number)
FE	fan exhaust (identification number)
FFCA	Federal Facilities Compliance Agreement
HEPA	high-efficiency particulate air (filter)
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
MEI	maximum exposed individual
ND	no detectable (emissions)
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 the Los Alamos National Laboratory (LANL) in 1996. This information is required under the Clean Air Act and is being reported to the U.S. Environmental Protection Agency (EPA). The effective dose equivalent (EDE) to a hypothetical maximum exposed individual (MEI) of the public was calculated, using procedures specified by the EPA and described in this report. That dose was 1.93 mrem for 1996. Emissions of ^{11}C, ^{13}N, and ^{15}O from a 1-mA, 800 MeV proton accelerator contributed over 92% of the EDE to LANL's MEI. Using CAP88, the EPA's dose assessment model, more than 86% of the total dose received by the MEI was via the air immersion pathway.

Section I. Facility Information

Location

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).

Source Description

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 most important facilities involved in releases 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 Section II in Tables 1 and 2. Some of the sources described below are characterized as nonpoint. Beginning in 1995, air sampling results from LANL's air sampling network were used, with EPA approval, to characterize potential off-site doses due to diffuse and fugitive emissions from nonpoint sources.

The radionuclides handled and released from point sources at LANL in calendar year (CY) 1996 are listed in Section II, Table 3. Tritium is released as tritium oxide and elemental tritium. Plutonium contains indeterminate traces of ^{241}Am, a transformation product of ^{241}Pu. Some of the uranium emissions are from open-air explosive tests involving depleted uranium. The most important facilities regarding airborne emissions are the following:

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

TA-15-PHERMEX, 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.

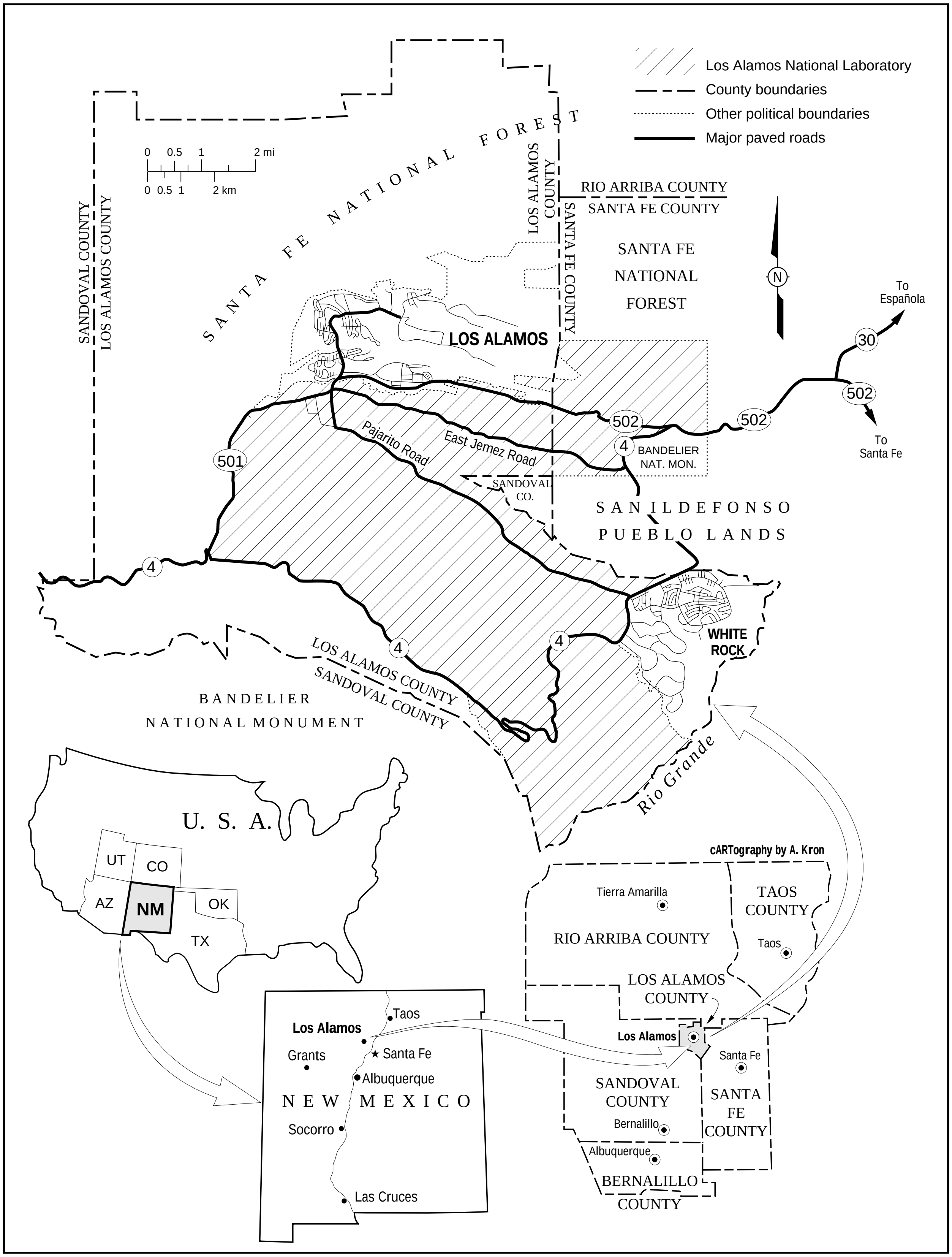

Fig. 1. Regional location of Los Alamos.

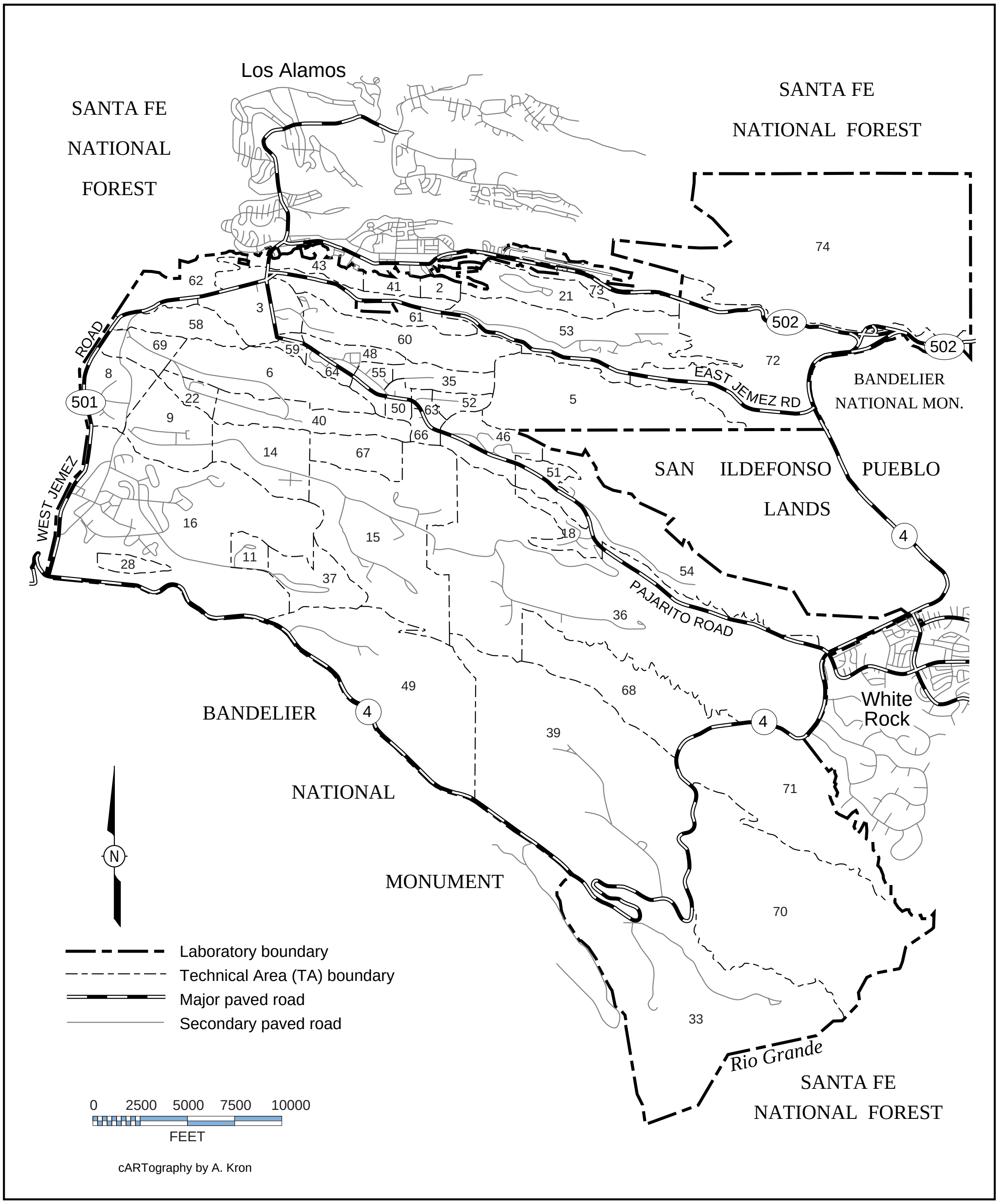

Fig. 2. Technical Areas (TAs) of Los Alamos National Laboratory in relation to surrounding landholdings.

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-21-324: This building houses a filtration system servicing a facility that formerly performed plutonium and uranium processing operations and in 1995 performed a variety of chemistry operations. This facility was torn down in 1996.

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 consist of a low-level liquid waste treatment plant. Also, there is a wastewater outfall from TA-50-1 that may create a diffuse source of airborne tritium.

TA-50-37: This controlled air incinerator was decommissioned in 1996 and is no longer active.

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. Airborne radioactive emissions result from the proton and secondary particle beams passing through and activating air in the beam stop and experimental areas. The great majority of the emissions are short-lived activation products such as ^{11}C, ^{13}N, and ^{15}O. Most of the activated air is vented through the main stack; however, a fraction of the activated air becomes a fugitive emission from the beam target areas. In addition, there are three wastewater lagoons at TA-53 that have received water containing radioactivity from the accelerator. Evaporation of water from the lagoons results in a diffuse release of tritium into the air.

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 H-3.

TA-55-4: The functional purposes of this facility are to perform special nuclear materials research to develop, demonstrate, and exchange technology and to provide production support to the national defense and energy programs.

Section II. Air Emissions Data

Point Sources

Table 1 lists the sampled point sources at LANL. Each entry is identified by technical area and building. Release points at each building are labeled with the old fan exhaust (FE) numbers. Building TA-3-29, for example, has two stacks, FE-14 and FE-16. Additional LANL facilities are described in Appendix A. Also shown next to the old FE numbers are the new exhaust stack numbers.

Table 1 also lists the type of 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, where 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 given in the last column of Table 1. The nearest receptor can be a residence, school, business, or office. The distance to the nearest farm producing milk is 20 km from the Laboratory boundary. The nearest farms producing meat and vegetables adjoin the Laboratory's eastern boundary.

Table 2 lists the unsampled release points at LANL. This is the third year that unsampled release points have been inventoried, characterized, and added to the LANL radionuclide air emissions report. These stacks and vents (listed as FE numbers) are points from which radioactive material could possibly have been released to the atmosphere. Emissions estimates and associated dose to LANL's maximum exposed individual (MEI) for the unsampled point sources were conservatively estimated using conservative methodology and are provided in the report "LANL 1996 Radionuclide Point Source Inventory Update" (Radian 1997). Per 40 CFR 61.93(b)(4)(i), sampling of these release points is not required because each release point has a potential calculated dose from emissions of less than 0.1 mrem/yr. In fact, the maximum amount of radioactive material that could have been emitted during normal operations from all of the unsampled release points together would contribute less than 1% of the 10 mrem/yr dose limit to any member of the public.

Table 1. Sampled Release Point Data

Technical Area and Building	Sampled Release Point	Exhaust Stack ID	Type of Control	Efficiency Performance Criteria	Stages	Distance to Nearest Receptor (m)
TA-3-29-2	FE-14[a]	03002914	HEPA	>99.95	2	999
	FE-15[a]	03002915	HEPA	>99.95	2	999
TA-3-29-3	FE-19[a]	03002919	Aerosol 95	80.00	1	1,139
	FE-20[a]	03002920	Aerosol 95	80.00	1	1,139
TA-3-29-4	FE-23[a]	03002923	Aerosol 95	80.00	1	1,010
	FE-24[a]	03002924	Aerosol 95	80.00	1	1,010
TA-3-29-5	FE-28[a]	03002928	HEPA	99.95	2	1,149
	FE-29[a]	03002929	HEPA	99.95	2	1,149
TA-3-29-7	FE-32[a]	03002932	HEPA	>99.95	2	1,165
	FE-33[a]	03002933	HEPA	>99.95	2	1,165
TA-3-29-9	FE-44[a]	03002944	Aerosol 95	80.00	1	1,197
	FE-45[a]	03003945	Aerosol 95	80.00	1	1,198
	FE-46[a]	03002946	Aerosol 95	80.00	1	1,197
TA-3-29-V	FE-37	03002937	HEPA	>99.95	2	1,113
TA-3-35	FE-1 (2)[a,b]	03003501	HEPA	99.95	1	1,129
TA-3-102	FE-18[a]	03010222	HEPA	99.95	1	1,164
	FE-25[c]	03010225	HEPA	99.95	1	1,164
TA-3-141	FE-6[c]	03014106	None	N/A	N/A	941
	FE-9[c]	03014109	None	N/A	N/A	941
	FE-10[c]	03014110	None	N/A	N/A	941
TA-16-205	FE-4[a]	16020504	None	N/A	N/A	710
TA-21-155N	FE-5[a]	21015505	None	N/A	N/A	668
TA-21-209	FE-1 (10, 12)[a]	21020901	None	N/A	N/A	700
TA-33-86	FE-6 (11)	33008606	None	N/A	N/A	2,301
TA-41-1	FE-4[c]	41000104	HEPA	>99.95	2	145
TA-41-4	FE-17	41000417	None	N/A	N/A	215
TA-48-1	FE-54[a]	48000154	HEPA	>99.95	2	751
	FE-60[a]	48000160	HEPA	99.95	1	766
	FE-7 (63, 64)[a]	48000107	HEPA	99.95	2	753
TA-50-1	FE-1[b,c]	50000101	None	N/A	N/A	1,153
	FE-2[a]	50000102	Aerosol 95	80.00	1	1,175
TA-50-37	FE-1 (2)[a]	50003701	HEPA	>99.95	2	1,161
TA-50-69	FE-1[c]	50006901	HEPA	99.95	1	1,175
	FE-2[c]	50006902	HEPA	99.95	1	1,175
	FE-3[a]	50006903	HEPA	>99.95	2	1,176
TA-53-3	FE-3[a]	53000303	HEPA	99.95	1	800
TA-53-7	FE-2[a]	53000702	HEPA	99.95	1	937
TA-55-4	FE-15[a]	55000415	HEPA	>99.95	3	1,004
	FE-16 (5)[a,b]	55000416	HEPA	>99.95	3	1,056

[a] These stacks require monitoring per EPA regulations.
[b] Parentheses means that this is a single release point with a single sampling point and multiple fans.
[c] These stacks were discontinued as a sampled release point during 1996.

Table 2. Unsampled Release Points

Technical Area and Building	Potential Release Point	Type of Control	Efficiency Performance Criteria	Stages	Distance to Nearest Receptor (m)
TA-3-16	FE-8	N/A	N/A	N/A	1,351
	FE-9	N/A	N/A	N/A	1,351
	FE-14	None	N/A	N/A	1,405
	FE-16	None	N/A	N/A	1,405
	FE-B1	N/A	N/A	N/A	1,351
	FE-CD-1	N/A	N/A	N/A	1,351
TA-3-29-1	FE-13	N/A	N/A	N/A	993
TA-3-29-2	FE-17	HEPA	99.95	1	993
	FE-18	HEPA	99.95	1	993
TA-3-29-3	FE-21	None	N/A	N/A	993
	FE-22	None	N/A	N/A	993
TA-3-29-4	FE-26	None	N/A	N/A	993
	FE-27	None	N/A	N/A	993
TA-3-29-5	FE-30	HEPA	99.95	1	993
	FE-31	HEPA	99.95	1	993
TA-3-29-7	FE-34	HEPA	99.95	1	993
	FE-35	HEPA	99.95	1	993
TA-3-40	FE-25	N/A	N/A	N/A	971
TA-3-66	FE-1	None	N/A	N/A	980
	FE-6	N/A	N/A	N/A	980
	FE-7	N/A	N/A	N/A	980
	FE-8	None	N/A	N/A	980
	FE-9	None	N/A	N/A	980
	FE-13	None	N/A	N/A	980
	FE-18	N/A	N/A	N/A	980
	FE-22	N/A	N/A	N/A	980
	FE-25	None	N/A	N/A	980
	FE-26	HEPA	99.95	1	980
	FE-43	N/A	N/A	N/A	980
TA-3-1698	N/A	N/A	N/A	N/A	566
TA-9-21	FE-3	N/A	N/A	N/A	3,310
TA-9-32	N/A	N/A	N/A	N/A	3,224
TA-15-69	FE-1	N/A	N/A	N/A	1,153
TA-15-183	N/A	N/A	N/A	N/A	4,136
TA-15-233	FE-1	N/A	N/A	N/A	4,136
TA-16-248	FE-B1	N/A	N/A	N/A	5,283
TA-16-410	FE-1	N/A	N/A	N/A	1,257
	FE-2	N/A	N/A	N/A	1,257
	FE-5	N/A	N/A	N/A	1,257
	FE-B1	N/A	N/A	N/A	1,257
TA-18-127	FE-2	N/A	N/A	N/A	3,947
TA-18-168	FE-1	N/A	N/A	N/A	3,854
TA-21-5	FE-7	HEPA	99.95	2	601
TA-21-150	FE-1	HEPA	99.95	1	587
TA-21-213	FE-B1	N/A	N/A	N/A	657

Table 2. Unsampled Release Points (Cont.)

Technical Area and Building	Potential Release Point	Type of Control	Efficiency Performance Criteria	Stages	Distance to Nearest Receptor (m)
TA-21-257	FE-4	None	N/A	N/A	569
TA-21-313	FE-1	HEPA	99.95	1	1,992
TA-21-315	FE-1	HEPA	99.95	1	472
TA-33-86	FE-2	N/A	N/A	N/A	2,443
	FE-4	N/A	N/A	N/A	2,443
TA-35-2	FE-2	N/A	N/A	N/A	1,228
TA-35-7	FE-2	None	N/A	N/A	2,301
	FE-7	None	N/A	N/A	1,338
TA-35-34	FE-1	N/A	N/A	N/A	1,299
TA-35-213	FE-5	None	N/A	N/A	991
	FE-8	N/A	N/A	N/A	991
TA-41-51	FE-17	N/A	N/A	N/A	204
TA-43-1	FE-9	None	N/A	N/A	51
	FE-10	None	N/A	N/A	51
	FE-12	None	N/A	N/A	51
	FE-13	None	N/A	N/A	51
	FE-34	None	N/A	N/A	51
TA-46-31	FE-25	N/A	N/A	N/A	2,592
	FE-41	N/A	N/A	N/A	2,592
TA-46-24	N/A	N/A	N/A	N/A	2,599
TA-46-31	N/A	N/A	N/A	N/A	2,592
TA-46-41	FE-6	N/A	N/A	N/A	2,671
TA-46-75	N/A	N/A	N/A	N/A	2,640
TA-46-154	FE-5	N/A	N/A	N/A	2,532
TA-48-1	FE-4 (11-14)	None	N/A	N/A	724
	FE-15 (16)	None	N/A	N/A	759
	FE-40 (38-40)	Aerosol 95	80.00	1	754
	FE-35	N/A	N/A	N/A	724
	FE-45	None	N/A	N/A	724
	FE-46	None	N/A	N/A	724
	FE-51	HEPA	99.95	1	724
	FE-61	N/A	N/A	N/A	724
TA-48-RC45	FE-PEF-1	N/A	N/A	N/A	698
TA-50-1	FE-2	Aerosol 95	80.00	1	1,175
	FE-3	HEPA	>99.95	2	1,189
	FE-6	HEPA	>99.95	2	1,163
	FE-17	HEPA	>99.95	2	1,167
	FE-25	HEPA	>99.95	2	1,168
	FE-27	HEPA	>99.95	2	1,110
TA-50-2	N/A	N/A	N/A	N/A	1,196
TA-50-66	FE-1	HEPA	>99.95	2	895
TA-51-21	FE-1	N/A	N/A	N/A	3,111
TA-53-1	FE-16	None	N/A	N/A	932
TA-53-4	FE-1	N/A	N/A	N/A	815
TA-54-2	FE-1	HEPA	>99.95	2	1,913
	FE-2	HEPA	99.95	1	1,913
TA-54-1009	FE-1	N/A	N/A	N/A	3,446

Table 2. Unsampled Release Points (Cont.)

Technical Area and Building	Potential Release Point	Type of Control	Efficiency Performance Criteria	Stages	Distance to Nearest Receptor (m)
TA-54-1009	FE-2	N/A	N/A	N/A	3,446
TA-59-1	FE-4(5,6,22)	N/A	N/A	N/A	1,039
	FE-14	N/A	N/A	N/A	1,039
	FE-30	N/A	N/A	N/A	1,039
	FE-B1	N/A	N/A	N/A	1,039
	FE-B2	N/A	N/A	N/A	1,039
	FE-B3	N/A	N/A	N/A	1,039
	FE-B4	N/A	N/A	N/A	1,039
	FE-B5	N/A	N/A	N/A	1,039
	FE-B6	N/A	N/A	N/A	1,039
	FE-B7	N/A	N/A	N/A	1,039

Radionuclides

Table 3 lists the radionuclides released from sampled point sources along with the annual release rate for each radionuclide. The point sources are now identified using an exhaust stack (ES) eight-digit identification number: the first two digits represent the LANL technical area, the next four the building area, and the last two the FE number. No detectable emissions are denoted as ND.

Table 3. Point Source Radionuclides

Source Identification	Radionuclide	Sampled Release (Ci)
03002914	ND	ND
03002915	Am-241	1.6E-07
	Pu-239	6.3E-08
	Pu-239	1.9E-07
03002919	Pu-238	1.0E-05
	Pu-239	8.7E-06
	U-234	6.9E-08
	Tc-99	2.2E-07
03002920	Am-241	1.2E-08
	Pu-238	1.0E-07
	Pu-239	5.7E-08
	U-234	2.0E-07
	Th-230	2.3E-07
	Th-232	1.6E-07

Table 3. Point Source Radionuclides (Cont.)

Source Identification	Radionuclide	Sampled Release (Ci)
03002923	Am-241	5.6E-08
	Pu-238	6.6E-08
	Pu-239	3.1E-08
	U-235	5.0E-07
	Th-231	5.0E-07
	U-238	5.7E-07
	Th-234	5.7E-07
	Pa-234	5.7E-07
	U-234	1.4E-05
	Tc-99	5.9E-07
03002924	Am-241	4.4E-07
	Pu-238	2.0E-06
	Pu-239	1.3E-06
	Th-228	1.3E-06
	U-235	1.3E-07
	Th-231	1.3E-07
	U-234	2.0E-05
	Tc-99	2.1E-06
03002928	ND	ND
03002929	Am-241	3.3E-08
	Pu-238	1.4E-07
	U-238	4.9E-08
	Th-234	4.9E-08
	Pa-234	4.9E-08
	U-234	7.0E-08
03002932	U-238	5.4E-08
	Th-234	5.4E-08
	Pa-234	5.4E-08
	U-234	7.5E-08
03002933	Am-241	1.4E-07
	U-234	5.2E-07
03002937	ND	ND
03002944	Am-241	1.2E-07
	Pu-238	1.2E-08
	Pu-239	1.2E-07

Table 3. Point Source Radionuclides (Cont.)

Source Identification	Radionuclide	Sampled Release (Ci)
03002944 (Cont.)	U-238	7.0E-08
	Th-234	7.0E-08
	Pa-234	7.0E-08
	U-234	7.8E-08
	Sr-90	1.1E-07
	Y-90	1.1E-07
03002945	Am-241	1.4E-07
	Pu-238	1.2E-08
	Pu-239	3.0E-07
03002945	U-234	7.1E-08
	Sr-90	7.2E-07
	Y-90	7.2E-07
	Cs-137	5.5E-09
	Ba-137	5.5E-09
	Sb-125	1.4E-05
03002946	ND	ND
03003501	Am-241	2.5E-08
	Pu-239	1.3E-08
	U-235	1.1E-08
	Th-231	1.1E-08
	U-238	3.6E-08
	Th-234	3.6E-08
	Pa-234	3.6E-08
	U-234	6.1E-07
03010222	Th-228	6.5E-09
	Th-230	8.8E-09
	Th-232	4.2E-09
	U-235	2.2E-08
	Th-231	2.2E-08
	U-238	1.3E-08
	Th-234	1.3E-08
	Pa-234	1.3E-08
	U-234	5.9E-07
03010225	Th-230	1.0E-08
	U-238	2.9E-08
	Th-234	2.9E-08
	Pa-234	2.9E-08

Table 3. Point Source Radionuclides (Cont.)

Source Identification	Radionuclide	Sampled Release (Ci)
03010225 (Cont.)	U-234	5.0E-09
03014106	U-238	6.4E-08
	Th-234	6.4E-08
	Pa-234	6.4E-08
	U-234	6.4E-08
03014109	Am-241	8.9E-08
	U-238	3.2E-07
	Th-234	3.2E-07
	Pa-234	3.2E-07
	U-234	2.0E-07
03014110	U-235	7.7E-08
	Th-231	7.7E-08
	U-238	1.3E-07
	Th-234	1.3E-07
	Pa-234	1.3E-07
	U-234	1.2E-07
16020504	H-3	9.9E+01
21015505	H-3	5.2E+01
21020901	H-3	3.4E+02
33008606	H-3	5.0E+01
41000104	H-3	3.9E-01
41000417	H-3	1.1E+02
48000107	Am-241	1.7E-09
	Br-82	2.1E-05
	Co-57	1.2E-08
	Ge-68	5.0E-06
	Ga-68	5.0E-05
	Rb-83	2.8E-06
	Se-75	1.1E-07

Table 3. Point Source Radionuclides (Cont.)

Source Identification	Radionuclide	Sampled Release (Ci)
48000154	Am-241	3.3E-09
	Pu-238	4.3E-09
	Pu-239	6.4E-09
48000160	Se-75	4.0E-07
50000101	Am-241	1.1E-08
	Pu-238	1.7E-09
	Pu-239	1.0E-08
	U-234	1.9E-08
50000102	ND	ND
50003701	Pu-239	3.1E-09
	U-238	5.2E-08
	Th-234	5.2E-08
	Pa-234	5.2E-08
	U-234	7.8E-08
50006901	U-238	1.6E-08
	Th-234	1.6E-08
	Pa-234	1.6E-08
	U-234	2.2E-08
50006902	Pu-239	2.0E-08
50006903	Am-241	1.4E-10
	Pu-238	6.3E-09
	Pu-239	2.2E-10
	U-238	2.7E-10
	Th-234	2.7E-10
	Pa-234	2.7E-10
	U-234	2.7E-10
53000303	Ar-41	1.5E+02
	C-10	3.5E+02
	C-11	3.7E+03
	N-13	1.8E-03
	N-16	2.9E+02
	O-14	1.7E+02
	O-15	6.0E+03

Table 3. Point Source Radionuclides (Cont.)

Source Identification	Radionuclide	Sampled Release (Ci)
53000303 (Cont.)	Be-7	4.9E-04
	Br-77	3.8E-02
	Br-82	6.4E-02
	Co-60	5.6E-05
	I-131	3.5E-04
	Os-185	3.7E-03
	Se-75	1.5E-04
	Ta-182	1.6E-02
	H-3	3.8E+00
53000702	Ar-41	1.2E+01
	C-10	3.9E+01
	C-11	4.9E+02
	N-13	7.6E+01
	O-14	1.2E+00
	O-15	9.3E+01
	Be-7	5.0E-05
	Br-82	1.5E-02
	H-3	1.0E+00
55000415	ND	ND
55000416	Am-241	3.1E-08
	Pu-238	2.5E-09
	Pu-239	8.6E-08
	U-238	2.9E-08
	Th-234	2.9E-08
	Pa-234	2.9E-08
	U-234	2.6E-08
	Th-234	2.9E-08
	H-3	3.1E+01

Nonpoint Sources

There are a variety of nonpoint sources within the 111 square kilometers of land occupied by LANL. Nonpoint sources can occur as a diffuse or large area source, or as leaks or fugitive emissions from facilities. Nonpoint sources of radionuclides include, but are not limited to, surface impoundment, 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 potential MEI locations. No significant emissions from nonpoint sources were observed at the LANL MEI locations.

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 site. 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 nonpoint sources as part of the Federal Facilities Compliance Agreement, which was approved in 1996. Results of the air sampling analysis are provided in Section III of this report.

Section III. Dose Assessment

Description of Dose Model

Dose calculations for point sources, unsampled point sources, and diffuse gaseous activation products from LANSCE were performed with the mainframe CAP88 version of AIRDOS. This procedure included using PREPAR2 to prepare the input file to AIRDOS2 and using the DARTAB preprocessor to prepare the dose conversion factor input file for DARTAB2. The calculations used dose conversion factors taken from the RADRISK database that was distributed with the CAP88 programs.

Development of Source Term

Emission measurement data from sampled stacks are used to develop the source term for the CAP88 model. In general, this source term is taken directly from the measured emissions. An exception occurs for parent radionuclides, such as ^{238}U, with short-lived progeny. In this situation, the amount of the parent radionuclide, ^{238}U, is measured, and the activities of the short-lived progeny are assumed equal to that of the parent. Another exception occurs for tritium emissions. While measurements are made to distinguish elemental from oxide forms of tritium, all tritium is assumed to be in the oxide form, resulting in an overestimate of dose.

Summary of Input Parameters

Effective dose equivalents to the MEI were calculated for all radioactive air emissions from sampled LANL point sources. The critical receptor location is different for each point source. However, since nearly 92% of the yearly MEI dose resulted from LANSCE emissions, the LANSCE MEI location is used for all dose assessments. This location is a business office approximately 800 m north-northeast of the LANSCE stack. The relationships of the receptor location to the source release points are given in Table 4.

The Air Quality Group operates an onsite network of five meteorological monitoring towers. The releases from point sources and diffuse gaseous activation products from LANSCE were modeled using the on-site meteorological data most appropriate for each source. Tables 5 through 7 in this section contain the wind speed, direction frequency, and stability data used in the modeling. Copies of the actual meteorological input files to CAP88 are included as Appendix B.

Table 4. Stack Dimensions and MEI Receptor Locations Used in the Dose Assessment

Source Identification	Stack Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Distance to MEI (m)	Direction to MEI
03002914	15.9	1.1	6.8	5,981	E
03002915	15.9	1.1	27.4	5,983	E
03002919	15.9	1.1	26.7	5,969	E
03002920	15.9	1.1	17.2	5,967	E
03002923	15.9	1.1	22.7	6,130	E
03002924	15.9	1.1	14.6	6,132	E
03002928	15.9	1.1	22.6	6,116	E
03002929	15.9	1.1	27.2	6,118	E
03002932	15.9	1.1	9.6	5,966	E
03002933	15.9	1.1	20.3	5,965	E
03002934	15.8	0.7	7.5	5,966	E
03002937	16.8	0.2	15.2	6,054	E
03002944	21.5	1.6	5.7	6,055	E
03002945	21.5	1.6	5.3	6,059	E
03002946	21.5	2.1	1.9	6,057	E
03003501	12.5	0.9	3.5	6,057	E
03010222	11.9	0.9	0.8	6,558	E
03010225	11.9	0.3	9.7	6,264	E
03014106	12.2	1.0	5.2	5,525	E
03014109	13.4	1.1	6.5	5,529	E
03014110	12.5	1.3	5.7	5,519	E
16020504	18.3	0.5	19.3	9,799	ENE
21015505	29.9	0.8	7.8	1,525	E
21020901	23.2	1.2	10.3	1,453	E
33008606	22.9	0.6	10.8	10,362	N
41000104	15.2	0.4	14.1	3,750	E
41000417	31.1	1.5	2.6	3,832	E
48000107	10.3	0.4	12.5	4,730	ENE
48000154	13.1	0.9	7.9	4,694	ENE
48000160	12.4	0.4	9.4	4,733	ENE
50000102	14.9	1.8	7.3	4,131	ENE
50003701	12.3	0.9	5.7	4,242	ENE
50006901	10.4	0.3	3.2	4,294	ENE
50006902	12.1	0.6	11.2	4,299	ENE
50006903	10.4	0.3	3.4	4,297	ENE
53000303	30.5	0.9	12.5	800	NNE
53000702	13.0	0.9	7.0	944	NNE
55000415	14.0	1.1	6.8	4,434	ENE
55000416	14.0	1.1	10.8	4,508	ENE

Table 5. 1996 Atmospheric Stability Percentages for CAP88 Input

Stability category	Percent Persistence TA-6 Tower	TA-53 Tower	TA-54 Tower
A	10.509	7.098	7.863
B	7.949	3.626	3.144
C	15.785	7.866	7.157
D	38.737	50.476	41.523
E	13.934	25.709	19.771
F	13.078	5.222	20.539

Table 6. 1996 Wind Direction Percentages for CAP88 Input

Wind Direction	Percent Persistence TA-6 Tower	TA-53 Tower	TA-54 Tower
N	3.267	5.036	4.581
NNE	3.621	5.010	4.994
NE	3.259	4.246	4.894
ENE	3.029	5.060	3.692
E	3.650	4.162	3.494
ESE	3.609	3.166	2.479
SE	3.828	3.110	2.246
SSE	6.213	5.309	3.161
S	7.612	9.236	7.005
SSW	7.963	12.265	11.799
SW	8.282	10.357	10.164
WSW	8.839	9.140	8.649
W	12.236	9.265	8.930
WNW	12.161	6.496	9.257
NW	8.362	3.965	9.372
NNW	4.061	4.176	5.281

Table 7. 1996 Wind Speed Percentages for CAP88 Input

Wind Speed in knots	Percent Persistence TA-6 Tower	TA-53 Tower	TA-54 Tower
0.00 - 1.56	25.650	21.243	21.951
1.56 - 3.35	52.657	42.767	48.408
3.35 - 5.59	16.403	27.189	21.822
5.59 - 8.27	4.247	7.831	7.217
8.27 - 10.95	0.882	0.924	0.585
10.95 - 200.00	0.152	0.043	0.014

Table 8 presents the dose estimates to LANL's MEI for each of the point sources at LANL. The calculated doses include doses from routine emissions as well as any unplanned releases. The dose from TA-53-3 is the sum of doses reported to the EPA in the 1996 monthly LANSCE reports (these reports included the dose from TA-53-7 emissions of gaseous mixed activation products as well).

Table 8. Dose Estimates from Sampled Point Sources

Source Identification	EDE/yr (mrem)
03002914	ND
03002915	9.29E-06
03002919	3.34E-04
03002920	1.21E-05
03002923	1.12E-04
03002924	2.57E-04
03002928	ND
03002929	4.05E-06
03002932	1.05E-06
03002933	8.46E-06
03002937	ND
03002944	7.69E-06
03002945	1.15E-05
03002946	ND
03003501	7.03E-06
03010222	5.29E-06
03010225	4.24E-07
03014106	1.23E-06

Table 8. Dose Estimates from Sampled Point Sources (Cont.)

Source Identification	EDE/yr (mrem)
03014109	8.47E-06
03014110	3.10E-06
16020504	4.39E-04
21015505	1.41E-03
21020901	1.06E-02
33008606	9.72E-05
41000104	4.31E-06
41000417	1.03E-03
48000107	2.46E-05
48000154	3.64E-07
48000160	5.78E-11
50000101	1.01e-06
50000102	ND
50003701	1.40E-06
50006901	3.84E-07
50006902	5.33E-07
50006903	1.78E-07
53000303	1.41E+00
53000702	2.11E-01
55000415	ND
55000416	3.64E-04

Environmental Data

The net annual average ambient concentration of important airborne radionuclides, measured by 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, Appendix E of 40 CFR 61, applying the assumption that each table value is equivalent to 10 mrem/yr from all appropriate exposure pathways (100% occupancy assumed at the respective location). Results from each air sampler are given in Table 9.

Table 9. 1996 Effective Dose Equivalent (net, in mrem) at Air Sampling Locations around LANL

#	Station Name	^{3}H	^{241}Am	^{238}Pu	^{239}Pu	^{234}U	^{235}U	^{238}U	Rounded Total
06	48th Street	0.001	0.000	0.000	0.000	0.007	0.000	0.000	0.01
07	Shell Station	0.003	0.000	0.001	0.001	0.004	0.000	0.006	0.01
08	McDonalds	0.013	0.001	0.000	0.002	0.003	0.000	0.006	0.03
09	Los Alamos Airport	0.007	0.000	0.000	0.011	0.005	0.000	0.007	0.03
10	East Gate (location of MEI)*	0.009	0.000	0.000	0.003	0.005	0.000	0.007	0.02
11	Well PM-1 (E. Jemez Road)	0.004	0.000	0.000	0.000	0.003	0.000	0.006	0.01
12	Royal Crest Trailer Court	0.006	0.000	0.004	0.004	0.004	0.000	0.003	0.02
13	White Rock Pinon School	0.010	0.001	0.000	0.002	0.005	0.000	0.006	0.02
14	Pajarito Acres	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.00
15	White Rock Fire Station	0.006	0.001	0.001	0.001	0.007	0.000	0.007	0.02
16	White Rock Nazarene Church	0.013	0.000	0.000	0.002	0.004	0.000	0.001	0.02
20	DP Road	0.008	0.001	0.002	0.005	0.003	0.000	0.007	0.03
32	County Landfill	0.007	0.008	0.003	0.021	0.048	0.001	0.047	0.13
60	LA Canyon	0.006	0.000	0.001	0.002	0.006	0.001	0.006	0.02
61	LA Hospital	0.005	0.000	0.001	0.000	0.018	0.000	0.016	0.04
62	Trinity Bible Church	0.008	0.000	0.000	0.002	0.006	0.000	0.008	0.02
63	White Rock Monte Rey South	0.005	0.000	0.000	0.000	0.002	0.000	0.003	0.01

*The net dose measured at this station is considered the dose to the MEI and is reported in Table 10 as the estimated dose from all other nonpoint sources.

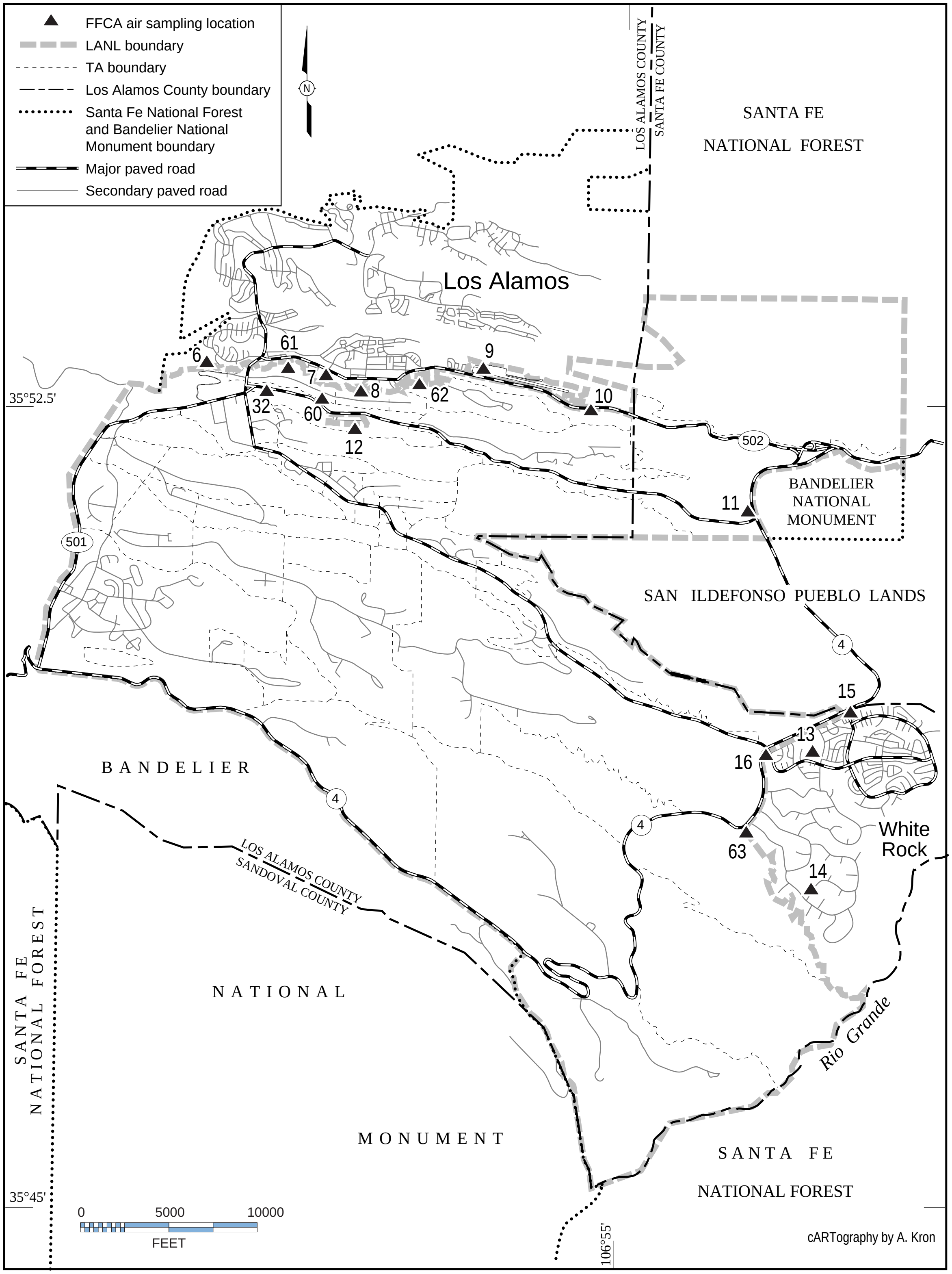

Fig. 3. Locations of air sampling stations used for nonpoint source compliance.

LANSCE Fugitive Emission Modeling

Some of the gaseous mixed activation products (G/MAP) 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. Improved operating conditions and engineering controls have decreased the magnitude of these nonpoint emissions compared to previous years. In 1996, approximately 212 Ci of ^{11}C and 9 Ci of ^{41}Ar 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; the dose to the MEI is given in Table 10.

Pajarito Canyon Site (TA-18) Nonpoint Emission Modeling

This site consists of a variety of nuclear assemblies which are operated at near-critical conditions. During the near-critical operations, neutrons are generated which in turn activate argon atoms in the air surrounding the assembly. For 1996, a total of 0.47 Ci of Ar-41 was estimated and modeled as an airborne release from this site. The dose from this release (3.08e-05 mrem) is included in Table 10 under the heading "CAP88 dose from other activated air products."

Compliance Assessment

The effective dose equivalent to LANL's MEI for 1996 operations was 1.93 mrem. The location of the MEI is at a business office 800 m north-northeast of the site boundary of TA-53. The doses from the various sources that contribute to the total dose are provided in Table 10. Stack and non-stack emissions from LANSCE contributed to nearly 92% of the total MEI dose in 1996.

Table 10. Dose to MEI by Source

	1996 EDE (mrem)
CAP88 dose from sampled release points[a]	1.64
CAP88 dose from unsampled release points	< 0.10
CAP88 dose from LANSCE fugitive emissions	0.16
CAP88 dose from other activated air products	< 0.01
Estimated dose from all other nonpoint sources[b]	0.02
1996 Total EDE	1.93

[a]Note: there were no unplanned releases in 1996.

[b]As determined by the environmental sampler at East Gate.

Constructions and Modifications

On June 3, 1996, LANL achieved compliance status with 40 CFR 61, Subpart H. On June 12, 1996, the Federal Facilities Compliance Agreement (FFCA) was signed by the EPA. Prior to achieving compliance status, the exemption for projects contributing less than 0.1 mrem/yr could not be exercised; thus, all new construction and modification projects having the potential to increase the release of radionuclides were submitted to EPA for approval. The **Low-Level Waste Compactor at TA-54** project was submitted and approved to operate by the EPA. However, because the startup date for the project came after the signing of the Federal Facilities Compliance Agreement and compliance was achieved, and the EDE for the project was less than 0.1 mrem/yr exemption, the formal notification of startup was not submitted for this project as discussed with EPA.

Since LANL was brought into compliance, new construction and modification projects having the potential to increase the release of radionuclides into the atmosphere were reviewed against the 0.1 mrem exemption rule of 40 CFR 61.96. A brief description of these projects follows.

Decontamination and Dismantling of the Tritium Beta Decay Experiment

The tritium beta decay experiment involved 1000 Ci of tritium at TA-35, Building 34. Based on survey results, about 1 Ci of tritium in the form of contaminated components is left over from the experiment. The project involves the dismantling and disposal of the contaminated components and decontamination of rooms.

Metallography Studies of Tritium Contaminated Reservoirs

This new project at TA-35, Building 213, will involve the analysis of empty reservoirs (from DOE's Savannah River Site) that have known tritium contamination. The project will involve mCi amounts of tritium per year of operation.

Cleanup Project to Remove Contaminated Soils in Los Alamos Canyon

A pre-construction application concerning contaminated soil removal from Hillsides 137, 138, and 140 using a vacuum truck was submitted in February of 1995 and approved in September of that year. In March of 1996 a Resource Conservation and Recovery Act Facility Investigation report determined that no further action was required for Hillside 138. A voluntary corrective action was submitted for Hillside 140 as a best management practice even though contamination levels were below screening action levels. After submittal and approval of the pre-construction application outlining the vacuum truck soil removal project, it was decided that due to environmental as well as worker health and safety concerns (steep grade of the hillside terrain), shovels and hand tools would be used to scoop and remove contaminated soil. In addition, water spray as a dust suppressant would be used. Contaminated soil removal from Hillsides 138 and 140 occurred in the fall of 1995 and 1996. Soil removal from Hillside 137 will not take place.

A total of 20 yd^3 (38.8 tons) of soil was removed from Hillside 138 and 15 yd^3 (29 tons) of soil was removed from Hillside 140. Emission estimates for the removal of the soil using hand tools was performed using AP-42, Volume I, Supplement F, Section 11.2.3.3. Although AP-42 does not contain specific information regarding manual excavation of soil, an emission factor for aggregate handling activities using front-end loaders or other heavy machinery was used as a conservative estimate. The estimate of emissions from soil removal activities was four times less than the amount naturally entrained in the air from wind erosion over a period of a year. Furthermore, ambient sampling of off-site air near the hillsides showed no increases in radionuclide emissions during the period of soil removal activities. In fact, a slight decrease was observed.

Prior to removal activities, an air sampling study was performed to determine if respirators would be required for field workers. Results of that study indicated that the use of hand tools and dust suppression techniques created very little dust and no personnel protective equipment other than full length clothes, gloves, and boots were required.

Once it was determined that emissions from hand tool soil removal would be less than naturally occurring dust from wind blown soils, a modification as defined in 40 CFR 61.15 was not applicable. Therefore, a notification under §61.09 was not required.

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., 1001).

Signature: ______________________ Date: 6/26/97

for G. Thomas Todd, Area Manager, Owner

Signature: ______________________ Date: 6/24/97

Dennis J. Erickson, Operator

Section IV. Additional Information

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

Environmental Monitoring

The Air Quality Group operates an extensive environmental monitoring network that includes several environmental monitoring stations located near the MEI location. Measurement systems at these stations include LiF thermoluminescent dosimeters, continuously operated air samplers, and an *in situ* ion chamber. The combination of these measurement systems allows for monitoring of radionuclide air concentrations and the radiation exposure rate. Results showed the total measured dose is less than 75% of the modeled dose given in this report. Results are published here and by the Environmental Assessments and Resource Evaluations Group in the annual Environmental Surveillance Report for LANL.

Supplemental Information for the Department of Energy

1. Collective effective dose equivalent for 1996 airborne releases: 1.2 person-rem/yr
2. Compliance with Subparts Q and T of 40 CFR 61 – Radon-222 Emissions

   This regulation applies 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. While 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, making the Laboratory subject to this regulation. Subject facilities cannot exceed an emissions rate of 20 pCi/m^2 -sec of Rn-222. In 1993 and 1994 LANL conducted a study to characterize emissions from the Area G disposal site. This study showed an average emission rate of 0.14 pCi/m^2 -sec 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.
3. Rn-220 (Thoron) emissions: Not Applicable at LANL
4. Status of compliance with EPA effluent monitoring requirements: As of June 3, 1996, LANL came into compliance with EPA effluent monitoring requirements.

References

EPA 1990: US Environmental Protection Agency, “Clean Air Act Assessment Package, CAP-88,” Radiation Shielding Information Center, Oak Ridge National Laboratory, TN (1990).

EPA 1995: US Environmental Protection Agency, Federal Register, Vol. 60, No. 107 (June 5, 1995).

Radian 1997: Radian Corporation, “LANL 1996 Radionuclide Point Source Inventory Update,” Los Alamos, NM (1997).

APPENDIX A

DESCRIPTIONS OF TECHNICAL AREAS AND THEIR ASSOCIATED PROGRAMS

Locations of the technical areas (TAs) operated by the Laboratory in Los Alamos County are shown in Fig. 2. The main programs conducted at each of the areas are listed in this appendix.

TA-2, Omega Site: Omega West Reactor, an 8-MW nuclear research reactor, is located here. It serves as a research tool by providing a source of neutrons for fundamental studies in nuclear physics and associated fields. This facility has been defueled and is in long-term shutdown awaiting decommissioning.

TA-3, Core Area: In this main technical area of the Laboratory is the Administration Building, which contains the director's office, administrative offices, and laboratories for several divisions. Other buildings house the central computing facility, materials division, chemistry and materials science laboratories, physics laboratories, technical shops, cryogenics laboratories, a Van de Graaff accelerator, the main cafeteria, and the study center.

TA-5, Beta Site: This site contains some physical support functions, several archaeological sites, and environmental monitoring and buffer areas.

TA-6, Two-Mile Mesa Site: This site is used in the development of special detonators to initiate high-explosive systems. Fundamental and applied research in support of this activity includes investigating phenomena associated with initiating high explosives and research in rapid shock-induced reactions.

TA-8, GT Site (or Anchor Site West): This is a dynamic testing site operated as a service facility for the entire Laboratory. It maintains capability in all modern nondestructive testing techniques for ensuring quality of material, ranging from test weapons components to high-pressure dies and molds. Principal tools include radiographic techniques (x-ray machines to 1,000,000 V and a 24-MeV betatron), radioactive-isotope techniques, ultrasonic and penetrate testing, and electromagnetic test methods.

TA-9, Anchor Site East: At this site, fabrication feasibility and physical properties of explosives are explored. New organic compounds are investigated for possible use as explosives. Storage and stability problems are also studied.

TA-11, K Site: Facilities are located here for testing explosive components and systems under a variety of extreme physical environments. The facilities are arranged so that testing may be controlled and observed remotely and so that devices containing explosives or radioactive materials, as well as those containing nonhazardous materials, may be tested.

TA-14, Q Site: This dynamic testing site is used for running various tests on relatively small explosive charges and for fragment impact tests.

TA-15, R Site: This is the home of PHERMEX, a multiple-cavity electron accelerator capable of producing a very large flux of x-rays for certain weapons development problems and tests. This site is also used for the investigation of weapons functioning and systems behavior in nonnuclear tests, principally by means of electronic recording.

TA-16, S Site: Investigations at this site include development, engineering design, prototype manufacture, and environmental testing of nuclear weapons warhead systems. Development and testing of high explosives, plastics, and adhesives, and research on process development for manufacture of items using these and other materials are accomplished in extensive facilities.

TA-18, Pajarito Laboratory Site: The fundamental behavior of nuclear chain reactions with simple, low-power reactors called critical assemblies is studied here. Experiments are operated by remote control and observed by closed-circuit television. The machines are housed in buildings known as kivas and are used primarily to provide a controlled means of assembling a critical amount of fissionable materials. This is done to study the effects of various shapes, sizes, and configurations. These machines are also used as a source of fission neutrons in large quantities for experimental purposes.

TA-21, DP Site: This site has two primary research areas: DP West and DP East. DP West is concerned with chemistry research; DP East is the high-temperature chemistry and tritium research site. Currently, several structures are undergoing decontamination and decommissioning. The future use of TA-21 is being studied.

TA-22, TD Site: This site is used in the development of special detonators to initiate high-explosive systems. Fundamental and applied research in support of this activity includes investigating phenomena associated with initiating high explosives and research in rapid shock-induced reactions.

TA-28, Magazine Area A: This is an explosives storage area.

TA-33, HP Site: An old high-pressure, tritium handling facility located here is being phased out. The National Radio Astronomy Observatory's Very Large Baseline Array Telescope is located at this site.

TA-35, Ten Site: Nuclear safeguards research and development, which are conducted here, are concerned with techniques for nondestructive detection, identification, and analysis of fissionable isotopes. Research in reactor safety and laser fusion is also done here.

TA-36, Kappa Site: Various explosive phenomena, such as detonation velocity, are investigated at this dynamic testing site.

TA-37, Magazine Area C: This is an explosives storage site.

TA-39, Ancho Canyon Site: Nonnuclear weapons behavior is studied here, primarily by photographic techniques. Investigations are also made into various phenomenological aspects of explosives, interactions of explosives, and explosions involving other materials.

TA-40, DF Site: This site is used in the development of special detonators to initiate high-explosive systems. Fundamental and applied research in support of this activity includes investigating phenomena associated with initiating high explosives and research in rapid shock-induced reactions.

TA-41, W Site: Personnel at this site were engaged primarily in engineering design and development of nuclear components, including fabrication and evaluation of test materials for weapons. All removable tritium was transferred from this facility in 1995.

TA-43, Health Research Laboratory and Center for Human Genome Studies: Research in cellular biology, biophysics, mammalian biology, mammalian metabolism, and genetics is performed at this site. A large medical library, special counters used to measure radioactivity in humans and animals, and animal quarters for dogs, mice, and monkeys are also located in this building.

TA-46, WA Site: Applied photochemistry, which includes development of technology for laser isotope separation and laser enhancement of chemical processes, is investigated here. Solar energy research, particularly in the area of passive solar heating for residences, is also done at this site.

TA-48, Radiochemistry Site: Laboratory scientists and technicians at this site study nuclear properties of radioactive materials by using analytical and physical chemistry. Measurements of radioactive substances are made, and “hot cells” are used for remote handling of radioactive materials.

TA-49, Frijoles Mesa Site: This site is currently restricted to carefully selected functions because of its location near Bandelier National Monument and because of past use for high-explosive and radioactive materials experiments.

TA-50, Waste Management Site: Personnel at this site have responsibility for treating and disposing of most industrial liquid and radioactive liquid waste received from Laboratory technical areas, for development of improved methods of solid waste treatment, and for containment of radioactivity removed by treatment.

TA-51, Environmental Research Site: Research and experimental studies on the long-term impact of radioactive waste on the environment and types of waste storage and coverings are studied at this site.

TA-52, Reactor Development Site: A wide variety of activities related to nuclear reactor performance and safety is done at this site.

TA-53, Neutron Science Center: The Los Alamos Neutron Science Center, a linear particle accelerator, is used to conduct research in areas of basic physics, cancer treatment, materials studies, and isotope production. The Los Alamos Neutron Scattering Center and the proton storage ring are also located at this TA.

TA-54, Waste Disposal Site: The primary function of this site is radioactive solid and hazardous chemical waste management and disposal.

TA-55, Plutonium Facility Site: Processing of plutonium and research in plutonium metallurgy are done at this site.

TA-57, Fenton Hill Site: This is the location of the Laboratory's Hot Dry Rock geothermal project. Scientists at this site are studying the possibility of producing energy by circulating water through hot, dry rock located hundreds of meters below the earth's surface. The water is heated and then brought to the surface to drive electric generators.

TA-58: This site is reserved for multi-use experimental sciences requiring close functional ties to programs currently located at TA-3.

TA-59, Occupational Health Site: Occupational health and environmental science activities are conducted at this site.

TA-60, Sigma Mesa: This area contains physical support and infrastructure facilities, including the Test Fabrication Facility and the Alignment Complex.

TA-61, East Jemez Road: This site is used for physical support and contains infrastructure facilities, including the sanitary landfill.

TA-62: This site is reserved for multi-use experimental science, public and corporate interface, and environmental research and buffer uses.

TA-63: This area contains physical support facilities operated by Johnson Controls Inc.

TA-64: This is the site of the central guard facility.

TA-65: This undeveloped TA was incorporated into TA-51 and no longer exists

TA-66: This site is used for industrial partnership activities.

TA-67: This is a dynamic testing area that contains significant archaeological sites. It is designated for future mixed and low-level hazardous waste storage.

TA-68: This is a dynamic testing area that contains archaeological and environmental study areas.

TA-69: This undeveloped TA serves as an environmental buffer for the dynamic testing area.

TA-70: This undeveloped TA serves as an environmental buffer for the high-explosives test area.

TA-71: This undeveloped TA serves as an environmental buffer for the high-explosives test area.

TA-72: This is the site of the Protective Force training facility.

TA-73: This area is the Los Alamos Airport.

TA-74, Otowi Tract: This large area, bordering San Ildefonso Pueblo on the east, is isolated from most of the Laboratory and contains a significant concentration of archaeological sites and an endangered species breeding area.

APPENDIX B

1996 Site Specific Meteorological Input Data to CAP88 for LANL

CAP88 Input Data from TA-06 Meteorological Tower

```
1  1  0.000830.000800.000110.000000.000000.00000
1  2  0.002210.000890.000030.000000.000000.00000
1  3  0.004600.002670.000000.000000.000000.00000
1  4  0.007590.003740.000000.000000.000000.00000
1  5  0.008130.005690.000000.000000.000000.00000
1  6  0.005780.007500.000000.000000.000000.00000
1  7  0.006320.010950.000060.000000.000000.00000
1  8  0.005030.010660.000110.000000.000000.00000
1  9  0.002700.005120.000170.000000.000000.00000
1 10  0.001410.002210.000400.000030.000000.00000
1 11  0.001030.001010.000170.000000.000000.00000
1 12  0.000460.000600.000060.000000.000000.00000
1 13  0.000460.000690.000090.000030.000000.00000
1 14  0.000370.000720.000090.000000.000000.00000
1 15  0.000690.001060.000200.000000.000000.00000
1 16  0.000600.000860.000140.000000.000000.00000
2  1  0.000370.000550.000370.000000.000000.00000
2  2  0.000860.001580.000170.000000.000000.00000
2  3  0.001290.003280.000170.000000.000000.00000
2  4  0.002590.004170.000030.000000.000000.00000
2  5  0.001720.003880.000000.000000.000000.00000
2  6  0.001380.004770.000030.000000.000000.00000
2  7  0.001210.007210.000430.000000.000000.00000
2  8  0.001380.010120.001810.000000.000000.00000
2  9  0.001030.007240.003360.000030.000000.00000
2 10  0.000340.003480.002760.000090.000000.00000
2 11  0.000460.001490.002210.000090.000000.00000
2 12  0.000110.000720.000890.000000.000000.00000
2 13  0.000170.000830.000460.000000.000000.00000
2 14  0.000060.000520.000340.000000.000000.00000
2 15  0.000260.000890.000890.000000.000000.00000
2 16  0.000230.000430.000720.000000.000000.00000
3  1  0.000800.001720.000630.000000.000000.00000
3  2  0.001610.003710.001720.000030.000000.00000
3  3  0.001750.004080.001440.000030.000000.00000
3  4  0.002160.003710.000090.000000.000000.00000
3  5  0.002240.005800.000030.000000.000000.00000
3  6  0.001240.005690.000340.000000.000000.00000
3  7  0.001180.003940.000200.000000.000000.00000
3  8  0.001720.011750.005140.000090.000000.00000
3  9  0.002070.016150.011520.000430.000000.00000
3 10  0.001410.008100.007960.000290.000000.00000
3 11  0.000630.004110.006490.000630.000000.00000
3 12  0.000550.002530.007640.001060.000000.00000
3 13  0.000200.001980.005950.000430.000000.00000
3 14  0.000030.001580.003910.000490.000000.00000
3 15  0.000340.001750.003790.000230.000000.00000
3 16  0.000490.001380.000780.000090.000000.00000
```

CAP88 Input Data from TA-06 Meteorological Tower (Continued)

```
4  1  0.007500.007590.000830.000030.000000.00000
4  2  0.006440.008710.002440.000200.000000.00000
4  3  0.005200.004310.000570.000000.000000.00000
4  4  0.003710.001290.000030.000000.000000.00000
4  5  0.003880.003620.000000.000000.000000.00000
4  6  0.004110.003130.000170.000000.000000.00000
4  7  0.003620.001490.000060.000000.000000.00000
4  8  0.005720.005000.000980.000090.000000.00000
4  9  0.007930.012590.001260.000370.000000.00000
4 10  0.007590.027440.005950.000520.000000.00000
4 11  0.007930.027160.008680.001700.000030.00000
4 12  0.006520.016290.009220.005340.000430.00003
4 13  0.004680.014890.019170.012870.002590.00026
4 14  0.004340.011090.019970.014600.005600.00124
4 15  0.005520.015350.008190.002640.000170.00000
4 16  0.006810.008560.001060.000060.000000.00000
5  1  0.003940.002930.000030.000000.000000.00000
5  2  0.002700.001240.000000.000000.000000.00000
5  3  0.001720.000520.000000.000000.000000.00000
5  4  0.000860.000000.000000.000000.000000.00000
5  5  0.000980.000090.000000.000000.000000.00000
5  6  0.001120.000230.000000.000000.000000.00000
5  7  0.000950.000230.000000.000000.000000.00000
5  8  0.001470.000370.000000.000000.000000.00000
5  9  0.002330.000750.000030.000000.000000.00000
5 10  0.003680.003560.000000.000000.000000.00000
5 11  0.004140.008590.000030.000000.000000.00000
5 12  0.003990.017180.000140.000000.000000.00000
5 13  0.002730.012640.002240.000000.000000.00000
5 14  0.003300.011380.005570.000000.000000.00000
5 15  0.003910.022300.000320.000000.000000.00000
5 16  0.004660.006470.000030.000000.000000.00000
6  1  0.002760.000860.000000.000000.000000.00000
6  2  0.001440.000230.000000.000000.000000.00000
6  3  0.000920.000030.000000.000000.000000.00000
6  4  0.000340.000000.000000.000000.000000.00000
6  5  0.000430.000000.000000.000000.000000.00000
6  6  0.000570.000030.000000.000000.000000.00000
6  7  0.000430.000000.000000.000000.000000.00000
6  8  0.000660.000030.000000.000000.000000.00000
6  9  0.000950.000090.000000.000000.000000.00000
6 10  0.002070.000340.000000.000000.000000.00000
6 11  0.004110.002130.000000.000000.000000.00000
6 12  0.005430.009170.000000.000000.000000.00000
6 13  0.007070.030830.001090.000000.000000.00000
6 14  0.005660.028740.002010.000000.000000.00000
6 15  0.005340.009770.000000.000000.000000.00000
6 16  0.004220.003020.000000.000000.000000.00000
```

CAP88 Input Data from TA-53 Meteorological Tower

```
1  1  0.001450.000290.000030.000000.000000.00000
1  2  0.002750.000960.000000.000000.000000.00000
1  3  0.004600.001740.000000.000000.000000.00000
1  4  0.008430.004660.000000.000000.000000.00000
1  5  0.006720.005970.000000.000000.000000.00000
1  6  0.005270.004430.000000.000000.000000.00000
1  7  0.004000.003190.000000.000000.000000.00000
1  8  0.002550.002140.000030.000000.000000.00000
1  9  0.001910.001480.000000.000000.000000.00000
1 10  0.001130.000840.000000.000000.000000.00000
1 11  0.000870.000460.000000.000000.000000.00000
1 12  0.000320.000550.000000.000000.000000.00000
1 13  0.000550.000230.000060.000000.000000.00000
1 14  0.000700.000230.000120.000000.000000.00000
1 15  0.000490.000580.000120.000000.000000.00000
1 16  0.000750.000350.000060.000000.000000.00000
2  1  0.000200.000230.000060.000000.000000.00000
2  2  0.000520.000780.000060.000000.000000.00000
2  3  0.001560.001910.000030.000000.000000.00000
2  4  0.001970.004810.000030.000000.000000.00000
2  5  0.001530.003970.000000.000000.000000.00000
2  6  0.000900.003360.000000.000000.000000.00000
2  7  0.000670.002950.000000.000000.000000.00000
2  8  0.000780.002520.000000.000000.000000.00000
2  9  0.000200.001480.000060.000000.000000.00000
2 10  0.000120.001070.000060.000000.000000.00000
2 11  0.000260.000580.000060.000000.000000.00000
2 12  0.000090.000640.000120.000000.000000.00000
2 13  0.000090.000430.000170.000030.000000.00000
2 14  0.000120.000610.000230.000000.000000.00000
2 15  0.000090.000260.000170.000000.000000.00000
2 16  0.000290.000170.000030.000000.000000.00000
3  1  0.000580.000520.000230.000000.000000.00000
3  2  0.001010.001590.000460.000000.000000.00000
3  3  0.001160.004170.000640.000000.000000.00000
3  4  0.002140.007850.000520.000000.000000.00000
3  5  0.001270.006520.000170.000000.000000.00000
3  6  0.000700.005010.000120.000000.000000.00000
3  7  0.000900.004920.000170.000000.000000.00000
3  8  0.000870.006280.000520.000000.000000.00000
3  9  0.000580.005910.001160.000000.000000.00000
3 10  0.000290.002840.000930.000030.000000.00000
3 11  0.000380.001390.001040.000060.000000.00000
3 12  0.000380.001160.001970.000170.000000.00000
3 13  0.000320.001270.003210.000200.000000.00000
3 14  0.000320.001480.002290.000200.000000.00000
3 15  0.000290.000430.000870.000030.000000.00000
3 16  0.000410.000430.000260.000030.000000.00000
```

CAP88 Input Data from TA-53 Meteorological Tower (Continued)

```
4  1  0.009210.009760.007670.002490.000290.00000
4  2  0.006810.010920.007960.001880.000350.00000
4  3  0.005180.008430.003560.000520.000030.00000
4  4  0.004920.007530.001450.000030.000000.00000
4  5  0.004580.005940.000720.000000.000000.00000
4  6  0.003820.003620.000580.000000.000000.00000
4  7  0.002930.004690.001510.000120.000000.00000
4  8  0.003270.013210.009900.002520.000260.00000
4  9  0.003740.021340.026960.009040.000290.00000
4 10  0.003710.017640.035130.014450.000700.00003
4 11  0.003300.019230.025110.010980.001330.00003
4 12  0.003190.009760.015700.012860.002780.00029
4 13  0.003240.010920.021320.009240.001300.00006
4 14  0.004000.008170.011870.008280.001250.00000
4 15  0.005880.005180.005160.003390.000410.00000
4 16  0.007240.006720.004870.001770.000260.00003
5  1  0.005010.007240.002780.000000.000000.00000
5  2  0.004080.005160.002090.000000.000000.00000
5  3  0.002660.002900.000840.000000.000000.00000
5  4  0.002230.001740.000170.000000.000000.00000
5  5  0.001820.001130.000000.000000.000000.00000
5  6  0.001620.000810.000030.000000.000000.00000
5  7  0.001070.001560.000170.000000.000000.00000
5  8  0.001160.003270.000670.000000.000000.00000
5  9  0.001800.007410.004170.000000.000000.00000
5 10  0.002200.018360.017060.000000.000000.00000
5 11  0.003240.022360.010170.000000.000000.00000
5 12  0.002690.017700.015700.000000.000000.00000
5 13  0.003040.018360.013520.000000.000000.00000
5 14  0.003760.012950.003390.000000.000000.00000
5 15  0.004260.007620.001800.000000.000000.00000
5 16  0.005210.008080.002030.000000.000000.00000
6  1  0.001680.000610.000030.000000.000000.00000
6  2  0.002030.000580.000120.000000.000000.00000
6  3  0.001880.000640.000000.000000.000000.00000
6  4  0.001680.000430.000000.000000.000000.00000
6  5  0.001220.000060.000000.000000.000000.00000
6  6  0.001250.000140.000000.000000.000000.00000
6  7  0.001710.000520.000030.000000.000000.00000
6  8  0.002030.001100.000000.000000.000000.00000
6  9  0.002200.002640.000000.000000.000000.00000
6 10  0.002720.003100.000260.000000.000000.00000
6 11  0.001650.001070.000000.000000.000000.00000
6 12  0.001190.003480.000700.000000.000000.00000
6 13  0.001130.003360.000580.000000.000000.00000
6 14  0.001820.003130.000060.000000.000000.00000
6 15  0.001710.000930.000000.000000.000000.00000
6 16  0.002200.000550.000030.000000.000000.00000
```

CAP88 Input Data from TA-54 Meteorological Tower

```
1  1  0.000630.000320.000000.000000.000000.00000
1  2  0.001430.000690.000000.000000.000000.00000
1  3  0.002780.002550.000000.000000.000000.00000
1  4  0.006710.005680.000000.000000.000000.00000
1  5  0.011620.006940.000000.000000.000000.00000
1  6  0.007830.004730.000000.000000.000000.00000
1  7  0.004990.003560.000000.000000.000000.00000
1  8  0.003590.002640.000000.000000.000000.00000
1  9  0.001780.001840.000030.000000.000000.00000
1 10  0.001060.000750.000000.000000.000000.00000
1 11  0.001000.000600.000000.000000.000000.00000
1 12  0.000860.000370.000000.000000.000000.00000
1 13  0.000430.000340.000000.000000.000000.00000
1 14  0.000490.000370.000000.000000.000000.00000
1 15  0.000550.000320.000030.000000.000000.00000
1 16  0.000750.000370.000000.000000.000000.00000
2  1  0.000170.000320.000030.000000.000000.00000
2  2  0.000320.000600.000000.000000.000000.00000
2  3  0.000460.003070.000000.000000.000000.00000
2  4  0.001430.003160.000000.000000.000000.00000
2  5  0.001230.003670.000000.000000.000000.00000
2  6  0.001000.002350.000000.000000.000000.00000
2  7  0.000860.002550.000000.000000.000000.00000
2  8  0.000570.002270.000000.000000.000000.00000
2  9  0.000260.001720.000030.000000.000000.00000
2 10  0.000230.001490.000030.000000.000000.00000
2 11  0.000110.000770.000030.000000.000000.00000
2 12  0.000200.000370.000030.000000.000000.00000
2 13  0.000200.000340.000110.000000.000000.00000
2 14  0.000090.000600.000170.000000.000000.00000
2 15  0.000060.000170.000060.000000.000000.00000
2 16  0.000140.000140.000000.000000.000000.00000
3  1  0.000110.000720.000140.000000.000000.00000
3  2  0.000750.002270.000200.000000.000000.00000
3  3  0.001320.007140.000860.000000.000000.00000
3  4  0.002120.005590.000340.000000.000000.00000
3  5  0.001350.003210.000110.000000.000000.00000
3  6  0.000860.002580.000060.000000.000000.00000
3  7  0.000600.002640.000090.000000.000000.00000
3  8  0.000340.004270.000370.000000.000000.00000
3  9  0.000550.006570.001610.000000.000000.00000
3 10  0.000320.004480.001320.000000.000000.00000
3 11  0.000340.002040.000750.000000.000000.00000
3 12  0.000430.001350.001780.000090.000000.00000
3 13  0.000170.000890.003380.000170.000000.00000
3 14  0.000200.001060.003410.000230.000000.00000
3 15  0.000170.000490.000860.000030.000000.00000
3 16  0.000140.000490.000200.000000.000000.00000
```

CAP88 Input Data from TA-54 Meteorological Tower (Continued)

4	1	0.005590.005650.004250.002440.000230.00003
4	2	0.004910.012050.008860.001580.000170.00000
4	3	0.005740.012770.005220.000400.000000.00000
4	4	0.004420.003560.000720.000000.000000.00000
4	5	0.002840.001610.000230.000000.000000.00000
4	6	0.001890.001640.000340.000030.000000.00000
4	7	0.001430.002700.001150.000140.000000.00000
4	8	0.001660.005190.004530.002350.000260.00000
4	9	0.002410.011330.020450.011850.000890.00000
4	10	0.002900.016640.040250.021340.001640.00000
4	11	0.002840.014370.021310.009900.001090.00011
4	12	0.002980.010930.013280.008580.001120.00000
4	13	0.004300.008000.011070.006140.000290.00000
4	14	0.004820.007720.010870.003380.000030.00000
4	15	0.005190.007520.006050.002470.000000.00000
4	16	0.004560.005970.002870.001060.000140.00000
5	1	0.003760.006800.002900.000000.000000.00000
5	2	0.002440.004820.002270.000000.000000.00000
5	3	0.001750.002070.000110.000000.000000.00000
5	4	0.001490.000660.000000.000000.000000.00000
5	5	0.001230.000550.000000.000000.000000.00000
5	6	0.000600.000320.000000.000000.000000.00000
5	7	0.000490.000490.000090.000000.000000.00000
5	8	0.000690.001320.000660.000000.000000.00000
5	9	0.000570.003530.002270.000000.000000.00000
5	10	0.001320.008580.009550.000000.000000.00000
5	11	0.001750.015150.013770.000000.000000.00000
5	12	0.001920.010470.002700.000000.000000.00000
5	13	0.003270.015400.001200.000000.000000.00000
5	14	0.005710.017210.002730.000000.000000.00000
5	15	0.007110.020770.000860.000000.000000.00000
5	16	0.006110.009180.001090.000000.000000.00000
6	1	0.004880.006450.000400.000000.000000.00000
6	2	0.003070.003070.000460.000000.000000.00000
6	3	0.001890.000800.000000.000000.000000.00000
6	4	0.000950.000090.000000.000000.000000.00000
6	5	0.000320.000030.000000.000000.000000.00000
6	6	0.000460.000090.000000.000000.000000.00000
6	7	0.000630.000060.000000.000000.000000.00000
6	8	0.000460.000430.000000.000000.000000.00000
6	9	0.000920.001380.000090.000000.000000.00000
6	10	0.001430.004070.000600.000000.000000.00000
6	11	0.002750.011020.001920.000000.000000.00000
6	12	0.004100.021940.002980.000000.000000.00000
6	13	0.007570.024100.001890.000000.000000.00000
6	14	0.011960.021430.000090.000000.000000.00000
6	15	0.009930.030410.000690.000000.000000.00000
6	16	0.005850.012340.001410.000000.000000.00000

Additional CAP88 Input Data For LANL

```
Annual average rainfall rate
  RR=45.3 cm/y

Height of Lid (depth of tropospheric mixing layer)
   LIPO=1525 m

Average Air Temperature
   TA=282 K

Vertical temperature gradient for Pasquill categories E, F, G
  TG=0.02,0.035,0.035 K/m

Height of wind speed measurement
   Z=10 m
```

Los Alamos
NATIONAL LABORATORY

Los Alamos, New Mexico 87545