**SEC Petition**

NIOSH OCAS

4676 Columbia Parkway, MS-C47

Cincinnati, Ohio 45226

Fax: (513) 533-6826

**To Whom It May Concern:**

I am submitting a petition to add a class of workers to Special Exposure Cohort under the Energy Employees Occupational Illness Compensation Program Act. The petition is for the Service Support Workers at Los Alamos National Laboratory from January 01, 1976 to December 31, 2005. I have enclosed a completed Special Exposure Cohort Petition — Form B, an attached narrative document, an attached document that lists and summarizes documents supporting the petition, printed supporting documents, affidavits, and a CDROM that contains additional supporting documents in PDF format. Also on the CDROM are PDF versions of the attached narrative document and attached list of supporting documents. Thank you for your consideration of this important matter.

Sincerely,

**Use of this form and disclosure of Social Security Number are voluntary. Failure to use this form or disclose *this number will not result in the denial of any right, benefit, or privilege to which you may be entitled.***

**General Instructions on Completing this Form** *(complete instructions are available in a separate packet)*:

Except for signatures, please **PRINT** all information clearly and neatly on the form.

04-03-08A08:45 RCVD

Please read each of Parts A — G in this form and complete the parts appropriate to you. If there is more than one petitioner, then each petitioner should complete those sections of parts A – C of the form that apply to them. Additional copies of the first two pages of this form are provided at the end of the form for this purpose. A maximum of three petitioners is allowed.

If you need more space to provide additional information, use the continuation page provided at the end of the form and attach the completed continuation page(s) to Form B.

If you have questions about the use of this form, please call the following NIOSH toll-free phone number and request to speak to someone in the Office of Compensation Analysis and Support about an SEC petition: **1-800-356-4674.**

| *If you are:* | | | |
|---|---|---|---|
| | ☐ A Labor Organization, | Start at D | on Page 3 |
| | ☑ An Energy Employee (current or former), | Start at C | on Page 2 |
| | ☐ A Survivor (of a former Energy Employee), | Start at B | on Page 2 |
| | ☐ A Representative (of a current or former Energy Employee), | Start at A | on Page 1 |

**A Representative Information** — *Complete Section A if you are authorized by an Employee or Survivor(s) to petition on behalf of a class.*

A.1 **Are you a contact person for an organization?** ☐ Yes (Go to A.2) ☐ No (Go to A.3)

A.2 **Organization Information:**

Name of Organization

Position of Contact Person

A.3 **Name of Petition Representative:**

Mr./Mrs./Ms. First Name Middle Initial Last Name

A.4 **Address:**

Street Apt # P.O. Box

City State Zip Code

A.5 **Telephone Number:** (____) ____-________

A.6 **Email Address:** ________________

A.7 ☐ Check the box at left to indicate you have attached to the back of this form written authorization to petition by the survivor(s) or employee(s) indicated in Parts B or C of this form. An authorization

**If you are representing a Survivor, go to Part B; if you are representing an Employee, go to Part C.**

Name or Social Security Number of First Petitione ____________

**B Survivor Information — Complete Section B if you are a Survivor or representing a Survivor.**

B.1 **Name of Survivor:** ______________________________

Mr./Mrs./Ms. First Name Middle Initial Last Name

B.2 **Social Security Number of Survivor:** ______________________________

B.3 **Address of Survivor:** ______________________________

Street Apt # P.O. Box

______________________________

City State Zip Code

B.4 **Telephone Number of Survivor:** (____) ____-________

B.5 **Email Address of Survivor:** ______________________________

B.6 **Relationship to Employee:**
- ❑ Spouse
- ❑ Son/Daughter
- ❑ Parent
- ❑ Grandparent
- ❑ Grandchild

**Go to Part C.**

**C Employee Information — Complete Section C UNLESS you are a labor organization.**

C.1 **Name of Employee:** ______________________________

Mr./Mrs./Ms. First Name Middle Initial Last Name

C.2 **Former Name of Employee** (e.g., maiden name/legal name change/other): ______________________________

Mr./Mrs./Ms. First Name Middle Initial Last Name

C.3 **Social Security Number of Employee:** ______________________________

C.4 **Address of Employee** (if living): ______________________________

Street Apt # P.O. Box

______________________________

City State Zip Code

C.5 **Telephone Number of Employee:** (____) ____-________

C.6 **Email Address of Employee:** ______________________________

C.7 **Employment Information Relate**

C.7a Employee Number (if known):

C.7b Dates of Employment: Start ! 1998 End N/A

C.7c Employer Name:

C.7d Work Site Location: Los Alamos National Laboratory - All Technical Areas

C.7e Supervisor's Name: ______________________________

**Go to Part E.**

**D Labor Organization Information — Complete Section D ONLY if you are a labor organization.**

D.1 **Labor Organization Information:**

_______________
Name of Organization

_______________
Position of Contact Person

D.2 **Name of Petition Representative:**

_______________

D.3 **Address of Petition Representative:**

_______________
Street Apt # P.O. Box

_______________
City State Zip Code

D.4 **Telephone Number of Petition Representative:** (____) ____-______

D.5 **Email Address of Petition Representative:** _______________

D.6 **Period during which labor organization represented employees covered by this petition** (please attach documentation): Start ________ End ________

D.7 **Identity of other labor organizations that may represent or have represented this class of employees** (if known):

_______________

**Go to Part E.**

## E Proposed Definition of Employee Class Covered by Petition — Complete Section E.

E.1 **Name of DOE or AWE Facility:** Los Alamos National Laboratory

E.2 **Locations at the Facility relevant to this petition:**
All Technical Areas

E.3 **List job titles and/or job duties of employees included in the class. In addition, you can list by name any individuals other than petitioners identified on this form who you believe should be included in this class:**
See Attached Narrative

E.4 **Employment Dates relevant to this petition:**

| | | | |
|---|---|---|---|
| Start | 1976 | End | 2005 |
| Start | | End | |
| Start | | End | |

E.5 **Is the petition based on one or more unmonitored, unrecorded, or inadequately monitored or recorded exposure incidents?:** ☒ Yes ☐ No

**If yes, provide the date(s) of the incident(s) and a complete description** (attach additional pages as necessary):
See Attached Narrative

**Go to Part F.**

Name or Social Security Number of First Petitioner: ____________

## F Basis for Proposing that Records and Information are Inadequate for Individual Dose — Complete Section F.

Complete **at least one** of the following entries in this section by checking the appropriate box and providing the required information related to the selection. You are not required to complete more than one entry.

F.1 ☒ I/We have attached either documents or statements provided by affidavit that indicate that radiation exposures and radiation doses potentially incurred by members of the proposed class, that relate to this petition, were not monitored, either through personal monitoring or through area monitoring.

*(Attach documents and/or affidavits to the back of the petition form.)*

Describe as completely as possible, to the extent it might be unclear, how the attached documentation and/or affidavit(s) indicate that potential radiation exposures were not monitored.

See Attached Narrative

F.2 ☒ I/ We have attached either documents or statements provided by affidavit that indicate that radiation monitoring records for members of the proposed class have been lost, falsified, or destroyed; or that there is no information regarding monitoring, source, source term, or process from the site where the employees worked.

(Attach documents and/or affidavits to the back of the petition form.)

Describe as completely as possible, to the extent it might be unclear, how the attached documentation and/or affidavit(s) indicate that radiation monitoring records for members of the proposed class have been lost, altered illegally, or destroyed.

See Attached Narrative

**Part F is continued on the following page.**

F.3 ☐ I/We have attached a report from a health physicist or other individual with expertise in radiation dose reconstruction documenting the limitations of existing DOE or AWE records on radiation exposures at the facility, as relevant to the petition. The report specifies the basis for believing these documented limitations might prevent the completion of dose reconstructions for members of the class under 42 CFR Part 82 and related NIOSH technical implementation guidelines.

(Attach report to the back of the petition form.)

F.4 ☒ I/We have attached a scientific or technical report, issued by a government agency of the Executive Branch of Government or the General Accounting Office, the Nuclear Regulatory Commission, or the Defense Nuclear Facilities Safety Board, or published in a peer-reviewed journal, that identifies dosimetry and related information that are unavailable (due to either a lack of monitoring or the destruction or loss of records) for estimating the radiation doses of employees covered by the petition.

(Attach report to the back of the petition form.)

**Go to Part G.**

## G Signature of Person(s) Submitting this Petition — Complete Section G.

**All F gn the petition.**

Signature Date

Signature Date

Signature Date

**Notice:** Any person who knowingly makes any false statement, misrepresentation, concealment of fact or any other act of fraud to obtain compensation as provided under EEOICPA or who knowingly accepts compensation to which that person is not entitled is subject to civil or administrative remedies as well as felony criminal prosecution and may, under appropriate criminal provisions, be punished by a fine or imprisonment or both. I affirm that the information provided on this form is accurate and true.

Send this form to:

SEC Petition
Office of Compensation Analysis and Support
NIOSH
4676 Columbia Parkway, MS-C-47
Cincinnati, OH 45226

**If there are additional petitioners, they must complete the Appendix Forms for additional petitioners. The Appendix forms are located at the end of this document.**

Name or Social Security Number of First Petitioner: ____________

## Public Burden Statement

Public reporting burden for this collection of information is estimated to average 300 minutes per response, including time for reviewing instructions, gathering the information needed, and completing the form. If you have any comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, send them to CDC Reports Clearance Officer, 1600 Clifton Road, MS-E-11, Atlanta GA, 30333; ATTN:PRA 0920-0639. Do not send the completed petition form to this address. Completed petitions are to be submitted to NIOSH at the address provided in these instructions. Persons are not required to respond to the information collected on this form unless it displays a currently valid OMB number.

## Privacy Act Advisement

In accordance with the Privacy Act of 1974, as amended (5 U.S.C. § 552a), you are hereby notified of the following:

The Energy Employees Occupational Illness Compensation Program Act (42 U.S.C. §§ 7384-7385) (EEOICPA) authorizes the President to designate additional classes of employees to be included in the Special Exposure Cohort (SEC). EEOICPA authorizes HHS to implement its responsibilities with the assistance of the National Institute for Occupational Safety (NIOSH), an Institute of the Centers for Disease Control and Prevention. Information obtained by NIOSH in connection with petitions for including additional classes of employees in the SEC will be used to evaluate the petition and report findings to the Advisory Board on Radiation and Worker Health and HHS.

Records containing identifiable information become part of an existing NIOSH system of records under the Privacy Act, 09-20-147 "Occupational Health Epidemiological Studies and EEOICPA Program Records. HHS/CDC/NIOSH." These records are treated in a confidential manner, unless otherwise compelled by law. Disclosures that NIOSH may need to make for the processing of your petition or other purposes are listed below.

NIOSH may need to disclose personal identifying information to: (a) the Department of Energy, other federal agencies, other government or private entities and to private sector employers to permit these entities to retrieve records required by NIOSH; (b) identified witnesses as designated by NIOSH so that these individuals can provide information to assist with the evaluation of SEC petitions; (c) contractors assisting NIOSH; (d) collaborating researchers, under certain limited circumstances to conduct further investigations; (e) Federal, state and local agencies for law enforcement purposes; and (f) a Member of Congress or a Congressional staff member in response to a verified inquiry.

This notice applies to all forms and informational requests that you may receive from NIOSH in connection with the evaluation of an SEC petition.

Use of the NIOSH petition forms (A and B) is voluntary but your provision of information required by these forms is mandatory for the consideration of a petition, as specified under 42 CFR Part 83. Petitions that fail to provide required information may not be considered by HHS.

Name or Social Security Number of First Petitione ____________________

**Special Exposure Cohort Petition**
under the Energy Employees Occupational Illness Compensation Act

**U.S. Department of Health and Human Services**
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

OMB Number: 0920-0639 Expires: 05/31/2007

**Special Exposure Cohort Petition — Form B**

***Appendix — Continuation Page***

**Continuation Page — Photocopy and complete as necessary.**

See Attached Narrative

**Attach to Form B if necessary.**

Name or Social Security Number of First Petitio

## Class Definition

All support service employees of the DOE, its predecessor agencies, or DOE contractors or subcontractors who were monitored, or should have been monitored, for radiological exposures while working in operational Technical Areas with a history of radioactive material use at the Los Alamos National Laboratory for an aggregate of at least 250 work days during the period from January 01, 1976 through December 31, 2005, or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

Support service employees includes, but is not limited to, security guards, firefighters, laborers, custodians, carpenters, plumbers, electricians, pipefitters, sheet metal workers, ironworkers, welders, maintenance workers, truck drivers, delivery persons, rad technicians, area work coordinators.

It is not necessary that the employee's position directly matches that of one of the titles listed above, merely that the description of the employees' position is one that can reasonably be considered "support."

## The Petition

This petition is made in accordance with 42 C.F.R § 83.13 (c) because National Institute of Occupational Safety and Health (NIOSH) is not able to estimate with sufficient accuracy radiation doses for members of the identified class. It is also determined that there is a reasonable likelihood that such radiation doses may have endangered the health of members of the class. The lack of bioassay data raises the issue of possible chronic exposure to internal sources of radiation.

With respect to these employees it has been determined that there is insufficient information to estimate the maximum radiation dose incurred by any member of the class being evaluated. The information available from the site profile and additional resources are insufficient to estimate the maximum internal and external potential exposure to members of the class during the period of radiological operations at LANL; 1976 through 2005. Plus, NIOSH has approved an SEC Petition for the years 1943 through 1975 with the knowledge that later years could be added to the class.

The SEC Petition (1943 through 1975) evaluation report indicates that data is insufficient for dose reconstruction after the years indicated in the petition:

> NIOSH found that the monitoring records, process descriptions, and source-term data available are not sufficient to complete dose reconstructions for the proposed class of employees, **at a minimum,** [Emphasis added] through December 31, 1975.[1]

Additionally, the 1943 - 1975 report states, "Nevertheless, the potential for monitored and unmonitored intakes has existed throughout the history of the site."[2] At the May

[1] SEC Petition Evaluation Report Petition SEC-00051 Page 110
[2] SEC Petition Evaluation Report Petition SEC-00051 Page 74

meeting of the Advisory Board on Radiation and Worker Health, Dr. Greg Macievic, who presented the SEC evaluation report to the Advisory Board, said, "So NIOSH can reopen a petition or present an 83.14 if further evaluation warrants."[3] Lavon Rutherford, another NIOSH health physicist, commented on the 1943 to 1975 Petition by saying:

> If you look at the petition, the petition was submitted to us up to 1975. There's still issues [sic] on the table after 1975, and we recognize those. However, for timeliness and -- we wanted to go ahead and -- and complete Ms. Ruiz's petition up for the time period that she had requested. So we have left it open and we -- we have committed to -- that we will evaluate those -- those issues, and if we can -- if we determine it's feasible to do dose reconstruction, we'll put the -- we'll identify that in the site profile. However, if we determine it's not feasible, we will do an 83.14 to add additional years onto that.[4]

He continued by saying:

> So we committed that we would continue on the evaluation of the mixed fission products and a few of the other issues past '75 period to determine if we need to add additional years.[5]

Exposures to radiation and various radionuclides have placed the lives and health of LANL support service workers at risk. Coupled with poor or lack of monitoring of the support service workers for these exposures, the risk has been compounded. In addition

3 Green S.R. page 271
4 Green S.R. Page 300
5 Green S.R. Page 301

to dosimetry and bioassay deficiencies, the environmental dose cannot be properly reconstructed due to insufficient data and poor methodology.

To begin, the Laboratory is divided into technical areas (TAs). The TAs contain buildings, facilities, experimental areas, and roads. The Laboratory has about 8.6 million square feet of floor space in around 2,000 structures. LANSCE has over 350 buildings alone.

Some of the buildings are very large. The Chemical Metallurgy Research (CMR) facility, as an example, has almost 555,000 total square feet. The building has a length of ¼ mile. The building has a basement and two stories. A central main corridor has eight laboratory wings. Other large buildings include the Plutonium Facility ( PF-4) at TA-55. PF-4 is a two story building that has approximately 151, 000 total square feet. The Sigma Building in TA-03 is two story building that contains about 168, 200 square feet.

This urban environment is situated in a unique and complex terrain. To explain, the geography and climate of the Los Alamos National Laboratory are unique. The geography at LANL has an effect on operations and radiological exposures. LANL is situated on the Pajarito Plateau on the eastern slope of the heavily wooded Jemez Mountains. The Pajarito Plateau was formed after two volcanic eruptions approximately 1.1 and 1.5 million years ago. The Valles Caldera located to the west of the Pajarito Plateau was a large volcano field. A dome formed under the crust of the earth as a large pocket of magma. The dome collapsed leading to an extremely large eruption that was about 250 times larger than the Mount St. Helen's eruption of 1980. The eruption dropped ash over much of northern New Mexico. The eruption also produced a pyroclastic flow down the eastern slope of the Jemez Mountains. A pyroclastic flow is a fast moving formation of superheated rock and ash. The flow cooled and formed the Pajarito Plateau. The densities of the rock and mineral formations varied within the flow. Additionally, the center of the flow cooled slower than the edges making it harder. As a result, portions of the plateau were susceptible to erosion. Over the period of the last million years, deep canyons were formed across the plateau. Some of these canyons are almost 800 feet deep. A portion of the Technical Areas and firing sights are located in the canyons. These canyons run into a large canyon that the Rio Grande River flows through. The Rio Grande River canyon borders some of the LANL Technical Areas and receives runoff from the LANL canyons.

A variety of vegetation occurs in the region. The parts of LANL located at higher elevations toward the western boundary are more densely covered by tall mixed conifer forests. However, parts of LANL located along mesa tops at bottom elevations toward the eastern site boundary are covered with grasslands, mixed shrubs, or short trees. Taller trees are ample in the canyons.

## LANL Climate and Weather

Further, the LANL climate influences the dispersion of radionuclides. The Los Alamos area has four seasons. The climate is temperate and dry. Most of the precipitation occurs in the summer months as rainfall from thunderstorms. The average annual precipitation is 18.95 inches. The temperature in the winter ranges from 30° Fahrenheit to 50° during the day. The night time temperatures range from 15° to 25°. The summer temperatures range from 70° to 88° during the day. The night time temperatures range from 50° to 59°. Solar heating during the day is high due to lack clouds in the sky from the dryness of the region. At night the heat is radiated off because the cloudless skies are unable to reflect the heat back to the surface. The complex topography causes uneven heating and cooling of air at the surface.

A part of the climate's influence is the wind. The average wind speed for Los Alamos in 2006 was 2.5 meters per second (5.5 miles per hour). On average the winds are south or south-westerly. This occurs because the air is heated during the day. As the air heats, it rises and flows upslope and up the Rio Grande Valley. However, the loss of heat during the night causes a shift in the wind. The air on the Pajarito Plateau cools and becomes heavy. It flows east down the plateau toward the Rio Grande Valley. The winds tend to follow the canyons that run west to east down the plateau. Additionally, the canyons influence southern and southwestern winds when they are faster than normal. As the winds blow across the plateau some of the air is forced down into the canyons. This air follows the walls and floor of the canyon and circles there in the canyon. These winds are called rotor winds. The wind in the canyon is usually described as "swirling" as a result of this effect.

Winds in Los Alamos also blow from different directions and at different speeds. The windiest months of the year are in the spring from March until June. The sustained wind speed is 4 meters per second (8.8 miles per hour) 1 day out of 5 days. The wind gusts to 14 meters per second (31 miles per hour) for 1 day out of 5 days.

Consequently, monitoring the winds at Los Alamos is difficult. The National Research Council said, "It is difficult to estimate the precise wind trajectory fields for sites of episodic releases or those for which meteorological data are inadequate."[6] To illustrate, the 1992 LANL Environmental Surveillance said this:

> Because the Laboratory site is topographically complex, it is difficult to design a meteorological monitoring network capable of capturing the full spatial variability of all the measured variables. Quantifying the representativeness of the wind measurements is an especially difficult task. Adequacy of the current network of four towers depends on meteorological conditions and on the applications of the data. When the data are used to compute statistics for periods of several days or more, results for a particular tower site are thought to be representative of an area (on the plateau) a few kilometers in radius. When the application is modeling plume transport in a stable atmosphere, this radius may shrink to a few hundred meters.[7]

In order to fully understand how wind affects dispersion, the earth's atmosphere and turbulence must be explained. The Earth's atmosphere contains several layers: troposphere, stratosphere, mesosphere, thermosphere, ionosphere, and exosphere. The lowest layer is the troposphere. The troposphere begins at the Earth's surface and extends to between 7 and 17 kilometers. 90% of the Earth's atmosphere by mass is located below 16 kilometers. The lowest portion of the troposphere is the peplosphere

[6] National Research Council Radiation Dose Reconstruction For Epidemiologic Uses Pg 38
[7] LA-12764-ENV page VIII-9

or planetary boundary layer. This portion contacts the surface of the earth. The roughness of the surface creates friction on the flow the atmosphere. This friction creates turbulence in the flow resulting in random, local changes in direction of the flow. This layer where friction slows and changes the wind is thickest during the day and thinnest at night. Daytime heating thickens the boundary layer as winds at the surface become increasingly mixed with winds aloft due to insolation, or solar heating.

Next, turbulence is a form of fluid flow in which the particles of the fluid move in a disordered manner or in irregular paths, resulting in an exchange of momentum from one portion of fluid to another. In turbulence recirculation, eddies, and apparent randomness dominates flow. Flow in which turbulence is not exhibited is called laminar. When fluid or air flows past an obstacle, it swirls and creates a reverse current. This is called an eddy. The moving fluid creates a void without flow on the back side of the obstacle. Fluid behind the obstacle flows into the void and back toward the obstacle. The direction change produces a swirling motion. Gases have a similar variation called vortex. Gas flows back due to lower pressure creating a rotation in the gas.

Moreover, heating and cooling of air near the surface also create turbulence. Vertical mixing occurs between layers as a result. This mixing affects the dispersion of aerosols and gases in the atmosphere. Wind velocity profiles are different for different terrain profiles. Air movement slows over complex terrain and urban terrain. The height above the ground that the terrain has limited effect varies for the different types of terrain. For example, wind speed increases more with height over land than over water. Because the surface of water is smoother, wind has more speed over water.

Equally important, weather affects dispersion. Uneven heating of the surface of the Earth creates wind. The air becomes less dense as it heats and rises. Cooler air moves to replace the air that has risen. Differences in barometric pressure also cause wind. Air moves from areas of high pressure to areas of low pressure until the pressure is equalized. Winds can be associated with large scale events like warm and cold fronts. Medium scale events such as thunderstorms create wind. Microscale winds are the turbulence created from the passage of a weather front. Microscale winds last or a short period of time and are limited to a few hundred meters above the earth.

As wind moves across the surface of the Earth, direction changes occur. That is, wind shear is a microscale wind event and occurs when the wind changes direction and/or speed in a short distance. The change creates a separation between layers of air. The atmospheric effect of surface friction with winds aloft force surface winds to slow and turn back counterclockwise near the surface of the Earth. The winds blow inward across isobars when compared to the winds in frictionless flow well above the Earth's surface. Radiative cooling overnight further enhances wind decoupling between the winds at the surface and the winds above the boundary layer and thereby increases wind shear. These wind changes force wind shear between the boundary layer and the wind aloft, and is most emphasized at night.

Terrain also affects the creation of wind. Mountain tops warm before valleys and canyons because the sun's rays reach the mountain tops first. The mountain warms the surrounding air causing it rise. Cooler air from the lower elevations flow upward to replace the rising air. When higher air cools, the flow reverses direction because the cooler air has more density. The denser air is drawn to lower elevations by gravity.

Next, to understand dispersion, releases must be explained. LANL releases radionuclides into the air from various sources. Exhaust stacks from buildings and explosives testing discharge or launch the radionuclides into the lower atmosphere above LANL. The lower level winds move the material away from the point of release. Variables, such as particle size and wind speed, affect the final resting position of the particles. Radionuclides were also buried and discharged into the canyons. Leeching and surface runoff moved the radionuclides away from the release points. After the surface water evaporated, the wind could resuspend the radionuclides.

LANL also releases radioactive gases into the atmosphere. Gas is a fluid (as in air) that has neither independent shape nor volume but tends to expand indefinitely. Or, a state of matter in which the matter concerned occupies the whole of its container irrespective of its quantity. An aerosol is the colloidal dispersion of a solid or liquid in gas. Dispersion is the distribution of fine particles through a medium. The range of size of particles that make up aerosols is from 0.001μm to 100 μm.

Further, the releases form plumes. A plume is an elongated and open band of smoke or exhaust gases. There are three types of plumes. Buoyant plumes are lighter than air because they are at a higher temperature and lower density than the ambient air which surrounds them, or because they are at about the same temperature as the ambient air but have a lower molecular weight and hence lower density than the ambient air. Dense

Gas plumes are heavier than air because they have a higher density than the surrounding ambient air. Passive or Neutral plumes are neither lighter nor heavier than air.

## LANL Explosives Testing

LANL conducts open air explosive testing. This explosives testing launches radionuclides into the air and then disperses them with the wind.

To begin, an explosion is rapid release of energy followed by expanding gases. The expanding gases compress the air around the area of the explosion creating a shock wave. Additionally, the explosion creates a vast amount of heat. This heat forms a fireball that rises into the air. The fireball draws dust and debris up with it. The fireball rises until its temperature cools to the ambient temperature of the air around it. A typical plume then results.

An explosion is categorized as either physical, chemical, or nuclear. The rupturing of a pressurized gas cylinder would be a physical explosion. A chemical explosion is the rapid burning of a chemical compound. A nuclear explosion is the release of energy caused by the separation of sub-atomic particles in an atom.

Although LANL develops nuclear explosive devices, LANL primarily tests chemical explosives. The chemical explosives tested at Los Alamos are high explosives. Often, the testing also involves the use of radionuclides such as depleted and natural uranium among others. These explosives contain oxygen and elements that can attach to the oxygen robustly. The transfer of oxygen to these elements releases the heat and energy of the explosion. Simply put, explosives burn. However, the rate at which they burn occurs in microseconds. Some of the explosives tested at LANL burned between 4,000 and 7,800 meters per second. The pressures generated by these explosives varied from 1,340 psi to 3,000 psi.

Furthermore, explosions are able to affect the area at the point the explosive is detonated. The quantity and type of explosives determine the effect. The effect is explained using two terms: power and brisance. Power is the ability to do work at a distance. Brisance is the shattering effect. The rate at which an explosive reaches peak pressure establishes brisance.

When an explosion is initiated, a wave forms that propagates through the explosive and carries beyond into the surrounding matter. The shape of the explosive forms the shape of the wave. By controlling the shape of the wave, the blast effects can be managed. If the wave is directed inward towards fissionable material, the necessary implosion can be created to cause a nuclear detonation. Alternatively, a wave directed outward creates a conventional explosion. When directed outward, air near the explosion compresses rapidly forming a blast wave. Since explosives burn at supersonic speeds, the wave created at detonation moves at supersonic speeds. The speed of the wave through the air causes pressures, densities, and temperatures to increase. Blast winds follow the pressure wave traveling at slower speeds. These blast winds carry dust and debris outward from the explosion. After the wave passes, negative pressure develops. Flow reverses toward a vacuum created from the explosion. The reverse flow often carries dust and debris back into the vacuum.

As a blast wave travels from the point of explosion, it becomes weaker. Debris from the blast will probably land within the 5 kPa overpressure contour of the blast wave. As the weight of the explosiveincreases, the radius of the blast wave increases. Blast effects are determined by the scaled distance. Scaled distance is explained using the equation[8]

$$Z = \frac{R}{W^{\frac{1}{3}}}$$

Where Z is the scaled distance, R is the distance from the explosion, and W is the weight of the explosive. This formula is a very simple application of mathematics to determine blast effect. This formula is based on using TNT as the explosive. A change in the variables of the amount of explosive, altitude, or reflective surface, require formulas that are more complex. Therefore, determining the area of the blast effect requires much information.

Also important is the heat created from the explosion. That is, the heat generated by the explosion is in the range of 3000°C to 4000° C. This heat localizes and forms into a ball. This fireball then rises into the air. As the fireball rises, air is drawn upwards into it. This motion propels dust and debris from the explosion up into the atmosphere. The pressure wave reflected off the ground carries more material upward. A cloud forms as the material slows. The force of the explosion determines the height the cloud will reach.

[8]Ngo, Mendis, Gupta, and Ramsey "Blast Loading on Structures: An Overview" page 78

As an example, the explosive force from 5 to 10 kilograms of TNT will create a cloud height of 50 to 150 meters above the ground. The formula to calculate this is

$$H_e = \xi(M^{.25})\, t^{\frac{1}{2}}$$

Where $H_e$ is the effective release height in meters, M is the amount of explosives in kilograms, t is time from start of the release in seconds, and ξ is a constant in range 30 – 50 m/ (kg $^{1/4}$ sec $^{1/2}$).[9]

However a different formula would yield different results. Sandia National Laboratory developed this formula for calculating dispersion height:

$$H_e = \alpha(76m^{.25})$$

Where, $H_e$ is the effective release height of the plume in meters. α equals 0.8. (This value is taken from the cloud mid-point). And, m is the amount of explosives in pounds.[10]

To continue, as the material lifted aloft cools it becomes part of the surrounding atmosphere. Depending on the strength and character of the wind, the material is deposited away from the point of the initial explosion. The size of the particles in the

[9] Deaves, D.M. and Hebden, C.R. Pg 20
[10] Deaves, D.M. and Hebden, C.R. Pg 20

aerosol affects deposition. The larger and heavier particles will be deposited before the lighter and smaller particles. When the material is carried in the updraft following the fireball, it moves straight up as though traveling through chimney. This information is contrary to the Site Profile for LANL which assumes the explosives testing created an area source. The column created by the material being entrained upward should be considered a point source. The point source has a higher concentration of radionuclides in the plume. Modeling for area sources and point sources is different. The data that resulted from using an area model for point sources would be flawed and the result would be non-representative data. For instance, the Final Environmental Impact Statement for the Dual Axis Radiographic Hydrodynamic Test (DARHT) facility assumes that DARHT releases to the atmosphere would be from point sources. The DARHT facility conducts open air explosives testing.

## Buildings Influence Dispersion

Another point to consider is that buildings influence dispersion. Building stack height, shape, orientation to the wind, and proximity to other buildings affect how aerosols released from buildings are dispersed.

To begin, contaminants leave buildings through vents or stacks designed to exhaust to the atmosphere. Plume rise is assumed to occur immediately. Depending on wind conditions a plume will be vertical or bent-over. Additionally, the plume can be drawn down the backside of the stack if pressure is low. The downwash can cause increased mixing at ground level. The velocity of the effluent needs to 1.5 times greater than the wind velocity to prevent down wash. Briggs[11] developed a formula to calculate the distance of plume downwash ($h_d$):

$$h_d = 2\left(\frac{w_o}{u} - 1.5\right)D$$

Effluent velocity is $w_o$.

Crosswind velocity is u.

Stack diameter is D.

Further, buildings develop a wake cavity on the down-wind side. The length of the wake cavity can be 2.5 times the height of the building. Vortices are created due lower pressure on the down-wind side of the building. Plumes entering the wake cavity are mixed down to ground level. The recirculation within the wake cavity extends the time for dispersion of material to occur. If a building has a stack height that 2.5 times the height of building, then plumes are unlikely to enter the wake cavity of the building. The stacks at LANL are considered to be level with the rooftops in the Site Profile. "The assumption that the building height was equivalent to the effluent release height was because releases were generally from small stacks or vents on the roofs."[12] Radionuclides in the plume would be drawn down to the ground outside of the building. There, workers would be exposed to the radionuclides.

[11] Hanna, S.R., Briggs, G.A., Hosker, Jr. R.P. page 19
[12] ORAUT-TKBS-0010-4 page 11

The proximity of other buildings can affect dispersion as well. Wind that collides with upper $^1/_3$ of a building will clear the building. Wind that collides with the lower $^2/_3$ of a building creates a down wash on the front of the building. When this down wash collides with the ground it changes directs to flow the opposite direction of the prevailing wind. If this occurs between 2 buildings, then the exhaust can be trapped between the buildings until the wind changes direction. The potential for exposure would be increased.

## Complex Terrain

Additionally, complex terrain affects dispersion. Dispersion in canyons, mountains, and trees is different from flat terrain. Dispersion over flat terrain is generally uniform and constant.

Alternatively, canyons and mountains affect the wind by channeling, blocking, or deflecting its flow. The wind is also affected by the uneven heating over the complex terrain. The different areas and elevations cause the convection of air to be irregular or intermittent. Cramer explained it best:

> During summer fair-weather patterns, local winds in mountainous terrain are greatly influenced by differences in temperature in the lower layers of the atmosphere. Surface air temperature varies with elevation, aspect slope, extent, and type of ground cover, as well as with the temperature and stability of the

overlaying air. These variations result in local density and pressure gradients that in turn produce complex wind patterns in the first 1000 ft or so above terrain.[13]

These variations in wind affect the dispersion of aerosols. For example, when plumes impact on canyon walls they can disperse laterally. Dilution increases with cross canyon flows as the plume is dispersed down into the canyon. The rotor winds that occur in canyons further affect the plume. As the plume moves through the canyon it encounters further turbulence created by the uneven surfaces within the canyon itself.

Additionally, trees and forests disperse plumes and in various ways. To begin, the trees create turbulence in the air above them. Going lower into the canopy, the wind slows because of the friction from the branches and leaves or needles. This friction then either changes the direction of the wind or creates eddies and backflows. The plume is further dispersed by impaction of the aerosol on the foliage, and deposition.

That is, deposition is the act of depositing material on the earth's surface. This can includes materials that have been eroded elsewhere and transported by means such as wind, precipitation, or rivers. The means of deposition from LANL plumes is either wet or dry. Wet deposition removes more particulate from the air than dry deposition. However, Los Alamos has limited precipitation so dry deposition is more common. Wet deposition is created two ways. First, when moisture collects on aerosol particles droplets are formed. These grow and eventually fall. Second, as the drops fall they capture aerosol particles. Dry deposition is influenced by different factors. The first is

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[13] Cramer, O.P. 11 page 44

particle size. Gravity influences the larger particles causing settling. A key point in settling is that higher altitudes have thinner air. This creates less resistance so settling happens at a higher rate. The Los Alamos elevation is approximately 7000 feet. According to the U.S. Standard Atmosphere, the density of the air is .99147 kg/m3. In comparison, the density at sea level is 1.2250 kg/m3.[14]

## Dispersion Modeling

Moreover, models have been developed to approximate dispersion. These models are used to evaluate monitoring and to determine the effects of releases.

Further, aerosol and gas dispersion models are systems of postulates, data and inferences that are presented as mathematical descriptions of actual plumes from sources. Box models depict the plume in the shape of an elongated box. The material is represented as being dispersed throughout the box. The Gaussian model assumes that the air pollutant dispersion has a normal probability distribution. Gaussian models are most often used for predicting the dispersion of continuous, buoyant air pollution plumes originating from ground-level or elevated sources. A Lagrangian dispersion model mathematically follows pollution plume particles as the particles move in the atmosphere and they model the motion of the particles as a random walk process. The Lagrangian model then calculates the air pollution dispersion by computing the statistics of the trajectories of a large number of the pollution plume parcels. A Lagrangian model uses a moving frame of reference as the parcels move from their initial location. It is said that an observer of a Lagrangian model follows along with the plume. A Eulerian dispersion model is similar to a Lagrangian model in that it also

[14] U.S. Standard Atmosphere Table 1 page52

tracks the movement of a large number of pollution plume particles as they move from their initial location. The most important difference between the two models is that the Eulerian model uses a fixed three-dimensional Cartesian grid as a frame of reference rather than a moving frame of reference. It is said that an observer of an Eulerian model watches the plume go by.[15]

At this point, an explanation of the types of sources is needed. A point source is a single, identifiable source of air pollutant emissions (for example, the emissions from a combustion furnace flue gas stack). Point sources are also characterized as being either elevated or at ground-level. A point source has no geometric dimensions. An area source is a two-dimensional source of diffuse air pollutant emissions (for example, the emissions from a forest fire, a landfill or the evaporated vapors from a large spill of volatile liquid). A volume source is a three-dimensional source of diffuse air pollutant emissions. Essentially, it is an area source with a third (height) dimension (for example, the fugitive gaseous emissions from piping flanges, valves and other equipment at various heights within industrial facilities such as oil refineries and petrochemical plants). Another example would be the emissions from a LANL paint shop with multiple roof vents or multiple open windows. A line source is one-dimensional source of air pollutant emissions (for example, the emissions from the vehicular traffic on Pajarito Road).[16]

## Emissions Monitoring

[15] Wikipedia Article "Dispersion Terminology"
[16] Wikipedia Article "Dispersion Terminology"

Equally important, monitoring emissions requires complex processes and systems. The air must be sampled in order to measure the amount of aerosol it contains. A sampling system contains three parts. The first is the vacuum which draws the air into the second part being the collector. The third part is a device that measures the radioactivity of the particulate. Particulates are collected in filtering material. Paper, glass fiber and membrane are the common types of filter material. Membrane captures particles on its surface. Paper and glass captures particles in the weave of their fibers.

In order to measure an aerosol, the size range of the particles to be measured must be considered. Different sizes of particles require different means of measurement. The different sized particles move in different ways. Therefore, the methods to collect the particles of different sizes must be different. Coarse particles have a higher gravitational settling than fine particles. The motion is considered to be uniform and changes in direction are gentle unless the particles collide with more massive objects. To continue, charged particles have uniform motion when moving through an electric filed. Finally, the motion of fine particles tends to be Brownian in nature. Brownian motion is the continuous random motion of microscopic solid particles in when suspended in a fluid or gaseous medium. The motion is caused by impact with the molecules of the surrounding medium.

Uniform motion can be described one dimensionally using the following formula:

$$x = Vt$$

Where x is equal to the distance the particle travels.

V is equal to the constant velocity of the particle.

And, t is equal to the quantity of time that the particle travels.

However, if the motion is diffusive, then the following formula would better illustrate the path of the particle:

$$x_{rms} = \sqrt{2Dt}$$

Where, x is equal to the displacement of the particle. With the subscript "rms" meaning the root mean square.

D is a constant whose value depends on the size of the particle, the air temperature and other factors.

And, t is equal to the period of time. However, the total movement increases with the square root of time.

As a result, diffusive motion is viewed statistically.

Further, the size of the particle affects the rate at which it falls. Larger particles are less affected by the viscosity of the air they are falling through. A particle will accelerate as it falls until it reaches its terminal velocity. At its terminal velocity it stops accelerating because the resistance of the air it is falling through equals the force of gravity. The velocity becomes constant. Since the surface area to mass ratio of smaller particles is larger, the air resistance on smaller particles is greater. So, they reach terminal velocity sooner than larger particles. Terminal velocity for course particles is demonstrated by the following formula:

$$F_d = -3\pi\eta V d$$

$F_d$ is the force of air.

$\eta$ is the viscosity of air.

V is the velocity of the particle.

The particle diameter is d.

Since the concern about aerosol emissions from LANL is radioactive particles, then the decay of the isotopes in the particles will affect the motion of the particles. When radioisotopes decay, they emit radiation in the form of alpha or beta particles, or gamma radiation. Recoil velocity and kinetic energy are created as a result of the spontaneous disintegration of the radionuclide. For the reason that an alpha particle is essentially a helium nucleus, it possesses the most mass that can be emitted. It has the largest recoil. This recoil can change the direction of the particle. Additionally, if a particle has been captured in a filter, the particle may be re-entrained into the flow going through the filter.

Jacob Shapiro described it by saying:

> An interesting reentrainment mechanism occurs in the filtration of particles that carry radioactive activity. When an alpha particle is emitted, the resulting recoil can be sufficient to knock a small particle off a fiber. Reentrainment is generally not very important, but the possibility must be considered for very hazardous substances such as plutonium where extremely high filter efficiency is required.[17]

The size of the particle to be measured determines the method used to collect the aerosol sample. Schery said, "With the exception of electron microscopy, no single technique is able to cover the entire aerosol range."[18] Some of the methods used to collect aerosol samples are diffusion screens, condensation nuclei counters, electric mobility analyzers, optical particle counters, conventional impactors, and optical microscopes. LANL uses filters to measure aerosols. Filters rely on three methods to collect aerosol particles. The first is inertial impaction. The particles are carried in the air flow to the filter. The air flows through the filter, but the particles because of their inertia are not able to follow to air flow and impact on the surface of the filter. Inertial impaction also affects flow through pipes that carry the aerosol to the collection filter. The greatest affect is seen in pipes with a ninety degree bend. Steven Schery says that the particle may not be able to make the turn. "The greater the average velocity $V_o$ of the airstream, the larger the mass of the particle, and the narrower the width of the channel, then the more likely the aerosol particle will impact on the lower surface."[19] Second, diffusion also causes particles to collect on filters. The particles stray from the airstream while moving through the filter and stick to the surface of the filter. Diffusion allows

[17] Shapiro page 400
[18] Schery Page 174
[19] Schery 177

*smaller particles* to be captured in filters. Third, particles are sieved when the particle is larger than the filter pore and are unable to pass through the filter.

Filter efficiency is determined by two factors: the air flow velocity and the size of the pores in the filter. The velocity of the air flow determines the amount of inertial impaction. As flow increases, more particles impact with the filter. However, collection by diffusion decreases because the flow prevents smaller particles from leaving the stream. Smaller pore size increases likelihood of particles being captured. But, the cost of smaller pores is increased resistance to the flow slowing it down. When pores become clogged, filter efficiency decreases. Air flow through the filter declines and air pressure on the face of the filter increases. LANL uses a 47 mm circular polypropylene filter with about 13 cm- effective surface area. The samples are halved when collected. The first half is analyzed immediately. The other half is retained and composited quarterly for isotopic analysis.

## LANL Dispersion Modeling

LANL emissions are modeled using various programs. Different programs are used for different sources and types of emissions.

Radioactive emissions from LANL are modeled using The *Clean Air Act* Assessment Package – 1988 (CAP-88). CAP-88 is one of the approved programs required by 40 CFR 61 subpart H. The CAP88 Model estimates dose and risk using a set of programs, databases and utilities. CAP-88 is approved by the Environmental Protection Agency to demonstrate compliance with the *National Emission Standards for Hazardous*

*Pollutants.* CAP-88 has limitations which affect the accuracy of the model at Los Alamos. First, CAP-88 assumes that terrain is flat. Variation in radionuclide concentrations due to complex terrain cannot be modeled. As illustrate above, the terrain at Los Alamos is anything but flat. Second, CAP-88 is not intended to calculate doses closer than 100 meters to the source. Therefore, because of stack tip downwash, doses to workers cannot be modeled. Third, the same plume rise mechanism (buoyant or momentum) is used for all sources. Fourth, while up to six stack or area sources can be modeled, all the sources are modeled as if located at the same point. Area sources are treated as uniform. Fifth, if the radiation cloud is overhead, the dose is not calculated. The National Research Council said this about using computer programs:

> Caution must be exercised in the uncritical use of "off-the-shelf" assessment codes that have been developed for the purpose of regulatory analysis. Their equations and data bases support generic assessments for reference situations, but because they usually are designed to determine compliance with regulations, they are seldom applicable to realistic estimates of exposure.[20]

In summary, CAP-88 does not address terrain height, building wake or tip downwash, multiple sources (i.e., all sources are co-located) or the skyshine pathway. These limitations are discussed in the 1999 LANL Site Wide Environmental Impact Statement on page B-5, Appendix B, Volume III.

[20] National Research Council Radiation Dose Reconstruction for Epidemiological Uses Page 36

CAP-88 is a modified Gaussian plume model. Gaussian models have limitations. Errors that seem small in the Gaussian model can result in large differences in the model's forecasts. Conditions must be invariable for the entire distance the plume travels for the forecast to be accurate. That is the wind speed and direction must be constant from the source point to the receptor. Atmospheric turbulence must also be constant. Most Gaussian dispersion models rely on the Briggs plume rise equations to foretell buoyant plume rise. The margin of error for the Briggs equations is ± 20 %.[21] The Gaussian dispersion equation also assumes that there is no deposition from plume along its path. Also, there are no other particulate losses due to washout, absorption, or transformation. Gaussian models are limited to a plume shaped like a cone. Gaussian models are only intended for flat terrain. In conclusion, the Gaussian dispersion model is useful for limited distances. Its accuracy depends on the availability of the local meteorological data. And, conditions need to be fairly uniform and horizontally consistent. This is not the case at LANL.

LANL uses different models for emergencies and for nonradiological releases. For Emergencies LANL uses the Meteorological Information and Dispersion Assessment System – MIDAS. MIDAS is actually two models. One is Gaussian and assumes flat terrain. It models puffs being released over a period of time and tracks them with vertical and horizontal displacement. The second model is for complex terrain. This model separates the release into small parcels and estimates the path of each parcel. Dispersion is simulated by application of arbitrary disturbances to the speed of the parcels.

[21] Beychok, M.R.

1999 LANL SWEIS modeling for non-radiological pollution accounts for complex terrain, building wake effects, stack down wash, and dispersion following explosions. The models are ISC-3, PUFF, and Hotspot. ISC-3 is capable of handling multiple point sources, stack-tip downwash calculation, buoyancy induced dispersion, as well as having an algorithm to account for downwash due to nearby buildings. The PUFF model is designed to estimate downwind concentrations from instantaneous releases of pollutants. HOTSPOT is designed for the detonation of high explosives. HOTSPOT is intended for use with radiological materials. Unfortunately, it was not used in the preparation of the 1999 LANL SWEIS. The National Research Council said this:

> Although computer codes can be verified, peer reviewed, and sanctioned by specific government agencies, their results still rely on the professional judgment of the user, and different users might get different results.[22]

Decidedly, this decision by LANL to not use HOTSPOT to model radiological particle dispersion after high explosive testing demonstrates this statement.

The AIRNET air samplers are located around the LANL perimeter. The AIRNET samplers are used to detect plutonium, uranium, tritium, and americium. The AIRNET samplers do not detect the other radionuclides released from LANL sources. The placement of the air monitors is to determine the dose to the public off-site.

[22] National Research Council Radiation Dose Reconstruction for Epidemiological Uses Pg 36

However, tracer studies have shown that radioactivity from activation products in plumes emitted from LANL exhaust stacks decays over time and distance. Additionally, depending upon wind speed and plume stability, the plume can become diluted. The AIRNET samplers are placed over various distances up to several miles from exhaust stacks. Few are located in areas that would determine the exposure to employees. The *Los Alamos National Laboratory Site Profile Review*, SCA-TR-Task1-0011, prepared by Sanford Cohen and Associates agrees

> SC&A believes that the lack of air monitoring stations, within a particular TA of known higher releases of a specified isotope, does not readily enable one to accurately estimate environmental dose. This is particularly true when using air monitoring data from an adjacent TA air monitoring station. It will be difficult for the dose assessor to accurately estimate environmental dose without accurate air monitoring data derived from a station proximal to the release point.[23]

Additionally, the placement and monitoring does not account for the change of wind direction that occurs after sunset. An example of this is the TA–72 firing range used by the guard forces for weapons qualifications. The firing range is located in Sandia Canyon about 1000 feet south-southwest from the LANSCE exhaust stack. There is no monitoring in the canyon for radioactive releases from the LANSCE although the LANSCE is the largest source of the off-site dose, about 90% of the dose. The firing range is typically used in the afternoon until late evening, generally between 1200 hours to 2400 hours. The highest emission rates from the LANSCE occur during those hours.

[23] Los Alamos National Laboratory Site Profile Review, SCA-TR-Task1-0011 page 83

The maximum is usually centered around 2000 hours. The winds blow down the canyons at night. Additionally, 26% of the evening winds at LANSCE are from the north-northwest.[24] The National Research Council stated, "External exposures can be significant for noble gases such as $^{41}$AR or $^{133}$XE or long-lived radionuclides that are deposited on the ground."[25] Finally, the LANL ES&H Self Assessment found fault with the holding of gases to allow for decay prior to release.[26]

> Finding/AX.2-3: The practice of holding, or delaying, the release of radioactive emissions to maximize radioactive decay has not been fully implemented.
>
> > Discussion: Although LAMPF is not a nuclear facility, it releases the highest level of activity on site. Currently, filtration and short transit air times are used, but it has been determined that a longer delay would significantly reduce emissions.

DOE conducted environmental surveys of its sites and found 1,277 findings. The report specifically mentions Los Alamos National Laboratory by saying, "At Los Alamos National Laboratory, a 1987 survey found improper disposal of hazardous waste, releases of hazardous material, leakage of toxic chemicals, and off-site releases of radioactive contaminants into canyons where they polluted soil and sediments."[27] In fact, Los Alamos National Laboratory was fourth highest in environmental problems

[24] Bowen, B.M. page 1230
[25] National Research Council Radiation Dose Reconstruction For Epidemiologic Uses Pg 41
[26] LA-12200-MS
[27] GAO 90-101 ES&H Problems at DOE sites Page 20

with 59. [28]And, Los Alamos National Laboratory was considered a significant non-complier of the Resource Conservation and Recovery Act.

Further, numerous safety deficiencies were discovered during the Tiger Team investigation conducted at Los Alamos National Laboratory. In March of 1993, the GAO prepared a report titled, *Corrective Actions on Tiger Teams' Findings Progressing Slower than Planned.* The 35 Tiger Teams reported 8,715 findings. The report said that progress had been slower than expected because contractors were unable to meet milestones. It stated, "As of March 31, 1992, the 23 facilities had not completed 1,326 (44 percent) of the 3,017 findings originally scheduled for completion by that date."[29] Los Alamos National Laboratory was not included in that list of facilities because its assessment report had not even been approved yet. There were several findings to be seen in the Tiger Team Los Alamos National Laboratory report itself. One finding was that the annual missed dose could be as high as 108mrem. Another finding revealed LANL failed to calibrate the radiation monitors annually. One last example is LANL failed to identify workers that should be in the bioassay program.

To continue, releases to the atmosphere must be monitored and recorded. According to the National Research Council, "Atmospheric releases require specification of the term from the height, diameter, air flow rate, and temperature in the stack and the

[28] GAO 90-101 ES&H Problems at DOE sites Page 28
[29] GAO 93-66 Corrective Actions on Tiger Team Findings Progressing Slower than Planned pg 5

contaminant concentrations in the discharged air. Information about the size distribution and chemical form of discharged aerosols and particles is important."[30]

The LANL ES&H self assessment discovered problems with the stack monitoring at LANL.[31]

> Finding/AX.2-1: Stack monitoring is inconsistently applied across Laboratory facilities.
>
> > Discussion: Different technologies and configurations are used for stack monitoring; many are not real-time monitors, while others are state-of-the-art systems. These systems are not being evaluated for adequacy for both normal and off-normal conditions. Continuous Air Monitor (CAM) alarms, which monitor the exhaust of some buildings, are not always monitored at a location remote from the operating area. Alarms are not routed to a remote location where operators can monitor them.

LANL failed to do this properly and lost a Clean Air Act citizens' lawsuit as a result. A federal judge ruled that the Los Alamos National Laboratory was in violation of the Clean Air Act. (Concerned Citizens for Nuclear Safety, Inc and Patrick Jerome Chavez, v. United States Department of Energy and Siegfried S. Hecker No. CIV 94-1039). The facts of the case stated that LANL activities emit radionuclides. The Clean Air Act and corresponding regulations recognize radionuclides as a hazardous air pollutant. The Environmental Protection Agency requires that emissions be monitored to ensure that they do not exceed the standard for emissions. The Environmental Agency found that

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30 National Research Council Radiation Dose Reconstruction For Epidemiologic Uses Pg 20
31 LA-12200-MS

the Los Alamos National Laboratory was not in compliance. Specifically, it found that not all sources of radionuclide emissions had been identified, stack monitoring equipment had not been installed on all stacks and vents emitting significant amounts of radionuclides into the air, for those stack and vents monitored, the monitoring systems did not meet regulatory requirements and upgrading, and LANL had not conducted and was not in compliance with the quality assurance programs required by the regulations. The National Research Council finds that this information is vital for dose reconstruction:

> Points of releases are particularly important; these should be established from plans of the site and facilities, information on processing activities, process flow sheets, and facility drawings. On-site inspection and mapping of the premises and remaining facilities is an essential part of such determinations.[32]

The following year the EPA performed an audit and found continuing violations of the standard of 10 mrem off-site dose as set in 40 CFR 61 Subpart H. LANL attempted to remediate the problems. However, by the middle of 1995, 31 out of 33 radionuclide emitting stacks were out of compliance. As a result of the suit, LANL was fined and had to submit to 3 independent audits of its air quality. The audits were conducted by Risk Assessment Corporation. The audits were monitored for Concerned Citizens for Nuclear Safety (CCNS) by the Institute for Energy and Environmental Research (IEER). Judge Meecham, the federal judge presiding in the case said:

[32] National Research Council Radiation Dose Reconstruction For Epidemiologic Uses Pg 20

> DOE merely protests that Plaintiffs exaggerate the safety risk of LANL's admitted non-compliance with what it characterizes as "technical" regulatory requirements. **To the contrary, Plaintiffs, and all the citizens of New Mexico, quite properly expect LANL to be utterly scrupulous in its observance of federal environmental regulations.**[33] [Emphasis added]

The final report of the First Independent Audit of Los Alamos National Laboratory for Compliance with the Clean Air Act, 40CFR, Subpart H was completed in 1999. The results of the first audit were that ESH-17 quality assurance is not credible because audits of ESH-17 were conducted by a contractor to ESH-17. ESH-17 failed to verify radionuclide inventory reports submitted by facilities. These inventories were necessary for record keeping requirements specified in the Clean Air Act. LANL tended to use informal methods to estimate quantities of radionuclides in inventory. One method used was "eye-balling" the contents of a container. Historical stack sampling did not meet 40 CFR 61 requirements. Operational changes were not reported to ESH-17. Evaluations to determine monitoring changes were not done as a result.

The results continued that LANL did not take representative samples of effluent. Sampler rates normally used for environmental monitoring are in the range of 34 cubic feet per minute (cfm). The rates of the AIRNET sampler are in the range of 4 cfm. Also, the samplers were not tested to determine if they were in compliance with EPA regulations. Samplers were not placed considering actual emission locations. LANL only calculated dose assessments at one location. By not calculating dose assessments at

33 Memorandum Opinion and Order page 8

other locations LANL may not have calculated the highest dose for the maximally exposed individual. LANL did not meet regulatory requirements to provide complete and accurate information when reporting. The 1996 annual RAD NESHAPS report to the EPA contained 20 errors. There were discrepancies in CAP-88 dose assessments. The reported doses to the public required correction. Required data concerning distances from points of releases or sources of meteorological were omitted or not provided causing a regulatory deficiency.

Prior to the lawsuit, LANL was aware of its inadequate air monitoring. In 1991 a report was prepared concerning the LANL air monitoring program. In a Memorandum to Siegfried Hecker, LANL Director, from LANL employees Ray Waller, Charles Keller and Sumner Barr referred to the report titled "The Los Alamos National Laboratory's Air Emissions Monitoring Program: A Quick Look Technical Review" and said:

> As stated in the report, the Laboratory's air emissions program is very complex and crosscuts many different laboratory organizations. Therefore, our quick-look is cursory in nature and may have missed some important issues.[34]

The report stated that LANL was not in compliance with 40 CFR61. The report stated, "Stack emissions monitoring are out of compliance with 40 CFR 61-a fact well known to those responsible for this effort (and one receiving concentrated attention)."[35] LANL was aware that approximately 90 stacks were involved in experiments which could

[34] Memorandum to S.S. Hecker from Ray Waller, Charles Keller, Sumner Barr Sept 06, 1991
[35] Los Alamos National Laboratory's Air Emissions Monitoring Program page 2

result in the release of radionuclides. Also, LANL knew it was not in compliance with regulations.

The stack emissions measurements were not in compliance with 40 CFR 61, Subpart H and 40 CFR 60, Appendices A and B. "Our noncompliance is recognized by LANL, DOE, and EPA. Two principle areas of noncompliance are (1) we do not have an inventory of stacks which must be monitored under the regulations and (2) the methods we use differ from those specified in the regulations and therefore cannot be audited."[36]

The ambient air monitoring also had inadequacies. The system design had poor coverage. Its ability to capture adequate samples was marginal at best. The report stated, "Placement and density of the sampling stations appears adequate, but barely so."[37] The report further explained by saying:

> Spacing between perimeter stations is typically on the order of 2 to 6 km. Plume widths depend on several factors including source configuration, distance from the source, and meteorological factors of wind and turbulence. Typical airborne plume widths at the perimeter from on-site stack emission sources would be in the range of 1 to 5 km, so there is a chance that the monitoring network may sample air concentrations that are less than the maximum (plume axis) values.[38]

[36] Los Alamos National Laboratory's Air Emissions Monitoring Program page 8
[37] Los Alamos National Laboratory's Air Emissions Monitoring Program page 10
[38] Los Alamos National Laboratory's Air Emissions Monitoring Program page 13

The air was not monitored around the buildings at LANL. The proximity of buildings has a dramatic effect on the dispersion of aerosols and gases. In the report "Dispersion near Buildings Application of Simple Modeling", this fact was illustrated by the statement, "Large Buildings may have a significant effect on the dispersion from elevated plumes. In this case, the enhanced mixing may bring down the plume to ground level more rapidly, thus increasing ground level concentrations."[39] Wake structures and turbulence will affect the direction, concentration, and shape of a plume. LANL knew it had not accounted for these factors. The air emissions report noted, "The role of stack parameters, plume rise, and the likely role of building downwash and wake dispersion has not been addressed in the emissions monitoring documentation that we have seen."[40] The report further nailed the point down by saying:

> The area of stack height has its specific concern. It is known that stack emissions from stacks that are short compared with the building height are partially trapped in the building's wake and appear immediately at the ground level. **One could question whether LANL employees near such buildings are at risk.**[41] [Emphasis added]

Documentation that would illustrate that LANL took corrective action has not been found. A point to remember comes from the National Council on Radiation Protection and Measurements (NCRP) which said:

[39] Dispersion Near Buildings Application of Simple Modeling page 2
[40] Los Alamos National Laboratory's Air Emissions Monitoring Program page 13
[41] Los Alamos National Laboratory's Air Emissions Monitoring Program page 14

> Analysis of human populations exposed by inhalation to environmentally dispersed materials also showed that a small percentage of the individuals may receive up to five times the average organ doses received by the population.[42]

The documentation that was used to prepare the Centers for Disease Control Los Alamos Historical Document Retrieval and Assessment (LAHDRA) report as well as the LANL Environmental Surveillance reports only address airborne concentrations that would affect people offsite. **These reports were main resources for the dosing tables in the Technical Basis Document. This is a key factor that was not addressed in the Technical Basis Document ORAUT TKBS-0010-4.** However, the document does point out that the locations of air monitors, in relation to workers, is not well known. Given that fact, dose reconstruction using environmental dose cannot be done because the necessary information for dosing is not available. The LANL SEC 1943-1975 evaluation report supports this by saying:

> Airborne concentrations are available for some years of operation, but are deficient for all ROCs.
>
> With area and environmental monitoring data missing for some time periods and deficient for all ROCs, a complete assessment of potential dose cannot be performed without the use of unsubstantiated assumptions.[43]

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[42] NCRP Report No. 87 page 53
[43] SEC Petition Evaluation Report Petition SEC-00051 Page 81

Additionally, problems exist with the air monitors and the data from them. In 2000, testing of the air monitors at Los Alamos revealed inconsistent wind sampling at high wind speeds. Different particle sizes affect the collection accuracy. The Environmental Protection Agency measuring standard is based on particles of less than or equal to 10 micrometers. Radioactive soil particles that can be resuspended in air and carried by the wind are usually 15 to 30 micrometers in size. Resuspension occurs under wind speeds of 5 to 10 meters per second (about 11 to 22 miles per hour).

Under high winds in the wind tunnel, the AIRNET sampler exhibited about 96% efficiency for 5 micrometer particles and about 60% efficiency for the respirable fraction represented by 10 micrometer particles. In addition, the AIRNET sampler overestimated the concentration for micrometer particles for all wind speeds tested. Further, the percentage of penetration into the sampler varied according to direction of the flow in relation to the direction the sampler was facing. The sampler was most efficient if the flow was into the front of the air sampler. As illustrated earlier, the winds in Los Alamos do not always blow from the same direction.

## LANL Records Deficiencies

An additional point to be considered is the deficiencies in DOE records management practices. The National Archives and Records Administration evaluated the DOE records management program and found numerous deficiencies. The records are of limited use for health studies.

To begin, DOE maintains copious records. Among these are records of workers exposure to radiation. The National Archives and Records Administration evaluated the Department of Energy in 1988 for its records management practices. The evaluation revealed numerous problems with DOE records management. The National Archives and Records Administration made over 30 specific recommendations to correct these deficiencies. In May of 1992, the GAO reviewed the actions DOE had taken to correct its records management problems. The report was titled "Better Planning Needed to Correct Records Management Problems". The report states that DOE persists in having records problems. DOE fails to ensure that DOE records are not removed with employees' personal papers. DOE facilities failed to maintain records of hazardous waste training. Additionally, DOE Tiger Teams routinely presented findings of problems with safety and health records. Even though DOE had addressed some of the problems, many remain. DOE had not even completed any plans for correcting findings. The report found

> Without plans that contain specific goals and benchmarks for measuring accomplishments, DOE may never complete all the actions recommended and may continue to have problems documenting its program activities and decisions and locating retrieving its records. DOE may also continue to have problems with employees removing or destroying its records.[44]

The Center for Disease Control's Los Alamos Historical Document Retrieval and Assessment illustrates further the problems with records. It states that LANL did not

[44] GAO/92-88 page 9

maintain records of radionuclide releases. Prior to the enacting of the Clean Air Act in 1969, Los Alamos National Laboratory did not maintain effluent data. Data that was recorded and maintained was often incomplete and lacking information on isotopes, flow rates, calibrations, or measurement corrections. No procedures used to collect the data were available either.

In fact, record keeping at Los Alamos National Laboratory is so problematic that there is a discrepancy in the weapons plutonium inventory. In 2005 the Institute for Energy and Environmental Research prepared a report that revealed this information. The authors prepared the report using information from DOE records. A DOE report titled Plutonium: The First Fifty Years exposed a discrepancy in the records of amounts of plutonium discharged to waste. DOE records reported a discharge to waste of 610 kilograms of plutonium. LANL records indicated that 1,375 kilograms of plutonium were discharged to waste. The difference between the records is 765 kilograms. DOE claimed the inconsistency was due to differences in accounting for waste and normal operating losses. However, the IEER report analyses all losses recorded by DOE and a discrepancy of about 300 kilograms still remained.

Moreover, the DOE Inspector General inspected LANL for its material control and accountability. The Inspector General found that accountable nuclear material had not undergone a 100 percent inventory for possibly 13 years. The inspector General went on to say:

> We concluded that LANL's MC&A [Material Control & Accountability] Program could be improved with regard to the provision of timely and accurate information concerning the inventory, transfers, characteristics, and location of accountable nuclear materials. We identified opportunities for improvement in controls over accountable nuclear material maintained both inside and outside the MAA. [45] [Material Access Area]

Information concerning the type, quantity, and location of radionuclides is required to prepare a dose reconstruction.

Truly, even the NIOSH experts have stated that the data is incomplete. Dr. James Neton of NIOSH stated while speaking at the Advisory Board on Radiation Worker and Health meeting, held in Santa Fe, NM October 16, 2002:

> Okay, what is the status. [Sic] We've got data from 15 of the major DOE facilities in-house right now. Not complete sets, but we have data – some piece of data for the site profiles from 15 different facilities. None of the sites have submitted everything we need. There are gaps in every one of these things, as I indicated.[46]

As has been said, Department of Energy and LANL Records are not sufficient. Several agencies or entities have faulted the Department of Energy for the way it manages records.

[45] DOE/IG-0774 page 4
[46] Lee, N page 13

Moreover, in 1991, the General Accounting Office issued a report titled Efforts to Strengthen DOE's Health and Epidemiology Programs. The report was critical of the DOE for it records keeping. It stated, "These records were not collected in a standardized manner no centralized so comprehensive assessments could be made." The report continued to fault the DOE for failing to take corrective action as indicated in prior GAO reports concerning worker health and safety. A DOE evaluation of its health programs also found problems with employee health records management. The Secretarial Panel for the Evaluation of Epidemiological Activities reported, "DOE's health related records were maintained differently throughout the complex and were not collected in a standardized manner. The panel also reported it is unknown whether the health data are of any use for epidemiological research." A study conducted at LANL found that while LANL subcontractor ZIA had employed 14,428 people between 1946 and 1978, records for only 5,424 of those employees were sufficient for occupational health studies. Further records shortfalls were cited in a report by Steve Wing and David Richardson:

> Most occupational health studies at LANL have been limited to white Anglo employees of the University of California. Radiation monitoring, personal and medical records for the Zia workforce, which includes many Hispanics and Native Americans, have been less complete than records for the University of California workforce. In one study personnel records were available for 97 percent of University of California workers but only 20 percent of Zia workers, and urinalysis records were available for 39 percent of University of California workers but only four percent of Zia workers. Hispanics, non-whites and women

have been excluded from a number of occupational health studies of University of California employees at LANL[47]

LANL prepared a report titled "LANL ES&H Self Assessment". The report detailed problems in the LANL documentation program. The following is excerpted from that report:

> OA.7 Document Control
>
> Performance Objective: Document control systems should provide correct, readily accessible information to support Laboratory operations.
>
> Finding/OA.7-1: Current policies and procedures do not ensure compliance with DOE Order 5480.19, "Conduct of Operations Requirements for DOE Facilities," and DOE Order 5700.6B.
>
> Discussion: Instructions do not exist as to when written operating procedures are required. Also not addressed are how procedures are to be written, what procedures require document control processes, and how procedure updates are to be controlled. The format for procedures is not standardized by a Laboratory-wide procedure. Definitions are not clear, requirements are not easily understood, and responsibilities are ambiguously assigned. A standard writer's manual for procedures has not been adopted so that all Laboratory procedures at all levels would look the same and contain the same type of information in the same location.

[47] Wing, S., Richardson, D. page 45

Finding/OA.7-2: The Laboratory does not have a clearly articulated policy that specifies standards for procedure development, document control, and records management.

Discussion: The Laboratory lacks a definitive records management policy. Laboratory-wide processes for the development, distribution, and control of procedures (including review, approval, and change) are not formally implemented. There is no function to adequately control the format, numbering system, or distribution; issue control documents needed for safety-related work; or manage the procedure review cycle and ensure that changes are properly issued and entered through issue of change receipts.[48]

The Tiger Team Assessment of 1991, which is attached to SEC petition 00051, also had findings concerning records. DOE Orders require that occurrences and off-normal incidents be reported even if the event did not result in an exposure of release of radioactive material. However, LANL did not report off-normal events if their own criteria for reporting were not met. Additionally, there was no oversight by LANL management when a facility decided an incident is not reportable. Further, some workplaces do not have records to demonstrate that warning lights interlocks were fail-safe for x-ray and radiography machines.

To continue, the Health Physics Measurement Group failed to generate and maintain records for field maintenance of detection instruments. The LANL Radiation Occurrence Report system was incompatible with the DOE system and lacked radiological occurrence criteria. Also, internal dosimetry specialists did not receive

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[48] LA-12200-MS

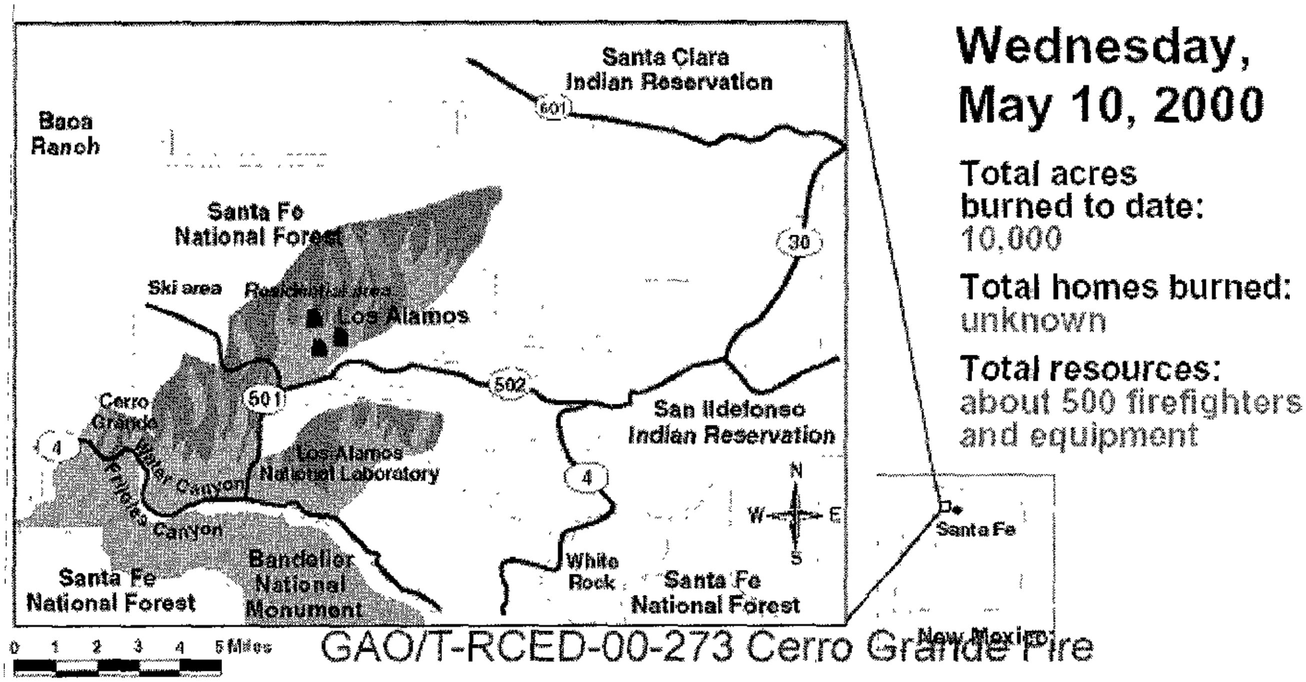
needed information because forms were not filled out, information was incomplete, or the forms were not returned to them. Bioassay samples were supposed to be tracked with chain-of-custody paperwork, but the paperwork was not always complete.

Other problems were reported by the Tiger Team. For example, radiation monitoring and contamination control documentation at the plutonium and depleted uranium areas did not help prevent the spread of contamination. Deficiencies in documentation of health physics surveys in the LANL radiation protection plans and procedures did not prevent the spread of contamination to employees. Another example, only machine operations that resulted in radiographic images were logged at the TA-8 linear accelerator. At TA-18 the placement of barriers and postings to the linear accelerator were not recorded. Some entries into operations logbooks were recorded in pencil. PHERMEX personnel had no knowledge of DOE records retention requirements. Finally, the dates of the original training of radiation protection technicians were not documented. Thus, no follow-up was required for recertification.

## The Cerro Grande Fire

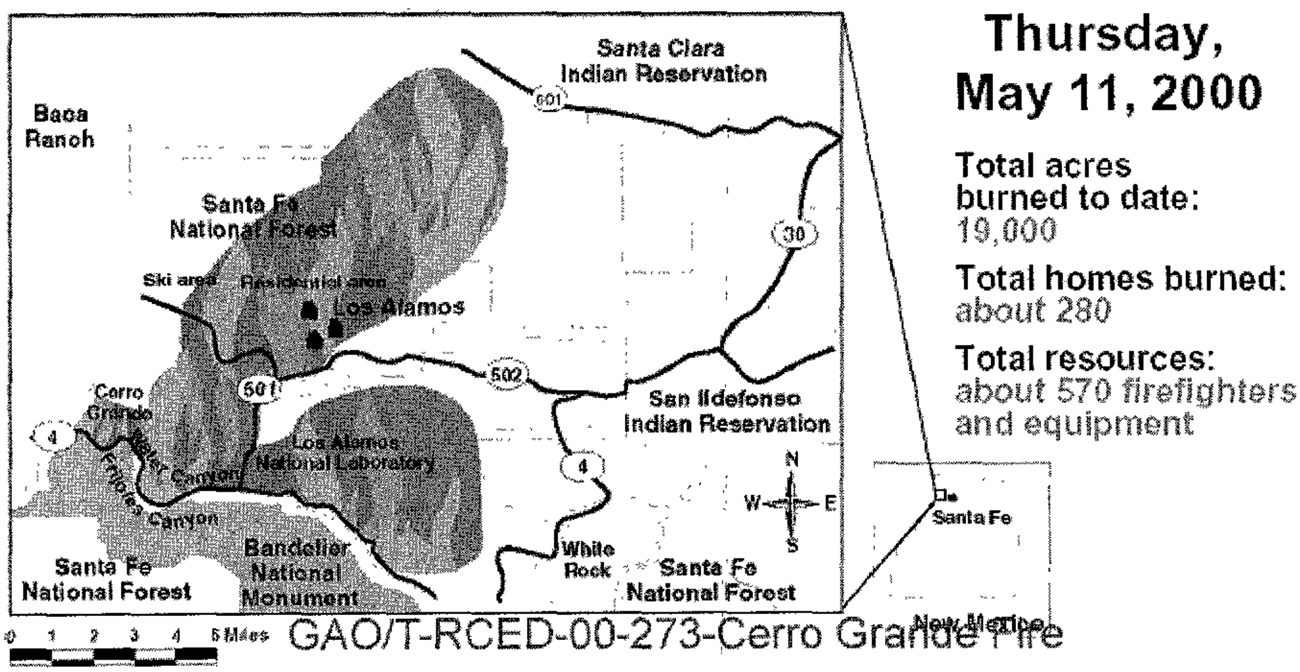
The Cerro Grande Fire was a large scale event that affected workers at LANL. Fires burned on laboratory property where radionuclides were either released or disposed. Monitoring of radionuclides in the air was affected by the amount of smoke and the winds during the fire.

On May 04, 2000, fire crews lit a controlled burn at the Bandelier National Monument. The burn was located at Cerro Grande. On May 05, 2000, sporadic winds caused the fire to jump out of the burn area. As a result, the fire was declared a wildfire at 1300 hours. The fire was contained until May 07, when winds increased and caused the fire to burn onto the Santa Fe National Forest. On May 08 LANL shut down operations. Security guards, other essential personnel, and of course fire fighters continued to report to work. On May 10, the fire was carried by high winds into Los Alamos Canyon. Burning embers were carried by the winds over a mile to the north, east and south. The entire town of Los Alamos was evacuated. Fires began burning on LANL property. On May 11, the fire crossed LANL boundaries. Also, the town of White Rock was evacuated.

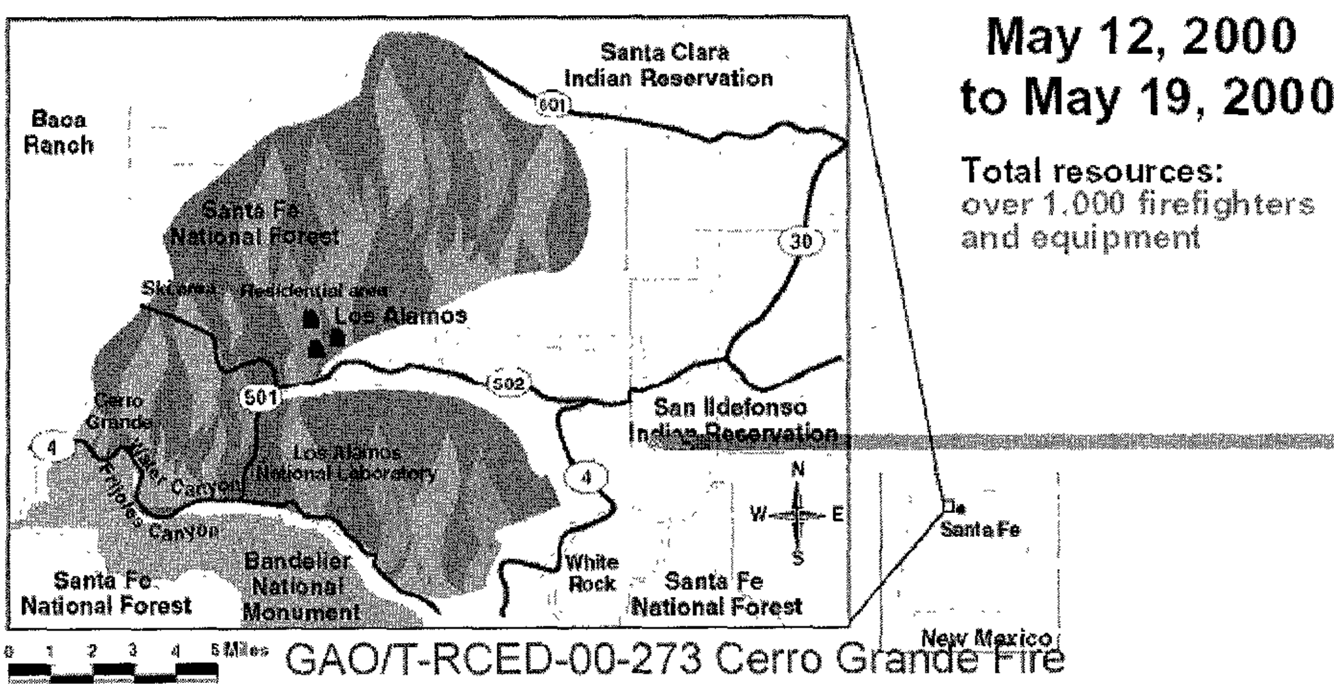



[49]

49 GAO/T-RCED-00-273 Appendix I pages 31-33




GAO/T-RCED-00-273-Cerro Grande Fire




GAO/T-RCED-00-273 Cerro Grande Fire

On May 15, the evacuation order was lifted. On May 22 the laboratory began to reopen. The technical Areas and structures were inspected to ensure it was safe to return prior to being occupied. On June 06 the fire was declared contained. Finally, on July 20, the fire was declared out. The fire burned over a 47,000 acre area. 7,500 acres of land and 112 structures were burned on LANL Property.

According to LANL, the fire did not burn any structures containing radionuclides. It did burn land areas that were contaminated or suspected of being contaminated with radionuclides. The following is a list of potential released sites located throughout LANL Property.

Potential Release Sites

<u>TA 00</u>
00-016
00-020
00-028(b)
00-011(a)
00-001

<u>TA 5</u>
5-001(a)
5-001(b)
5-002
5-003
5-004
5-005(a)
5-005(b)
5-006(b)
5-006(c)
5-006(e)
5-006(h)

<u>TA 6</u>

<u>TA 9</u>
9-001(a)
9-001(b)
9-001(c)
9-001(d)
9-002
9-003(a)
9-003(b)
9-003(d)
9-003(e)
9-003(g)
9-003(h)
9-003(i)
9-004(a)
9-004(b)
9-004(c)
9-004(d)
9-004(e)
9-004(f)

11-005
11-005a
11-005b
11-005c
11-006a
11-006b
11-006c
11-006d
11-007
11-009
11-010
11-011a
11-011b
11-011c
11-011d
11-012c

<u>TA 15</u>
15-002
15-003
15-011(c)
15-014(a)
15-014(b)
15-014(i)
15-014(j)
15-014(k)
15-014(l)

<u>TA 16</u>
16-001(a)
16-001(b)
16-001(c)
16-001(d)
16-001(e)
16-003(a)
16-003(b)
16-003(c)
16-003(d)
16-003(e)
16-003(f)
16-010(j)
16-010(k)
16-010(l)
16-010(m)
16-010(n)
16-013
16-016(a)
16-016(b)
16-016(c)
16-018
16-019
16-020
16-021(a)
16-021(c)
16-026(b)
16-026(c)
16-026(d)
16-026(e)
16-026(h2)

6-001(a)
6-001(b)
6-002
6-003(a)
6-003(c)
6-003(d)
6-003(e)
6-003(f)
6-003(h)
6-005
6-006
6-007(a)
6-007(b)
6-007(c)
6-007(d)
6-007(e)
6-007(f)
6-007(g)

TA 8

8-002
8-003(a)
8-004(a)
8-004(b)
8-004(c)
8-004(d)
8-005
8-006(a)
9-004(g)
9-004(h)
9-004(i)
9-004(j)
9-004(k)
9-004(l)
9-004(m)
9-004(n)
9-004(o)
9-005(a)
9-005(d)
9-005(g)
9-006
9-008(b)
9-009
9-013
9-001

TA 11

11-001
11-001a
11-001b
11-002
11-003
11-003a
11-003b
11-004
11-004a
15-004(a)
15-004(b)
15-004(c)
15-004(f)
15-004(g)
15-004(i)
15-006(a)
15-006(b)
15-006(c)
15-006(d)
15-007(a)
15-007(b)
15-007(c)
15-007(d)
15-008(a)
15-008(b)
15-008(c)
15-008(d)
15-009(a)
15-009(b)
15-009(c)
15-009(e)
15-009(f)
15-009(g)
15-009(h)
15-009(i)
15-009(k)
16-003(g)
16-003(h)
16-003(i)
16-003(j)
16-003(k)
16-003(l)
16-003(m)
16-003(n)
16-003(o)
16-004(a)
16-004(b)
16-004(c)
16-004(d)
16-004(e)
16-004(f)
16-005(g)
16-005(n)
16-006(a)
16-006(c)
16-006(d)
16-006(e)
16-007(a)
16-008(a)
16-009(a)
16-010(a)
16-010(b)
16-010(c)
16-026(j2)
16-029(a)
16-029(b)
16-029(c)
16-029(d)
16-029(e)
16-029(f)
16-029(g)
16-030(h)
16-035
16-036
16-026(v)

TA 18

18-001(a)
18-001(b)
18-001(c)
18-002(a)
18-002(b)
18-003(a)
18-003(b)
18-003(c)
18-003(d)
18-003(e)
18-003(f)
18-003(g)
18-003(h)
18-004(a)

| | | | | |
|---|---|---|---|---|
| 8-009(a) | 11-004b | 15-010(a) | 16-010(d) | 18-004(b) |
| 8-009(d) | 11-004c | 15-010(b) | 16-010(e) | 18-005(a) |
| 8-009(e) | 11-004d | 15-010(c) | 16-010(f) | 18-012(a) |
| 8-010 | 11-004e | 15-011(a) | 16-010(h) | 18-012(b) |
| | 11-004f | 15-011(b) | 16-010(i) | |

Potential Release Sites

| | | |
|---|---|---|
| <u>TA 20</u> | <u>TA 40</u> | <u>TA 42</u> |
| 20-001(a) | 40-001(b) | 42-001(a) |
| 20-001(b) | 40-001(c) | 42-001(b) |
| 20-002(a) | 40-003(a) | 42-001© |
| 20-002(b) | 40-004 | 42-002(a) |
| 20-002(c) | 40-005 | 42-002(b) |
| 20-002(d) | 40-006(a) | 42-003 |
| 20-003(a) | 40-006(b) | 42-004 |
| 20-003(b) | 40-006(c) | <u>TA 50</u> |
| 20-003© | 40-009 | 50-006(d) |
| 20-005 | 40-010 | 50-009 |
| <u>TA35</u> | <u>TA49</u> | <u>TA 53</u> |
| 35-001 | 49-001(b) | 53-001(a) |
| 35-003(r) | 49-001(c) | 53-001(b) |
| 35-004(b) | 49-001(d) | 55-004 |
| 35-005(a) | 49-001(e) | 53-005 |
| 35-008 | 49-001(f) | 53-012(a) |
| 35-009(c) | 49-001(g) | 53-016 |

| | | |
|---|---|---|
| 35-009(d) | 49-003 | 53-006(c) |
| 35-010(a) | 49-004 | 53-006(d) |
| 35-010(b) | 49-005(a) | 53-006(e) |
| 35-010(c) | 49-006 | 53-006(f) |
| 35-010(d) | 49-008a | 53-007(a) |
| 35-012(a) | 49-008c | TA 55 |
| 35-012(b) | 49-008d | 55-009 |
| 35-016(o) | | 55-011(a) |
| 35-016(q) | | 55-011(b) |
| | | 55-011(d) |

The National Research Council addressed the impact of fires in the book *Radiation Dose Reconstruction for Epidemiologic Uses* by stating, "Uncontrolled processes, such as burning contaminated materials also lead to atmospheric contamination."[50]

Air monitoring was conducted during the fire, but it was not continuous. When the fire was burning on LANL property, power was lost and the AIRNET monitors were turned off. The National Research Council addresses the problem of monitoring by saying:

> Lack of monitoring data is another source of uncertainty in release estimates. In some cases, releases were not measured, and sometimes the records of measurements have been lost or destroyed. Data might be missing for only a brief period because of sampler failure or there can be substantial uncertainty in the

[50] National Research Council Radiation Pg 20

release estimates that must therefore be developed without effluent-monitoring data.[51]

Also, the filters became clogged from the large amount of particulate in the air. Filters are normally exchanged every 2 weeks. However, during the fire filters were exchanged as often as every day. LANL was aware of the sampling problems and stated in a report concerning the effectiveness of air monitoring, "Because the samples represented much smaller air volumes than normal samples, the uncertainties associated with the isotopic analyses of plutonium and americium were more than an order of magnitude larger than our usual uncertainties."[52]

To continue, the filters from the AIRNET sampler located at TA-2 were not collected because they were not considered important for data that would pertain to emissions from the fire. However, the decision to exclude this AIRNET sampler did not take into account the rotor winds that occur in the canyons. Winds during the fire were extreme. The winds reached speeds up to 70 miles per hour. The AIRNET samplers lose accuracy at higher wind speeds. Gross radioactivity was elevated from normal during the fire. One measurement retrieved from Tsankawi Monument, which is located near the junction of East Jemez Road and State Road 4, was 8800aCi/m$^3$. Uranium samples were not considered because they were considered to be natural in origin. However, the act does not differentiate from natural or man-made sources. Also, LANL often used natural uranium in explosives testing. The Energy Employees Occupational Illness Program Act only stipulates that the exposure to radiation be during the performance of

[51] National Research Council Radiation Pg 23-24
[52] LA-UR-01-1132 page 5

duties while working for the DOE or its predecessors. Security guards were not provided with any breathing apparatus throughout this period. Additionally, overtime restrictions were lifted during the fire. Security Guards were working 16 hour days, 7 days a week during the fire.

## The Sigma Americium Contamination Incident

Another serious incident at LANL occurred when Americium-241 was released off-site from the TA-3, SM-66 Sigma Complex.

On July 14, 2005 a significant contamination incident occurred at the Sigma building, SM-66 in Technical Area-3 at LANL. Americium contaminated uranium nitride pellets were shipped from PF-4 at TA-55 to SM-66TA-3. The person that received the shipment opened the packaging without a Radiological Control Technician (RCT) present. The workers at PF-4 that had packed the uranium pellets new that the glove box they were working in may contain americium contamination. However, they did not check the packages to determine if contamination was present. They also did not inform the worker at Sigma of the possibility of americium contamination. The worker opened the packages and contaminated the glove box and laboratory with americium. The worker left for a three day weekend. The worker went to Colorado and Kansas. When the worker came back the following week the worker continued performing work in the contaminated glove box. The worker also worked at other Sigma locations as well as other LANL locations. The worker also handled some parts that were sent to Bettis Atomic Laboratory in Pennsylvania.

The contamination was not discovered until July 25, 2005. An RCT discovered the open packaging and conducted surveys. The survey indicated 600,000 dpm/ 100cm$^2$ total contamination on the glove box door. The worker's thumb and identification badge had 9,000 dpm alpha contamination. The worker's dosimetry badge had contamination of 18,000 dpm alpha. The worker's computer keyboard had contamination of 10,000 dpm. Objects in the worker's office had contamination of 4,000 dpm. RCTs discovered in room R-108 contamination of 50,000 dpm. The worker also handled a paper that recorded the shipment. RCTs found contamination of 1,000,000 dpm/100cm$^2$ on that paper. The worker's home, and automobile had contamination. The parts sent to Pennsylvania had contamination. Surveys were conducted at other locations including the main guard station at Sigma. Contamination was not found. However, the surveys were not conducted until late afternoon. The morning of the day the surveys were conducted, a custodian had cleaned all surfaces in the station with Fantastic. The floor was mopped as well. In addition, guards cleaned the reader portion of the badge reader regularly because it would not read badges when it became dirty. As a result, the swipes taken at the station did not reveal any contamination.

Guards routinely handled the worker's badge. Whenever a person entered or exits the Sigma area through the guard station, the guard physically inspects the badge. Guard stations are also located on Pajarito Road. The worker drives this road to and from work. His badge would be physically inspected by the guards manning these stations. The worker often entered and exited the guard station during the day as he routinely walked in the TA3 and TA-60 areas. It is unknown how many guards actually handled the worker's badge during the period from when the contamination occurred and when it was discovered. The type B investigation of the incident said that the worker's hands likely had 2,000,000 dpm/cm² contamination.[53]

The Swagelocks™ had a contamination level of 740,000,000 dpm/cm².[54] The total contamination present in this accident was about 4,000 microcuries. This is the equivalent of 4,000 smoke detectors. The Committed Effective Dose Equivalent (CEDE) of only 1 smoke detector is 100,000 mrem. On July 26, 2005 all the personal that were in Sigma were monitored for contamination. Only guards that were working at Sigma on July 26, 2005 were monitored for contamination. Other guards were not monitored. Additionally, only the computer logs of the badge reader were checked for persons to be monitored. Personnel not registered on the computer system, most often KSL employees, must be recorded on handwritten logs. These logs were not examined. Some guards requested in-vivo and in-vitro monitoring as they remember handling the workers badge the day the contamination occurred. Guards are not enrolled in the routine bioassay program. Additionally, as a result of this incident, LANL revealed that recently hired guards had not received base-line bioassay monitoring required of new hires.

Even if support service workers were enrolled in the routine bioassay program, their *in vitro* bioassay results probably would not be accurate. The reason is bioassay kits are collected on a weekly basis. For example, at TA-55 the kits are returned to a wooden

53 Type B Investigation page 19
54 Minnema, D. Slide 8

cabinet with glass doors. These kits are collected for analysis every Tuesday. The kits are a cardboard box that contains 4 Nalgene plastic bottles. The kits do not have any labeling indicating contents. The NCRP commented on collection of *in vitro* samples:

> All biological samples are subject to deterioration by bacteriological action that may interfere with subsequent analysis. Prompt analysis following collection is the preferred method of avoiding these complications. When samples must be kept longer than a day, they should be refrigerated, acidified to minimize precipitation, or have a preservative added to prevent bacterial growth.[55]

Further, the LANL bioassay program is insufficient. Support Service workers were not routinely monitored under the bioassay program. Further the records are either inadequate or incomplete. The LANL 1943-1975 SEC Petition evaluation report states:

> Initial acquisition and use of pre-1990 LANL internal monitoring data for EEOICPA claimant dose reconstructions was problematic. Most of the original LANL bioassay data were archived from legacy computer systems and was recorded in a variety of formats that made it very difficult to use, particularly by non-LANL personnel. Data retrieval proved to be a daunting task for LANL staff as they attempted to provide timely, complete, and accurate claimant data sets to NIOSH dose reconstructors. In addition, older bioassay data had not been validated when it was converted into electronic data after the original dose calculations were completed. *In vivo* data did not have assigned MDAs and only

[55] NCRP Report No. 87 page 31

> records with positive results were retained. Older *in vivo* data were stored in a different location from the newer data.
>
> As a result, in the summer of 2004, LANL and NIOSH representatives agreed to undertake a joint effort to collect, validate, verify, and upload LANL internal monitoring data into a central repository suitable for efficient retrieval during the NIOSH dose reconstruction process. Results of this effort have been documented in *Los Alamos National Laboratory (LANL) Bioassay Data Project Final Report* (ORAUT-OTIB-0063, draft). This report has served as the source for the summary LANL internal data review information presented below. **Because of the nature of the effort, not all results summaries are limited to the 1943-1975 class timeframe.**[56][Emphasis added]

The LANL SEC 1943-1975 evaluation report also states:

> Interviews with current and past LANL personnel involved with bioassay indicate that fission products were not considered a significant source term for intake among LANL workers. However, site reports contain references to high airborne fission product concentrations.[57]

Next, LANL used a variety of radionuclides over its history. Monitoring for "exotic" radionuclides was rare. The LANL SEC 1943-1975 evaluation report pointed out:

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[56] SEC Petition Evaluation Report Petition SEC-00051 page 67
[57] SEC Petition Evaluation Report Petition SEC-00051 page 78

> *LANL has always been a center for research. As such, small-scale use of various radionuclides not addressed above has occurred throughout the history of LANL ("small-scale" as in number of persons or activity of the source). Little or no documentation has been found on bioassay for these nuclides, which included: Ac-227, P-32, C-14, Cm-244, Th-232, Th-230, and Pa-231. Even so, most of these radionuclides received considerable discussion in monthly reports. From these discussions, it can be surmised that, during some periods,* **these radionuclide** [sic] **represented significant source terms.** [Emphasis added] *Such discussions addressed the need for bioassay, listing of these radionuclides as significant environmental effluents, and identification of the lack of monitoring as an assessment finding.*
>
> *Inventory records to establish the significance of the source term of these "exotic" radionuclides is limited. Most available information is limited to waste activity reports.*[58]

Another issue is the neutron dosimetry at LANL. The LANL 7776 type TLD was in use at LANL until 1998 when the Model 8823 was adopted. To determine neutron dosimetry, the LANL 7776 required the use of site specific neutron correction factors (NCFs). Hoffman and Mallett said this about neutron correction factors, "NCFs can vary by more than an order of magnitude at LANL facilities."[59] Considering that Support Service workers could work at several facilities during a day, dose reconstruction using the data from the LANL 7776 type TLD cannot be done. The National Research Council supports this by stating,

[58] SEC Petition Evaluation Report Petition SEC-00051 page 79
[59] Hoffman, J.M. and Mallett, M.W. page S98

> Dosimetric Data are essential for any epidemiologic study, but the detail and accuracy needed depend on the purposes to be served. If the need is for a monitoring or scoping study, then general information about doses will suffice; a study that is expected to contribute to scientific information about quantitative radiation risk requires careful individual dose estimates.[60]

Further, LANL radioactive wastes disposed onsite are sources of contamination. Onsite disposal of radioactive wastes has occurred since the beginning of the Manhattan Project in 1943. Liquid effluents were discharged into canyons and solid wastes were buried on the mesas. Large amounts of radioactive material have been disposed in the ground. LANL does not have reliable source inventories for solid wastes disposed onsite. LANL has Material Disposal Areas (MDA), Solid Waste Management Units (SWMU), Areas of Concern (AOC) and Potential Release Sites (PRS). MDAs contain radioactive and hazardous wastes. LANL has 25 MDAs. 829 SWMUs and AOCs are in the process of being investigated need investigations, or are pending a decision from the New Mexico Environmental Department. 478 PRSs are confirmed or suspected radiological sites. Two of the MDAs, U and V, have unknown radionuclide inventories. The MDAs contain radionuclides stored in unlined pits, trenches and shafts carved out of the volcanic tuff. Precipitation and subsequent runoff from the MDAs can cause leaching and migration of the radionuclides. Additional contaminants that have settled in canyons can be carried downstream in storm runoff. The Committee for the Technical Assessment of Environmental Program at the Los Alamos National Laboratory found:

[60] National Research Council Radiation Dose Reconstruction For Epidemiologic Uses Pg 63

> There are still large uncertainties in LANL's estimates of the inventories of principal contaminant sources and their locations. Similarly, analyses are lacking to approximate the current locations of contaminants (which may have migrated from these sources) in the various hydrogeological units that constitute the LANL site and surrounding areas.[61]

LANL needs to determine the amounts of radionuclides it has disposed as waste and where these were disposed. LANL needs to develop mass balances in order to show it can account for its disposed radionuclides. A mass balance is an accounting of material that enters a system and either accumulates in the system or departs the system. Mass balances are used widely in engineering and environmental analyses. Until a mass balance is completed a complete dose reconstruction for workers cannot be done. In order to do a dose reconstruction, the source terms must be identified. The National Research Council said, "A full description of the source term includes what was released and in what form and where and when the release occurred."[62] Over the past 65 years, LANL has released radioactive materials to the environment. The LANL RCRA permit application lists voluminous numbers of SWMUs and AOCs that have had releases that are unknown or unspecified radionuclides. The Mew Mexico Environment Department considers any spilling, leaking, pouring, emitting, emptying, discharging, injecting, pumping, escaping, leaching, dumping, or disposing of hazardous wastes (including hazardous constituents) into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing hazardous

[61] National Research Council Ground Water Protection at LANL Page 33
[62] National Research Council Radiation Dose Reconstruction For Epidemiologic Uses Pg 16

wastes or hazardous constituents) as a release.[63] The LANL 1943-1975 SEC Petition evaluation report states, "Direct exposure to gamma-emitting contaminants in soils was also possible where spills had occurred, or in waste areas..."[64]

42 CFR 82.2 requires:

> If individual monitoring data are not available or adequate, dose reconstructions may use monitoring results for groups of workers with comparable activities and relationships to the radiation environment.

However, the task and assignments for support service workers are not comparable to regular laboratory workers. Support Service workers routinely worked in different locations at LANL sometimes a different TA every day or a series of TAs in a day. Regular laboratory workers were assigned to the same locations year in and year out. The changing assignments had to affect the neutron doses assigned using the older TLDs. And then, the other monitoring data cannot equal the exposures support services workers received. Support Service workers often worked overtime in excess of the standard year. And, the personal protective equipment, if provided, was usually different from regular laboratory workers. All together, there is no other group of LANL workers with comparable activities and relationships to the radiation environment. (The

[63] Draft Permit page 2
[64] SEC Petition Evaluation Report Petition SEC-00051 page 97

Site Profile review conducted by Sanford Cohen and Associates described the working conditions of Support Services Workers extremely well.)

42 CFR 82.2 also requires:

> For internal exposures, this model includes such factors as the quantity and composition of the radioactive substance (the source term), the chemical form, particle size distribution, the level of containment, and the likelihood of dispersion.

Equally important 42 CFR 83.13 c (1) (i) requires:

> NIOSH must also determine that it has information regarding monitoring, source, source term, or process from the site where the employees worked to serve as the basis for a dose reconstruction.

Finally, 42 CFR 83.13 c (1) (ii) requires:

> In many circumstances, to establish a positive finding under paragraph (c)(1)(i) of this section would require, at a minimum, that NIOSH have access to reliable information on the identity or set of possible identities and maximum quantity of each radionuclide (the radioactive source material) to which members of the class were potentially exposed without adequate protection.

Source terms have not been adequately identified at LANL. Again, the LANL RCRA permit application lists numerous SWMUs and AOCs that have had releases that are unknown or are unspecified radionuclides. Releases to the air have not been sufficiently monitored to perform a dose reconstruction. Service Support workers were not always enrolled in the bioassay program. Generally, the monitoring program is not suitable for the vast amount of radionuclides that have been used at LANL.

The DOE in general and LANL in particular have been faulted for their records keeping practices. Problems with Quality Assurance have existed in LANL as reported in the ES&H Self Assessment, the Tiger Team Reports, and the Clean Air Act Audits. In conclusion, due to the insufficient methods used to monitor the environment, the variability of their work locations, and the lack of adequate bioassay and dosimetry data for support service workers, a class should be added to the Special Exposure Cohort for Support Service Workers at Los Alamos National Laboratory from January 01, 1976 to December 31, 2005.

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# LANL Support Services Workers Special Exposure Cohort Petition

## Supporting Documents

### Documents on Disk

PowerPoint Presentation
Type B Investigation of the Am-241 Contamination Accident at the Sigma Facility, LANL, July 14, 2005 Doug Minnema, PhD, CHP

This provides information concerning an americium contamination incident.

PDF file
Office Memorandum Tritium Leak at TA-35-1 August 4, 1980
John Ahlquist

This provides information on a tritium leak at TA-35-1.

PDF File
Informal Investigation Report Kiva I UF6 Release Bldg 23, TA-18 on August 22, 1979
R.E. Malenfant, A.M. Valentine

A Protective Force Inspector reported an enriched uranium hexafluoride leak.

PDF File
Stack Parameters Annual Review (1984)

This provides information about stack releases at LANL to include flow rates, stack dimensions, and materials released.

PDF File
The Los Alamos National Laboratory's Air Emissions Monitoring Program: A Quick Look Technical Review (9/9/91)
Ray Waller, Charles Keller, and Sumner Barr

This is LANL report on stack emissions and monitoring. This report indicates non-compliance with the Clean Air Act and no monitoring near LANL buildings for worker exposures.

PDF File
Resource Conservation and Recovery Act (RCRA) Permit Containing All Changes since 1995 September 27, 2004
Jack Ellvinger

This permit application contains information concerning source terms and locations.

PDF File
Aspects of Dispersion following an Explosive Release (2004)
D. M. Deaves, C. R. Hebden,

> This report addresses how source terms (as used in subsequent dispersion models) are defined for explosive type releases, which may result either from explosions, or from rapidly boiling releases from pressurized or refrigerated storage.

PDF File
Improving the Accuracy of Dispersion Models
Richard H. Schulze

> This report discusses the accuracy of dispersion models and how they can be improved. The report indicates the models used for aerosol dispersion models like the ones used at LANL are inadequate.

PDF File
The Physics and Mechanisms of Primary Blast Injury
James H. Stuhmiller, Yancy Y Phillips III, and Donald R. Richmond

> This report discusses the fundamentals of blast and blast waves, blast measurements and effects, tolerance to air blast, underwater blast, and the mechanisms and predictions of injury to the lung. The discussion of blast, blast waves, and blast measurements and effects are useful to understand the explosives testing conducted at LANL. They help to explain the means of dispersal of radionuclides used in explosives testing.

PDF File
Blast Loading and Blast Effects on Structures – An Overview
T. Ngo, P. Mendis, A. Gupta & J. Ramsay (2007)

> This paper presents a comprehensive overview of the effects of explosion on structures. An explanation of the nature of explosions and the mechanism of blast waves in free air is given. This paper also introduces different methods to estimate blast loads and structural response. This paper helps to explain the forces present in the explosives testing at LANL.

PDF File
Guidelines for the Inclusion of Low Wind Speed Conditions into Risk Assessments (2000)
I.G. Lines, J.H. Daycock and D.M. Deaves

> This paper studies low wind speed and dispersion. It presents guidelines for low wind speed modeling. This paper discusses the effects of low wind speed on

dispersion, release rates and the effects on population. These effects were not considered at LANL.

PDF File
Workbook on the Dispersion of Dense Gases (1988)
R.E. Britter, J. McQuaid

Information on the dispersion of dense gases is needed to determine the effects on nearby population. This paper provides information on dense gas dispersion that was not applied at LANL.

PDF File
Considering the Feasibility of Developing a Simple Methodology to Assess Dispersion in Low/Zero Windspeeds (1998)
I.G. Lines, D.M. Deaves

This report focused on the implications of using low wind conditions in risk assessments. In general, low wind speeds lead to higher toxic concentrations. Therefore, it is important that dispersion in low wind speeds is adequately modeled in order to quantify the risks accurately.

PDF File
DOE/EIS-0380D June 2006 Draft Site Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico

Presents the cumulative impacts associated with LANL operations. This report provides a detailed site description to include geology, climate, processes, source terms, releases, and monitoring.

PDF File
LA-14341-ENV Environmental Surveillance 2006

This report characterizes LANL's environmental management, summarizes environmental occurrences and responses, describes compliance with environmental standards and requirements, and highlights significant programs and efforts.

PDF File
In-Place Testing Summary (199 1)
John P. Ortiz, Douglas Barney

This report is about an ongoing in-place testing program for high efficiency filtration and chemical adsorber systems at LANL. This testing is in support of the Laboratory's airborne effluent management programs. The purpose of this report is to provide an overview of system performance and the testing procedures.

PDF File
Tiger Team Report 1

PDF File
Tiger Team Report 2

The Tiger Team reports show findings that LANL's safety, monitoring, quality assurance, and records procedures were inadequate. Dose Reconstructions based on the LANL information are inadequate as a result.

PDF File
Long-Term Risk from Actinides in the Environment: Modes of Mobility (2000)
David D. Breshears, et al

The mobility of actinides in surface soils is the major driver of risks to human health and the environment for DOE facilities in arid and semiarid environments. The objective this study was to quantify the mobility of soil actinides from all three modes of wind erosion, water erosion, and vertical migration using a combination of field studies, laboratory studies, and modeling for several sites. This study demonstrates the errors in the site profile assumption of the direction actinides move in the soil at LANL.

PDF File
Dispersion Near Buildings; Application of Simple Modelling (1997)
I.G. Lines, D.M. Deaves

This report discusses building wake effects on elevated plume releases. LANL did not consider building wake effects in its monitoring program. The effect of building wake effects cause workers to receive higher doses than doses received by people off-site.

PDF File
LANL Hazardous Waste Permit Fact Sheet Attachment listing new SWMUs and AOCs

Listed in this Attachment to the LANL Permit Fact Sheet are units requiring corrective action but are not currently included on the LANL Permit. This Attachment contains listings for three types of units; Areas of Concern (AOCs), newly identified Solid Waste Management Units (SWMUs), and Canyons. This attachment describes areas that contain known and unknown radionuclides, as well as uncharacterized areas. This information shows that source terms have not been adequately identified to do dose reconstructions.

PDF File

Citizens Monitoring and Technical Assessment – June 2007 Analysis of Radiochemical Contaminants in Los Alamos Region Biota and Environmental Materials at the Perimeter of the Los Alamos National Laboratory
Marco Kaltofen, Pe, Tom Carpenter

> The study found that indoor dust samples had higher radiation levels than surrounding soils. Significant Plutonium 239/240 detections were found. Three of the test sites exceeded sediment reference values for Plutonium 239/240 cited by the New Mexico Department of Environment. Overall, the findings of the study, particularly in dust samples and plant materials, suggest that efforts to reduce airborne transport of radionuclides are not as complete as those for sediments. Offsite concentrations of radionuclides necessarily are below onsite radionuclide concentrations, since LANL is the source of the bulk of the uncontrolled contamination.

PDF File
Better Oversight Needed for Safety and Health, Activities at DOE's Nuclear Facilities EMD-81-108 (1981)
GAO

> This report evaluates four major functional areas --occupational safety and health, emergency preparedness, facility design safety, and environmental monitoring. These four areas were chosen for review because they all directly affect the health and safety of workers and the public. This report identifies problems in those areas.

PDF File
Nuclear Health and Safety Efforts to Strengthen DOE's Health and Epidemiology Program GAO/RCED-91-67 (1991)
GAO

> This report discusses problems with DOE'S management of its epidemiology research and health programs.

PDF File
GAO/RCED-98-197 Uncertain Progress in Implementing Reforms (1998)
GAO

> Identifies the recommendations by various advisory groups for addressing management weaknesses at DOE and the laboratories and evaluates how DOE and its laboratories have responded to these recommendations. This report indicates that DOE is not adequately correcting problems.

PDF File
Need for Improved Responsiveness to Problems at DOE Sites GAO/RCED-90-101 ES&H Problems at DOE Sites (1990)

GAO

This report summarizes DOE'S and contractors' responsiveness to findings contained in DOE technical safety appraisals and environmental surveys. These appraisals and surveys have been done at DOE facilities and sites to identify the extent of the department's ES&H problems and prioritize them for corrective action.

PDF File
DOE's Safety and Health Oversight Program at Nuclear Facilities Could Be Strengthened GAO/RCED-84-50 (1993)
GAO

This report reviews plans and actions to improve the Department of Energy's safety and health oversight program for nuclear facilities. The report addresses questions concerning prior Department of Energy and General Accounting Office reports, the Department's resultant action plan, and the implementation of that plan. It states that DOE's safety and health program has deficiencies.

PDF File
Better Planning Needed to Correct Records Management Problems GAO/RCED-92-88 (1992)
GAO

National' Archives and Record Administration evaluated DOE's record management program. NARA's evaluation identified major problems with DOE's management of the records program that caused serious shortcomings in every phase of the records' life cycle-from creation and maintenance through retention and disposal. These problems could seriously limit the ability of DOE to, among other things, adequately document its programs' policies, decisions, and actions and locate records needed to conduct important studies, such as those involving information on the health and mortality of its workers. This report discusses the lack of effectiveness of DOE's corrective actions.

PDF File
Corrective Actions on Tiger Teams' Findings Progressing Slower Than Planned GAO/RCED-93-66 (1993)
GAO

Tiger Teams assessed DOE facilities' compliance with E S & H regulations. DOE'S recent progress assessments indicate that considerable action will be required to achieve full compliance with ES&H requirements and to establish vigorous and formal ES&H programs throughout the agency. It is expected to take as long as 7 years to complete all corrective actions on Tiger Team findings.

PDF File

Protecting Workers and the Public Continues to Challenge DOE GAO/T-RCED-94-283 (1994)
GAO

DOE's ES&H Office manages a Health Surveillance Program that is designed to analyze data about workers' health and on-the-job exposures in order to detect work-related health problems as early as possible. Although DOE hoped to fully implement its program by 1992, the program would not be fully implemented until 1998. The goals to limit workers' exposures, identify the causes of adverse health effects, intervene to minimize or eliminate the causes of the adverse effects and institute policies and procedures to prevent reoccurrences were not being met.

PDF File
Handbook on Atmospheric Diffusion (1982)
Steven R. Hanna, Gary A. Briggs, and Rayford P. Hosker, Jr.

With the Clean Air Acts and increased environmental consciousness, many engineers, consulting companies, planners, and meteorologists find themselves propelled into the work of calculating atmospheric diffusion. Many of these people are not interested in knowing the detailed theoretical derivation of a formula and its complete set of references. All they want to know are the best current formulas for their problems plus a simple physical description of the principles of analysis. This book should be helpful to those who must make such problem-solving calculations of atmospheric diffusion.

PDF File
General and Specific Characteristics for Model: HOTSPOT

This file provides information on the dispersion model HOTSPOT. The model is used at LANL for pollutant dispersion following explosions.

PDF File
Feasibility study of Modelling Particle Deposition onto a Person using Computational Fluid Dynamics (2006)
N. Gobreau, D. Mark, A. Garrard

A number of factors that affect particle deposition onto a person including the effects of wake, thermal plume, heat and humidity release, respiration, movement and the mechanisms of particle transport and deposition are reviewed in this report.

PDF File
Audit Report on "The Department's Reporting of Occupational Injuries and Illnesses" DOE/IG-0648 (2004)

This report identified record keeping and reporting problems concerning occupational injuries and illnesses.

PDF File
Security and Other Issues Related to Out-Processing of Employees at Los Alamos National Laboratory
DOE/IG-0677 (2005)

This report indicates problems with LANL record keeping because there was no assurance that terminating employees returned documents, media or computers that belonged to LANL. This indicates further problems with LANL record keeping.

PDF File
Characterization Wells at Los Alamos National Laboratory
DOE/IG-0703 (2005)

This report reveals that LANL methods of monitoring radioactive contaminants released from septic systems, pits, surface impoundments, trenches, shafts, landfills, and waste piles at the facility are flawed.

PDF File
Increased Wind Erosion from Forest Wildfire: Implications for Contaminant-Related Risks (2006)
Jeffrey J. Whicker, John E. Pinder III, and David D. Breshears

This report discusses transport of radioactive contaminants by wind erosion following the Cerro Grande fire.

PDF File
A Guide to Radiological Accident Considerations for Siting and Design of DOE Nonreactor Nuclear Facilities
J. C. Elder, et al

This Guide was prepared to provide the experienced safety analyst with accident analysis guidance in greater detail than is possible in Department of Energy (DOE) Orders. This guide discusses accidents and accident consequences. It provides information concerning source terms, releases, meteorological analysis and dispersion, and doses.

PDF File
LA-13235-T Compliance Program for 40 CFR 61, Subpart H at Los Alamos National Laboratory (1997)
Eric A. McNamara

This report discusses historical stack sampling at LANL and upgrades to conform to changes in the Clean Air Act.

PDF File
LA-13839-MS U.S. Department of Energy Report 2000 LANL Radionuclide Air Emissions (Parts 1, 2, and 4)
Keith Jacobson

This is the Laboratory-wide certified report regarding radioactive effluents released into the air by LANL in CY 2000. This information is required under the Clean Air Act and is being reported to the U.S. Environmental Protection Agency (EPA). Included in this report are the effluents released during the Cerro Grande wildfire during mid-May. [Part 3 is not available via the web.]

PDF File
Brief Climatology for Los Alamos, NM
LANL 1999

The climate description presented here summarizes some of the Bowen analyses and discusses some recent observations of wind patterns in Los Alamos canyon and evapotranspiration. Dispersion modeling uses this basic information to calculate dispersion.

PDF File
Los Alamos Cancer Rate Study: Phase I Cancer Incidence in Los Alamos County, 1970-1990 Final Report (1993)
William F. Athas, PhD, Charles R. Key, MD, PhD

The Los Alamos Cancer Rate Study is an on-going multi-phase study of cancer incidence among populations residing in proximity to the Los Alamos National Laboratory. The study is being conducted in response to community concerns about an alleged recent large excess occurrence of brain cancer in Los Alamos County, particularly among residents of the Western Area neighborhood. These allegations that radioactive emissions or waste disposal practices associated with LANL might have increased the occurrence of cancer among county residents. Results presented in this report comprise the major findings of a Phase I descriptive epidemiologic study of cancer incidence in Los Alamos County for the time period 1970-1990. Incidence rates for brain and nervous system cancer and 22 other major cancers were calculated for Los Alamos County using data of the population-based New Mexico Tumor Registry. The county rates were then compared to rates derived from a New Mexico state reference population and a national reference population as represented by the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program.

PDF File
LAMS-202 Explosives (1945)

G.M. Kistiakowski

A summary of some of the information on properties and behavior of explosives as it is available from the open pre-war literature, Ordnance reports, reports from NDRC and British reports. This is useful in understanding explosives. Explosive testing occurs at LANL and dispersion of radionuclides occurred as a result of this testing.

PDF File
Death Rate Report for New Mexico by County, death years through 2002

This contains reports concerning cancer incidents by county in New Mexico. This demonstrates the health effects in Los Alamos and surrounding counties.

PDF File
LA-UR-97-4765 Overview of Los Alamos National Laboratory—1997

This is summary information of LANL's organization, programs, ecological setting, infrastructure, and operations.

PDF File
LASL-77-36 Laboratory Activities Description of Work Done At LASL
By Division, Department, and Group (1977)

This report provides summaries of work performed by each division at LASL in 1977.

PDF File
LA-UR-00-1168 Siting of Environmental Direct-Penetrating- Radiation Dosimeters
Michael W. McNaughton, David H. Kraig, and Joseph C. Lochamy

This document establishes the criteria for locating environmental direct penetrating radiation (DPR) dosimeters such as thermo-luminescent dosimeters (TLDs) or electretion chambers (EICs) near Los Alamos National Laboratory (LANL). It also outlines the objectives and regulations, establishes the criteria, identifies locations for monitors, discusses the criteria, and applies the criteria to each technical area (TA) of LANL.

PDF File
LA-UR-00-3091 Performance Evaluation of LANL Environmental Radiological Air Monitoring Inlets at High Wind Velocities Associated with Resuspension
John Rodgers, Piotr Wasiolek, Jeff Whicker, Craig Eberhart, Keith Saxton, David Chandler,

This report presents results of testing of the air monitors at LANL. The results show that the accuracy of the air monitors relies on optimal conditions.

PDF File
LA-UR-00-3471 A Special Edition of the SWEIS Yearbook: Wildfire 2000

This Special Yearbook Edition—Wildfire 2000—compares the postulated accident in the LANL 1999 Site Wide Environmental Impact Statement with the Cerro Grande fire. This provides more information on the Cerro Grande fire and emissions that resulted from the fire.

PDF File
LA-UR-04-0195 Unplanned Airborne Releases at Los Alamos National Laboratory: A Comparison between Observations and Model Predictions (2004)
Scot Johnson

The MIDAS plume segment model is the primary emergency plume model of the Emergency Operations Center of LANL. This report compares the results of the models prediction with air monitoring results during releases at LANL.

PDF File
Long Term Tracer Study at Los Alamos, New Mexico Part I: Wind, Turbulence, and Tracer Patterns (1994)
Brent M. Bowen

External radiation levels caused by emissions from LAMPF were measure in 1986 and 1987. The results are presented in this report.

PDF File
Long Term Tracer Study at Los Alamos, New Mexico Part II: Evaluation and Comparison of Several Methods to Determine Dispersion Coefficients
Brent M. Bowen

This report provides information on dispersion in complex terrain at LANL. It compares model predictions with monitoring results.

PDF File
New Mexico Air Quality Bureau Dispersion Modeling Guidelines (2003)

An air dispersion modeling analysis must be submitted with each air quality permit application under New Mexico Air Quality Control Regulation 20NMAC2.72 (previously AQCR 702). These guidelines define what the Bureau considers as acceptable for a dispersion modeling analysis. The purpose of the modeling analysis is to demonstrate that all applicable air quality standards and, as appropriate, Prevention of Significant Deterioration (PSD) increments, will be met after a proposed construction or modification.

PDF File
Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution throughout the Contiguous United States (1972)
George C. Holzworth

This presents maps of the continental United States with lines indicating mixing height and wind speeds. This presents basic information applied to dispersion modeling.

PDF File
Los Alamos National Laboratory Radiological Facility List PS-OAB-403, Revision 1 (2002)
George F. Nolan

This is a list of radiological facilities at LANL. And, this list is useful in determining source terms.

PDF File
DOE/DP-0137 Plutonium the First 50 Years (1996) United States Plutonium Production, Acquisition, and Utilization from 1944 through 1994 (1996)

This report identifies four sources that add plutonium to the DOE/DOD inventory and seven types of transactions which remove plutonium form inventory. This report also discuss the nuclear material control and accountability system which records all nuclear material transactions, compares records with inventory and calculates material balances, which analyses differences to verify that nuclear materials are in quantities reported. This report reveals discrepancies in accountability at LANL. The location and amount of plutonium at LANL are different in two tracking systems. This calls into question record keeping practices and presents problems with determining source terms at LANL.

PDF File
The Effect of Stack Height, Stack Location and Rooftop Structures on Air Intake Contamination: A Laboratory and Full-Scale Study (2004)
Ted Stathopoulos, Louis Lazure, Patrick Saathoff, and Amit Gupta

This report investigates the dispersion of exhaust from a rooftop stack on a low-rise building in an urban environment using field and wind tunnel experiments.

The results give guidelines for stack height and placement on buildings in an urban environment. This demonstrates the flaws in LANL stack design and the resulting exposure to workers of contaminated effluent.

PDF File
New Mexico's Right to Know: The Impacts of Los Alamos National Laboratory Operations on Public Health and the Environment (2003)
Bernd Franke, Catherine M. Richards, Steve Wing, and David Richardson

This report provides a review of historical and current emissions of radioactive materials from LANL into the air, cancer incidence and mortality in Los Alamos county and New Mexico 1970-1996, and occupational health studies at LANL.

PDF File
Source Term Modelling of Releases within Building Complexes (2003)
A. Scaperdas and C. R. Hebden

This study relates to the dispersion of dense gases within, and then downstream of, building complexes.

PDF File
*LA-UR-98-* 4539 Emergency Responders' "Rules-of-Thumb" for Air Toxics Releases in Urban Environments (1998)
Michael J. Brown

This report provides illustrations and descriptions of the effects of wind and building placement on dispersion.

PDF File
SCA-TR-TASK1-0011 Los Alamos National Laboratory Site Profile Review (2006)
Joseph Fitzgerald

This report provides the results of an independent audit conducted by S. Cohen and Associates of the technical basis documents that make up the site profile for LANL developed by NIOSH. The audit revealed the following findings: The site profile does not adequately address data insufficiency for impact and implications to early worker dose reconstruction. Inadequate consideration has been given in the site profile to potential exposure and missed dose from secondary radionuclides. Dose estimation is not addressed for LANL personnel assigned to weapons testing. Neutron dose reconstruction approach in TBD may result in underestimated dose. Neutron dose reconstruction approach in TBD may result in underestimated dose. TBD does not address potentially missed Am-241 intakes prior to the mid-1990s. Internal dose TBD lacks a clear means to assign dose to unmonitored workers. TBD does not adequately address potential dose contribution from external high-radiation exposures to unbadged workers. Unmonitored exposures of Zia Company maintenance, construction, and facility support workers, as well as LANL security guards, not sufficiently addressed.

PDF File
Investigation of Excess Thyroid Cancer Incidence in Los Alamos County
Final Report (1996)
William F. Athas

In 1991, the DOE funded the New Mexico Department of Health to conduct a review of cancer incidence rates in LAC in response to citizen concerns over what was perceived as a large excess of brain tumors and a possible relationship to radiological contaminants from the Laboratory. The study found no unusual or alarming pattern in the incidence of brain cancer, however, a fourfold excess of thyroid cancer was observed during the late-1980s. A rapid review of the medical records for cases diagnosed between 1986 and 1990 failed to demonstrate that the thyroid cancer excess had resulted from enhanced detection. Surveillance activities subsequently undertaken to monitor the trend revealed that the excess persisted into 1993. A feasibility assessment of further studies was made, and ultimately, an investigation was conducted to document the epidemiologic characteristics of the excess in detail and to explore possible causes through a case-series records review. Findings from the investigation are the subject of this report. Examination of the incidence of thyroid cancer in surrounding counties (Santa Fe, Rio Arriba, Taos, and Sandoval) showed that the excess was geographically localized to Los Alamos County. A notably higher percentage of male cases had their tumor discovered at the Laboratory compared to females, suggesting an impact from occupational medical surveillance.

PDF File
Dangerous Discrepancies: Missing Weapons Plutonium in Los Alamos National Laboratory Waste Accounts (2006)
Arjun Makhijani, Brice Smith,

There are major discrepancies in the materials accounts for weapons plutonium in Los Alamos Waste. If much or most of the unaccounted for plutonium was disposed of as buried low-level waste and buried transuranic waste on site at Los Alamos, the long term radiation doses would far exceed any allowable limits.

JPEG Image
LANL-04M Satellite Image of Los Alamos

This is a satellite photograph of LANL and surrounding areas.

**Cerro Grande Folder**

PDF Files
Cerro Grande Fire maps 2, 3, 4, 5, and 6

Maps illustrating the Technical Areas, Areas of Concern, Solid Waste Management Units, and areas burned by the Cerro Grande Fire.

PDF File
Comments on the 2002 Risk Assessment Corporation analysis of risks from the 2000 Cerro Grande fire at Los Alamos National Laboratory (2005)
Abel Russ

The Risk Assessment Corporation (RAC) report reviewed here was intended to evaluate the potential health risks associated with the burning of a part of LANL during a wildfire in May of 2000. The RAC authors observe that measured data were insufficient for a meaningful risk assessment; the estimates derived from actual data are very uncertain. Modeling was also associated with a great deal of uncertainty; the conservative approach used here, although it is relatively efficient, tends to obscure this uncertainty. In several cases observed concentrations of contamination were greater than modeled predictions. The report is not capable of providing much reassurance that the risk can be accurately estimated. This is mainly due to insufficient data characterizing the area and insufficient monitoring data for the burn period and immediate post-burn period. The inability to quantify meaningful estimates of risk from the Cerro Grande fire indicates that site characterization and regional monitoring need to be greatly improved.

PDF File
LA-13769-MS Effects of the Cerro Grande Fire (Smoke and Fallout Ash) on Soil Chemical Properties within and Around Los Alamos National Laboratory
P. R. Fresquez, W. R. Velasquez, and L. Naranjo, Jr.

Because the fire burned over 7,000 acres of LANL lands and some areas are known to contain radionuclides and chemicals in soils and plants above background concentrations, some of these materials via smoke and ash may have been suspended and transported by wind. The objective of this study then was to compare radionuclides and nonradionuclides in soil samples collected directly after the fire to soil samples collected in 1999.

PDF File
LA-13914 Radiological and Nonradiological Effects after the Cerro Grande Fire
David Kraig, Randall Ryti, Danny Katzman, Thomas Buhl, Bruce Gallaher, and Philip Fresquez

Observations and sampling have shown that the aftereffects of the Cerro Grande Fire resulted in increased concentrations of radiological and nonradiological chemicals in runoff and in sediments deposited during CY 2000. The predominance of these effects was caused by the increased mobilization of locally deposited worldwide fallout or of naturally occurring substances that were concentrated by the fire. For many of them LANL was not able to preclude the possibility that legacy LANL wastes in canyons and the area surrounding LANL contributed to the increases. If individuals were exposed for long periods of time at some of the potential maximum concentrations LANL calculated, some health effects could be possible.

PDF File
LA-UR-01-1132 Updated Calculation of the Inhalation Dose from the Cerro Grande Fire Based on Final Air Data
David H. Kraig, Thomas E. Buhl, Craig F. Eberhart, and Ernie S. Gladney

A preliminary dose assessment was prepared to calculate the inhalation dose received by fire workers or members of the public during the fire. At the time that study was completed, only preliminary air monitoring data were available. The current report describes recalculations based on final air monitoring data. In the original calculation, two doses were calculated; to the hypothetical maximally exposed firemen or volunteer who was working actively in the Los Alamos area throughout the worst of the burn duration, and to the maximally exposed member of the public outside Los Alamos. Those calculations are updated here and a third is added; to a fireman or other worker in the vicinity of Station #23 in Mortandad Canyon where elevated levels of LANL-derived airborne uranium occurred during the peak of the fire.

PDF File
LA-UR-01-1630 The Cerro Grande Fire Los Alamos, New Mexico
M.Diana Webb, Kelly Carpenter

This report is a brief description of the Cerro Grande fire. It includes information concerning the previous fires that lead to the Cerro Grande fire and information about the aftermath of the Cerro Grande Fire.

PDF File
Lessons Learned From the Cerro Grande (Los Alamos) Fire and Actions Needed to Reduce Fire Risks GAO/T-RCED-00-273
GAO

This is a GAO report about the Cerro Grande fire and lessons learned from the response. The report contains information and illustrations about the movement of the fire over a two week period.

PDF File
Summary Report: Analysis of Exposure and Risks to the Public from Radionuclides and Chemicals Released by the Cerro Grande Fire at Los Alamos (2002)
S. Shawn Mohler, et al

This report summarizes information provided in more detail in the following final reports. The risk of cancer from exposure to radionuclides and carcinogenic (cancer-causing) metals in and on vegetation that burned was greater than that from radionuclides and chemicals released from contaminated sites at LANL. The air monitoring data could not be used directly because not enough different locations were monitored. Only a limited number of chemicals and radionuclides were measured. And, the documentation for some of the data was incomplete.

JPEG Image
Los Alamos Satellite Image April 14, 2000

This a satellite image of the Los Alamos area before the fire.

Jpeg Image
Los Alamos Satellite Image June 17, 2000

This is a satellite image of the Los Alamos area after the fire.

**Clean Air Act Audits Folder**

PDF File
DRAFT REPORT Independent Technical Audit of Los Alamos National Laboratory for Compliance with the Clean Air Act, 40 CFR 61, Subpart H in 2001 DOJ File Number: 90-5-1749A Case Name: *CCNS v DOE* October 2002 (CCNS Comments)

This draft contains the comments from Concerned Citizens for Nuclear Safety.

PDF File
FINAL REPORT Independent Technical Audit of Los Alamos National Laboratory for Compliance with the Clean Air Act, 40 CFR 61, Subpart H in 2001 DOJ File Number: 90-5-1749A Case Name: *CCNS v DOE* October 2002 (Independent Technical Audit for 2001)

This report documents results of the third independent audit of Los Alamos National Laboratory regarding compliance with the Clean Air Act, 40 CFR 61, Subpart H for the year 2001. A number of general issues, in addition to specific regulatory requirements, were evaluated for each area, including traceability of data to their original source, documentation supporting compliance, technical competence, quality assurance, and overall confidence of the audit team in the compliance program. We include some additional suggestions for improvements in this report and assume that LANL will consider them carefully. Quality assurance procedures were considered for each area, and the assessments are presented in their respective report chapters. The radionuclide usage, effluent monitoring, environmental sampling, and dose calculation chapters of this report present conclusions drawn by the audit team about LANL.s compliance status.

PDF File
FINAL REPORT Independent Technical Audit of Los Alamos National Laboratory for Compliance with the Clean Air Act, 40 CFR 61, Subpart H in 2001 DOJ File Number: 90-5-1749A Case Name: *CCNS v DOE* October 2002 (IEER Comments)

This draft contains the comments from IEER.

PDF File
Memo: Some Quality Assurance Issues Regarding Input Data For Unmonitored Sources Dose Estimation Date September 01, 2002
Arjun Makhijani

This memorandum follows up on one aspect of my July 11, 2002 memorandum regarding unmonitored sources: quality assurance relating to input data.

PDF File
Memo: Some issues for the ITAT review regarding unmonitored sources during the third CAA audit. Date: 11 July 2002
Arjun Makhijani

This will provide a formal record of the issues that IEER believes that the ITAT should review. In the course of review of the documents regarding estimation of doses from unmonitored sources, a number of issues came up.

PDF File
Monitoring Report of the Institute for Energy and Environmental Research on the First Independent Technical Audit of the Los Alamos National Laboratory's Compliance Status with Respect to the Clean Air Act 11 April 2000
Arjun Makhijani and Bernd Franke

The Institute for Energy and Environmental Research (IEER) has monitored the first Independent Audit of LANL's compliance status with respect to the completeness of the audit and the findings of the audit. IEER is in general agreement with the findings of the ITAT team on all but one major issue. That issue is related to compliance with the 10 millirem (mrem) per year dose standard, which is the primary standard specified in the 40 CFR 61, Subpart H.

PDF File

Final Report of the Institute for Energy and Environmental Research on the Second Clean Air Act Audit of Los Alamos National Laboratory by the Independent Technical Audit Team 13 December 2000
Arjun Makhijani and Bernd Franke

The Institute for Energy and Environmental Research (IEER) finds that, overall, the second audit was thorough. Within the limitations of the available resources, we also find that the audit was complete. IEER has one major disagreement with the ITAT report on the second audit. The ITAT's finding that Los Alamos National Laboratory (LANL) was in compliance with the Clean Air Act in 1999 should have been conditional rather than unconditional. A finding of unqualified compliance presumes that LANL did all the scientifically work necessary for compliance. However, LANL did not perform an uncertainty analysis, which is a normal and essential part of scientific work that should be done as part of compliance assessment.

PDF File
Report of the Monitoring Team of the Institute for Energy and Environmental Research on the [Third] Independent Audit of Los Alamos National Laboratory for Compliance With the Clean Air Act, 40 CFR 61, Subpart H in 2001 to Concerned Citizens for Nuclear Safety December 18, 2002
Arjun Makhijani, Ph.D., and Bernd Franke

This is the final report of the Institute for Energy and Environmental Research (IEER) on the monitoring of the third audit of the Los Alamos National Laboratory's compliance with the radionuclide emission standards of the Clean Air Act that was conducted by an independent technical audit team (ITAT) led by Dr. John E. Till. In monitoring the audit and reviewing the final report, IEER has concluded that the ITAT should have called out four substantive technical deficiencies:

1) a lack of quality assurance of the data on radionuclide usage supplied by the facilities to the Meteorology and Air Quality Group (MAQ),
2) the problem of detecting radiologically elevated concentrations of plutonium-238 in samples in some cases,
3) the need to provide continuous monitoring of airborne emissions from TA-54 waste characterization activities, and
4) the significant uncertainties in the coverage of AIRNET stations with respect to Los Alamos North Mesa residences that justify an additional sampling station that has not been installed.

PDF File
LANL Comments on the RAC Audit Draft Report

This draft contains LANL comments on the draft report.

**DARHT EIS Folder**

The U.S. Department of Energy (DOE) proposes to provide enhanced high-resolution radiography capability for the purpose of performing hydrodynamic tests and dynamic experiments in support of the Department's historical mission and near-term stewardship of the nuclear weapons stockpile. This environmental impact statement (EIS) analyzes the environmental consequences of alternative ways to accomplish the proposed action. The major discriminator among alternatives would be potential impacts from depleted uranium contamination to soils and surface waters. There is a projected increase in the estimated worker dose from radioactive materials under all options of the Enhanced Containment Alternative. This is a result of a potential increase in worker exposure to radiation as a result of vessel or building cleanout operations. Potential impacts from the use of plutonium would be essentially identical under all alternatives, with the possibility of an accident having consequences of up to 12 latent cancer fatalities in the exposed population. The impacts from accidents involving single-walled containment vessels would be higher than those for uncontained tests.

PDF Files
Acronyms and Abbreviations
Appendix A
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**LANL Environmental Surveillance 2000 Folder**

This report presents environmental data and analyses that characterize environmental performance and addresses compliance with environmental laws at the Laboratory during 2000. Over 600 sites were evaluated after the Cerro Grande fire in order to reduce the possibility of contaminants moving during post-fire floods. In this report, LANL calculates potential radiological doses to **members of the public** who may be exposed to Laboratory operations. A maximum **off-site dose** considering all pathways (not just air) was 0.55 mrem. Air surveillance at Los Alamos includes monitoring emissions, ambient air quality, direct penetrating radiation, and meteorological parameters to determine the air quality impacts of Laboratory operations. The Cerro Grande fire produced large amounts of smoke with very high concentrations of particulate matter, carbon monoxide, and nitrogen oxides in the vicinity of the fire. Gross alpha and gross beta concentrations at sites impacted by the fire smoke were elevated. In 2000, 28 gross alpha measurements in water runoff samples exceeded by 5 to 10 times the DOE's derived concentration guidelines (DCG) for radiation protection of the public. Tritium, gross beta, strontium-90, and americium-241 exceeded drinking water DCGs or maximum contaminant levels.

PDF Files
Part 1
Part2

**LANL ES&H Self Assessment Folder**

This folder contains scans from the book. The book was borrowed from a Non-governmental Organization library and returned to it. These scans are information relevant to the SEC petition. The information demonstrates flaws in LANL safety, monitoring, record keeping, and quality assurance practices.

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**LANL SEC Petition 1943-1975 Folder**

The LANL SEC petition covering the years of 1943-1975 also contains information pertaining to later years. This information includes the Tiger Team report and affidavits from workers employed after the period of the petition.

PDF Files
LANLpet1
LANLpet2
LANLpet3
LANLpet4

**LANL SWEIS 1999 Folder**

The SWEIS analyzes four alternatives for the continued operation of LANL to identify the potential effects that each alternative could have on the human environment. This section contains three parts. The first, presents a summary comparison of the potential consequences of the four alternatives for the continued operation of LANL. The second is a comparison of the potential consequences (including both construction and operations) of the alternatives for two projects that depend upon or span multiple facilities at LANL: the Expansion of the TA–54/Area G Low-Level Waste Disposal Area, and the Enhancement of Plutonium Pit Manufacturing. (The construction and operations for these two projects are included only in the Expanded Operations Alternative.) The third part highlights the Environmental Restoration Project impacts and benefits due to the unique nature of this activity (as compared to other LANL activities) and the level of public interest in these activities. The major discriminators among alternatives would be: collective worker risk due to radiation exposure, socioeconomic effects due to LANL employment changes, and electrical power demand. The separate analyses of impacts to air and water resources constitute some of the source information for analysis of impacts to human health and the environment. The risk to workers is affected by the change in frequency of the operations. Worker exposures to physical safety hazards are expected to result in a range of 417 (Reduced Operations) to 507 (Expanded Operations) reportable cases each year; typically, such cases would result in minor or short-term effects to workers, but some of these incidents could result in long-term health effects or even death. Worker risk due to plutonium accidents is highly dependent on the number of workers present at the time of the event, on the type of protective measures taken at the time of the accident, on the speed with which these measures are taken, and on the effectiveness of medical treatment after exposure; as such, **worker risks cannot be predicted quantitatively or reliably.**

PDF Files
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**Meteorology Folder**

The files in the meteorology folder are Peer-reviewed articles from the journal of the American Meteorological Society. These articles present information concerning the effects of complex terrain on dispersion.

PDF File
Aerodynamic Properties of Urban Areas Derived from Analysis of Surface Form (1999)
C. S. B. Grimmond, T. R. Oke

Cities are about the roughest surfaces there are. This fact has major implications for surface drag, aerodynamic conductance for momentum transport, the scales and intensity of turbulence, mesoscale mass convergence (uplift) and divergence (subsidence), the depths of the roughness sublayer and Ekman layer, wind speed and the shape of the wind profile, and the type of flow found in the urban canopy layer. These factors affect dispersion over urban terrain.

PDF File
Application of Atmospheric Transport Models for Complex Terrain (1984)
David S. King, Susan S. Bunker

Simulations of the airflow and pollutant distribution were carried out in three regions of different meteorological and topographic conditions. This report describes the results of the simulations. It discusses the comparison of calculations with observations on wind fields and pollutant concentration distribution.

PDF File
Atmospheric Transport Models for Complex Terrain (1984)
C.G. Davis, S.S. Bunker, and J.P. Mutschlecner

The modeling of pollutant transport over complex terrain is a matter of practical importance for environmental concerns. This report describes several codes that have been developed and tested to model such transport.

PDF File
Diffusion in a Canyon within Rough Mountainous Terrain (April 1975)
G.E. Start, C.R. Dickerson, and L.L. Wendall

An accelerated field measurements program was conducted to quantify atmospheric diffusion within a deep, steep-walled canyon in rough, mountainous terrain. Two principle objectives were pursued: impaction of plumes upon elevated terrain, and diffusion of gases within the canyon versus diffusion over flat, open terrain. Stability-category-related differences in canyon diffusion versus flat diffusion were found.

PDF File
Dispersion in Complex Terrain: A Summary of the AMS Workshop held in Keystone, Colorado, 17-20 May 1983
Bruce A Egan, Francis Schiermeier

This article summarizes a workshop convened under the direction of the AMS Steering Committee for the EPA Cooperative Agreement on Air Quality Modeling. The purpose of the workshop was to address the status of the understanding of dispersion in complex or mountainous terrain settings, with a specific focus on the ability of current technologies to predict air pollution concentrations in different terrain settings. The meteorological phenomena of importance for estimating the effects of elevated plumes interacting with high terrain are described in detail.

PDF File
Dispersion Parameters over Forested Terrain (1988)
R.T. pinker, J.Z. Holland

This report discusses wind variability parameters, which characterize the dispersion process within and above the forest canopy and over a nearby clearing under different stability conditions. Values of turbulence intensity based on wind speed measurements support the above findings and show that dispersion rates within the forest canopy would be larger, relative to the mean transport velocity, than in free air.

PDF File
Earth's Atmosphere
http://en.wikipedia.org/wiki/Earth%27s_atmosphere

This is an encyclopedia article on the Earth's Atmosphere.

PDF File
Meteorology

http://en.wikipedia.org/wiki/Meteorology

This is an encyclopedia article on Meteorology.

PDF File
Influence of External Meteorology on Nocturnal Valley Drainage Winds (1988)
Sumner Barr, Montie M. Orgill

This paper interprets nocturnal drainage in terms of ambient characteristics. It describes changes in the depth of drainage and volume flux in terms of external wind and radiative effects on the collection of cool air in a valley airshed, and on erosion of an established drainage by turbulent entrapment. The report describes evidence for internal buoyancy waves and rotors that can have a major effect on transport and dispersion in the nocturnal cool-air drainage regime.

PDF File
Harmonization in the Preprocessing of Meteorological Data for Atmospheric Dispersion Models (COST 710)
Bernard Fisher, David Thomson

The objective of the project described in this volume, is to improve both the quality of the meteorological data used in air pollution calculations and the ways in which such data is used. Dispersion models often require meteorological inputs which are not routinely measured, such as surface heat flux or boundary layer depth (or mixing depth), which have to be inferred from other measurements. These quantities need to be estimated before the dispersion calculation can be performed. There are also other quantities, such as wind speed and direction, which although routinely measured may not be available at the locations required for the dispersion calculation. When dispersion climatologies are applied, the meteorological data at a site needs to be processed to provide a climatological description of the dispersion characteristics of the site. This can be done in various ways; for example by using several years of observations as input to the dispersion model, or by statistically processing the data prior to running the model in order to reduce the number of dispersion calculations needed. By testing widely used methods of pre-processing the meteorological input data required by air pollution models, this co-operative study aims to encourage improvements and harmonization.

PDF File
Nocturnal Wind Direction Shear and Its Potential Impact on Pollutant Transport (2000)
Brent M. Bowen, Jeffrey A. Baars, and Gregory L. Stone

The potential effects of vertical wind direction shear on pollutant transport at a complicated, semiarid site are examined using tower measurements. The effects of vertical wind direction shear on plume transport are studied by performing two model simulations of release at 50 m above ground level during a period when strong directional shear persisted for several hours. In the simulation using the full wind profile, southwest winds above a shallow drainage layer initially transport material to a community located 2 km to the northeast of the release. However, when only the 12-m wind is used, the model predicts that the material impacts a different community located 10 km to the southeast. This simulation demonstrates that ignoring the vertical shear effects can result in serious mistakes in responding to an emergency.

PDF File
Potential Temperature Analysis for Mountainous Terrain (1972)
Owen P. Cramer

The complicating influence of mountainous terrain on weather conditions at the surface is most evident in windflow patterns. The blocking, deflecting, and channeling of windflow are obvious effects of rugged terrain. More subtle are the heat sources of varying size and elevation resulting from uneven upthrust of the earth's surface.

PDF File
On Pressure-Driven Wind in Deep Forests (1989)
Joshua Z. Holland

In the lower portion of a deep forest the mean wind and the fluctuations of wind velocity result primarily from the mean horizontal pressure gradient respectively, acting against friction, rather than from vertical momentum and kinetic energy transport processes typical of the surface layer in the free atmosphere.

PDF File
Surface Delays for Gases Dispersing in the Atmosphere (2001)
John D. Wilson, Thomas K. Flesch, and Real D'Amours

In atmospheric dispersion models, a lower boundary separates the atmosphere into a resolved upper region and a near-ground region that is ignored, because it is considered to be irrelevant. This paper examines the unresolved delays and displacements that occur while particles are "waiting" in that neglected near-surface layer before reinjection to the flow above

PDF File
Tributary, Valley and Sidewall Air Flow Interactions in a Deep Valley (1989)

William F. Porch, Richard B. Fritz, Richard L. Coulter, Paul H. Gudikson

Field experiments measureing nocturnal tributary flows have shown complex internal structure. Variations in the flow range from short-term oscillations to long-term flow changes throughout the night. The mean verticle structure in the tributary flow shows a three layer structure. Outflow winds are observed near the surface and in an elevated jet up to several hundred meters in height. A flow minimum or counterflow exists at about the height of of the drainage flow maximum in the main valley. Comparisons of flow volume and variations from a single large tributary show that 5%-15% of the nocturnal flow in the main valley may be contributed trough one tributary. This implies thattributaries may dominate the main valley sidewall and midvalley subsidence contributions to valley drainage flows.

PDF File
Two-Zone Convective Scaling of Diffusion in Complex Terrain (1994)
C.E. Skupniewicz

A two-zone convective scaling equation is developed that allows for a step change in scaling parameters. The two-zone method is shown to unambiguously select appropriate convective scaling paremeters for the partially cloud-covered cases. While the two-zone method works for maximum concentration predictions at any downwind distance, all models underpredict plume width and crosswind-integrated concentration measured at long ranges. It is speculated that the observed enhancement is due to near-surface topographic flows that spread the plume at the surface but maintain centerline concentration.

PDF File
U.S. Standard Atmosphere 1976

The U.S. Standard Atmosphere is a idealized, steady-state representation of the earth's atmosphere from the surface to 1000 km, as it is assumed to exist for a period of moderate solar activity.

**Price-Anderson Folder**

Tis folder contains letters that detail violations by LANL of the Price-Anderson Act Amended. The violations would have resulted in heavy fines for LANL if the contractor, the University of California, was not exempt from the fines because of its tax-exempt status.

PDF Files
EA98-10R1
EA9607R1
EA198808R01
EA200013R01
EA200205
EA-2003-02WS
EA-2005-05WS
EA_2006_05_UC
HSP-DOE-LANL-2006

DOE/IG-0591 Allegations Concerning the Reporting of a Radiological Incident at the Los Alamos National Laboratory

On February 15, 2001, an unanticipated airborne release of Plutonium-238 (Pu-238) occurred from a glovebox at the Los Alamos National Laboratory (Los Alamos) Technical Area 55 (TA-55) Site. The incident resulted in the contamination of workers. As required, Los Alamos officials prepared an Occurrence Report outlining the circumstances of the incident. The National Nuclear Security Administration (NNSA) referred to the Office of Inspector General a complaint that questioned the thoroughness and competence of the evaluation of the incident by Los Alamos and the failure to consider the procedural violations that caused the incident. Consequently, the purpose of our inspection was to evaluate the facts and circumstances surrounding the reporting of the incident.

**Special Environmental Analysis Cerro Grande Fire Folder**

These files comprise the report prepared after the Cerro Grande fire.

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Fig37
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Photo13
Photo14-1
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Photo28
Photo210
Photo211

**Printed Documents**

Rad-NESHAPs Project Records
Quality Assurance Review of Dose Factors Calculated from Nuclear Decay Data for S-38

Rad-NESHAPs Project Records
Quality Assurance Review of Dose Factors Calculated from Nuclear Decay Data for S-37

Rad-NESHAPs Project Records
Quality Assurance Review of Dose Factors Calculated from Nuclear Decay Data for S-35

Rad-NESHAPs Project Records
Quality Assurance Review of Dose Factors Calculated from Nuclear Decay Data for Au-192

Rad-NESHAPs Project Records
Quality Assurance Review of Dose Factors Calculated from Nuclear Decay Data for Au-193

Rad-NESHAPs Project Records
Quality Assurance Review of Dose Factors Calculated from Nuclear Decay Data for Au-194

Rad-NESHAPs Project Records
Quality Assurance Review of Dose Factors Calculated from Nuclear Decay Data for Au-196

> These provide quality assurance review of dose factors calculated from nuclear decay data.

Plans and Practices for Groundwater Protection at the Los Alamos National Laboratory
National Academies Press (2007)
[Available for download at http://www.nap.edu/catalog.php?record_id=11883]

> Groundwater protection is an important issue because water resources in the LANL area of north-central New Mexico are limited. Seven of Los Alamos County's twelve drinking water supply wells are located on the LANL site. Los Alamos County and the County and City of Santa Fe have water supply wells located along the projected flowpath of groundwater leaving the LANL site. Under authority of the U.S. Environmental Protection Agency, the State of New Mexico regulates protection of its water resources through the New Mexico Environment Department (NMED). The findings and recommendations presented in this report are intended to help ensure the efficacy of LANL's work. There are four overarching findings that arose from the committee's study and that have relevance to essentially all parts of the task statement.

Type B Investigation of the Americium-241 Contamination at the Sigma Facility, Los Alamos National Laboratory

> This report describes the incident and deficiencies in LANL procedures that allowed the incident to happen.

The LANL Model 8823 Whole-Body TLD and Associated Dose Algorithm
Jeffery M. Hoffman and Michael W. Mallett
The Radiation Protection Journal November 1999

> This report explains why the new TLDs were adopted because of problems with the older TLDs and the procedures used to analyze the TLDs.

Memorandum Opinion and Order
Concerned Citizens for Nuclear Safety, Inc. and Patrick Jerome Chavez v. United States Department of Energy and Siegfried S. Hecker No. Civ 94-1039M

This is a United States District Court ruling that LANL was not in compliance with the Clean Air Act for monitoring for radionuclides in its emissions.

US Department of Energy Memorandum dated Aug 7, 1991
Subject: Informal National Emissions Standards for Hazardous Air Pollutants Evaluation of the Los Alamos National Laboratory
Frank H. Sprague

An evaluation of LANL compliance with the requirements of 40 CFR 61 Subpart H – National Emission Standards for Emissions of Radionuclides other than Radon From U.S. Department of Energy Facilities. This report discussed the findings of this evaluation. The methods used to monitor stacks are not in compliance. A site inventory which would verify that the currently monitored emission points are all that exist at LANL has not been completed. Nor has a screening of the currents stacks been completed to determine which stacks need to be continuously monitored. **The inventory will have to be completed to determine which isotopes and in what form it will be necessary to monitor for.** The information derived from the program is questionable. The input data for the CAP-88 program is questionable. The quality assurance program at LANL would not meet the requirements of 40 CFR 61. Data validation is extremely tenuous.

Summary of Man-Made Detected Sources
1994 Gamma Fly-over

This is a table presenting location, site description, identified isotope and point source strength.

Final Report Independent Audit of Los Alamos National Laboratory for Compliance with the Clean Air Act, 40 CFR 61, Subpart H November 1999

This audit finds that LANL did not meet regulatory and technical requirements and was not in compliance with 40 CFR 61, Subpart H for 1996.

Wind Patterns in the Canyons of the Los Alamos Area
Greg Stone and Jeff Baars 7/25/00

This report presents an analysis of observations in two canyons of different geometry: Los Alamos Canyon represents the V-shaped-notch geometry and has a depth-to-width ratio of 0.3, and Pajarito Canyon represents the U-shaped canyon with a depth-to-width ratio of 0.1 Long-term statistics for wind direction and speeds are presented. The relationship between the wind in the canyon and the flow over the mesa is discussed. For each canyon there is a general description of the flow over a typical 24 hour cycle. The report closes with some speculation on how canyon flow patterns might affect the transport and dispersion of airborne material.

Summary of Radiological Incident Reports January 1993 to June 1996
Bob Bates July 12, 1996

This summary contains radiological data unique to LANL. This summary was developed by the ESH-12 Dose Optimization Team as merely a means of communicating metric trends that could be of use to LANL management.

CMR Occurrence Report List 1990 – Present (95-0001293)
LANL January 25, 1995

This is a list of occurrence reports concerning CMR. The list provides the occurrence report number, facility name, occurrence category, report type, discovery date and report date. The list presents numerous contamination incidents that occurred at CMR.

TA-55 Occurrence Report List 1990 – Present (95-0001294)
LANL January 25, 1995

This is a list of occurrence reports concerning TA-55. The list provides the occurrence report number, facility name, occurrence category, report type, discovery date and report date. The list presents numerous contamination incidents that occurred at TA-55.

Occurrence Subject/Title Report Sorted by Occurrence Report Number
LANL 06/29/95

This is a list of occurrence reports concerning various locations at LANL. The list provides the occurrence report number, facility name, occurrence category, report type, discovery date and report date. The list presents numerous contamination incidents that occurred at various locations at LANL.

Occurrence Subject/Title Report Sorted by Occurrence Report Number
Notation: material presented by Chris Michaels 11/26/96
LANL 06/29/95

This is a list of occurrence reports concerning various locations at LANL. The list provides the occurrence report number, facility name, occurrence category, report type, discovery date and report date. The list presents numerous contamination incidents that occurred at various locations at LANL.

Occurrence Subject/Title Report Sorted by Occurrence Report Number
LANL 12/20/95

This is a list of occurrence reports concerning various locations at LANL. The list provides the occurrence report number, facility name, occurrence category, report type, discovery date and report date. The list presents numerous contamination incidents that occurred at various locations at LANL.

ALO-LA-LANL-TSF-1995-001 Occurrence Report
Hinde, Michele B. 06/05/1995

This is a final report of a violation of radiological sign requirements regarding item removal and a violation of procedures for documenting equipment and item removal. An employee removed 2 tritium contaminated pumps from a radiological area room 236A TA-41-4.

ALO-LA-LANL-TSF-1995-002 Occurrence Report
Hinde, Michele B. 06/29/1995

This is a final report of a solder joint failing causing a tritium release that actuated a nearby monitor in room 179 TA-21-209.

ALO-LA-LANL-TSF-1995-003 Occurrence Report
Hinde, Michele B. 08/25/95

This is an initial update report of tritium contaminated equipment measuring over either 225,000 dpm/100cm$^2$ or 250,000 dpm/100cm$^2$ found outside of a radiological control area at TA-21-209. The report has two values for the contamination on the equipment, an oxygen reactor furnace.

ALO-LA-LANL-TSF-1995-005 Occurrence Report
Hinde, Michele B. 10/06/95

This is a final report of historical contamination discovered in an uncontrolled area during decontamination and decommissioning activities at TA-21-152. The contamination was uranium and technetium.