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☐ **New document**
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Radiological Air Quality Compliance•

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Radiological Air Quality Compliance

1.0 Introduction

Both the Department of Energy (DOE) and the Environmental Protection Agency (EPA) regulate the impact of radioactive material releases to the atmosphere from routine operations and accidents at DOE facilities, including the Lawrence Livermore National Laboratory (LLNL). The impact of radioactive material releases on the public's health and the environment is monitored, and potential sources are regulated through stages from planning and design to full operation. Controls are imposed on any new equipment, operations, processes, and equipment modifications that can cause radiological air pollution. This *Environment, Safety and Health (ES&H) Manual* document provides the information necessary to operate, monitor, assess, and report on these sources at LLNL in full compliance with regulations.

1.1 Standards for Release of Radiation

The principle standards for airborne radionuclide emissions are defined in 40 CFR 61, Subpart H, "National Emission Standards for Hazardous Air Pollutants (NESHAPs)," under Section 112 of the federal Clean Air Act. The NESHAPs prohibit DOE facilities from emitting radionuclides in amounts that would cause any member of the public to receive, in any year, an effective dose equivalent (EDE) of 10 millirem (mrem) or greater. In addition, the construction or modification of a radiological facility must comply with regulations. If the offsite EDE from any emission point from new or modified facilities is expected to be greater than or equal to one percent of the 10-mrem/year standard (i.e., greater than or equal to 0.1 mrem/year), allowing full credit for emission abatement devices, an application must be filed with the EPA.

This same criterion, but with *no* credit allowed for abatement measures, determines whether continuous monitoring of an emission source is required. When determining requirements for continuous monitoring, estimated radionuclide release rates shall be based on discharge of the effluent stream that would result if all pollution-control equipment did not exist, but facility operations were otherwise normal.

This document addresses the sources of and impacts from radioactive material released to the air. A related category is prompt radiation from particle accelerators or nuclear energy (fusion, fission) sources. Examples of nuclear energy sources are beams or rays of neutrons, protons and other charged particles, and gamma rays, all of which may propagate beyond facility boundaries. The DOE Order (DOE O) 5400.5, "Radiation Protection of the Public and the Environment," limits the public dose from such sources to 100 mrem/year for prolonged exposures and 500 mrem/year for occasional exposures. (See DOE O 5400.5, Chg. 2, Chapter II, Paragraph 1, "Public Dose Limits.")

1.2 Environmental ALARA

In addition to achieving and maintaining compliance with federal regulations, LLNL's policy is to plan and conduct its radiological activities in a manner that protects the health and safety of all its employees, contractors, the general public, and the environment. (See Document 1.2, "ES&H Policies of LLNL," in the *ES&H Manual*.) By following this policy, LLNL ensures that efforts are taken to reduce radiological exposures and releases as low as reasonably achievable (ALARA), taking into account social, technical, economic, practical, and public policy considerations.

ALARA represents a process, not a dose standard, encompassing a set of practices an performance objectives. The DOE has distributed guidance to its contractor sites on achieving ALARA for both workers and others located onsite (Occupational ALARA) and members of teh public and biota (Environmental ALARA). LLNL's environmental ALARA program is described in "Environmental ALARA Program Plan," Environmental Protection Department, Operations & Regulatory Affairs Division, Nov. 1999 (UCRL-AR-138061).

Environmental ALARA concerns are normally adequately addressed by carrying out reviews and evaluations of radiological activities as discussed in this chapter and other ES&H Manual environmental chapters. In the rare instance when these reviews indicate the potential for significant radiological release, programmatic personnel should contact an environmental analyst in the Terrestrial and Atmospheric Monitoring and Modeling (TAMM) Group in EPD's Operations and Regulatory Affairs Division (ORAD) or their ES&H Team environmental analyst for a more detailed, directed assessment.

See Document 20.4, "LLNL Occupational Radiation Protection ALARA Program," in the ES&H Manual for information related to occupational ALARA.

1.3 Annual Review and Reports

Programs at LLNL shall comply annually with 40 CFR 61, Subpart H. The Environmental Protection Department (EPD), the lead organization in this effort, relies on LLNL program personnel to respond to information requests regarding radionuclide use. Program personnel should consult a TAMM environmental analyst, or their ES&H Team environmental analyst, for assistance with radiological emissions and compliance issues.

As part of complying with 40 CFR 61, Subpart H, programs shall use methods approved by the EPA, such as methods for stack monitoring and abatement, and computer models for calculating dispersion of airborne radioactive material and doses to exposed individuals.

The ORAD is required to report Laboratory activities with the potential to release airborne radionuclides. This requirement is satisfied through two annual reports: the *NESHAPs Annual Report,* and the Laboratory's *Site Annual Environmental Report (SAER).* These provide detailed

information on radionuclide sources, facilities, control programs, monitoring and modeling activities, impact assessments, and other aspects of operations at LLNL involving radionuclides.

1.4 Scope

This document describes the hazards, controls, and responsibilities associated with air quality compliance with respect to LLNL operations that may produce airborne radioactive pollutants.

2.0 Hazards

The federal Clean Air Act and other air quality standards enforced by state and regional air districts were established to protect the health of the most sensitive members of the population. Examples of sensitive individuals include children, the elderly, and those with allergies, asthma, emphysema, or compromised immune systems. Uncontrolled airborne emissions of radioactive pollutants can negatively impact public health and the environment.

3.0 Controls

This section discusses the required administrative and engineering controls for radiological air quality compliance.

3.1 Administrative Controls for Radioactive Air Emissions

Administrative controls require that any LLNL project using radionuclides shall (1) evaluate the quantity and type of radionuclides potentially released to the atmosphere by project operations; (2) determine whether or not it is necessary to install EPA-approved continuous air effluent monitoring of the radiological emissions; and (3) determine whether or not it is necessary to obtain EPA approval for project start-up. Section 4.0 is a self-contained primer for meeting NESHAPs compliance.

Administrative controls also call for certain facility and ES&H documents to cite and acknowledge NESHAPs obligations. For new facilities, experiments, and projects, radioactive pollutants releases are addressed in National Environmental Policy Act (NEPA) document reviews. (See Document 3.6, "Environmental Planning," in the *ES&H Manual*.) They are also addressed when preparing Integration Work Sheets (IWSs) for planned activities. (See Document 2.2, "Managing ES&H for LLNL Work," in the *ES&H Manual* and Section 4.0 of this document.) By consulting these documents and communicating with EPD and program management personnel when planning and executing projects, workers become aware of the need to consider air releases potentially leading to radiological doses as well as the requirements for controlling and monitoring air emissions. .

Administrative controls also identify the locations where work using radioactive materials is performed. These locations, designated as Radioactive Materials Management Areas (RMMAs), are tracked (e.g., additions and removals over time) by the Hazard Control Department's (HCD) Safety Programs Division. Their RMMA documentation identifies the locations (e.g., buildings, rooms, areas) where unencapsulated radioactive material is handled, or where material in the area could possibly become activated by radiation-generating devices such as accelerators or reactors.

3.2 Engineering Controls for Radioactive Air Emissions

Abatement devices can substantially reduce radiological air emissions. Device examples include High Efficiency Particulate Air (HEPA) filters, activated carbon filters, and Venturi scrubbers; see Appendix D to 40 CFR Part 61, Table 1 for details. These devices provide some control over air contaminant emissions and restrict the possible impact of emissions on the environment and the public.

Stack effluent monitoring (both continuous monitoring and short-term confirmatory tests) falls under the category of engineering controls, and is in place at key LLNL radiological facilities. (See the discussion in Section 4.2.) Modeling and other analyses are routinely carried out to evaluate potential releases and their impacts on the public and the environment. HEPA filters or other abatement devices for radioactive particles and gases are in place where needed.

In addition, internal control measures are in place for all activities involving radionuclides. These internal engineering control measures address (1) radioisotope handling procedures and work enclosures, and (2) the evaluation of potential hazards, ventilation systems, emergency response, and monitoring of the workplace environment.

4.0 Complying with NESHAPs

Prior to initiating a new project or significantly modifying an existing one, the project's compliance with NESHAPs regulations shall be evaluated. To do so, some basic data is required. This data can determine whether continuous monitoring of radioactive effluent from a particular exhaust point is required and whether it is necessary to obtain EPA approval for start-up of the project. The TAMM Group provides guidance and calculations to help the project's Responsible Individual make these determinations and, if needed, provides regulatory representation.

4.1 NESHAPs Checklist

Prior to start-up of operations, the Responsible Individual or other project-responsible person should answer the following questions for the TAMM environmental analyst:

- What is the building number and room number in which the operation or experiment would take place?
- What radionuclides would be used?
- What is the quantity of each radionuclide that would be used (expressed in curies)? (The usage inventory in a year is needed, as distinguished from annual inventory on hand or facility limits.)
- What is the physical state (solid, liquid, powder, gas) of each radionuclide that would be used? (Give fraction of time in different states, if applicable.)
- What is the type of area where the operation would take place (e.g., fume hood, glove box, open air)?
- What would be the characteristics of the release points? (For example, for a stack release, give the stack height relative to ground, stack diameter, stack flow rate, and exhaust identification number.)
- Would emission-control (abatement) devices be used (e.g., HEPA filters, Venturi scrubbers, Douglas bags, or activated carbon filters)?
- What is the rated efficiency of the abatement equipment that would be used (for example, 99.97% for one-stage HEPA)?
- What would be the maximum frequency of emissions? (For example, would it be a one-time puff or a continuous release of 4 hours per day, 5 days per month?)
- Describe the project or experiment. What would it do? Would it produce any activation products, produce any waste, or involve heating, melting, or vaporization of radioactive substances?
- When would the equipment be installed? When do you expect operations to commence?

With this information, the TAMM environmental analyst can evaluate whether or not continuous monitoring is required and EPA permission needed to begin operations.

4.2 Continuous Effluent Monitoring Evaluation

The NESHAPs regulations require that any operation that could produce an annual-averaged offsite dose greater than or equal to 0.1 mrem/year, with no credit for any emission abatement devices allowed, shall be continuously monitored using EPA's methods. The potential offsite dose is determined by using the EPA-approved CAP88-PC air dispersion and dose model, or other EPA-approved code, assuming a source term (effluent emission rate) that is derived from

projected usage quantities of radionuclides. (EPA provides physical-state-dependent factors for these determinations; see Appendix D, 40 CFR 61.)

If the NESHAPs evaluation concludes that monitoring is required, the program shall install EPA-approved monitoring systems prior to the start of operations. The TAMM Group is available to help design the monitoring systems. Monitoring system requirements are spelled out in the EPA standards ANSI/HPS N13.1–1999 and ANSI N13.1–1969; see Section 7.2. (Stacks for which construction/modification began before May 2000 qualify under the older 1969 standard. The more stringent 1999 standard must be met by newer constructions or more recently modified existing ones.”.)

4.3 Permission for Start-Up Evaluation

The NESHAPs regulations require that any operation that could produce an annual-averaged offsite dose greater than or equal to 0.1 mrem/year, after taking full credit for emission-abatement devices such as HEPA filters, must obtain EPA approval prior to start-up of operations. The same calculation discussed above for continuous effluent monitoring applies, except that credit is allowed for emission-abatement devices in the start-up evaluation. For example, EPA allows the potential released quantity of radioactive particulates to be reduced by a correction factor 0.01 for each stage of HEPA filtration (the true reduction is expected to be 0.003 per HEPA stage). If the NESHAPs evaluation concludes that permission for start-up is required, the program may not begin operations with radioactive materials (as opposed to non-radioactive surrogates) until written approval is received from EPA Region IX.

4.4 Citation of NESHAPs in NEPA Documents, IWSs, and Facility Documents

This section describes how to cite NESHAPs compliance obligations in other regulatory documents.

4.4.1 NEPA Documents

New and significantly modified radiological emission sources must be reviewed by the Environmental Evaluations Group (EEG, a group within EPD) for compliance with NEPA. Document 3.6 of this manual describes how and why EEG does NEPA reviews. EEG needs the following information in order to perform their NEPA review: (1) description of the project and information on the radionuclides to be used (e.g., specific radionuclides, their quantity, physical state), (2) the potential for their release to the atmosphere in normal operations, and (3) the potential for accidental releases to occur. Please contact EEG or your EOG analyst to initiate or learn more about the NEPA review process.

4.4.2 Integration Work Sheets and Facility Documents

Facility management personnel (Facility Managers) and workers responsible for individual projects (e.g., Responsible Individuals, Authorizing Individuals, Principal Investigators) should be aware of the NESHAPs annual reporting requirements for any operation/experiment with the potential to release airborne radioactive material. These should be considered when preparing Integration Work Sheets with Safety Plans (IWS/SPs), design reviews, and facility documents such as Facility Safety Plans. (See Document 3.3, "Facility Safety Plans and Integration Work Sheets with Safety Plans," in the *ES&H Manual.*) Including a statement such as the following is encouraged:

> "As part of LLNL's annual demonstration of compliance with NESHAPs, the Responsible Individual, Authorizing Individual, or other project-responsible person will report to the Environmental Protection Department, when requested, a list of the radioactive materials that have the potential to be released into the atmosphere in conducting these operations. The associated stack information (stack height above ground level, stack diameter and flow rate, and stack identification number) will also be provided."

4.5 Annual Compliance Evaluation/Demonstration

Each year (generally in March), the TAMM Group requests radiological data and other information from Laboratory programs—specifically, from Assurance Managers, Facility Managers, and Responsible Individuals—on projects that could emit airborne radioactive material. This data helps TAMM demonstrate to the EPA and the DOE that LLNL's operations comply with NESHAPs. This effort is guided by the TAMM Group and documented in each year's NESHAPs Annual Report. The Responsible Individual for each project should contribute all radiological data requested by the TAMM Group, using the forms and guidance provided.

4.6 Causes and Consequences of Violations

Strict violation of the NESHAPs standard occurs when the potential EDE to the most-exposed individual member of the public, arising from releases to air of radioactive material, summing contributions from all sources at a site, equals or exceeds 10 mrem/year. Lesser violations, such as improper procedures, failure to comply with all requirements (e.g., not installing continuous stack monitoring when required), and failure to adequately demonstrate that a site is in compliance can result in penalties, fines, and adverse publicity. In a case of extreme and continuing violations, the EPA could shut down a process, facility, and possibly an entire site.

5.0 Responsibilities

All workers and organizations shall refer to Document 2.1, "Laboratory and ES&H Policies, General Worker Responsibilities, and Integrated Safety Management," in the *ES&H Manual* for a list of general responsibilities.

The following subsections describe specific responsibilities of LLNL organizations and workers who have key roles related to the potential release of airborne radioactive material in LLNL operations.

5.1 Environmental Protection Department

The EPD is the lead organization for environmental support to Laboratory programs. It provides guidance, assessments, and regulatory interaction and also performs reporting functions.

5.1.1 Terrestrial and Atmospheric Monitoring and Modeling Group

The TAMM Group in ORAD shall:

- Assess air releases of radioactive materials and demonstrate Laboratory compliance with NESHAPs.
- Determine and characterize release sources, monitor environmental surveillance and stack-effluent equipment, model air dispersions and dose assessments, and report results and conclusions to the DOE and EPA.
- Perform dispersion and dose modeling, make determination of start-up and stack monitoring requirements, interact with regulatory agencies, coordinate audits, inspections, and reviews, and perform annual reporting to demonstrate compliance with NESHAPs.
- Prepare the LLNL NESHAPs Annual Report.

If continuous monitoring is required, the TAMM environmental analysts shall:

- Assist with design, development, and implementation of stack monitoring.
- Participate in the review and tracking of monitoring data and the archival of pertinent records.

If continuous monitoring is not required, the TAMM Group shall:

- Perform periodic confirmatory sampling measurements.

5.1.2 ES&H Team Environmental Analyst

Each ES&H Team has an environmental analyst from the Environmental Operations Group (EOG) within the Operations and Regulatory Affairs Division (ORAD) of EPD. Environmental analysts are familiar with the more common air emission sources within various authorizing organizations. Environmental analysts shall:

- Help Responsible Individuals (RIs) and air quality specialists locate and identify potential sources of air emissions.
- Help authorizing organizations determine NESHAPs and National Environmental Protection Act (NEPA) requirements.
- Periodically communicate with authorizing organization personnel to ensure that they understand and comply with current regulatory and record keeping requirements.

5.1.3 Environmental Evaluations Group

The EEG shall:

- Support the DOE in evaluating Laboratory projects for compliance under NEPA. NEPA reviews, conducted in close interaction with LLNL program personnel, emphasize the need to consider certain applicable regulatory compliance requirements, including NESHAPs, to program proponents.

5.2 Hazards Control Department

The HCD has primary responsibility for radiological protection of workers; correspondingly, the main focus of HCD health physicists is worker safety.

5.2.1 Health Physicists

Health physicists shall:

- Act primarily in a supporting role regarding radiation protection of the public and the environment.
- Interface and work in concert with EPD analysts on the ES&H team to support Laboratory program personnel.

5.2.2 Health and Safety Technologists

Health and Safety Technologists shall:

- Perform stack sample duties as directed in Facility Discipline Action Plans.

5.2.3 Radiological Measurements Laboratory

The Radiological Measurements Laboratory shall :

- Provide the radiochemistry analyses for LLNL's stack monitoring samples.

5.3 Project Responsible Individual

When a potential air emission source is identified, the Responsible Individual from the authorizing organization shall:

- Identify potential sources of air emissions and consult with a TAMM environmental analyst to determine appropriate actions.
- Notify the environmental analyst of any new or modified operations that are potential sources of air emissions and consult with the assigned air quality specialist to determine whether stack monitoring and or permission to start operations is required. (See Sections 4.1–4.3.) Notification can be initiated through the IWS and NEPA document process (Section 4.4).
- Provide requested data and other information to the TAMM Group for the annual assessment of LLNL's compliance with NESHAPs (Section 4.5).
- Provide EPD personnel with answers to the checklist questions in Section 4.1.

5.4 Authorizing Organization

The LLNL authorizing organization shall:

- Cover the cost of required stack monitoring equipment, including its installation, support for routine operation and data collection, and maintenance.
- Provide funding and implement emission-control and effluent monitoring strategies, as necessary, to comply with NESHAPs regulations.
- Assure compliance of the organization's operations with 40 CFR 61, Subpart H.

6.0 Work Smart Standards

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants."

40 CFR 61.90–61.97, "National Emission Standards for Hazardous Air Pollutants, National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities."

40 CFR 63, "National Emission Standards for Hazardous Air Pollutants for Source Categories."

42 USC 7401, et seq., Clean Air Act (CAA).

42 USC 7671, et seq., Clean Air Act amendments of 1990.

ANSI/HPS N13.1–1999, "Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities."

ANSI N13.1–1969, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities."

DOE O 5400.5, Chg. 2, Chapter II, "Requirements for Radiation Protection of the Public and the Environment," P.1 (except 1.a.3.c. and 1.c), Public Dose Limits, P.2, ALARA, P.5, Release of property having residual radioactive material, P.6, Demonstration of compliance with dose limits, and P.8a, Records.

7.0 Resources for More Information

7.1 References

DOE Order 5400.5, Radiation Protection of the Public and the Environment.

Gallegos, G.M. (1998), *NESHAPs Annual Report Guidance Document*, Lawrence Livermore National Laboratory, Operations and Regulatory Affairs Division, Livermore, CA (EMP-NS-S).

Harrach, R.J. (1998), *Guidance for Radiological Dose Assessment,* Lawrence Livermore National Laboratory, Operations and Regulatory Affairs Division, Livermore, CA (EMP-R-DA).

7.2 Other Sources

Current NESHAPs regulations on monitoring radioactive effluent from stacks are described in:

40 CFR 61.93, Subpart H, "Emission monitoring and test procedures." In particular, see references to standards ANSI N13.1–1969, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities," and ANSI/HPS N13.1–1999, "Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities."

LLNL NESHAPs Annual Reports (1990–present); most recent report (2002) is:

Harrach, R. J., G. M. Gallegos, S. R. Peterson, P. J. Tate, N. A. Bertoldo, K. R. Wilson, P. E. Althouse, and J. M. Larson, (2003), LLNL NESHAPs 2002 Annual Report, Lawrence Livermore National Laboratory, Livermore, CA, UCRL-ID-113867-03.

LLNL *Site Annual Environmental Report (SAER),* (1972–present). SAERs covering operations in 1994 to the present are available online at the address http://www.llnl.gov/saer. The most recent report (2002) is:

Sanchez, L., P. E. Althouse, N. A. Bertoldo, R. G. Blake, S. L. Brigdon, R. A. Brown, C. G. Campbell, E. Christofferson, L. M. Clark, G. M. Gallegos, A. R. Grayson, R. J. Harrach, W. G. Hoppes, H. E. Jones, J. M. Larson, D. Laycak, D. H. MacQueen, S. Mathews, M. Nelson, L. Paterson, S. R. Peterson, M. A. Revelli, M. J. Taffet, P. J. Tate, R. J. Ward, R. A. Williams, and K. R. Wilson, (2003), Environmental Report 2002, Lawrence Livermore National Laboratory, Livermore, CA, UCRL-50027-02.

7.3 Contacts

Contact the TAMM environmental analyst for assistance in assessing potential radionuclide emissions and evaluating obligations (if any) to install continuous monitoring and/or to report to the EPA for permission to proceed. As noted in Section 4.0, the TAMM environmental analyst also provides regulatory interaction if needed, and documents compliance with radiological NESHAPs requirements annually.