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U.S. Department of Energy

Oakland Operations Office, Oakland, California

FINAL
RADIONUCLIDE AIR EMISSION ANNUAL REPORT
(Subpart H of 40 CFR 61)
CALENDAR YEAR 1997

for the:

Laboratory for Energy-Related Health Research (LEHR)
University of California at Davis, California

prepared for:

United States Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 95612-5208

prepared by:

Weiss Associates
5500 Shellmound Street
Emeryville, California 94608

June 11, 1998
Rev. 0

DOE Oakland Operations Contract DE-AC03-96SF20686

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Approvals Page

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FIGURES

ATTACHMENTS

ACRONYMNS

°F	Degrees Fahrenheit
AEC, now DOE	Atomic Energy Commission
Co-60	Cobalt-60
D&D	Decontamination and decommissioning
DOE	United States Department of Energy
EDE	Effective dose equivalent
EPA	United States Environmental Protection Agency
ER/WM	Environmental Restoration/Waste Management
GPR	Ground-penetrating radar
ITEH	UC Davis Institute of Toxicology and Environmental Health
LEHR	Laboratory for Energy-Related Health Research

LFI	Limited Field Investigation
MEI	Maximally exposed individual
mrem	Millirem
NESHAP	National Emissions Standards for Hazardous Air Pollutants
PM_{10}	μ-meters aerodynamic diameter
Ra-226	Radium-226
rem	Unit of dose equivalent
Site	LEHR Site
Sr-90	Strontium-90
TPHRL	Toxic Pollutant Health Research Laboratory
UC Davis	University of California, Davis
UCL	Upper confidence limit

US Department of Energy
Radionuclide Air Emission Annual Report
(Subpart H of 40 CFR 61)
Calendar Year 1997

Site Name: Laboratory for Energy-Related Health Research (LEHR)

Field Office Information

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1. FACILITY INFORMATION

The Laboratory for Energy-Related Health Research (LEHR) facility is in compliance with the requirements of 40 CFR Part 61 Subpart H - National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Emissions of Radionuclides from DOE Facilities. The NESHAP regulations require that radionuclide emissions not exceed levels that would result in an effective dose equivalent (EDE) of 10 mrem/yr. There are currently no remaining point sources of radionuclides emissions at the LEHR facility. Potential fugitive/area sources of radionuclide emissions were modeled using the EPA atmospheric dispersion/radiation dose calculation computer code, CAP88-PC version 1.0. The total estimated contribution to the EDE from non-point source emissions for reporting year 1997 was estimated to be 1.8×10^{-3} mrem (less than 0.02% of the standard).

1.1 Site Description

The LEHR Site (Site) is located in Solano County, California, in the southeast one-quarter of Section 21, Township 8 North, Range 2 East, Mount Diablo Base and Meridian. It is approximately 1.5 miles south of the town of Davis (Figure 1), and occupies the southeast portion of the University of California, Davis (UC Davis) campus. The Site is bounded by UC Davis research facilities, private farmland, and the South Fork of Putah Creek. The southern boundary of the LEHR Site is the northern levee of the South Fork of Putah Creek.

The local climate is Mediterranean, with mild winters and long summers. In winter, the average temperature is 46.9 degrees Fahrenheit (°F), and the average daily minimum temperature is 37.6°F. In summer, the average temperature is 73.0 °F and the average daily maximum temperature is 92.3°F. Based upon data collected from the on-site meteorological station in 1997. The mean annual precipitation is 17.0 inches, most of which occurs between October and April (DOE, 1996). The sun shines approximately 95% of the time in summer and about 45% in winter.

Based upon data collected from the on-site meteorological station in 1997, in winter the average temperature was 54°F, and in summer the average temperature was 71 °F. Precipitation data were also collected from the UC Davis climatological data center, located approximately one mile northwest of the Site. Based upon the UC Davis data, the total precipitation for 1997 was 16.3 inches (with 22.8 inches and 25.4 inches recorded in 1995 and 1996 respectively).

The prevailing wind direction is from the south, reflecting frequent incursions of marine air through the Carquinez Strait into the Sacramento Valley. Changes in wind direction are common, with winds from the northwest occurring diurnally. Several times a year, strong winds blow from the north, generally following the passage of Pacific storm systems (DOE, 1994). Based upon data

collected from the on-site meteorological station in 1997, during the winter months (October – April) the wind directions vary, with the primary wind direction frequency being from the north and a significant wind direction frequency from the south. During the summer months (May – September) the predominant wind direction is from the south. The average windspeed recorded at the LEHR Site meteorological station in 1997 is approximately 1.6 m/s (3.7 mph), the maximum windspeed was 7.4 m/s (16.5 mph) and the median windspeed was 1.4 m/s (3.1 mph).

The land within a one-mile radius of the Site is owned both privately and by UC Davis, and is used for animal research, agriculture, and recreation. Immediately adjacent to the LEHR Site to the east and west are UC Davis-owned research facilities. Privately owned lands within one mile to the south and east of the Site include permanent residences and support some crops. Approximately 75 percent of the surrounding land in the general vicinity of the LEHR Site is used for agriculture. Major crops include fruits, nuts, and grains. Approximately 40 percent of the agricultural land in the LEHR vicinity is irrigated, and some of the nearby lands are used for cattle grazing (DOE, 1988).

The Site covers approximately 15 acres and contains laboratory buildings and former animal-handling facilities (Figure 2). Of the 15 acres, approximately 40 percent is paved or covered by structures. Approximately 30 percent is unpaved and relatively free of vegetation. Five percent is covered by large, deep-rooted vegetation. Outdoor dog pens occupy approximately 20 percent, or 3 acres, of the LEHR Site. The land is owned by the Regents of the University of California and was leased to the United States Department of Energy (DOE) through 1989. DOE still owns the buildings on-site.

The Atomic Energy Commission (AEC, now DOE) began conducting radiological studies on laboratory animals, particularly beagles, in the early 1950s. Initial studies were carried out on the main campus and involved the irradiation of beagles. The LEHR Site began operating in its present location in 1958 when full-scale experimental use of radioactive materials began. Research at LEHR through the mid-1980s focused on the health effects from chronic exposure to radionuclides, primarily strontium-90 (Sr-90) and radium-226 (Ra-226). In the early 1970s, a cobalt-60 (Co-60) irradiator facility was constructed at the LEHR Site to study the effects of chronic exposure to gamma rays on bone marrow cells of beagles. In 1975, the DOE initiated a program at the Site to study the potential health effects of combustion products from fossil fuel power plants. In 1983, the Toxic Pollutant Health Research Laboratory (TPHRL) was established at the LEHR Site. DOE-funded research at LEHR ended in 1989. The Site is presently occupied by the UC Davis Institute of Toxicology and Environmental Health (ITEH) and LEHR Environmental Restoration/Waste Management (ER/WM) personnel.

1.2 Source Description

During 1995, decontamination and decommissioning (D&D) activities resulted in the removal of the Imhoff building and the radiological sources contained in the Cobalt-60 building, the only remaining point sources at the LEHR Site with the potential for small releases of radionuclide emissions at that time. These D&D activities were summarized in the 1995 LEHR facility NESHAP report (PNNL, 1996).

The NESHAP requirements primarily target point source/stack emissions. However, a Memorandum of Understanding between the DOE and the EPA (DOE, 1995) applies the same point source criteria to potential diffuse area sources. There are areas of the LEHR Site where surface soil radionuclide activities to exceed background levels. The potential exists in these areas for wind blown dust to result in diffuse area source emissions of radionuclides. Three potential diffuse area sources were evaluated for the 1995 LEHR facility NESHAP report, and determined to result in emissions which were negligible compared with LEHR facility point-sources existing at the time. These potential fugitive area sources were reevaluated for the 1996 NESHAP report based upon additional surface soil data collected in 1996 (Weiss Associates, 1997a).

Additional sampling was performed in 1996 at the Site to determine whether potential sources in these areas pose an unacceptable threat to ground water. During the summer of 1996, surface soil samples (0-3 ft below ground surface) were collected from the Eastern and Western Dog Pens Area following the removal of the pens. Sampling was also conducted in the Southwest Trenches and Ra/Sr Treatment Areas as the DOE source areas at the Site were further characterized during the Limited Field Investigation (LFI) the summer of 1996. Waste from, and associated with, the DOE Disposal Box was removed in September and October 1996 as part of a CERCLA Time-Critical Removal Action (Weiss Associates, 1997b). Sampling was also conducted in 1995 and 1996 to determine local background levels of constituents of concern for comparison to data acquired from the Site. These data were presented in the *Site Characterization Summary Report* (Weiss Associates, 1997b).

Based upon the additional surface soil data collected during 1996, emissions rates for the potential diffuse sources were re-estimated for the LEHR facility 1996 NESHAP report. Due to the distribution of surface soil samples, the size of the diffuse sources was adjusted to account for the entire investigation area, rather than individual potential sources within each area. Estimated emissions from the Eastern Dog Pens were included in the 1996 NESHAP evaluation in addition to the Western Dog Pens addressed in the 1995 NESHAP report. Table 1 lists the LEHR facility diffuse sources with a potential to emit radionuclides above background through wind blown dust. The following three sections summarize background information for the LEHR facility non-point sources.

In 1997, additional soil samples and gravel samples were collected from the Dog Pens area, and a detailed gamma radiation survey was conducted on selected dog pens. These data were collected to determine whether "hot spots" were present in the surface soil, and if so, whether there was any identifiable pattern or correlation which would help to predict the location of such "hot spots". In addition, surface soil samples were collected from eight off-site locations along Old Davis Road, and from seven on-site background soil borings. These samples were collected to provide additional background soil data. The results of these investigations are presented in detail in the *Draft Technical Report: Results of Western Dog Pens, Background, and Off-Site Investigations* (Weiss Associates, 1998).

No changes to Site conditions occurred during 1997 that would result in emissions different from those estimated for 1996. Additional surface soil data collected in the Western Dog Pens and background levels established for the Site (Weiss Associates, 1998). Additional surface soil data

collected in the Western Dog Pens is discussed in more detail in Section 1.2.3 below. Background levels established for the Site were slightly lower than, but similar to those assumed during preparation of the 1996 NESHAP report, with the exception of Sr-90 which dropped from 0.36 pCi/g to 0.056 pCi/g). The changes in background concentrations, however, did not result in the inclusion of additional radionuclides in activities above background. Because only maximum activities were used in the calculation of emission rates, as described in the following sections, the background levels established for the Site do not affect the emissions assumptions made during preparation of the 1996 NESHAP report.

Additional surface soil data collected in the Western Dog Pens and background levels established for the Site could be used to refine the initial emission rates calculated during preparation of the *1996 Radionuclide Air Emission Annual Report.* However, reductions in the estimated emissions rates would likely be less than an order of magnitude and would not change the conclusions of this report.

1.2.1 Southwest Trenches Area

The Southwest Trenches Area is located in the southwest corner of the LEHR facility (Figure 2). The disposal trenches in the area are reported to have received primarily LEHR-generated low-level radioactive waste, fecal material, and laboratory wastes. It was also reported that a resin column from the Imhoff system may have been buried in one of the trenches (Weiss Associates, 1997b).

Although the locations and dimensions of the trenches are not known with certainty, the trenches were reportedly about 120-ft long, 2 ft wide, 8-to-10 ft deep, and oriented in a north-south direction. Three trenches in the Southwest Trenches Area were reportedly used between September 1963 and November 1965. Additional burial areas are likely present in the Southwest Trenches Area, based on a ground-penetrating radar (GPR) survey conducted in 1994 (Weiss Associates, 1997b).

A chemical dispensing area where chemicals were reportedly stored in an open wooden structure was also present in the Southwest Trenches Area. The chemical dispensing area was the only part of the area assumed to be a source of diffuse radionuclide emissions for the 1995 NESHAP report.

Sampling was conducted in the Southwest Trenches Area as part of the 1996 LFI. Maximum activities of radioactive compounds detected in surface soil samples above background were used to reevaluate emission rates assumed for the area in the 1995 NESHAP report. No additional surface soil data were collected in 1997 for the Southwest Trenches Area. Southwest Trenches Area emissions are summarized in Section 2 below.

1.2.2 Ra/Sr Treatment Systems Area

The Radium and Strontium Treatment Systems are located between Animal Hospital Nos. 1 and 2 (H-219 and H-218) in the western portion of the LEHR facility (Figure 2) and together comprise the Ra/Sr Treatment System Area. These systems were used to treat radiological liquid wastes generated from the animal experiments.

The Ra-226 Treatment System reportedly received low-level radioactive waste, including fecal material and washdown water from Animal Hospital 2. The system consisted of two septic tanks with each tank consisting of two compartments separated by a weir, a distribution box, three dry wells, and one leach trench and associated distribution pipelines. The septic tanks allowed for the settling of solids. Fluids were pumped from the tanks, fed through the distribution box to one of the three vertical dry wells or the leach trench. Currently, all four of the tanks associated with this system are empty.

The Sr-90 (Imhoff) Treatment System reportedly received low-level radioactive waste from Sr-90 experiments. Effluent was processed through the Imhoff Treatment System and then was discharged to two leach fields. The Imhoff Treatment System, consisting of a series of nine tanks, primarily used sedimentation, aeration, chemical clarification, and filtration to treat the wastes prior to passing the remaining waste water through a cation exchange resin and discharging the remaining water to the Sr-90 leach fields.

The Ra/Sr Treatment System Area was investigated and characterized as part of the 1996 LFI. Analysis of the distribution of radionuclides in the soil of the Ra/Sr Treatment System Area indicate that the Strontium (Imhoff) Treatment System operations did not significantly impact surrounding soil. Significant Ra/Sr contamination associated with the Ra Treatment System is generally confined to, or immediately adjacent to, the leach lines and dry wells. Maximum activities of radioactive compounds detected in surface soil samples above background from the area were used to reevaluate emission rates assumed for the area in the 1995 NESHAP report. No additional surface soil data were collected in 1997 for the Ra/Sr Treatment System Area. The Ra/Sr Treatment System Area emissions are summarized in Section 2 below.

1.2.3 Eastern & Western Dog Pens Area

The Western and Eastern Dog Pens Area located near the center of the LEHR facility (Figure 2) are a potential diffuse source of radiological emissions. The western set originally contained 320 pens. In 1975, 64 pens were removed to allow for construction of the Cellular Biology Lab (Building H-294; Figure 2). The eastern set contained 96 pens and overlies UC Davis Landfill No. 2. The dog pens were used to house dogs involved in the Ra-226 and Sr-90 research activities at the LEHR Site. The Western Dog Pens reportedly housed the dogs that received the highest dosages of Sr-90 and Ra-226. Excreta from dogs housed in outdoor pens contained low levels of radiological constituents. Solids were removed from the pens on a daily basis. Urine evaporated and/or infiltrated the gravel fill in the pens. An estimated 2 mCi of Sr-90 and 0.5 mCi of

Ra-226 were potentially excreted in dog urine in these areas over the life of the project (Weiss Associates, 1997b).

From June through August 1996, the 256 Western and 96 Eastern Dog Pens, dog pen pedestals, and some soil were removed. Following the removal of the dog pens, 24 surface soil samples were collected from randomly selected locations. All 24 samples were submitted for radionuclide analysis. Only Sr-90, Ra-226 and Cs-137 were detected above background in the 24 samples collected from the Western and Eastern Dog Pen Areas. Because many radionuclides were not detected above background in the Western and Eastern Dog Pen Areas during the 1996 investigation, maximum activities of radionuclides in surface soil samples from all investigations to date from these areas were used to reevaluate emission rates assumed for the Western Dog Pens Area in the 1995 NESHAP report, and to include the Eastern Dog Pens Area as a potential source of radionuclide emissions. The Western and Eastern Dog Pens Area emissions are summarized in Section 2 below.

As presented in detail in the *Draft Technical Report: Results of Western Dog Pen, Background and Off-Site Investigations* (Weiss Associates, 1998), additional investigation was performed in the Western Dog Pens in 1997. Phase A of the investigation consisted of review of historical information, and a general gamma scan of the dog pens gravel. During Phase B, 46 gravel and 75 soil samples, including 4 gravel and 6 soil duplicates, were submitted to GEL for selected radionuclide analyses. Results of the analysis concluded that only Ra-226 (at a maximum activity of 1.94 pCi/g), Sr-90 (at a maximum activity in gravel of 3.59 pCi/g), Cs-137 (at a maximum activity of 0.115 pCi/g), Thorium-234 (at a maximum activity less than 2 pCi/g) and Uranium-238 (at a maximum activity of 1.62 pCi/g) are present in soil in activities above background. Maximum activities of these radionuclides were comparable to those assumed for the 1996 NESHAP report.

These data are sufficient to eliminate a number of radionuclides from consideration in the Western Dog Pens Area and to estimate a 95% upper confidence limit (UCL) mean activity for the Western Dog Pens Area, which would be more representative of fugitive dust emissions than the use of maximum activities. The data used for the 1996 NESHAP report are therefore more conservative than previously assumed. Estimating emissions data based upon the 1997 soil data, however, would not change the conclusions of this report.

2. AIR EMISSION DATA

2.1 Point Sources

As noted in Section 1 and summarized in the 1995 LEHR facility NESHAP report, during 1995 D&D activities removed the Imhoff Building and the radiological sources in the Cobalt-60 building, the only remaining point sources at the LEHR Site with the potential for small releases of radionuclide emissions. There are currently no point sources of radionuclide emissions at the LEHR facility.

2.2 Non-Point Sources

As discussed in Section 1, radionuclide emission sources at the LEHR facility in 1997 are limited to four areas of potential windblown, fugitive dust emission sources of radionuclides: the Southwest Trenches Area; the Ra/Sr Treatment Systems Area; and the Western and Eastern Dog Pen Areas. Based upon the surface soil sampling results, surface contamination is conservatively assumed to exist across the entire area of each potential radionuclide emissions source. No changes to site conditions occurred during 1997 that would result in emissions different from those estimated for the 1996 NESHAP report. Modeling assumptions discussed here are therefore identical to those assumed in the 1996 LEHR facility NESHAP report.

To calculate air emissions for the 1997 LEHR facility NESHAP report, the Southwest Trenches Area is assumed to have an area of 1,915 m^2. The Ra/Sr Treatment System Area is conservatively assumed to have an area of 1,980 m^2, which includes the former Ra/Sr Treatment System Area. The area of the Western Dog Pens is assumed to be 9,500 m^2, and the area of the Eastern Dog Pens is assumed to be 3,900 m^2.

The particulate resuspension rate model used to calculate the fugitive dust emission rate is based upon the United States Environmental Protection Agency's (EPA's) guidance document entitled *Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites* (Cowherd, 1985). Cowherd provides a methodology for the rapid, worst-case assessment of inhalation exposure to respirable particulate emissions, defined as airborne particles equal to or smaller than 10 μ-meters aerodynamic diameter (PM_{10}). PM_{10} particulate emission rates from LEHR site fugitive sources were estimated using the equation developed for estimating respirable particle emissions from wind erosion of surfaces with an "unlimited reservoir" of erodible particles, adjusted for site specific data using the following formula:

$$E_{10} = 0.036 \times (1 - V) \times \left(\frac{[u]}{u_t} \right)^3 \times F(x) \qquad \text{(Eq. 1)}$$

where

E_{10} = Annual average PM_{10} emission rate per unit contaminated surface, g/(m^2-hr),

V = Fraction of contaminated surface vegetative cover (assumed zero for bare soil),

[u] = mean annual windspeed at 7 m (m/s) = $[u]_{site} \times \ln(700/ z_o)/\ln(300/ z_o)$ = 2.61 m/s,

$[u]_{site}$ = 95% UCL of LEHR site meteorological tower mean annual windspeed at 3-m (2.23 m/s),

z_o = Emission source area roughness height (2 cm),

x = 0.866 u_t / [u] = dimensionless ratio,

F(x) = function plotted in Figure 4-3 of the guidance document, (= 5.6 x 10^{-2}),

u_t = Threshold value of windspeed at 7 m (7.3 m/sec) = $u_{friction}$ / 0.4 × ln(700/ z_o); and,

$u_{friction}$ = Threshold friction velocity (50 cm/sec).

The fraction of contaminated surface vegetative cover was conservatively assumed to be zero for bare soil. The roughness height of 2 cm represents a value between the ranges for a plowed field and grasslands (Cowherd, 1985). Cowherd recommends a procedure for determining the threshold friction velocity based upon surface soil sieve analysis data. Because no surface soil sieve analysis data were available for the LEHR Site, a conservative threshold friction velocity of 50 cm/s was selected, following Cowherd's example application #1, for a rural emergency response application (Cowherd, 1985).

Cowherd (1985) recommends using the mean annual windspeed data tabulated in Table 4-1 of the particulate emission rate guidance document. However, since the tabulated values are based upon 1977 meteorological data from Sacramento, and because site specific data are available from the LEHR on-site meteorological tower, the on-site data were selected as more representative of local site conditions. The 95% UCL of the LEHR Site meteorological tower mean annual windspeed data was calculated using meteorological data collected between November 1994 and November 1995. The 95% UCL was calculated using equations for characterizing confidence limits of the mean for lognormal populations (Gilbert, 1987), as recommended by EPA Guidance (EPA, 1992a). The resulting 95% UCL of LEHR site meteorological tower mean annual windspeed is 2.23 m/s. (The 95% UCL of LEHR site meteorological tower mean annual windspeed for 1997 is 2.32 m/s). Because the on-site meteorological tower is 3-m, the windspeed must be converted to the equivalent windspeed at a height of 7-m using a variation of Cowherd's equation 4-3, which assumes a logarithmic velocity profile near the earth's surface.

The annual average PM_{10} emission rate per unit contaminated surface estimated using equation 1 and the data discussed above is 2.54×10^{-8} g/(m^2-sec). This emission rate is combined with the maximum measured surface soil activities above background for each potential radionuclide emission source to calculate a particulate emission rate based upon the following equation:

$$E_{area} = E_{10} \times A_{area} \times (60 \times 60 \times 24 \times 365 \text{ sec./yr.}) \times C_{Rad} \times (10^{-12} \text{ Ci/pCi}) \quad \text{(Eq. 2)}$$

where

E_{area} = Annual average PM_{10} emission rate for the potential radionuclide emission source, Ci/yr,

E_{10} = Annual average PM_{10} emission rate per unit contaminated surface, g/(m^2-sec),

A_{area} = Surface area of potential radionuclide emission source, m^2,

C_{Rad} = Maximum measured surface soil activities above background, pCi/g,

Equations 1 and 2 and the methodology discussed above were used to estimate the non-point source fugitive dust radionuclide emission rate for each of the four potential radionuclide emission sources, as presented in Tables 2 through 5, respectively.

3. DOSE ASSESSMENTS

3.1 Description of Dose Model

Compliance with the NESHAP requirements for diffuse, non-point source emissions was assessed using the EPA atmospheric dispersion/radiation dose calculation computer code, CAP88-PC version 1.0. CAP88-PC version 1.0 was used to calculate the EDE to individual receptors at various distances and from the four potential LEHR facility radionuclide emission sources. A total of four CAP88-PC runs were executed to model the fugitive dust emission sources described in Section 2. For each of four potential radionuclide emission sources, the maximally exposed individual (MEI) was identified in the north, south, east and west quadrants from the source.

The area source algorithm employed by CAP88-PC, version 1, assumes the distance from an area source to a receptor is measured as the distance from the centroid of the area source to the receptor (EPA, 1992b). For the LEHR facility CAP88-PC modeling, the distance from an area source to a receptor is measured as the approximate distance form the centroid of the area source to the building assumed to house the receptor. Each CAP88-PC run included receptor distances to the respective source's MEI, as well as the distances to MEIs identified for the other three potential radionuclide emission sources ("location" column for each source in Table 6). The reported EDE to an MEI at the LEHR facility includes contributions from all four potential LEHR facility radionuclide emission sources based upon the CAP88-PC model output. Based upon the combined source exposures, the MEI at the LEHR facility is located in the Medical Clinic Building (H-215) (Table 6).

The collective population dose is calculated as the average radiation dose to an individual in a specified area, multiplied by the number of individuals in that area. A total of four "population" CAP88-PC runs were executed to model the four fugitive dust emission sources. For each of four potential radionuclide emission sources, the CAP88-PC model was run with the same population data file used in the 1995 LEHR facility NESHAP report. This population file includes receptors only to a distance of 10 km, rather than 80 km as specified in DOE guidance to avoid including the large number of receptors in the Sacramento area whose exposure to radionuclides resulting from the LEHR facility would be negligible, but whose population numbers would have a large effect on the collective population dose results. This approach is appropriate for calculating the collective population dose for the primarily rural LEHR facility surroundings. The results of the CAP88-PC population runs based upon the combined source exposures are presented in Table 7.

3.2 Summary of Input Parameters

The input parameters for the CAP88-PC version 1.0 runs are summarized for the Southwest Trenches Area; the Ra/Sr Treatment Systems Area; and the Western and Eastern Dog Pen Areas in Tables 8, 9, 10, and 11, respectively. As noted above, the areal extent of each source was conservatively calculated assuming that the maximum observed radiological surface soil contamination was present across the entire potential radionuclide emission source area. Conservative radionuclide emissions were calculated using maximum soil activities measured above background for each potential area source and applying the EPA recommended particulate resuspension rate model to calculate the fugitive dust emission rates.

The Sacramento area wind file included with the CAP88-PC version 1.0 computer code was used for the modeling. This is appropriate because of the Sites' close proximity (approximately 15 miles) to Sacramento, the similar geography and the lack of intervening geographical anomalies. The same population data file as used in 1995 was used for the determination of collective dose equivalent for the 1996/1997 LEHR facility NESHAP compliance modeling. The population data file includes population data for Davis, California and for the University of California, Davis campus.

4. COMPLIANCE ASSESSMENT

Point Source Effective Dose Equivalent: None

Non-Point Source Effective Dose Equivalent: 1.8×10^{-3} mrem/yr (1.8×10^{-5} mSv/yr)

Location of Maximally Exposed Individual: Medical Clinic Building (H-215), 30 m north of the former Southwest Trenches Area

4.1 Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. (See, 18 U. S. C. 1001).

Signature: Michael D. Dresen for Date: 6/11/98
Robert Devany
LEHR Site ER/WM Project Manager

Signature: _____ Date: _____
Susan Fields
DOE-LEHR Project Manager

5. ADDITIONAL INFORMATION

For facilities that have completed construction or modification projects during the 1997 calendar year for which no application for approval to construct or modify was required for submission to EPA, provide a brief description of the construction or modification project and an estimate of potential doses to the public.

There were no construction or modification projects completed within the 1997 calendar year at the LEHR facility for which approval to construct or modify was required or waived under Section 61.96 of Subpart H of 40 CFR 61.

- **Identify any unplanned releases of radionuclides to the atmosphere.**

There were no unplanned releases of radionuclides to the atmosphere during 1997.

- **Results of the dose assessment associated with the diffuse source emissions from the facility.**

As noted in Sections 1 and 2, there are currently no point sources of radionuclide emissions at the LEHR facility. Since the only potential sources of radionuclide emissions remaining at the LEHR Site are diffuse sources of fugitive dust, the results of the dose assessment associated with the diffuse source emissions from the LEHR facility are presented in Section 3. The total contribution to the EDE [to the] MEI resulting from non-point source emissions was estimated to be 1.8×10^{-3} mrem/yr (1.8×10^{-5} mSv/yr), far below the 10 mrem/yr standard.

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7. ACKNOWLEDGEMENTS

The following personnel worked on the LEHR Facility 1997 NESHAP Report:

Name and Position	Responsibility
Michael Dresen LEHR Program Manager, WA	Senior guidance and review, and quality assurance
Robert Devany LEHR Project Manager, WA	Project management, guidance and review.
Carolyn Atwood Risk Assessment Task Leader, WA	Technical guidance and review, and quality assurance
Pleas McNeel Senior Staff Engineer, WA	Project coordination, report writing
Craig Adams Graphics, WA	Graphics
Nerissa de Jesus Administrative Assistant, WA	Word processing and report compilation

TABLES

Table 1. Summary of LEHR Site Potential Diffuse Radionuclide Sources

Potential Fugitive Source	Description
Southwest Trenches	Disposal trenches and chemical dispensing area in the southwest corner of the LEHR Site.
Radium Treatment System	Ra-226 treatment tank and the associated leach field and dry wells.
Strontium Treatment System	Sr-90 treatment tanks and associated leach system.
Dog Pens Areas	The western and eastern Dog Pens Areas.

Table 2. Summary of Maximum Surface Soil Activities of Radionuclides Exceeding Background and Their Associated PM_{10} Emission Rates, Southwest Trenches Area

Radionuclide	Maximum Activity (pCi/g)	Maximum PM_{10} Emission Rate (Ci/yr)
Americium-241	0.021	3.2E-11
Bismuth-212	0.47	7.2E-10
Bismuth-214	0.59	9.1E-10
Carbon-14	3.9	6.0E-09
Cesium-137	23	3.5E-08
Cobalt-60	0.021	3.2E-11
Lead-210	5.4	8.3E-09
Plutonium-241	0.1	1.5E-10
Radium-223	0.47	7.2E-10
Radium-226	1.16	1.8E-09
Strontium-90	20.3	3.1E-08
Thorium-234	0.94	1.4E-09
Tritium	91.1	1.4E-07
Uranium-235	0.1	1.5E-10

Table 3. Summary of Maximum Surface Soil Activities of Radionuclides Exceeding Background and Their Associated PM_{10} Emission Rates, Ra/Sr Treatment System

Radionuclide	Maximum Activity (pCi/g)	Maximum PM_{10} Emission Rate (Ci/yr)
Americium-241	0.024	3.8E-11
Bismuth-212	0.38	6.0E-10
Cesium-137	0.054	8.6E-11
Lead-210	1.4	2.2E-09
Plutonium-241	1.5	2.4E-09
Radium-223	0.04	6.3E-11
Radium-226	1.73	2.7E-09
Thorium-234	0.55	8.7E-10
Uranium-235	0.12	1.9E-10

Table 4. Summary of Maximum Surface Soil Activities of Radionuclides Exceeding Background and Their Associated PM_{10} Emission Rates, Western Dog Pens Area

Radionuclide	Maximum Activity (pCi/g)	Maximum PM_{10} Emission Rate (Ci/yr)
Bismuth-212	0.62	4.7E-09
Bismuth-214	0.84	6.4E-09
Carbon-14	11.3	8.6E-08
Cesium-137	0.159	1.2E-09
Cobalt-60	0.028	2.1E-10
Lead-210	3.3	2.5E-08
Lead-212	0.99	7.5E-09
Radium-223	0.32	2.4E-09
Radium-226	1.9	1.4E-08
Strontium-90	5.66	4.3E-08
Thallium-208	0.272	2.1E-09
Thorium-234	0.93	7.1E-09
Uranium-235	0.14	1.1E-09

Table 5. Summary of Maximum Surface Soil Activities of Radionuclides Exceeding Background and Their Associated PM_{10} Emission Rates, Eastern Dog Pens Area

Radionuclide	Maximum Activity (pCi/g)	Maximum PM_{10} Emission Rate (Ci/yr)
Bismuth-212	0.49	1.5E-09
Carbon-14	11.3	3.5E-08
Cobalt-60	0.028	8.7E-11
Radium-223	0.32	1.0E-09
Radium-226	1.04	3.2E-09
Strontium-90	3.25	1.0E-08
Thorium-234	0.88	2.7E-09
Uranium-235	0.14	4.4E-10

Table 6. Summary of On-Site Effective Dose Equivalent (EDE) to Maximally Exposed Individuals (MEIs) Resulting from Radionuclide Emissions from Each Potential Fugitive Dust Emission Source

MEI Receptor Description	Southwest Trenches Area		Ra/Sr Leach Systems Area		Western Dog Pens Area		Eastern Dog Pens Area		Maximum Total Dose
	(mrem/yr)[1]	Location[2]	(mrem/yr)[1]	Location[2]	(mrem/yr)[1]	Location[2]	(mrem/yr)[1]	Location[2]	(mrem/yr)[3]
Medical Clinic Building (H-215)	6.6E-04	30 m North	6.3E-05	50 m South	1.1E-03	40 m West	8.3E-06	130 m West	**1.8E-03**
UCD Building East of LEHR Site	2.2E-05	350 m East	2.4E-05	350 m East	6.6E-05	300 m East	1.7E-06	180 m East	1.1E-04
Offsite Receptor South of Putah Creek	2.2E-05	1000 m South	2.4E-05	1400 m South	6.2E-05	1200 m South	6.4E-07	1000 m South	1.1E-04
Offsite Receptor West of LEHR Site	2.9E-05	250 m West	2.7E-05	250 m West	7.1E-05	400 m West	1.1E-06	500 m West	1.3E-04
Animal Hospital Building No. 1 (H-219)	9.3E-05	100 m North	6.9E-04	15 m North	4.0E-04	65 m West	5.4E-06	165 m West	1.2E-03
Animal Hospital Building East of OU-2	1.1E-04	90 m North	1.6E-04	25 m East	1.1E-03	40 m West	7.2E-06	140 m West	1.4E-03
Animal Hospital Building No. 2 (H-218)	1.4E-04	75m North	4.0E-04	15 m South	4.0E-04	65 m West	5.4E-06	165 m West	9.5E-04
Cell Biology Laboratory (H-294)	4.5E-05	140 m NNE	4.5E-05	90 m NNE	4.8E-04	65 m North	6.1E-06	150 m NNE	5.8E-04

[1] The EDE to the MEI is taken as the maximum modeled dose within a 22.5° sector in the direction and at the distance indicated in the "location" column. The dose 30 m North of the Southwest Trenches Area, for example, would be the maximum modeled dose at 30 m North, 30 m NNE and 30 m NNW.

[2] The distance from an area source to a receptor is defined by CAP88-PC as distance from the centroid of the area source to the receptor (EPA, 1992b). For the LEHR facility CAP88-PC modeling the distance from an area source to a receptor is measured as the approximate distance from the centroid of area source to the building assumed to house the receptor.

[3] The Maximum Total Dose is the sum of EDEs modeled for each MEI receptor from the four potential radionuclide fugitive dust sources. Value in boldface is the Maximum Total Dose for the Site-wide MEI.

Table 7. Summary of Estimated Collective Population Dose Resulting from Radionuclide Emissions from Each Fugitive Dust Emission Source

Potential Emission Source	Maximally Exposed Individual (mrem/yr)	Location	Collective Population Dose (person-rem/yr)
Southwest Trenches Area	1.20E-05	250 m North	4.01E-05
Ra/Sr Leach Systems Area	4.56E-06	250 m North	1.50E-05
Western Dog Pens Area	3.66E-05	250 m North	1.21E-04
Eastern Dog Pens Area	3.25E-06	250 m North	1.06E-05
Total LEHR Site	**5.64E-05**		**1.87E-04**

Table 8. LEHR Facility NESHAP - CAP88-PC Inputs: Southwest Trenches Area

Run type (Dataset ID: OU1RECEP.SCR)	Individual	Receptor distances (m): 30, 75, 90, 100, 140, 250, 350, 1000	
Run type (Dataset ID: OU1POP.SCR)	Population	Population file to use: DAV-LEHR.POP	
Modeling Options	Generate genetic effects?		Yes
	Create Dose and Risk Factor file?		Yes
	Create Concentration Table file?		Yes
	Create Chi/Q Table file?		Yes

Meteorological Data	
Windfile to use:	SAC0320.WND (CAP88-PC supplied wind file)
Annual precipitation (cm/yr):	46 (1993-1996 Average)
Annual ambient temperature (deg. C):	16 (1995 on-site meteorological station average)
Height of lid (m):	1,000 (CAP88-PC default)
Source Data	
Source type:	AREA
Number of source:	1
Height (m):	0
Area (m^2):	1,915
Plume rise:	Zero (Plume rise is zero for each Pasquill stability category.)

Agricultural Data — Source: Rural (CAP88-PC defaults)

	Vegetable	Milk	Beef
Fraction home produced:	0.7	0.399	0.442
Fraction from assessment area:	0.3	0.601	0.558
Fraction imported:	0	0	0

Beef cattle density (#/km^2):	8.81E-02 (CAP88-PC default)
Milk cattle density (#/km^2):	2.85E-02 (CAP88-PC default)
Land fraction cultivated for vegetable crops:	0.25 (Site specific parameter per 1995 NESHAP)

Radionuclide Release Data

PM_{10} Emission Rate (g/m^2-sec): 2.54E-08 (Using Cowherd, 1985, unlimited erosion potential.)

Nuclide ID	Max. Soil (pCi/g)	Emis. Rate (Ci/yr)	Size[1] (μm)	Class[1]
Am-241	0.021	3.2E-11	1	W
Bi-212	0.47	7.2E-10	1	W
Bi-214	0.59	9.1E-10	1	W
C-14	3.9	6.0E-09	0	*
Cs-137	23	3.5E-08	1	D
Co-60	0.021	3.2E-11	1	Y
Pb-210	5.4	8.3E-09	1	D
Pu-241	0.1	1.5E-10	1	Y
Ra-223	0.47	7.2E-10	1	W
Ra-226	1.16	1.8E-09	1	W
Sr-90	20.3	3.1E-08	1	D
Th-234	0.94	1.4E-09	1	Y
H-3	91.1	1.4E-07	0	*
U-235	0.1	1.5E-10	1	Y

[1] CAP88-PC default particle size and lung retention class.

Table 9. LEHR Facility NESHAP - CAP88-PC Inputs: Ra/Sr Treatment System

Run type (Dataset ID:OU2RECEP.SCR)	Individual	Receptor distances (m): 15, 25, 50, 90, 250, 350, 1400	
Run type (Dataset ID: OU2POP.SCR)	Population	Population file to use: DAV-LEHR.POP	
Modeling Options	Generate genetic effects?		Yes
	Create Dose and Risk Factor file?		Yes
	Create Concentration Table file?		Yes
	Create Chi/Q Table file?		Yes

Meteorological Data	
Windfile to use:	SAC0320.WND (CAP88-PC supplied wind file)
Annual precipitation (cm/yr):	46 (1993-1996 Average)
Annual ambient temperature (deg. C):	16 (1995 on-site meteorological station average)
Height of lid (m):	1,000 (CAP88-PC default)
Source Data	
Source type:	AREA
Number of source:	1
Height (m):	0
Area (m^2):	1,980
Plume rise:	Zero (Plume rise is zero for each Pasquill stability category.)

Agricultural Data — Source: Rural (CAP88-PC defaults)

	Vegetable	Milk	Beef
Fraction home produced:	0.7	0.399	0.442
Fraction from assessment area:	0.3	0.601	0.558
Fraction imported:	0	0	0

Beef cattle density (#/km^2):	8.81E-02 (CAP88-PC default)
Milk cattle density (#/km^2):	2.85E-02 (CAP88-PC default)
Land fraction cultivated for vegetable crops:	0.25 (Site specific parameter per 1995 NESHAP)

Radionuclide Release Data

PM_{10} Emission rate (g/m^2-sec): 2.54E-08 (Using Cowherd, 1985, unlimited erosion potential.)

Nuclide ID	Max. Soil (pCi/g)	Emis. Rate (Ci/yr)	Size[1] (µm)
Am-241	0.024	3.8E-11	1
Bi-212	0.38	6.0E-10	1
Cs-137	0.054	8.6E-11	1
Pb-210	1.4	2.2E-09	1
Pu-241	1.5	2.4E-09	1
Ra-223	0.04	6.3E-11	1
Ra-226	1.73	2.7E-09	1
Th-234	0.55	8.7E-10	1
U-235	0.12	1.9E-10	1

[1] CAP88-PC default particle size and lung retention class.

Table 10. LEHR Facility NESHAP - CAP88-PC Inputs: Western Dog Pens

Run type (Dataset ID: OU3aRECP.SCR)	Individual	Receptor distances (m): 40, 65, 300, 400, 1200	
Run type (Dataset ID: OU3aPOP.SCR)	Population	Population file to use: DAV-LEHR.POP	
Modeling Options	Generate genetic effects?		Yes
	Create Dose and Risk Factor file?		Yes
	Create Concentration Table file?		Yes
	Create Chi/Q Table file?		Yes

Meteorological Data	
Windfile to use:	SAC0320.WND (CAP88-PC supplied wind file)
Annual precipitation (cm/yr):	46 (1993-1996 Average)
Annual ambient temperature (deg. C):	16 (1995 on-site meteorological station average)
Height of lid (m):	1,000 (CAP88-PC default)
Source Data	
Source type:	AREA
Number of source:	1
Height (m):	0
Area (m^2):	9,500
Plume rise:	Zero (Plume rise is zero for each Pasquill stability category.)

Agricultural Data — Source: Rural (CAP88-PC defaults)

	Vegetable	Milk	Beef
Fraction home produced:	0.7	0.399	0.442
Fraction from assessment area:	0.3	0.601	0.558
Fraction imported:	0	0	0

Beef cattle density (#/km^2):	8.81E-02 (CAP88-PC default)
Milk cattle density (#/km^2):	2.85E-02 (CAP88-PC default)
Land fraction cultivated for vegetable crops:	0.25 (Site specific parameter per 1995 NESHAP)

Radionuclide Release Data

PM_{10} Emission rate (g/m^2-sec): 2.54E-08(Using Cowherd, 1985, unlimited erosion potential.)

Nuclide ID	Max. Soil (pCi/g)	Emis. Rate (Ci/yr)	Size[1] (μm)	Class[1]
Bi-212	0.62	4.7E-09	1	W
Bi-214	0.84	6.4E-09	1	W
C-14	11.3	8.6E-08	0	*
Cs-137	0.159	1.2E-09	1	D
Co-60	0.028	2.1E-10	1	Y
Pb-210	3.3	2.5E-08	1	D
Pb-212	0.99	7.5E-09	1	D
Ra-223	0.32	2.4E-09	1	W
Ra-226	1.9	1.4E-08	1	W
Sr-90	5.66	4.3E-08	1	D
Tl-208	0.272	2.1E-09	1	D
Th-234	0.93	7.1E-09	1	Y
U-235	0.14	1.1E-09	1	Y

[1] CAP88-PC default particle size and lung retention class.

Table 11. LEHR Facility NESHAP - CAP88-PC Inputs: Eastern Dog Pens

Run type (Dataset ID: OU3bRECP.SCR)	Individual	Receptor distances (m): 130, 140, 150, 165, 180, 500, 1000	
Run type (Dataset ID: OU3bPOP.SCR)	Population	Population file to use: DAV-LEHR.POP	
Modeling Options	Generate genetic effects?		Yes
	Create Dose and Risk Factor file?		Yes
	Create Concentration Table file?		Yes
	Create Chi/Q Table file?		Yes

Meteorological Data	
Windfile to use:	SAC0320.WND (CAP88-PC supplied wind file)
Annual precipitation (cm/yr):	46 (1993-1996 Average)
Annual ambient temperature (deg. C):	16 (1995 on-site meteorological station average)
Height of lid (m):	1,000 (CAP88-PC default)
Source Data	
Source type:	AREA
Number of source:	1
Height (m):	0
Area (m^2):	3,900
Plume rise:	Zero (Plume rise is zero for each Pasquill stability category.)

Agricultural Data — Source: Rural (CAP88-PC defaults)

	Vegetable	Milk	Beef
Fraction home produced:	0.7	0.399	0.442
Fraction from assessment area:	0.3	0.601	0.558
Fraction imported:	0	0	0

Beef cattle density (#/km^2):	8.81E-02 (CAP88-PC default)
Milk cattle density (#/km^2):	2.85E-02 (CAP88-PC default)
Land fraction cultivated for vegetable crops:	0.25 (Site specific parameter per 1995 NESHAP)

Radionuclide Release Data

PM_{10} Emission Rate (g/m^2-sec): 2.54E-08 (Using Cowherd, 1985, unlimited erosion potential.)

Nuclide ID	Max. Soil (pCi/g)	Emis. Rate (Ci/yr)	Size[1] (μm)	Class[1]
Bi-212	0.49	1.5E-09	1	W
C-14	11.3	3.5E-08	0	*
Co-60	0.028	8.7E-11	1	Y
Ra-223	0.32	1.0E-09	1	W
Ra-226	1.04	3.2E-09	1	W
Sr-90	3.25	1.0E-08	1	D
Th-234	0.88	2.7E-09	1	Y
U-235	0.14	4.4E-10	1	Y

[1] CAP88-PC default particle size and lung retention class.

FIGURES

ATTACHMENT 1

DOE SUPPLEMENTAL INFORMATION

ATTACHMENT 1

DOE SUPPLEMENTAL INFORMATION

- **Provide an estimate of collective dose equivalent for 1997 releases.**

  – The collective population dose for calendar year 1997 emissions to the population within an 80-km distance of the facility is estimated to be 1.87×10^{-4} person-rem/yr.

- **Provide information on the status of compliance with Subparts Q and T of 40 CFR Part 61.**

  – LEHR is in compliance with Subparts Q and T of 40 CFR part 61, based on a radon study conducted at the LEHR facility by DOE (DOE, 1990).

- **Provide information on radon-220 emissions from sources containing uranium-232 and thorium-232 where emissions potentially can exceed 0.1 mrem/yr to the public or 10% of the nonradon dose to the public.**

  – There are no unencapsulated uranium-232 or thorium-232 sources stored at the facility. The emissions from radon-220 from encapsulated sources would not result in a dose to a member of the public in excess of 0.1 mrem/yr or exceed 10% of the nonradon dose to the public from the Site.

- **Provide information on radon-222 emissions from nondisposal/nonstorage sources where emissions potentially can exceed 0.1 mrem/yr to the public or 10% of the nonradon dose to the public.**

  – There are no nondisposal or nonstorage sources of radon-222 located at the facility.

- **Give the number of emission points subject to the continuous monitoring requirements of Section 61.93(b) of 40 CFR, the number of these emission points that do not comply with Section 61.93(b) requirements, and the cost of upgrades. Describe site periodic confirmatory measurement plans. Indicate the status of the QA program described by Appendix B, Method 114.**

  – There are no point source emissions that require continuous monitoring according to Subpart H of 40 CFR.