



U.S. Department of Energy
Office of Legacy Management

**RADIONUCLIDE AIR EMISSION ANNUAL REPORT
CALENDAR YEAR 2005**

for the

**LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH
UNIVERSITY OF CALIFORNIA, DAVIS**

prepared for:

SM Stoller Corporation
2597 B ³/₄ Road
Grand Junction, Colorado 81503

prepared by:

Weiss Associates
5801 Christie Avenue, Suite 600
Emeryville, California 94608-1827

June 20, 2006
Rev. 0

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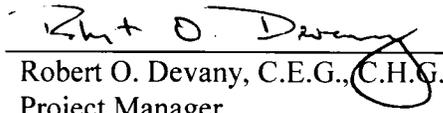


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ACRONYMS AND ABBREVIATIONS

°C	degree(s) Celsius
Ac-228	actinium-228
Bi-212	bismuth-212
Bi-214	bismuth-214
CAP88-PC	atmospheric dispersion/radiation dose calculation computer code (US EPA)
C-14	carbon-14
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
Ci/yr	curies per year
cm	centimeter(s)
cm/s	centimeter(s) per second
cm/yr	centimeter(s) per year
Co-60	cobalt-60
Cs-137	cesium-137
DOE	United States Department of Energy
E	east
EDE	effective dose equivalent
EDPs	Eastern Dog Pens
Eq.	equation
g/m ² -hr	gram(s) per square meter-hour(s)
H-3	tritium
K-40	potassium-40

km	kilometer(s)
km ²	square kilometer(s)
LEHR	Laboratory for Energy-Related Health Research
m	meter(s)
m/s	meter(s) per second
m ²	square meter(s)
Max.	maximum
MEI	maximally exposed individual
mrem/yr	millirem(s) per year
mSv/yr	millisievert(s) per year
N	north
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NNE	north-northwest
No.	number
NW	northwest
Pb-210	lead-210
Pb-212	lead-212
Pb-214	lead-214
pCi/g	picocurie(s) per gram
person-rem/yr	person – roentgen(s) equivalent man per year
PM ₁₀	particulate matter with an aerodynamic diameter less than or equal to 10 micrometers
RA	removal action
Ra-226	radium-226

S	south
Sr-90	strontium-90
Th-228	thorium-228
Th-232	thorium-232
Th-234	thorium-234
Tl-208	thallium-208
U-235	uranium-235
U-238	uranium-238
UC Davis	University of California, Davis
UCL	upper confidence limit
US EPA	United States Environmental Protection Agency
W	west
WDPs	Western Dog Pens
µm	micrometer(s)

US Department of Energy
Radionuclide Air Emission Annual Report
(Subpart H of 40 CFR 61)
Calendar Year 2005

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

Field Office Information¹

Office: U.S. Department of Energy
Office of Legacy Management

Address: 3610 Collins Ferry Road
Morgantown, WV 26507

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Site Information

Operator: Weiss Associates

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Senior Project Manager
Weiss Associates

¹ Oversight of LEHR was transferred from the DOE Oakland Environmental Programs Office to the DOE Office of Legacy Management on October 1, 2005.

1. FACILITY INFORMATION

This Radionuclide Air Emission Annual Report documents that, in 2005, the United States Department of Energy (DOE) facilities at the Laboratory for Energy-Related Health Research (LEHR) complied with the requirements of Title 40 Code of Federal Regulations (CFR) Part 61 Subpart H - National Emissions Standards for Hazardous Air Pollutants (NESHAPs) for Emissions of Radionuclides. The NESHAPs regulations require that radionuclide emissions not exceed levels that would result in an effective dose equivalent (EDE) of 10 millirems per year (mrem/yr).

LEHR is located on the campus of the University of California, Davis (UC Davis). This report, however, applies to only the DOE areas at LEHR. The DOE areas will be referred to as “the Site,” whereas the entire 15-acre property where both DOE and UC Davis conduct activities will be referred to as “LEHR.” There are currently no point sources of radionuclide emissions at the Site, but there are potential diffuse sources (i.e., surface soil) of radionuclide emissions. These emissions were modeled using the United States Environmental Protection Agency (US EPA) atmospheric dispersion/radiation dose calculation computer code, CAP88-PC, Version 1.0. Based on the results from this model, the total contribution to the maximum EDE from diffuse-source emissions for reporting year 2005 is estimated to be 5.9×10^{-4} mrem/yr (about 0.006% of the 10 mrem/yr standard). This result is similar to the results of the previous six years (Table 1).

1.1 Site Description

The LEHR facility is located in Solano County, California, in the southeast quadrant 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 about 15 acres on the southeast portion of the UC Davis campus. The LEHR facility is bounded by UC Davis research facilities, private farmland, and the South Fork of Putah Creek. The southern boundary of the LEHR facility is the northern levee of the South Fork of Putah Creek (Figure 2).

The local climate is Mediterranean with mild winters and dry summers. Precipitation and temperature data specific to 2005 were obtained from the Davis WSW weather station located approximately one mile northwest of the LEHR facility (Western Regional Climate Center, 2006). The average temperature for 2005 was approximately 16.5 degrees Celsius (°C) (61.7 degrees Fahrenheit), and the total precipitation for 2005 was approximately 22.2 inches (56.5 cm). These values are based on the reported monthly average temperatures and precipitation totals. For those months in which these values were not available, the average long-term (1917 through 2003) values were substituted. Specifically, the values that were not available were the average temperatures of January and August, and the total precipitation in January. The sun shines approximately 95% of the

time during daylight hours in the summer and about 45% of the time during daylight hours in the winter.

The prevailing wind direction is from the south, due to frequent incursions of marine air through the Carquinez Strait into the Sacramento Valley. Changes in wind direction, however, 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, 1994a). The average wind speed for 2005 was calculated from hourly wind measurements recorded at the Sacramento Executive Airport (NCDC, 2006). The 95% upper confidence limit (UCL) of the mean hourly wind speed was 2.6 meters per second (m/s) (5.8 miles per hour).

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

The LEHR facility contains laboratory buildings and former animal-handling facilities (Figure 2). Approximately 45% of the Site is paved or covered by structures. Approximately 45% is unpaved and relatively free of vegetation, and 5% is covered by large, deep-rooted vegetation. Former outdoor dog pens consisting of asphalt, concrete, gravel and soil occupy the remaining 5% of the Site. The Regents of the University of California own the land and the buildings on the Site.

In the early 1950s, the Atomic Energy Commission (now DOE) began conducting radiological studies at UC Davis on laboratory animals, particularly beagles. Initial studies were carried out on the main campus, north of LEHR, and involved irradiation of beagles. DOE began operating at LEHR in 1958 when full-scale experimental use of radioactive materials began. Research at the Site 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 irradiator facility was constructed at the Site to study the effects of chronic exposure to gamma rays on bone-marrow cells of beagles. In 1975, 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 was established at the Site. In 1989, DOE-funded research ended at LEHR. The LEHR facility is presently occupied by the UC Davis Center for Health and the Environment. UC Davis radionuclide emissions are not included in this report.

1.2 Source Description

Applicable sources of radionuclide air emissions at LEHR, along with lists of the radioactive materials at the facility, are discussed below.

1.2.1 Point Sources

No potential point sources of radionuclide emissions existed at the Site in 2005.

1.2.2 Diffuse Sources

Diffuse radionuclide emission sources in 2005 were wind-eroded dust from the Western Dog Pens (WDPs) and Eastern Dog Pens (EDPs) areas (Figure 2, Table 2). These are “fugitive” emissions, by definition, because they were not released through an actively ventilated air stream (US EPA, 2004). No ground-disturbing or development activities have been conducted in these two areas since 2002. Therefore, the emissions are expected to be similar to emissions from previous years; the only factors controlling emissions that are different from previous years are meteorological conditions. No other activities were conducted at the Site in 2005 that would have generated radionuclide air emissions.

1.2.3 Western and Eastern Dog Pens Areas

The WDPs and EDPs areas, located near the center of the LEHR facility (Figure 2), are the two potential diffuse sources of radiological emissions from fugitive dust. Historically, these areas contained outdoor pens that were used to house dogs involved in the former Ra-226 and Sr-90 research activities at the Site. The pens were constructed of concrete curbs and chain-link fencing. The floor of each pen was partly covered by asphalt and partly covered by gravel. In the areas covered by gravel, there was no impermeable barrier between the gravel and the underlying soil. Each pen included above-grade structures, which have been removed.

The WDPs area originally contained 320 pens. In 1975, 64 of these pens were removed to construct the Cellular Biology Laboratory (Building H-294, Figure 2). In 1996, the above-grade structures and interior chain-link fencing from the remaining 256 pens were removed, properly packaged and shipped to the DOE Hanford site for disposal. In 2001, the remaining materials from the 256 pens were removed during the WDPs removal action (RA) conducted under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (WA, 2002b). The material, which was removed by an excavator, included concrete curbing, gravel, metal grating, fence posts and asphalt. The material was transported to a temporary on-site stockpile, and removed entirely from the Site in 2003 and 2004. Following the 2001 WDPs CERCLA RA, the southern portion of the WDPs was backfilled to grade with clean imported fill. The portion of the WDPs that is a potential source of airborne radionuclide emissions is between the clean imported fill (in the south) and the Cellular Biology Laboratory (in the north). In this central area, the soil that was originally underneath the dog pens is exposed.

The EDPs area, which overlies UC Davis Landfill Number (No.) 2, contained 96 pens. In 1996, the above-grade structures and interior chain-link fencing were removed, as they were at the WDPs, and properly packaged and shipped to the DOE Hanford site for disposal. In 1999, the

interior chain-link fencing was released according to DOE Order 5400.5 and recycled (EMS, 1999). Currently, the EDPs area is covered by the concrete curbing, asphalt and gravel. The EDPs area is a potential source of airborne radionuclide emissions, because soil is exposed in some of the pens and in areas where asphalt is degraded and broken.

Low levels of Sr-90 and Ra-226 are known to have been released at the WDPs and EDPs in excreta from the dogs, and these radionuclides are now potentially contained in soil and fugitive-dust emissions associated with these areas. For this report, it has been conservatively assumed that all radionuclides detected at the WDPs and EDPs soil in concentrations greater than background are contained in fugitive-dust emissions (The term "concentration," where applied to radionuclides, refers to the radioactive activity measured in a unit mass of soil, in units of picocuries per gram [pCi/g]). Furthermore, the concentrations of radionuclides in the soil are conservatively assumed to be the concentrations in the samples that contained the highest detected concentrations in soil at each area. Although part of the total concentrations can be attributed to background, background concentrations were not subtracted to correct for this. This ultimately results in a conservative estimate of the radionuclide air emissions at LEHR. The concentrations of radionuclides in soil at the WDPs area are based on samples collected from the upper two feet of soil (Table 3). The emissions are assumed to be generated only from the central portion of the WDPs (Figure 2), because the southern portion of the WDPs area was covered with clean imported fill and the northern pens were removed in 1975 to construct the Cellular Biology Building. The concentrations of radionuclides in soil at the EDPs area are based on soil samples collected during the 1999 EDPs investigation (WA, 1999), which is the only CERCLA investigation in this area (Table 4).

2. AIR EMISSION DATA

2.1 Point Sources

As discussed in Section 1, there were no point sources of radionuclide emissions at the Site in 2005.

2.2 Diffuse Sources

As discussed in Section 1, there were two diffuse sources of radionuclide emissions present at the Site in 2005, the WDPs and EDPs. These areas are discussed in detail in Section 1. According to the US EPA, these two areas are classified as “unlimited open areas,” because the reservoir of erodible particles at each area will not appreciably decrease with time (US EPA, 2004). To estimate the emissions of radionuclides from such potential sources, the first step is to calculate the general emission rate for respirable particles based on meteorological and soil conditions at the Site (Equation [Eq.] 1). Respirable particles are defined as airborne particles equal to or smaller than 10 micrometers (PM₁₀). Secondly, to determine the specific emission rate for each radionuclide, the general emission rate is multiplied by the area over which the radionuclide-bearing soil is exposed, the time during which the soil is exposed and the concentration of the radionuclide in the soil (Eq. 2).

The general emission rate for respirable particles is conservatively estimated by the particulate-resuspension rate model to calculate the fugitive dust emission rate based on the US EPA’s guidance document *Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites* (Cowherd et al., 1985):

$$E_{10} = 0.036 \times (1 - V) \times \left(\frac{[u]_{7m}}{u_t} \right)^3 \times F(x) \quad (\text{Eq. 1})$$

where,

- E_{10} = annual average PM₁₀ emission rate per unit contaminated surface, grams per square meter-hour [g/(m²-hr)];
- V = fraction of contaminated surface vegetative cover (assumed zero for worst-case bare soil);
- $[u]_{7m}$ = calculated 95% UCL of the mean hourly wind speed at 7 meters (m) height (= $[u]_{10m} \times \ln(700/z_o)/\ln(1000/z_o) = 2.5$ m/s);

- $[u]_{10m}$ = 95% UCL of the mean hourly wind speed at Sacramento Executive Airport at a height of ten meters (= 2.6 m/s);
- z_o = emission source-area roughness height (= 2 centimeters [cm]);
- u_t = threshold value of wind speed at 7 meters height = $u_{friction} / 0.4 \times \ln(700/z_o) = 7.3$ m/s;
- $u_{friction}$ = threshold friction velocity (= 50 cm per second [cm/s]);
- x = $0.866 u_t / [u]_{7m}$ = dimensionless ratio (= 2.58); and
- $F(x)$ = function plotted in Figure 4-3 (= 3.9×10^{-2}) of Cowherd et al., 1985.

The fraction of contaminated surface vegetative cover was conservatively assumed to be zero (i.e., bare soil) to calculate a worst-case value. The two-cm roughness height represents a value between the ranges for a plowed field and grasslands (Cowherd et al., 1985). Cowherd et al. recommend 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 Site, a conservative threshold friction velocity of 50 cm/s was selected, following the example in Cowherd et al. (1985), for a rural emergency response application (Application No. 1).

Cowherd et al. recommend using the mean annual wind speed data tabulated in Table 4-1 of the particulate emission rate guidance document (Cowherd et al., 1985). During previous years (through 2002), site-specific data from the LEHR meteorological station were used to calculate the mean annual wind speed. The meteorological station was taken off line in mid-2003. Therefore, the 2005 hourly wind speed data from the Sacramento Executive Airport meteorological station were used to calculate the 95% UCL of the mean.

The 95% UCL of the mean wind speed was calculated using equations for characterizing confidence limits of the mean for nonparametric populations (Gilbert, 1987, Eq. 11.13). The resulting 95% UCL of the mean hourly wind speed for 2005 was 2.6 m/s. Because the height of the Sacramento Executive Airport meteorological tower is 10 m (NCDC, 2005), this wind speed must be converted to the equivalent wind speed at a height of seven meters using a variation of the equation in Cowherd et al. (1985) (see parameter $[u]_{7m}$ above), which assumes a logarithmic velocity profile near the earth's surface.

The result of Eq. 1 and the site-specific and 2005-specific data is 7.63×10^{-5} g/m²-hr. This emission rate is multiplied by the area over which the radionuclide-bearing soil is exposed, the time during which the soil is exposed, and the concentration of the radionuclide in the soil, to determine the specific emission rate for each radionuclide:

$$E_{area} = E_{10} \times A_{area} \times (24\text{-hr/day} \times 365 \text{ days/yr}) \times C_{Rad} \times (10^{-12} \text{ curies per picocurie}) \quad (\text{Eq. 2})$$

where,

- E_{area} = annual average PM₁₀ emission rate for the potential radionuclide-emission diffuse source, curies per year (Ci/yr);
- E_{10} = annual average PM₁₀ emission rate per unit contaminated surface, g/(m²-hr);
- A_{area} = surface area of potential radionuclide-emission diffuse source, m²; and

C_{Rad} = maximum value of the measured surface-soil radionuclide concentrations, pCi/g.

The surface area of each source area (Table 2) was determined using a scaled map of the Site (Figure 2). The highest measured (non-decay-corrected) concentrations are conservatively assumed to be uniformly distributed across each area. The concentration in the fugitive dust is assumed to be equal to the concentration measured in soil. The results of Eq. 2 for each of the two source areas are presented in Tables 3 and 4.

2.3 Particulate Matter-10

No excavation or other ground-disturbing activities were conducted at the DOE areas during calendar year 2005. Therefore, the site air-monitoring stations were not in operation and no PM₁₀ data were collected.

3. DOSE ASSESSMENTS

3.1 Description of Dose Model

Compliance with the NESHAPs requirements for diffuse-source emissions was assessed using the US EPA atmospheric dispersion/radiation dose calculation computer code, CAP88-PC, Version 1.0. This code was used to calculate the EDE to individual receptors at various distances from the WDPs and EDPs, which are the two potential site radionuclide-emission diffuse sources. A total of two "individual receptor" CAP88-PC runs, one for each source area, were executed to model the fugitive-dust emission sources described in Section 2. For each of the two potential radionuclide-emission sources, a human receptor was identified in each of the north, south, east and west quadrants relative to the potential source.

The area-source algorithm employed by CAP88-PC, Version 1.0, 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 (US EPA, 1992). For the site CAP88-PC modeling, the distance from an area source to a receptor is measured as the approximate distance from 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 maximally exposed individual (MEI), as well as the distances to MEIs identified for the other potential radionuclide-emission sources ("Location" column for each source in Table 5).

The reported EDE to an MEI at the LEHR facility includes contributions from the two potential site radionuclide-emission diffuse sources based on the CAP88-PC model output. Based on the combined diffuse-source exposures, the MEI at the LEHR facility is located in the Specimen Storage Building (Building H-216) (Figure 2, Table 5).

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. Two "population" CAP88-PC runs, one for each source area, were executed to model the two fugitive dust emission diffuse sources. The CAP88-PC model output for each run is included in Appendix A. For each of the two potential radionuclide-emission diffuse sources, the CAP88-PC model was run with an updated population data file calculated from the United States Census Bureau 2005 population estimates for counties (US Census Bureau, 2006).

The population file includes receptors within a distance of 80 kilometers (km) from the Site, as specified by DOE guidance. Using geographical information system software, the area within 80 km of the Site was split into 128 sectors by dividing the area into eight 10-km-wide rings and sixteen compass directions. The population of each sector was calculated from the population density of the

county or counties occupied by that sector. The populations of the counties were obtained from the 2005 Annual Population Estimates Program of the United States Census Bureau (US Census Bureau, 2006). The results of the CAP88-PC population runs based upon the combined source exposures are presented in Table 6 and Appendix A.

Supplemental information required by DOE (DOE, 1994b) is included in Section 6.

3.2 Summary of Input Parameters

The input parameters for the CAP88-PC runs are summarized for the WDPs and EDPs areas in Tables 7 and 8, respectively. As noted above, the areal extent of each diffuse source was conservatively calculated assuming that the maximum concentrations (not corrected for background) of the observed radiological surface- and shallow-soil contamination for the WDPs and EDPs areas were present across the entire potential radionuclide emission diffuse source area. Conservative estimates of radionuclide emissions were calculated using the maximum of the soil radionuclide concentrations measured for each potential area source and applying the US EPA-recommended particulate-resuspension rate model to calculate the fugitive dust emission rates.

The Sacramento area wind file included with the CAP88-PC computer code was used for the modeling. The hourly wind speeds recorded at Sacramento Executive Airport were used to calculate particle-emission rates. Use of the Sacramento wind data is appropriate because of the Site's proximity (approximately 15 miles) to Sacramento, the similar geography of the two areas, the lack of intervening geographical anomalies, and the absence of a compatible meteorological data file from a closer air station.

4. COMPLIANCE ASSESSMENT

Point-Source Effective Dose Equivalent: None

Diffuse-Source Maximum Effective Dose Equivalent: 5.9×10^{-4} millirem per year [mrem/yr]
 $(5.9 \times 10^{-6}$ millisieverts [mSv] per yr) (about
0.006% of the 10 mrem/yr standard).

Location of On-Site Maximally Exposed Individual: Specimen Storage Building
(Building H-216), 48m west of the WDPs

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: Robert D. Devany Date: 6-20-06
Robert Devany
LEHR Program Manager

Signature: Vijendra Kothari Date: 6/20/06
Vijendra Kothari
DOE-LEHR Project Manager

5. ADDITIONAL INFORMATION

In 2005, no construction or modifications were completed at the LEHR facility.

As required in the memorandum of understanding for facilities that were exempt from having to submit an application to the US EPA for construction or modifications, the following information is provided for the Site:

- **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 at the LEHR Site in 2005.

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

There were no unplanned releases of radionuclides to the atmosphere during 2005.

- **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 Site. The only potential sources of radionuclide emissions remaining at the Site are diffuse sources of fugitive dust. The results of the dose assessment associated with the diffuse source emissions from the Site are presented in Section 3 and Table 5. The total EDE to the on-site MEI resulting from diffuse-source emissions was estimated to be 5.9×10^{-4} mrem/yr (5.9×10^{-6} mSv/yr), far below the 10 mrem/yr standard.

6. SUPPLEMENTAL DOE INFORMATION

- **Provide an estimate of collective dose equivalent for 2005 releases.**
 - The collective population dose for calendar year 2005 emissions to the population within an 80-km distance of the facility is estimated to be 1.8×10^{-5} 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 non-radon 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 non-radon dose to the public from the Site.
- **Provide information on radon-222 emissions from non-disposal/non-storage sources where emissions potentially can exceed 0.1 mrem/yr to the public or 10% of the non-radon dose to the public.**
 - There are no non-disposal or non-storage 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 quality assurance program described by Appendix B, Method 114.**
 - There are no point-source emissions that require continuous monitoring according to Subpart H of 40 CFR.

7. REFERENCES

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TABLES

Table 1. Results of National Emissions Standards for Hazardous Air Pollutants Reports for the Past Six Years

Calendar Year	Effective Dose Equivalent to Maximally Exposed Individual (mrem/yr)	Reference
1999	1.35×10^{-3}	WA, 2000
2000	7.52×10^{-4}	WA, 2001
2001	1.0×10^{-3}	WA, 2002a
2002	3.8×10^{-4}	WA, 2003
2003	1.4×10^{-3}	WA, 2004
2004	1.6×10^{-3}	WA, 2005
2005	5.9×10^{-4}	This document

Abbreviation

mrem/yr millirem(s) per year

Table 2. Summary of Potential Diffuse-Area Radionuclide Sources

Potential Source	Description	Surface Area (m ²)
Western Dog Pens Area	Former outdoor dog pens with potential radioactive surface releases.	5,263
Eastern Dog Pens Area	Former outdoor dog pens with potential radioactive surface releases.	3,900

Abbreviation

m² square meters

Table 3. Maximum Surface-Soil Concentrations for Radionuclides Exceeding Background and PM₁₀ Emission Rates, LEHR Western Dog Pens Area

Radionuclide	Maximum Concentration ¹ (pCi/g)	Maximum PM ₁₀ Emission Rate (Ci/yr)
Actinium-228	0.719	1.76E-09
Bismuth-212	0.628	1.54E-09
Bismuth-214	1.09	2.67E-09
Carbon-14	11.3	2.77E-08
Cesium-137	0.115	2.82E-10
Cobalt-60	0.028	6.87E-11
Lead-210	4.96	1.22E-08
Lead-212	0.744	1.82E-09
Lead-214	1.41	3.46E-09
Potassium-40	14.3	3.51E-08
Radium-226	1.9	4.66E-09
Strontium-90	0.675	1.66E-09
Thallium-208	0.272	6.67E-10
Thorium-234	1.62	3.97E-09
Uranium-235	0.232	5.69E-10
Uranium-238	1.62	3.97E-09

Note

¹Not corrected for background or decay.

Abbreviations

Ci/yr curies per year
 pCi/g picocuries per gram
 PM₁₀ particulate matter with an aerodynamic diameter less than or equal to 10 micrometers

Table 4. Maximum Surface-Soil Concentrations for Radionuclides Exceeding Background and PM₁₀ Emission Rates, LEHR Eastern Dog Pens Area

Radionuclide	Maximum Concentration ¹ (pCi/g)	Maximum PM ₁₀ Emission Rate (Ci/yr)
Bismuth-212	0.415	7.54E-10
Bismuth-214	0.572	1.04E-09
Cesium-137	0.191	3.47E-10
Lead-214	0.607	1.10E-09
Strontium-90	0.164	2.98E-10
Thallium-208	0.219	3.98E-10
Thorium-228	1.54	2.80E-09
Thorium-232	1.26	2.29E-09
Thorium-234	0.89	1.62E-09
Tritium	1.21	2.20E-09
Uranium-235	0.383	6.96E-11

Note

¹Not corrected for background or decay.

Abbreviations

Ci/yr curies per year
pCi/g picocuries per gram
PM₁₀ particulate matter with an aerodynamic diameter less than or equal to 10 micrometers

Table 5. On-Site Effective Dose Equivalent to Maximally Exposed Individual Resulting from Radionuclide Emissions from Each Potential Fugitive-Dust-Emission Diffuse Source

Receptor Location	Western Dog Pens Area		Eastern Dog Pens Area		Total Dose to MEI (mrem/yr) ³
	(mrem/yr) ¹	Location ²	(mrem/yr) ¹	Location ²	
Specimen Storage Building (Building H-216)	5.1E-04	48 m W	7.9E-05	132 m W	5.9E-04
UC Davis Building E of LEHR Site	2.8E-05	300 m E	1.2E-05	180 m E	4.0E-05
Off-Site Receptor S of Putah Creek	2.5E-05	1,200 m S	1.2E-06	1,000 m S	2.6E-05
Off-Site Receptor W of LEHR Site	3.2E-05	400 m W	5.9E-05	500 m W	9.1E-05
Animal Hospital Building No. 1 (Building H-219)	3.0E-04	65 m W	5.1E-05	165 m W	3.5E-04
Inter-Regional Project No. 4 Building (Building H-217)	4.4E-04	52 m W	6.8E-05	143 m W	5.1E-04
Animal Hospital Building No. 2 (Building H-218)	3.0E-04	65 m W	5.1E-05	165 m W	3.5E-04
Cellular Biology Laboratory (Building H-294)	3.8E-04	65 m N	9.3E-05	150 m NNE	4.7E-04
Clinical Pathology (H-215)	1.4E-04	99 m W	6.2E-05	150 m W	2.0E-04
Main Office (H-213)	3.8E-04	65 m NW	5.3E-05	187 m NW	4.3E-04

Notes

¹The effective dose equivalent to the maximally exposed individual is taken as the maximum modeled dose within a 45° sector in the direction and at the distance indicated in the “Location” column. For example, the dose 65 m north of the Western Dog Pens area would be the maximum modeled dose within the sector bounded by 65 m NNE and 65 m NNW.

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

³The maximum total dose is the sum of the EDEs modeled for each MEI receptor from the two potential radionuclide fugitive-dust-emission diffuse sources. Value in **bold face** is the maximum total dose for the site.

Abbreviations

E	east	EDE	effective dose equivalent
NW	northwest	m	meters
MEI	maximally exposed individual	No.	number
mrem/yr	millirem(s) per year	S	south
N	north	UC Davis	University of California, Davis
NNE	north by northeast	W	west

Table 6. Estimated Collective Population Dose Resulting from Radionuclide Emissions from Diffuse Sources

Potential Source	Off-Site Maximally Exposed Individual		Collective Population Dose ¹ (person-rem/yr)
	(mrem/yr)	Location	
Western Dog Pens Area	1.48E-07	5,000 m north	1.03E-05
Eastern Dog Pens Area	1.63E-07	5,000 m north	8.02E-06
Total LEHR Site	3.1E-07		1.8E-05

Notes

Source of data: CAP88-PC, Version 1.0 modeling output files.

¹The collective population dose is for receptors within a 80-km radius.

Abbreviations

km kilometer(s)
 LEHR Laboratory for Energy-Related Health Research
 m meter(s)
 mrem/yr millirem per year
 person-rem/yr person-roentgen equivalent man per year

Table 7. CAP88-PC Input for the Western Dog Pens Area

Run type	Individual	Receptor distances (m): 48, 52, 65, 99, 300, 400, 1200			
Run type	Population	Population file to use: 05LEHR.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					
Wind file to use:	SAC0320.WND (CAP88-PC supplied wind file)				
Annual precipitation (cm/yr):	56.49 (2005 Davis total)				
Annual ambient temperature (°C):	16.49 (2005 Davis 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):	5,263				
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 (No./km ²):	8.81E-02 (CAP88-PC default)				
Milk cattle density (No./km ²):	2.85E-02 (CAP88-PC default)				
Land fraction cultivated for vegetable crops:	0.25 (Site-specific parameter per 1995 NESHAPs)				
Radionuclide Release Data					
PM ₁₀ emission rate (g/m ² -hr):	5.32E-05 (Using Cowherd, 1985, unlimited erosion potential)				
	Nuclide	Max. Soil (pCi/g)	Emission Rate (Ci/yr)	Size ¹ (µm)	Class ¹
	Ac-228	0.719	1.76E-09	1	Y
	Bi-212	0.628	1.54E-09	1	W
	Bi-214	1.09	2.67E-09	1	W
	C-14	11.3	2.77E-08	0	G
	Cs-137	0.115	2.82E-10	1	D
	Co-60	0.028	6.87E-11	1	Y
	Pb-210	4.96	1.22E-08	1	D
	Pb-212	0.744	1.82E-09	1	D
	Pb-214	1.41	3.46E-09	1	D
	K-40	14.3	3.51E-08	1	D
	Ra-226	1.9	4.66E-09	1	W
	Sr-90	0.675	1.66E-09	1	D
	Tl-208	0.272	6.67E-10	1	D
	Th-234	1.62	3.97E-09	1	Y
	U-235	0.232	5.69E-10	1	Y
	U-238	1.62	3.97E-09	1	Y

Table 7. CAP88-PC Input for the Western Dog Pens Area (continued)

Note

¹CAP88-PC default particle size and lung retention class (D = day, G = gas, W = week, Y = year).

Abbreviations

µm	micrometer
km ²	square kilometer
°C	degrees Celsius
Ac-228	actinium-228
Bi-212	bismuth-212
Bi-214	bismuth-214
C-14	carbon-14
Ci/yr	curies per year
cm/yr	centimeter(s) per year
Co-60	cobalt-60
Cs-137	cesium-137
g/m ² -hr	grams per square meter-hour(s)
K-40	potassium-40
m	meters
m ²	square meter(s)
Max.	maximum (concentration)
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
No.	number
Pb-210	lead-210
Pb-212	lead-212
Pb-214	lead-214
pCi/g	picocurie per gram
PM ₁₀	particulate matter with an aerodynamic diameter less than or equal to 10 micrometers
Ra-226	radium-226
Sr-90	strontium-90
Th-234	thorium-234
Tl-208	thallium-208
U-235	uranium-235
U-238	uranium-238

Table 8. CAP88-PC Input for the Eastern Dog Pens Area

Run type	Individual	Receptor distances (m): 132, 143, 150, 165, 180, 187, 500, 1000			
Run type	Population	Population file to use: 05LEHR.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					
Wind file to use:	SAC0320.WND (CAP88-PC supplied wind file)				
Annual precipitation (cm/yr):	56.49 (2005 Davis total)				
Annual ambient temperature (°C):	16.49 (2005 Davis 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 (No./km ²):	8.81E-02 (CAP88-PC default)				
Milk cattle density (No./km ²):	2.85E-02 (CAP88-PC default)				
Land fraction cultivated for vegetable crops:	0.25 (Site specific parameter per 1995 NESHAPs)				
Radionuclide Release Data					
PM ₁₀ emission Rate (g/m ² -hr):	5.32E-05 (Using Cowherd, 1985, unlimited erosion potential)				
	Nuclide	Max. Soil (pCi/g)	Emission Rate (Ci/yr)	Size ¹ (µm)	Class ¹
	Bi-212	0.415	7.54E-10	1	W
	Bi-214	0.572	1.04E-09	1	W
	Cs-137	0.191	3.47E-10	1	D
	Pb-214	0.607	1.10E-09	1	D
	Sr-90	0.164	2.98E-10	1	D
	Tl-208	0.219	3.98E-10	1	D
	Th-228	1.54	2.80E-09	1	Y
	Th-232	1.26	2.29E-09	1	Y
	Th-234	0.89	1.62E-09	1	Y
	H-3	1.21	2.20E-09	0	G
	U-235	0.0383	6.96E-11	1	Y

Note

¹CAP88-PC default particle size and lung retention class (D = day, G = gas, W = week, Y = year).

Abbreviations

µm micrometer
°C degrees Celsius
Bi-212 bismuth-212

Table 8. CAP88-PC Input for the Eastern Dog Pens Area (continued)

Bi-214	bismuth-214
Ci/yr	curies per year
cm/yr	centimeter(s) per year
Cs-137	cesium-137
g/m ² -hr	grams per square meter-hour(s)
H-3	tritium
km ²	square kilometer
m	meter(s)
m ²	square meter(s)
Max.	maximum (concentration)
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
No.	number
Pb-214	lead-214
pCi/g	picocurie per gram
PM ₁₀	particulate matter with an aerodynamic diameter less than or equal to 10 micrometers
Sr-90	strontium-90
Th-228	thorium-228
Th-232	thorium-232
Th-234	thorium-234
Tl-208	thallium-208
U-235	uranium-235

FIGURES

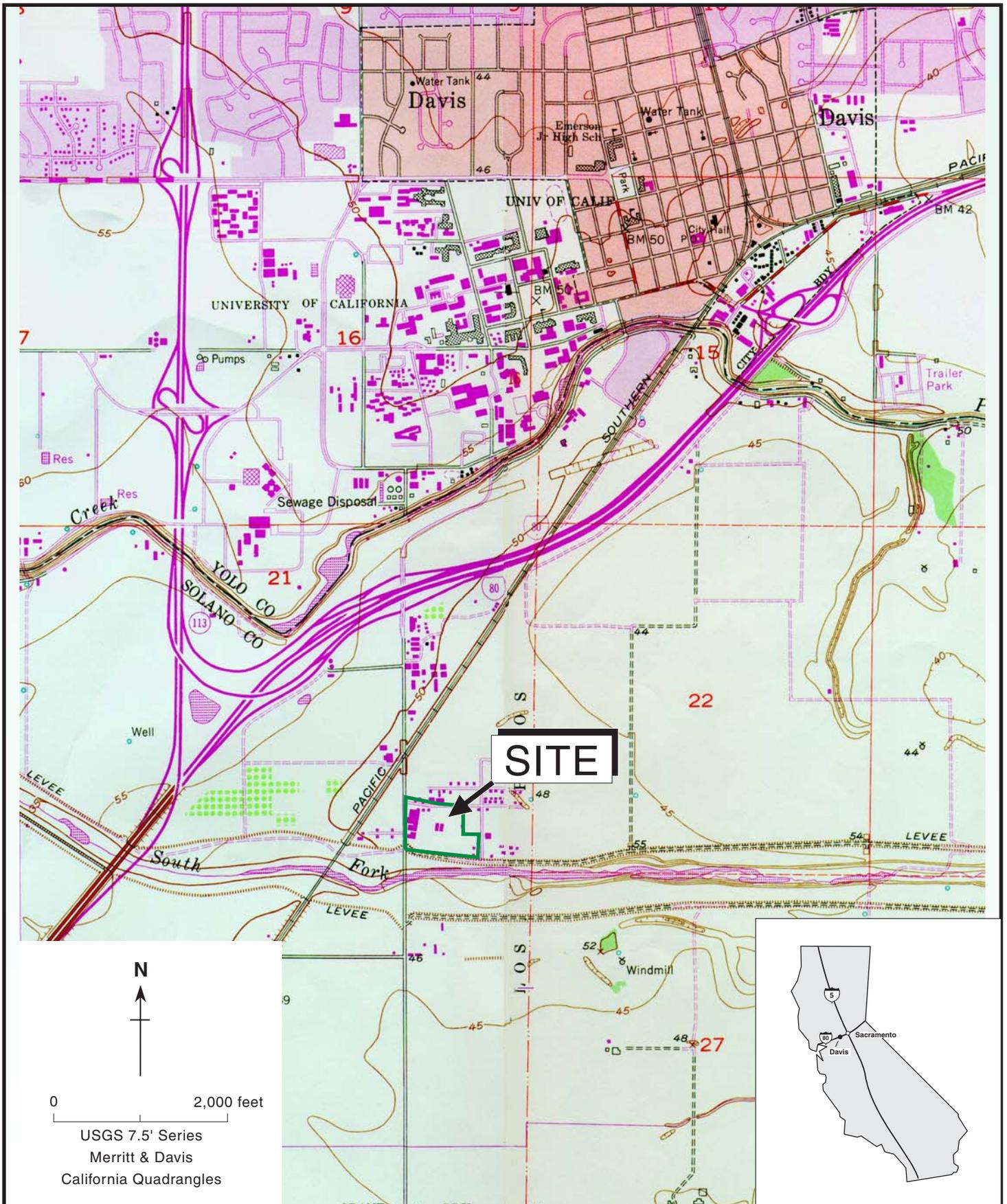


Figure 1. LEHR Facility Location Map, University of California, Davis

Weiss Associates

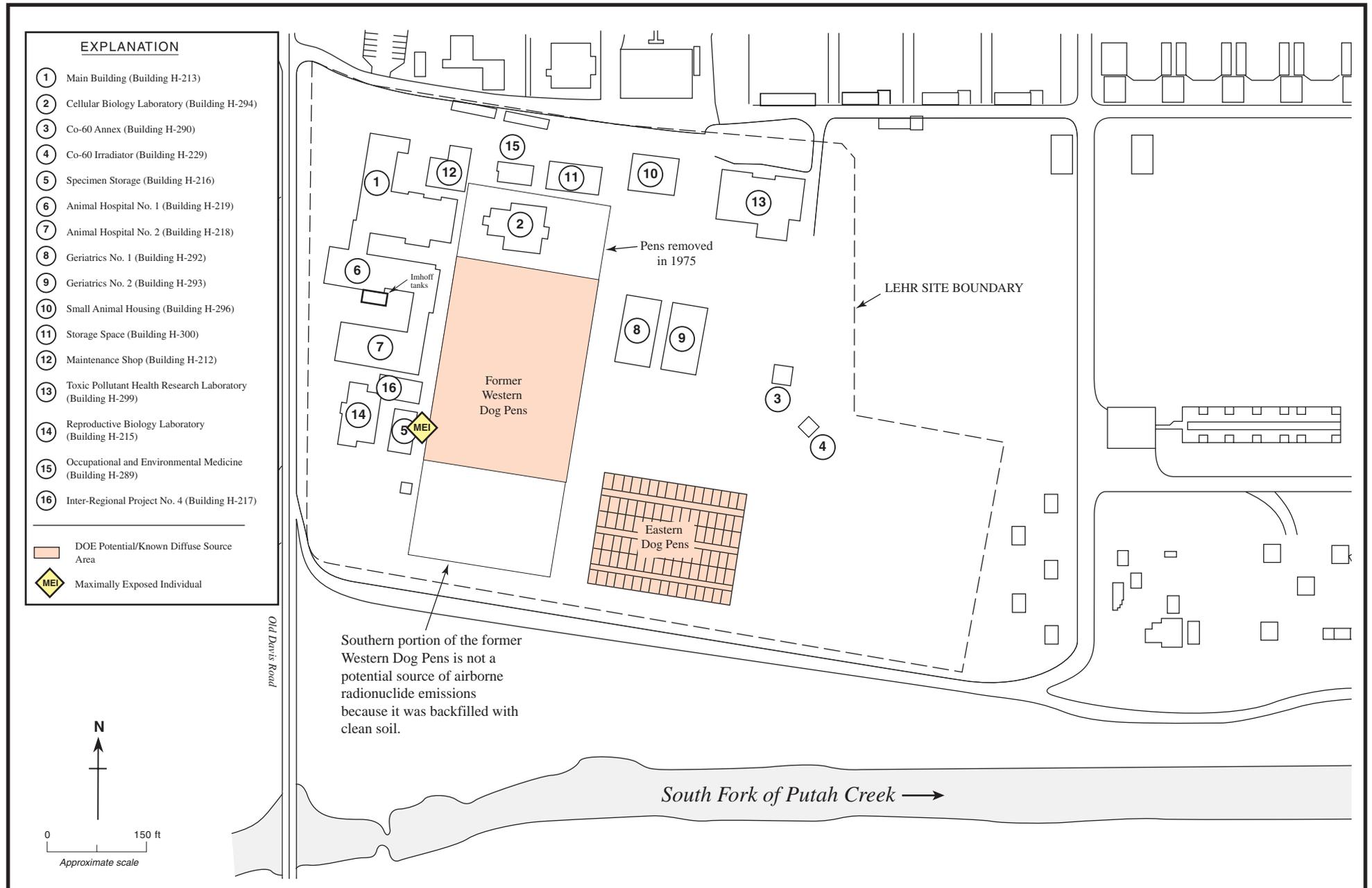


Figure 2. LEHR Facility DOE Diffuse-Source Areas and Location of Maximally Exposed Individual

APPENDIX A

CAP88-PC OUTPUT RESULTS

H. SUM

C A P 8 8 - P C

Versi on 1. 00

Clean Air Act Assessment Package - 1988

D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E S

Non-Radon Individual Assessment
May 10, 2006 3: 42 pm

Facility: LEHR
Address: Old Davis Road
City: Davis
State: CA Zip: 95616

Source Category: diffuse
Source Type: Area
Emission Year: 2005

Comments: Western Dog Pens area

Dataset Name: WDPind05
Dataset Date: May 10, 2006 3: 36 pm
Wind File: WNDFILES\SAC0320.WND

May 10, 2006 3: 42 pm

SUMMARY
Page 1

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)
GONADS	1. 06E-04
BREAST	1. 02E-04
R MAR	4. 28E-04
LUNGS	2. 42E-03
THYROID	1. 03E-04
ENDOST	4. 94E-03
RMNDR	4. 53E-04

EFFEC H. SUM 6. 71E-04

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)
INGESTION	2. 67E-04
INHALATION	3. 67E-04
AIR IMMERSION	4. 77E-09
GROUND SURFACE	3. 72E-05
INTERNAL	6. 34E-04
EXTERNAL	3. 72E-05
TOTAL	6. 71E-04

May 10, 2006 3: 42 pm

SUMMARY Page 2

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem/y)
AC-228	7. 56E-08
BI -212	2. 60E-08
BI -214	1. 85E-09
C-14	4. 40E-07
CS-137	1. 24E-07
CO-60	1. 98E-07
PB-210	2. 86E-04
PB-212	1. 52E-07
PB-214	1. 87E-09
K-40	6. 60E-05
RA-226	3. 89E-05
SR-90	2. 40E-06
TL-208	7. 16E-10
TH-234	1. 43E-07
U-235	3. 66E-05
U-238	2. 40E-04
TOTAL	6. 71E-04

May 10, 2006 3: 42 pm

SUMMARY Page 3

CANCER RISK SUMMARY

Cancer Selected Individual Total Lifetime Fatal Cancer Risk
Page 2

H. SUM

LEUKEMIA	6.24E-10
BONE	2.74E-10
THYROID	3.72E-11
BREAST	3.12E-10
LUNG	4.33E-09
STOMACH	1.97E-10
BOWEL	1.05E-10
LIVER	1.37E-09
PANCREAS	1.65E-10
URINARY	3.14E-10
OTHER	2.02E-10
TOTAL	7.93E-09

PATHWAY RISK SUMMARY

Pathway	Selected Individual	
	Fatal	Total Lifetime Cancer Risk
INGESTION	2.44E-09	
INHALATION	4.59E-09	
AIR IMMERSION	1.15E-13	
GROUND SURFACE	9.02E-10	
INTERNAL	7.03E-09	
EXTERNAL	9.02E-10	
TOTAL	7.93E-09	

May 10, 2006 3:42 pm

SUMMARY
Page 4

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual	
	Fatal	Total Lifetime Cancer Risk
AC-228	1.52E-12	
BI-212	3.34E-13	
BI-214	2.15E-13	
C-14	1.07E-11	
CS-137	3.23E-12	
CO-60	4.95E-12	
PB-210	2.04E-09	
PB-212	2.60E-12	
PB-214	3.20E-13	
K-40	1.66E-09	
RA-226	5.52E-10	
SR-90	4.05E-11	
TL-208	1.75E-14	
TH-234	4.88E-12	
U-235	4.82E-10	
U-238	3.14E-09	

H. SUM

TOTAL

7. 93E-09

May 10, 2006 3: 42 pm

SUMMARY
Page 5

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

Di recti on	Di stance (m)						
	48	52	65	99	300	400	1200
N	6. 3E-04	5. 3E-04	3. 5E-04	1. 8E-04	4. 5E-05	3. 6E-05	2. 6E-05
NNW	6. 7E-04	5. 8E-04	3. 8E-04	1. 7E-04	3. 9E-05	3. 3E-05	2. 5E-05
NW	6. 2E-04	5. 2E-04	3. 4E-04	1. 7E-04	4. 2E-05	3. 4E-05	2. 5E-05
WNW	5. 1E-04	4. 4E-04	3. 0E-04	1. 4E-04	3. 7E-05	3. 2E-05	2. 5E-05
W	3. 8E-04	3. 2E-04	2. 1E-04	1. 0E-04	3. 3E-05	2. 9E-05	2. 5E-05
WSW	2. 5E-04	2. 1E-04	1. 3E-04	6. 6E-05	2. 8E-05	2. 6E-05	2. 4E-05
SW	1. 9E-04	1. 5E-04	8. 6E-05	4. 9E-05	2. 7E-05	2. 5E-05	2. 4E-05
SSW	2. 0E-04	1. 7E-04	1. 1E-04	5. 6E-05	2. 7E-05	2. 5E-05	2. 4E-05
S	2. 5E-04	2. 2E-04	1. 5E-04	8. 2E-05	3. 1E-05	2. 8E-05	2. 5E-05
SSE	2. 7E-04	2. 4E-04	1. 7E-04	9. 4E-05	3. 4E-05	3. 0E-05	2. 5E-05
SE	2. 5E-04	2. 2E-04	1. 5E-04	7. 5E-05	3. 0E-05	2. 7E-05	2. 4E-05
ESE	2. 0E-04	1. 7E-04	1. 1E-04	5. 7E-05	2. 7E-05	2. 6E-05	2. 4E-05
E	2. 0E-04	1. 6E-04	9. 6E-05	5. 5E-05	2. 8E-05	2. 6E-05	2. 4E-05
ENE	2. 7E-04	2. 3E-04	1. 4E-04	7. 1E-05	2. 8E-05	2. 6E-05	2. 4E-05
NE	4. 0E-04	3. 3E-04	2. 1E-04	1. 1E-04	3. 5E-05	3. 0E-05	2. 5E-05
NNE	5. 4E-04	4. 7E-04	3. 2E-04	1. 5E-04	3. 7E-05	3. 1E-05	2. 5E-05

May 10, 2006 3: 42 pm

SUMMARY
Page 6

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

Di recti on	Di stance (m)						
	48	52	65	99	300	400	1200
N	7. 4E-09	6. 3E-09	4. 1E-09	2. 1E-09	5. 0E-10	3. 9E-10	2. 6E-10
NNW	7. 9E-09	6. 8E-09	4. 5E-09	2. 0E-09	4. 3E-10	3. 5E-10	2. 6E-10
NW	7. 3E-09	6. 2E-09	4. 0E-09	1. 9E-09	4. 6E-10	3. 7E-10	2. 6E-10
WNW	6. 1E-09	5. 2E-09	3. 5E-09	1. 7E-09	4. 1E-10	3. 4E-10	2. 6E-10
W	4. 5E-09	3. 8E-09	2. 4E-09	1. 2E-09	3. 6E-10	3. 1E-10	2. 5E-10
WSW	3. 0E-09	2. 5E-09	1. 5E-09	7. 5E-10	2. 9E-10	2. 7E-10	2. 5E-10
SW	2. 2E-09	1. 7E-09	9. 8E-10	5. 4E-10	2. 8E-10	2. 6E-10	2. 5E-10
SSW	2. 4E-09	2. 0E-09	1. 2E-09	6. 2E-10	2. 8E-10	2. 6E-10	2. 5E-10
S	2. 9E-09	2. 6E-09	1. 8E-09	9. 3E-10	3. 3E-10	2. 9E-10	2. 5E-10
SSE	3. 2E-09	2. 8E-09	2. 0E-09	1. 1E-09	3. 6E-10	3. 1E-10	2. 5E-10
SE	2. 9E-09	2. 5E-09	1. 7E-09	8. 6E-10	3. 1E-10	2. 8E-10	2. 5E-10
ESE	2. 4E-09	2. 0E-09	1. 2E-09	6. 4E-10	2. 8E-10	2. 7E-10	2. 5E-10

				H. SUM			
E	2.3E-09	1.9E-09	1.1E-09	6.1E-10	2.9E-10	2.7E-10	2.5E-10
ENE	3.2E-09	2.7E-09	1.7E-09	8.0E-10	2.9E-10	2.7E-10	2.5E-10
NE	4.7E-09	3.9E-09	2.4E-09	1.2E-09	3.7E-10	3.2E-10	2.5E-10
NNE	6.4E-09	5.5E-09	3.8E-09	1.7E-09	4.0E-10	3.3E-10	2.6E-10

I . SYN

C A P 8 8 - P C

Versi on 1.00

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Popul ati on Assessment
May 10, 2006 3: 44 pm

Facility: LEHR
Address: Old Davis Road
City: Davis
State: CA Zip: 95616

Effecti ve Dose Equi val ent
(mrem/year)

1. 48E-07

At Thi s Locati on: 5000 Meters North
Source Category: di ffuse
Source Type: Area
Emi ssi on Year: 2005

Comments: Western Dog Pens area

Dataset Name: WDPpop05
Dataset Date: May 10, 2006 3: 42 pm
Wind File: WNDFILES\SAC0320. WND
Popul ati on File: POPFILES\05LEHR. POP

May 10, 2006 3: 44 pm

SYNOPSIS
Page 1

MAXI MALLY EXPOSED I NDI VI DUAL

Locati on Of The Indi vi dual : 5000 Meters North
Li feti me Fatal Cancer Ri sk: 1. 72E-12
Page 1

I . SYN

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)	Collective Population (person-rem/y)
GONADS	2.35E-08	1.84E-06
BREAST	2.25E-08	1.78E-06
R MAR	9.64E-08	8.15E-06
LUNGS	5.14E-07	2.58E-05
THYROID	2.28E-08	1.79E-06
ENDOST	1.12E-06	9.56E-05
RMNDR	1.02E-07	8.56E-06
EFFEC	1.48E-07	1.03E-05

FREQUENCY DISTRIBUTION OF LIFETIME FATAL CANCER RISKS

Risk Range	Number of People	Number of People In This Risk Range Or Higher	Deaths/Year In This Risk Range	Deaths/Year In This Risk Range Or Higher
1.0E+00 TO 1.0E-01	0	0	0.00E+00	0.00E+00
1.0E-01 TO 1.0E-02	0	0	0.00E+00	0.00E+00
1.0E-02 TO 1.0E-03	0	0	0.00E+00	0.00E+00
1.0E-03 TO 1.0E-04	0	0	0.00E+00	0.00E+00
1.0E-04 TO 1.0E-05	0	0	0.00E+00	0.00E+00
1.0E-05 TO 1.0E-06	0	0	0.00E+00	0.00E+00
LESS THAN 1.0E-06	3585509	3585509	1.60E-09	1.60E-09

May 10, 2006 3:44 pm

SYNOPSIS
Page 2

RADIONUCLIDE EMISSIONS DURING THE YEAR 2005

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
AC-228	Y	1.00	1.8E-09	1.8E-09
BI-212	W	1.00	1.5E-09	1.5E-09
BI-214	W	1.00	2.7E-09	2.7E-09
C-14	*	0.00	2.8E-08	2.8E-08
CS-137	D	1.00	2.8E-10	2.8E-10
CO-60	Y	1.00	6.9E-11	6.9E-11
PB-210	D	1.00	1.2E-08	1.2E-08
PB-212	D	1.00	1.8E-09	1.8E-09
PB-214	D	1.00	3.5E-09	3.5E-09
K-40	D	1.00	3.5E-08	3.5E-08
RA-226	W	1.00	4.7E-09	4.7E-09
SR-90	D	1.00	1.7E-09	1.7E-09
TL-208	D	1.00	6.7E-10	6.7E-10
TH-234	Y	1.00	4.0E-09	4.0E-09

I. SYN

U-235	Y	1.00	5.7E-10	5.7E-10
U-238	Y	1.00	4.0E-09	4.0E-09

SITE INFORMATION

Temperature: 17 degrees C
 Precipitation: 56 cm/y
 Mixing Height: 1000 m

May 10, 2006 3:44 pm

SYNOPSIS
Page 3

SOURCE INFORMATION

Source Number: 1

Source Height (m): 0.00
 Area (sq m): 5.26E+03

Plume Rise Pasquill Cat:	A	B	C	D	E	F	G
Zero:	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AGRICULTURAL DATA

	<u>Vegetable</u>	<u>Milk</u>	<u>Meat</u>
Fracti on Home Produced:	0.700	0.399	0.442
Fracti on From Assessment Area:	0.300	0.601	0.558
Fracti on Imported:	0.000	0.000	0.000
Beef Cattle Density:	8.81E-02		
Milk Cattle Density:	2.85E-02		
Land Fracti on Cultivated for Vegetable Crops:	2.50E-01		

May 10, 2006 3:44 pm

SYNOPSIS
Page 4

POPULATION DATA

Di recti on	Di stance (m)						
	5000	15000	25000	35000	45000	55000	65000
N	1402	4104	6839	8902	9731	9803	13870
NNW	1396	4099	6831	9563	10596	2479	1937

	I . SYN						
NW	1434	4099	6830	9562	12302	13552	8799
WNW	1618	4111	6830	9416	11723	14023	11477
W	3636	8846	10700	9695	11467	14009	18911
WSW	3665	10996	18320	13738	12524	14009	26298
SW	3665	10996	18321	23882	32240	29317	42404
SSW	3665	10996	18324	25653	31386	48925	124813
S	3670	11009	18348	25860	48819	111273	133498
SSE	3663	7189	16673	52994	66588	56632	59590
SE	2793	4099	25669	70100	59596	40686	45571
ESE	2125	4676	40002	72472	93250	108938	72034
E	2011	8046	50326	72470	93253	113921	42570
ENE	1821	4131	45841	72472	81677	69337	12303
NE	1555	4153	49354	36137	14744	17572	20762
NNE	1422	4099	13048	7810	10156	11754	11929

Distance (m)

Di recti on 75000

N	16148
NNW	2576
NW	3790
WNW	7594
W	29450
WSW	33474
SW	54861
SSW	153824
S	154040
SSE	62428
SE	52579
ESE	21883
E	8944
ENE	11440
NE	19387
NNE	11871

J. SUM

C A P 8 8 - P C

Versi on 1. 00

Clean Air Act Assessment Package - 1988

D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E S

Non-Radon Individual Assessment
May 10, 2006 3: 49 pm

Facility: LEHR
Address: Old Davis Road
City: Davis
State: CA Zip: 95616

Source Category: diffuse
Source Type: Area
Emission Year: 2004

Comments: Eastern Dog Pens area

Dataset Name: EDPind05
Dataset Date: May 10, 2006 3: 48 pm
Wind File: WNDFILES\SAC0320.WND

May 10, 2006 3: 49 pm

SUMMARY
Page 1

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)
GONADS	4. 19E-07
BREAST	4. 31E-07
R MAR	4. 95E-05
LUNGS	7. 50E-04
THYROID	4. 21E-07
ENDOST	6. 12E-04
RMNDR	1. 23E-06

EFFEC J. SUM 1. 15E-04

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)
INGESTION	8. 13E-07
INHALATION	1. 14E-04
AIR IMMERSION	1. 45E-10
GROUND SURFACE	1. 55E-08
INTERNAL	1. 15E-04
EXTERNAL	1. 56E-08
TOTAL	1. 15E-04

May 10, 2006 3: 49 pm

SUMMARY
Page 2

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem/y)
BI -212	1. 88E-09
BI -214	1. 05E-10
CS-137	2. 39E-08
PB-214	8. 72E-11
SR-90	6. 68E-08
TL-208	5. 27E-11
TH-228	5. 26E-05
TH-232	6. 15E-05
TH-234	8. 86E-09
H-3	1. 14E-10
U-235	6. 72E-07
TOTAL	1. 15E-04

May 10, 2006 3: 49 pm

SUMMARY
Page 3

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
LEUKEMIA	4. 46E-11
BONE	2. 89E-11
THYROID	8. 06E-14

	J. SUM
BREAST	6.96E-13
LUNG	1.33E-09
STOMACH	5.78E-13
BOWEL	8.80E-13
LIVER	2.45E-12
PANCREAS	4.00E-13
URINARY	3.62E-13
OTHER	4.90E-13
TOTAL	1.41E-09

PATHWAY RISK SUMMARY

Pathway	Selected Individual	
	Total Fatal	Li fetime Cancer Risk
INGESTION		4.39E-12
INHALATION		1.41E-09
AIR IMMERSION		3.51E-15
GROUND SURFACE		3.58E-13
INTERNAL		1.41E-09
EXTERNAL		3.62E-13
TOTAL		1.41E-09

May 10, 2006 3:49 pm

SUMMARY
Page 4

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual	
	Total Fatal	Li fetime Cancer Risk
BI-212		2.42E-14
BI-214		1.22E-14
CS-137		6.25E-13
PB-214		1.49E-14
SR-90		1.13E-12
TL-208		1.29E-15
TH-228		1.05E-09
TH-232		3.47E-10
TH-234		3.00E-13
H-3		3.07E-15
U-235		8.85E-12
TOTAL		1.41E-09

May 10, 2006 3:49 pm

SUMMARY
Page 5

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

J. SUM

Distance (m)

Di recti on	132	143	150	165	180	187	500
N	1. 1E-04	1. 0E-04	9. 3E-05	7. 9E-05	6. 6E-05	6. 2E-05	9. 3E-06
NNW	9. 2E-05	7. 7E-05	7. 0E-05	5. 7E-05	4. 8E-05	4. 4E-05	6. 7E-06
NW	1. 0E-04	8. 8E-05	8. 1E-05	6. 8E-05	5. 7E-05	5. 3E-05	7. 9E-06
WNW	7. 9E-05	6. 8E-05	6. 2E-05	5. 1E-05	4. 3E-05	4. 0E-05	5. 9E-06
W	5. 4E-05	4. 7E-05	4. 3E-05	3. 5E-05	3. 0E-05	2. 8E-05	4. 1E-06
WSW	2. 5E-05	2. 0E-05	1. 8E-05	1. 5E-05	1. 2E-05	1. 1E-05	1. 7E-06
SW	1. 6E-05	1. 3E-05	1. 2E-05	9. 7E-06	8. 1E-06	7. 5E-06	1. 2E-06
SSW	1. 8E-05	1. 4E-05	1. 3E-05	9. 9E-06	8. 3E-06	7. 7E-06	1. 2E-06
S	4. 0E-05	3. 5E-05	3. 2E-05	2. 7E-05	2. 3E-05	2. 1E-05	3. 2E-06
SSE	5. 3E-05	4. 6E-05	4. 3E-05	3. 6E-05	3. 1E-05	2. 8E-05	4. 3E-06
SE	3. 3E-05	2. 8E-05	2. 5E-05	2. 1E-05	1. 8E-05	1. 6E-05	2. 5E-06
ESE	2. 0E-05	1. 6E-05	1. 5E-05	1. 2E-05	1. 0E-05	9. 3E-06	1. 4E-06
E	2. 1E-05	1. 8E-05	1. 6E-05	1. 3E-05	1. 1E-05	1. 0E-05	1. 6E-06
ENE	2. 6E-05	2. 1E-05	1. 8E-05	1. 5E-05	1. 2E-05	1. 1E-05	1. 8E-06
NE	6. 0E-05	5. 2E-05	4. 8E-05	4. 1E-05	3. 4E-05	3. 2E-05	4. 8E-06
NNE	7. 7E-05	6. 5E-05	5. 8E-05	4. 8E-05	4. 0E-05	3. 7E-05	5. 7E-06

Distance (m)

Di recti on	1000
N	2. 5E-06
NNW	1. 8E-06
NW	2. 1E-06
WNW	1. 6E-06
W	1. 1E-06
WSW	4. 9E-07
SW	3. 6E-07
SSW	3. 6E-07
S	8. 8E-07
SSE	1. 2E-06
SE	7. 1E-07
ESE	4. 3E-07
E	4. 7E-07
ENE	5. 2E-07
NE	1. 3E-06
NNE	1. 6E-06

May 10, 2006 3: 49 pm

SUMMARY
Page 6

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

Di recti on	132	143	150	165	180	187	500

J. SUM

N	1.4E-09	1.2E-09	1.1E-09	9.7E-10	8.2E-10	7.6E-10	1.1E-10
NNW	1.1E-09	9.5E-10	8.5E-10	7.0E-10	5.9E-10	5.5E-10	8.2E-11
NW	1.2E-09	1.1E-09	9.9E-10	8.3E-10	7.0E-10	6.5E-10	9.7E-11
WNW	9.8E-10	8.3E-10	7.6E-10	6.3E-10	5.3E-10	4.9E-10	7.2E-11
W	6.7E-10	5.7E-10	5.2E-10	4.4E-10	3.7E-10	3.4E-10	5.0E-11
WSW	3.0E-10	2.5E-10	2.2E-10	1.8E-10	1.5E-10	1.4E-10	2.0E-11
SW	1.9E-10	1.6E-10	1.4E-10	1.2E-10	9.9E-11	9.2E-11	1.4E-11
SSW	2.2E-10	1.7E-10	1.5E-10	1.2E-10	1.0E-10	9.5E-11	1.4E-11
S	5.0E-10	4.3E-10	3.9E-10	3.3E-10	2.8E-10	2.6E-10	3.9E-11
SSE	6.5E-10	5.7E-10	5.3E-10	4.5E-10	3.8E-10	3.5E-10	5.3E-11
SE	4.1E-10	3.4E-10	3.1E-10	2.6E-10	2.2E-10	2.0E-10	3.0E-11
ESE	2.4E-10	2.0E-10	1.8E-10	1.5E-10	1.2E-10	1.1E-10	1.7E-11
E	2.5E-10	2.2E-10	2.0E-10	1.6E-10	1.4E-10	1.3E-10	1.9E-11
ENE	3.2E-10	2.6E-10	2.3E-10	1.8E-10	1.5E-10	1.4E-10	2.1E-11
NE	7.4E-10	6.4E-10	5.9E-10	5.0E-10	4.2E-10	3.9E-10	5.9E-11
NNE	9.5E-10	8.0E-10	7.2E-10	5.9E-10	5.0E-10	4.6E-10	7.0E-11

Distance (m)

Di recti on	1000
N	3.0E-11
NNW	2.2E-11
NW	2.5E-11
WNW	1.9E-11
W	1.3E-11
WSW	5.5E-12
SW	3.9E-12
SSW	4.0E-12
S	1.0E-11
SSE	1.4E-11
SE	8.2E-12
ESE	4.8E-12
E	5.3E-12
ENE	5.9E-12
NE	1.6E-11
NNE	1.9E-11

K. SYN

C A P 8 8 - P C

Versi on 1.00

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Popul ati on Assessment
May 10, 2006 3: 49 pm

Fac i l i t y: LEHR
Address: Ol d Davi s Road
Ci t y: Davi s
State: CA Zi p: 95616

Effecti ve Dose Equi val ent
(mrem/year)

1. 63E-07

At Thi s Locati on: 5000 Meters North
Source Category: di ffuse
Source Type: Area
Emi ssi on Year: 2004

Comments: Eastern Dog Pens area

Dataset Name: EDPpop05
Dataset Date: May 10, 2006 3: 49 pm
Wi nd Fi le: WNDFI LES\SAC0320. WND
Popul ati on Fi le: POPFI LES\05LEHR. POP

May 10, 2006 3: 49 pm

SYNOPSIS
Page 1

MAXI MALLY EXPOSED I NDI VI DUAL

Locati on Of The Indi vi dual : 5000 Meters North
Li feti me Fatal Cancer Ri sk: 2. 00E-12
Page 1

K. SYN

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)	Collective Population (person-rem/y)
GONADS	5.86E-10	3.15E-08
BREAST	6.05E-10	3.26E-08
R MAR	7.04E-08	3.56E-06
LUNGS	1.06E-06	5.19E-05
THYROID	5.87E-10	3.16E-08
ENDOST	8.70E-07	4.37E-05
RMNDR	1.77E-09	1.08E-07
EFFEC	1.63E-07	8.02E-06

FREQUENCY DISTRIBUTION OF LIFETIME FATAL CANCER RISKS

Risk Range	Number of People	Number of People In This Risk Range Or Higher	Deaths/Year In This Risk Range	Deaths/Year In This Risk Range Or Higher
1.0E+00 TO 1.0E-01	0	0	0.00E+00	0.00E+00
1.0E-01 TO 1.0E-02	0	0	0.00E+00	0.00E+00
1.0E-02 TO 1.0E-03	0	0	0.00E+00	0.00E+00
1.0E-03 TO 1.0E-04	0	0	0.00E+00	0.00E+00
1.0E-04 TO 1.0E-05	0	0	0.00E+00	0.00E+00
1.0E-05 TO 1.0E-06	0	0	0.00E+00	0.00E+00
LESS THAN 1.0E-06	3585509	3585509	1.39E-09	1.39E-09

May 10, 2006 3:49 pm

SYNOPSIS
Page 2

RADIONUCLIDE EMISSIONS DURING THE YEAR 2004

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
BI-212	W	1.00	7.5E-10	7.5E-10
BI-214	W	1.00	1.0E-09	1.0E-09
CS-137	D	1.00	3.5E-10	3.5E-10
PB-214	D	1.00	1.1E-09	1.1E-09
SR-90	D	1.00	3.0E-10	3.0E-10
TL-208	D	1.00	4.0E-10	4.0E-10
TH-228	Y	1.00	2.8E-09	2.8E-09
TH-232	Y	1.00	2.3E-09	2.3E-09
TH-234	Y	1.00	1.6E-09	1.6E-09
H-3	*	0.00	2.2E-09	2.2E-09
U-235	Y	1.00	7.0E-11	7.0E-11

K. SYN
SITE INFORMATION

Temperature: 17 degrees C
Precipitation: 56 cm/y
Mixing Height: 1000 m

May 10, 2006 3: 49 pm

SYNOPSIS
Page 3

SOURCE INFORMATION

Source Number: 1

Source Height (m): 0.00
Area (sq m): 3.90E+03

Plume Rise Pasquill Cat:	A	B	C	D	E	F	G
Zero:	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.700	0.399	0.442
Fraction From Assessment Area:	0.300	0.601	0.558
Fraction Imported:	0.000	0.000	0.000
Beef Cattle Density:	8.81E-02		
Milk Cattle Density:	2.85E-02		
Land Fraction Cultivated for Vegetable Crops:	2.50E-01		

May 10, 2006 3: 49 pm

SYNOPSIS
Page 4

POPULATION DATA

Direction	Distance (m)						
	5000	15000	25000	35000	45000	55000	65000
N	1402	4104	6839	8902	9731	9803	13870
NNW	1396	4099	6831	9563	10596	2479	1937
NW	1434	4099	6830	9562	12302	13552	8799
WNW	1618	4111	6830	9416	11723	14023	11477
W	3636	8846	10700	9695	11467	14009	18911
WSW	3665	10996	18320	13738	12524	14009	26298
SW	3665	10996	18321	23882	32240	29317	42404

	K. SYN						
SSW	3665	10996	18324	25653	31386	48925	124813
S	3670	11009	18348	25860	48819	111273	133498
SSE	3663	7189	16673	52994	66588	56632	59590
SE	2793	4099	25669	70100	59596	40686	45571
ESE	2125	4676	40002	72472	93250	108938	72034
E	2011	8046	50326	72470	93253	113921	42570
ENE	1821	4131	45841	72472	81677	69337	12303
NE	1555	4153	49354	36137	14744	17572	20762
NNE	1422	4099	13048	7810	10156	11754	11929

Di stance (m)

Di recti on 75000

N	16148
NNW	2576
NW	3790
WNW	7594
W	29450
WSW	33474
SW	54861
SSW	153824
S	154040
SSE	62428
SE	52579
ESE	21883
E	8944
ENE	11440
NE	19387
NNE	11871
