Los Alamos
NATIONAL LABORATORY
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Safeguards Division
SAFE-1, Classification
MS F674
Los Alamos, New Mexico 87545
505-667-5011/Fax 505-665-4251

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Cheryl Kirkwood
ORAU Team
Dose Reconstruction Project for NIOSH
4850 Smith Road, Suite 200
Cincinnati, Ohio 45212

Subject: DDR-2011-0045 (Whitepaper –Revision to Cerro Grande White Paper; Rev 01; 4/04/2011; 3 pgs.)

Cheryl:

I have reviewed the subject document and determined that it does not contain classified information or Unclassified Controlled Nuclear Information (UCNI). I have marked the documents to reflect my determination. If I can be of further assistance, please let me know.

Daniel J. Gerth, Ph.D.
Classification Officer
Los Alamos National Laboratory
MS F674
Los Alamos, NM 87545
(505)-667-5011, dgerth@lanl.gov

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Revision to Cerro Grande White Paper
Rev. 1, April 4, 2011

1. Introduction

Formerly, a white paper was written to provide a technical basis for an overestimate of dose to workers with potential intakes of radioactive material while working on the Los Alamos site during the Cerro Grande fire of May, 2000. With this re-evaluation, a modified estimate methodology is based upon the results of an updated study from August 2010 (Eberhart 2010), which presents an in-depth analysis of the field data from the fire.

2. Radionuclides

Radiological releases resulting from the fire are described in the reference. The primary dosimetric consideration was suspended radon decay products that had accumulated for many years on vegetation and on the forest floor. Concentrations of plutonium, americium, and depleted uranium were also measured; however, these results were considered to be, in general, consistent with measurements made outside the fire period (Eberhart 2010). Gamma spectroscopy identified only naturally-occurring radionuclides. For the purpose of an overestimate of potential inhalation to Los Alamos workers, intakes for plutonium, americium, and uranium are calculated based on the highest measured value, without considering likely background inhalation rates.

The concentration values were chosen based only upon the maximum measured result for each radionuclide. Two isotopes of plutonium, ^{238}Pu and ^{239}Pu, were considered, since detectable concentrations are available in the reference.

3. Methodology

Intakes were estimated using the maximum measured concentrations from four radionuclides listed in the tables in the reference. The values are listed in the table. Total intakes were calculated using the relation below.

$$Total\ intake = Concentration\ \left(^{dpm}/_{m^3}\right) \cdot Inhalation\ rate\ \left(^{m^3}/_{hour}\right) \cdot Exposure\ time\ (hours)$$

3.1. Breathing Rate Assumptions

Standard breathing rate assumptions are unlikely to apply to emergency workers responding to the fire. For this reason, the breathing rate was adapted from ICRP (1975), Table 120, as shown.

$$V_h = f \cdot V_T \cdot time\ (minutes)$$

Where:

V_m = *Volume of air per minute*

f = *Frequency of inhalation breaths per minute (min^{-1})*

V_T *Tidal volume, which varies with activity level*

In this case, f and V_T were selected for an adult performing heavy work from the reference (Table 120), with the result below.

$$V_h = 21\,min^{-1} \cdot 2030\,mL \cdot 60\ {}^{min}/_{hour} = 2.56\,E+06\ {}^{mL}/_{hour} = 2.6\,{}^{m^3}/_{hour}$$

3.2. Additional Assumptions

Additional assumptions are listed below:

- A bounding intake is used to overestimate worker internal dose consequences;
- Individuals were assumed to spend the entire 60-hour period at the location of the highest potential intake;
- The highest measured values for each alpha-emitter were identified from the data in Eberhart (2010). These values are listed in the table;
- A 60-hour exposure period is assumed;
- A 'Heavy Work' breathing rate was assumed for the entire 60-hour period;
- Respiratory protection was not worn;

4. Calculated Intakes

Intakes calculated from the methodology described above are listed in the table.

Radionuclide	Date	Location	Concentration		Total Intake
			(aCi/m³)	(dpm/m³)	(dpm)
Am-241	May 12	TA-54	125[1]	3.79 E-03	0.043
Pu-238	May 13	McDonald's	65[2]	2.78 E-04	0.023
Pu-239	May 13	Los Alamos Inn	472[3]	1.05 E-03	0.17
U-234	May 13	TA-5	1709[4]	1.44 E-04	0.59

5. Recommendation

The dose estimation methodology in section 3, above, is likely to bound any actual doses due to conservative assumptions for location, exposure time, and breathing rate. However, the listed intakes are unlikely to represent a significant dose to any potential claimant. Doses were estimated using the IMBA program, assuming an acute inhalation of each of the listed intakes, over a number of organs, and assuming cancer was diagnosed in May 2010. The highest resulting dose was 1.06 E-04 rem, or 0.1 millirem, for an assumed ^{238}Pu, absorption Type S, intake and the thoracic lymph nodes (LN(TH)) as the internal organ assumed for dose reconstruction. All other organs, including lung, bone, and red bone marrow, were approximately an order of magnitude or more less than this value. The other radionuclides for all possible absorption types, also resulted in lower doses.

[1] Eberhart 2010, Table A-16.
[2] Ibid, Table A-17.
[3] Ibid, Table A-18.
[4] Ibid, Table A-19.

Since this dose is below the level regarded as significant, and because current practice is the assignment of a larger dose based on claimant favorable assumptions for environmental internal dose, it is unnecessary to include dose estimated during exposure during the Cerro Grande fire.

6. References

- Eberhart, C., "Measurements of Air Contaminants during the Cerro Grande Fire at Los Alamos National Laboratory," LA-14250, Los Alamos National Laboratory, August 2010
- International Commission on Radiological Protection (ICRP), *No. 23, Report of the Task Group on Reference Man* (ICRP 23), Adopted October 1974, Pergamon Press, 1975.