



**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Institute of Standards and Technology**  
325 Broadway  
Boulder, Colorado 80305-3328

July 11, 2008

Mr. Arthur T. Howell, III  
Director, Division of Nuclear Materials Safety  
U. S. Nuclear Regulatory Commission, Region IV  
612 East Lamar Blvd., Suite 400  
Arlington, Texas 76011  
Facsimile: 817-860-8188

**SUBJECT: Confirmatory Action Letter Item 4(a): Estimate of Release to the City of  
Boulder Sanitary Sewerage**

Dear Mr. Howell:

Pursuant to the July 2, 2008 Confirmatory Action Letter (CAL) addressed to Dr. James M. Turner, Deputy Director, National Institute of Standards and Technology (NIST), enclosed please find the subject report on the release to the City of Boulder sanitary sewerage subsequent to the June 9, 2008 spill event at NIST Laboratories in Boulder, Colorado. Note that NIST had requested an extension until July 11, 2008 to provide this report.

Please do not hesitate to contact me should you have any questions or concerns with respect to the content of the attached document or if I can assist you in any other way as the Nuclear Regulatory Commission continues its investigation of this incident. You may reach me via electronic mail at [richard.kayser@nist.gov](mailto:richard.kayser@nist.gov) or by telephone at 301-975-2300.

Sincerely,

Richard F. Kayser  
Chief Scientist

Enclosure

**NIST**

cc:

Department of Public Health and Environment  
Hazardous Materials & Waste Management Division  
Attn: Joe Vranka, Director  
4300 Cherry Creek Drive South  
Denver, Colorado 80246-1530

City of Boulder  
Water Quality and Environmental Services  
Attn: Mr. Ridge Dorsey  
4049 North 75<sup>th</sup> St.  
Boulder, Colorado 80301

U.S. Department of Commerce  
National Institute of Standards and Technology  
ATTN: Tom O'Brian, Director  
325 Broadway – MC 104.02  
Boulder, CO 80305-3328

**Information Provided Pursuant to Subpart 4(a) of July 2, 2008 Confirmatory  
Action Letter:  
Estimate of Release to the City of Boulder Sanitary Sewerage**

July 11, 2008

On June 9, 2008, a contamination incident occurred at the Boulder Laboratories of the National Institute of Standards and Technology (NIST) when a glass vial containing plutonium (Pu) powder broke. The individual handling the vial washed his hands in the sink in the laboratory resulting in an unauthorized and unmonitored release of Pu to the City of Boulder sanitary sewerage.

The Pu powder was a Certified Reference Material (CRM 138) isotopic standard provided by New Brunswick Laboratory and consisting of approximately 0.25 grams of Pu isotopes in the form of plutonium sulfate tetrahydrate.

Subsequent characterization measurements conducted by NIST staff and the Department of Energy/National Nuclear Security Administration (DOE/NNSA) Radiological Assistance Program (RAP) were used to estimate the amount of material retained in the laboratory.

The spill contaminated several areas of the laboratory, but it was not possible to measure all those areas during the initial response to the incident. The sealing of the lab after the initial response precluded further measurements.

For the purposes of the calculations of this report, NIST has assumed, *very conservatively*, that any Pu unaccounted for by measurements in the laboratory was released to the sanitary sewerage.

On June 19, 2008, DOE/NNSA RAP team personnel using an Ortec Detective EX-100 gamma nuclide identifier analyzed several items within the laboratory using the known amount ( $0.25 \text{ g} \pm 6\%$ ) of Pu in an unbroken CRM 138 to quantify the amount of Pu measured.

The broken vial and the metal container it was handled in were measured. After adjusting for counting errors, uncertainty in the amount of material originally in the vial, and geometric measurement factors, the DOE/NNSA RAP team and supporting analysts determined that between 44% and 54% of the original material remained in the broken vial and aluminum can.

The RAP team took a dry maslin wipe of the most highly contaminated area on the floor near the spill and counted the wipe by gamma spectroscopy. The gamma spectrum indicated between 16% and 24% of original material on the wipe. The RAP team also observed that the direct-reading dose rate of this area on the floor did not diminish significantly between the before-wipe and after-wipe conditions, indicating that significant activity remained on the floor.

Combined, the DOE/NNSA RAP team and triage analysis determined that between 60% and 78% of the original material remained in the broken vial and on the dry maslin wipe. As noted in the DOE/NNSA triage report, alpha survey results indicated remaining Pu contamination at several locations in the laboratory, notably a large hot spot on the floor, but also several smaller

spots on the floor, desk and countertop surfaces, a rolling table, a keyboard, and clothing worn by researchers. It is difficult to quantify the Pu present in these locations from the data provided.

To estimate the material left on the floor, NIST health physicists assumed that the maslin wipe removed 50% of the available material on the floor, an assumption that overestimates the amount removed given that the direct-reading dose rate did not change significantly after the wipe. Ignoring the material in the other locations, one concludes that *at least* an additional 16% to 24% of the original material remained on the floor after the wipe.

In summary, DOE/NNSA determined that 60% to 78% of the original material remained in the vial or was removed by the wipe. NIST determined that *at least* an additional 16% to 24% of the original material remained on the floor. The summed range of the estimates is therefore 76% to 102%.

If one estimates the amount of accounted-for material using the midpoints of each of the estimated ranges, *at least* 89% of the original material remained in the room; that is, *at most* 11% was discharged to the sanitary sewerage. If one estimates the amount of accounted-for original material using the lower limits of each of the estimated ranges, *at least* 76% of the original material remained in the room; that is, *at most* 24% was discharged to the sanitary sewerage. Given the conservative nature of the calculations, NIST believes that the actual percentage of the original material released was less than 11%.

The Nuclear Regulatory Commission (NRC) discharge limits<sup>1</sup> are based on monthly average effluent flow. NIST calculated the average effluent flow for June 2008, i.e., the month of the incident, by averaging measurements of the effluent flow conducted in May 2008 and July 2008, the result being 237,030 gallons per day. NIST contracts for these measurements in the odd months of every year to meet the requirement of its discharge permit with the City of Boulder.

The table below indicates NIST's current best estimate for the release to the sanitary sewer resulting from the Pu incident of June 9, 2008. Using the midpoints of the estimated ranges, one obtains a release of *at most* 11% of the original material, representing 49% of the NRC release limit. Using the lower limits of the estimated ranges, one obtains a release of *at most* 24% of the original material, representing 106% of the NRC release limit.<sup>2</sup> Given the conservative nature of the calculations, NIST believes that the actual release was less than 49% of the release limit.

Further characterization and refinements of the retained fraction may be provided as decontamination efforts progress.

---

<sup>1</sup> State discharge limits coincide with NRC limits.

<sup>2</sup> This result differs from that announced in a June 24, 2008 press release primarily because CRM 138 was purified and certified in 1966, not 1987 as assumed in the earlier calculations.

Central tendency Estimate of fraction released = 0.11

Maximum Fraction release = 0.24

Daily Average Effluent Volume\*\* (gallons) = 237030

Daily Average Effluent Volume (ml) = 8.972E+08

Isotope	Source term activity in vial*	Central Tendency Estimated Released uCi	Maximum Amount Estimated Released uCi	Central Tendency 30 day averaged effluent concentration uCi/ml	Maximum 30 day averaged effluent concentration uCi/ml	Isotope Specific 10CFR20 appendix B table 3 uCi/ml	Central Tendency Estimated Release % of limit	Maximum amount estimated release % of limit
Pu-238	4.30E+02	4.73E+01	1.03E+02	1.76E-09	3.83E-09	2.00E-07	0.88	1.92
Pu-239	1.40E+04	1.54E+03	3.36E+03	5.72E-08	1.25E-07	2.00E-07	28.61	62.42
Pu-240	4.45E+03	4.89E+02	1.07E+03	1.82E-08	3.96E-08	2.00E-07	9.09	19.82
Pu-241	2.07E+04	2.28E+03	4.98E+03	8.48E-08	1.85E-07	1.00E-05	0.85	1.85
Pu-242	3.28E+01	3.61E-02	7.87E-02	1.34E-12	2.93E-12	2.00E-07	0.00	0.00
U-234	5.15E+02	5.66E-03	1.24E-02	2.10E-13	4.59E-13	3.00E-06	0.00	0.00
U-235	5.85E+00	6.44E-01	1.40E+00	2.39E-11	5.22E-11	3.00E-06	0.00	0.00
U-236	5.40E+03	5.94E-04	1.30E-03	2.21E-14	4.81E-14	3.00E-06	0.00	0.00
Am-241	4.46E+03	4.91E+02	1.07E+03	1.82E-08	3.98E-08	2.00E-07	9.12	19.89
Np-237	3.52E+02	3.88E-03	8.46E-03	1.44E-13	3.14E-13	2.00E-07	0.00	0.00
U-238	4.46E+06	4.91E-07	1.07E-06	1.82E-17	3.98E-17	3.00E-06	0.00	0.00
<b>Sum=</b>	<b>4.41E+04</b>	<b>4.85E+03</b>	<b>1.06E+04</b>		<b>3.93E-07</b>		<b>49%</b>	<b>106%</b>

\* Source term activity in vial is based on information provided to NIST on July 9, 2008 by New Brunswick Laboratory, U.S. Department of Energy.

\*\* Effluent flow rate is based on the average of flow rates measured in May 2008 and July 2008.