Radiation Sources at the U.S. Capitol and Library of Congress Buildings

By Steven J. Milloy and Michael Gough[1]

Summary

Gamma radiation dose rates were measured at several locations in and around the U.S. Capitol and U.S. Library of Congress buildings in Washington, D.C. A qualified radiation surveyor used a Bicron MicroRem meter for measuring. Dose rates inside the Capitol building and outside the Thomas Jefferson Building were measured at 30 microrem per hour. This dose rate: (1) exceeds local background radiation dose rates; (2) is up to 550 percent greater than the typical dose rate "at the fence line" around nuclear power plants; (3) is about 13,000 times greater than the average individual dose rate from worldwide nuclear power production; (4) is about 13,000 times greater than ongoing worldwide exposures to radiation from the Chernobyl accident; and (5) exceeds the dose rate associated with the radiation protection standards proposed for the Yucca Mountain high-level nuclear waste facility. The measured level of radiation is associated with up to a 0.5 percent increase in cancer risk, according to U.S. EPA risk assessment methods.

Introduction

Humans are exposed to natural and manmade sources of ionizing radiation. Natural sources include terrestrial sources (such as soils and building materials) and cosmic sources (such as gamma rays from space). Manmade sources include medical x-rays and other technological applications of radioactive materials. Background radiation exposures in the U.S. average about 360 millirem per year (mrem/yr).[1]

Ionizing radiation can cause a variety of health effects. These effects are classified as either "non-stochastic" or "stochastic." Non-stochastic effects are those for which the damage increases with increasing exposure, such as the destruction of cells or reddening of skin. They are seen in cases of exposures to large amounts of radiation.

Stochastic effects are associated with long-term exposure to low levels of radiation. Their type or severity does not depend upon the amount of exposure. Instead, the chance that an effect, for example, cancer, will occur is assumed to increase with increasing exposure.

The three categories of stochastic effects are cancer, mutations and teratogenic effects. Cancers caused by radiation are indistinguishable from those occurring from other causes. Cancers attributed to radiation have been reported in humans. However, the risk of cancer at the exposure levels normally encountered by members of the public must be estimated by statistical extrapolation from higher doses.

The U.S. Environmental Protection Agency assumes there is no safe level of exposure to radiation. In its proposal to establish radiation protection standards for exposures to the public from the high-level nuclear waste repository at Yucca Mountain, Nevada,[2] the EPA specifically

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declined to set a "negligible incremental risk" level.[3] The EPA did acknowledge, however, that health effects resulting from a 0.0003 mrem/yr dose rate were "uncertain."

Based on these and other determinations, the EPA proposed to establish radiation protection standards for Yucca Mountain ranging from 4 mrem/yr for individual exposure from radionuclides in ground water to 15 mrem/yr for individuals from all radionuclide exposure pathways. The 15 mrem/yr standard corresponds to an incremental or "extra" 3 in 10,000 chances of contracting a fatal cancer over the course of a lifetime. The EPA proposed that the Department of Energy ensure compliance with these standards for 10,000 years.

Sen. Harry Reid (D-Nev) recently expressed concern that President George W. Bush might direct the EPA to revise the proposed radiation standards for Yucca Mountain to make them less stringent.[4] To gain perspective on the EPA proposal and Sen. Reid's concerns, we undertook to measure radiation exposures in and around the U.S. Capitol and Library of Congress buildings.

Methods

Radiation dose rate measurements were made at various locations in and around the U.S. Capitol building and Library of Congress' Thomas Jefferson Building.

A qualified radiation surveyor measured the dose rates. A qualified health physicist provided oversight.

Ambient gamma and contact survey data were recorded on Radiological Survey Forms.

Cancer risk estimates were developed with methods used by the EPA in proposing radiation protection standards for the Yucca Mountain facility.[5]

Results

Measured gamma radiation dose rates for 10 sites are presented in Table 1. As shown, three locations were measured for background radiation dose rates. The radiation dose rates at the seven survey sites significantly exceed the background dose rates.

The highest dose rates were measured inside the U.S. Capitol building and outside the entrance to the Thomas Jefferson Building. The highest level was 30 microrem per hour (μrem/hr) from: (1) the red marble pedestal for the statute of Roger Williams located in the hallway between the Capitol Rotunda and the Senate Chamber; and (2) street-level granite blocks of the Thomas Jefferson Building.

Table 1. Background and Survey Site Dose Rates		
Measurement Type	**Location**	**Maximum Dose Rate (microrem per hour)**
Background	U.S.Capitol – East exit	5.5
Background	Supreme Court – Street level	3.5
Background	First & C Sts., SW	6.5
Survey site	Library of Congress, Thomas Jefferson Building – Street level	30
Survey site	Pedestal for the statue of Jeanette Rankin - Main House Hallway, U.S. Capitol	16
Survey site	Pedestal for the statue of John McLoughlin - Main House Hallway, U.S. Capitol	20
Survey site	Pedestal for the statue of Florence Sabin – Statuary Hall – U.S. Capitol	20
Survey site	Pedestal for the statue of Abraham Lincoln – U.S. Capitol Rotunda	19
Survey site	Pedestal for the statue of Roger Williams – Rotunda/Senate Chamber Hallway, U.S. Capitol	30
Survey site	Dirksen Senate Office Building Wall – First Street side	22

Discussion

Radiation dose rates measured at surveyed locations exceed dose rates associated with: (1) "background" radiation; (2) nuclear power production; (3) ongoing exposures from the Chernobyl accident; and (4) the EPA proposal for the Yucca Mountain high-level nuclear waste repository. The measured dose rates are associated with up to a 0.5 percent increase in cancer risk when analyzed using EPA risk assessment methods.

Radiation Levels

Typical radiation dose rates around nuclear power plants range from 5 µrem/hr to 20 µrem/hr.[6] The dose rates measured at the Roger Williams statue and outside the Thomas Jefferson Building exceed this dose rate by between 50 percent to 550 percent.

Nuclear energy production and the accident at the Chernobyl nuclear power plant each produce an average worldwide radiation dose rate of about 20 µrem/yr, according to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).[7] The radiation dose rates

measured at the Roger Williams statue and outside the Library of Congress exceed this dose rate by about 13,000 times.

Cancer Risks

For radiation protection purposes, the EPA uses the linear, non-threshold dose-response model (LNT) to predict cancer risk from low-level radiation exposures. The EPA estimates five to six of 100,000 people receiving a uniform radiation dose of 100 mrem/yr to the entire body at a low rate will die of cancer. This is in addition to the roughly 20,000 fatal cancers that are expected to occur in the same population from all other causes.

An individual exposed to the maximum measured dose rate for a typical 2,000-hour working year would incur a radiation dose of 60 mrem/yr. This exposure level is 4 times and 15 times higher than the Yucca Mountain all-pathways and ground water exposure standards, respectively. These exposures correspond to an incremental 1 in 1,000 chances of experiencing a fatal cancer over the course of a lifetime.

An individual exposed to the maximum measured radiation dose rate on a constant basis would incur a radiation dose exceeding 260 mrem/yr. This exposure level is 17 times and 65 times higher than the Yucca Mountain all-pathways and ground water exposure standards, respectively. These exposures correspond to an incremental 5 in 1,000 chances of experiencing a fatal cancer over the course of a lifetime.

The EPA typically orders Superfund-type clean-ups where incremental cancer risks exceed 1 in 10,000 chances. The incremental cancer risks associated with the Roger Williams statue and Thomas Jefferson Building are 10 times and 50 times greater than the Superfund clean-up trigger level.

Although it is unlikely that any individual would spend a great deal of time at the Roger Williams statue or outside the Thomas Jefferson Building, employees and visitors may be exposed to other similar radiation sources in and around the U.S. Capitol. Ubiquitous marble and granite building materials may emit gamma radiation at similar or higher levels. These cumulative exposures could be comparable to long-term exposures to the Roger Williams statue and Thomas Jefferson Building.

Our exposure scenarios are reasonable in light of current EPA practices for Yucca Mountain.[8] The proposed standards for Yucca Mountain are based on the improbable exposure scenario of a subsistence farmer living near the Yucca Mountain site 10,000 years from now.

There is uncertainty in these risk estimates. A recent analysis published by the National Council on Radiation Protection and Measurements (NCRP Report 126) estimated that the actual risk of cancer from whole-body exposure to low doses of radiation could be between 1.5 times higher and 4.8 times lower (at the 90 percent confidence interval) than the LNT methodology used by the EPA.

Further, existing epidemiologic data do not rule out the existence of a threshold dose, a radiation dose below which radiation does not increase cancer risk.

The risks of genetic abnormalities and mental retardation are less well known than those for cancer and, thus, may include a greater degree of uncertainty. It is possible that the risks are the same as, less than or greater than for cancer.

Despite these uncertainties, estimates of the risks from exposures to low levels of ionizing radiation are better understood than for virtually any other environmental carcinogen, according to the EPA.

Conclusion

We measured radiation dose rates inside the U.S. Capitol building and outside the Library of Congress' Thomas Jefferson Building to be substantially greater than the dose rates associated with background radiation, radiation from nuclear power production, ongoing worldwide radiation exposures from the Chernobyl accident and the radiation protection standards proposed by the EPA for the high-level nuclear waste repository at Yucca Mountain. Potential exposures to these radiation sources may increase the risk of fatal cancer by as much as 0.5 percent based on EPA risk assessment practices.

References

[1] National Council on Radiation Protection and Measurements, Report No. 91, "recommendations on Limits to Ionizing Radiation", June 1, 1987.

[2] The Yucca Mountain facility is located in Nye County, Nevada, about 100 miles northwest of Las Vegas on federally owned land on the western edge of the Department of Energy's Nevada Test Site. If approved, the repository will be built approximately 1,000 feet below the top of the mountain and 1,000 feet above the ground water. Spent nuclear fuel and high-level radioactive waste make up most of the material to be disposed at Yucca Mountain. Approximately 90% of the waste proposed for disposal is from commercial nuclear power plants, with the remainder coming from defense programs.

[3] U.S. Environmental Protection Agency. 64 FR 46975, "Environmental Radiation Protection Standards for Yucca Mountain" (Proposed Rule), Nevada (August 27, 1999).

[4] Las Vegas Review-Journal, "Reid fears new EPA administrator may roll back radiation standards," (January 18, 2001).

[5] U.S. Environmental Protection Agency. 64 FR 46975, "Environmental Radiation Protection Standards for Yucca Mountain" (Proposed Rule), Nevada (August 27, 1999).

[6] *See* e.g., Associated Press, Radioactive steam leaks at Indian Point 2," (February 16, 2000).

[7] *See e.g.*, http://www.un.org/ha/chernobyl/unsceare.htm.

[8] The EPA's exposure scenarios for Yucca Mountain extend 10,000 years in the future and assume subsistence living in the vicinity of the nuclear waste repository.