(10)

JUN 8 1989

Mr. John Radin, City Manager
City of Watsonville, City Hall
P. O. Box 430
Watsonville, California 95077

Dear Mr. Radin:

In your letter of April 12, 1989 to the Secretary of the U.S. Nuclear Regulatory Commission (NRC), you asked to be advised of proposed changes in regulations which would allow certain low-level radioactive waste to be disposed of at municipal facilities.

In response to your concerns, I would first point out that the NRC has not published any proposed regulations which would allow disposal of low level waste in public landfills or incinerators. The NRC, however, is in the process of developing a regulatory "exemption" policy which would be applicable to the use, distribution, or disposal of radioactive material. As a key step in this development effort, the Commission issued the enclosed advance notice in the Federal Register on December 12, 1988 and solicited public comment. In part, this initiative, and a final procedural statement of policy issued in August 1986, are directed toward NRC responsibilities defined in the Low Level Radioactive Waste Policy Amendments Act of 1985. It is true that this exemption policy could provide the underpinning for the development of subsequent Commission regulations and that these regulations could address disposal of very low level radioactive waste at other than licensed low-level radioactive waste disposal sites.

With regard to the possibility of future regulations, NRC is aware that the nation's nuclear utilities are funding research to determine, in their view, what low-level radioactive waste could be potentially classified as "below regulatory concern." We have been informed that the utilities are working through their research institute and management council and that they intend to submit a petition for rulemaking to the NRC within the next few months. This petition, and any potentially resulting Commission regulation, would be published for public comment in keeping with standard NRC procedures.

I believe, and I hope you would agree, that the issue of proper and reasonable disposal of all our society's waste is one upon which the public's attention is, and should continue to be, rightly focused. In fact, the NRC's goal in formulating its exemption policy is to attempt to address this issue for radioactive materials - providing for public health and safety and protecting the environment while effectively using and disposing of radioactive material in an optimum fashion.

Along with the copy of the advance notice, I have enclosed a copy of an International Atomic Energy Agency document which you may find informative. Please accept my apology for this belated reply. However, if you have further questions or if I can be of further assistance, please contact me at (301) 492-3774.

Sincerely,

William R. Lahs
Regulation Development Branch
Division of Regulatory Applications
Office of Nuclear Regulatory Research

Enclosures:
1. Federal Register Advance Notice
2. IAEA Safety Series Document

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103

Recommendations for Radioactive Waste Reduction in Biomedical/Academic Institutions

(*Received* 23 *June* 1988)

Dear Editors:

AFTER REVIEWING the field of low-level radioactive waste (LLRW) for the Annual Review Of Public Health, it is apparent that many academic, biomedical, governmental and industrial institutions do not characterize their LLRW sufficiently to achieve maximum volume reduction and waste minimization. Most of the biomedical/academic LLRW does not have to, and should not, be buried. A careful analysis of the biomedical waste stream at this university has shown that a reduction of greater than 95% in the volume of waste, which must be shipped for burial, is achievable. The decay of short-lived radioisotopes on-site can eliminate 74% of the materials now shipped for burial. Essential to this important step is the institution's allocation of 100–200 m^2 (1000–2000 square feet) of space in which 55 gallon drums can be stored for decay for interim periods prior to disposal of the materials as non-radioactive liquids and trash. Most of the following practices have been implemented at The Rockefeller University. The combination of segregation, compaction, decay of short-lived isotopes and regulated sewage disposal represented a 96% reduction in volume of radioactive waste shipped, a saving of $271,000 in 1987. Detailed comparison of the radioactive waste profiles of the nine major biomedical institutions in New York City suggests that these volume reduction steps are generally applicable. Apart from the obvious reduction in costs and liabilities for the generating institutions, these volume reductions have an effect upon the waste disposal policies now being drafted across the country in response to the Low-Level Radioactive Waste Policy Amendments Act of 1985. The collective action by the biomedical and academic community would impact the LLRW disposal problem and provide leadership crucial to assuage the public confidence.

Waste Identification

It is essential that waste be segregated and labelled according to isotope and form. Labels should contain the information upon which disposal decisions will be based: department, name of generator, building and room number, phone number, date, volume of waste, isotope, activity (Bq, μCi or mCi), form (gas, liquid-aqueous, liquid-organic, solid, carcass/tissue, scintillation vials, other), unabbreviated chemical and biological names and percentages of all components. All wastes contaminated with radioactive materials should be collected and centrally processed.

Waste Categories

Solid waste, consisting of plastic and glassware, papers, gloves, spent electrophoretic gels, chromatography resins, needles and syringes, and occasionally some sealed sources, normally contains less than 10% of the total activity disposed. It should be packed in clear plastic bags to allow inspection of the contents. Needles, Pasteur pipettes and other sharp objects should be placed in puncture-proof containers.

1. *Short-lived isotopes*. Waste from isotopes with half-lives of 90 d or less should be separated in groups according to half-life and volume and held for decay. For example, if the waste stream contains predominantly ^{32}P, ^{125}I and ^{35}S, divide it into three groups: group I, half-life of 1–15 d; group II, half-life of 16–65 d; group III, half-life of 66–90 d. Waste decayed to "background," or to a *de minimis* level, should be verified with a survey meter and then incinerated as laboratory waste or disposed as trash.

2. *Long-lived isotopes*. *De minimis* and "below regulatory concern" (BRC) levels for these wastes should be sought from the NRC or regulatory authority, since the total amount of radioactivity is low and its specific activity is comparable to currently deregulated waste. At present, $^3H/^{14}C$ waste and waste from other isotopes with half-lives greater than 90 d should be compacted and shipped to a commercial disposal facility. Laboratory waste can be compacted at an average ratio of 6 to 1 with a 9.5 ton drum compactor to reduce the volume of waste shipped.

Liquid waste contains more than 90% of the radioactivity disposed. It should be collected in polyethylene bottles (4–20 L, 1–5 gal) which, unlike those of glass, are unbreakable, produce less bremsstrahlung, are impervious to most organic chemicals and do not form sharp edges when compacted. Pathogenic materials should be inactivated with a bleach solution, e.g., 10% chlorine bleach, prior to collection. Radioiodine waste should be collected into bottles containing enough sodium thiosulfate to bind free I (0.1 M final concentration).

1. *Aqueous liquids* should have a pH between 6 and 9. The individual generator has the responsibility for adjusting the pH of the waste. The pH is verified upon collection.

(a) *Short-lived isotopes* should be poured in plastic drums, a growth retardant added (e.g., 4 mL chloroform, 0.93 g sodium dodecyl sulfate, 0.33 mL methanol per gallon of waste), sampled for radioactivity and held for decay. Before disposal, the liquid should be sampled to verify that it has reached background levels. Records should be kept of the initial and final activities.

(b) *Long-lived isotopes* should be sampled for activity, measurements recorded, and released into the sanitary sewer in accordance with the regulations (10 CFR Part 20.303). The NRC allows 1.85×10^3 MBq (5 Ci) of ^3H, 3.7×10^1 MBq (1 Ci) of ^{14}C and 3.7×10^4 MBq (1 Ci) per y of other isotopes to be discarded as sewage. Reduce the number of drains used, possibly to only one, and choose them in locations that will minimize the contamination of plumbing.

2. *Organic liquids*, belonging to the "mixed waste" category, should be segregated according to their chemical components, e.g., phenol, chloroform, methylene chloride, and sampled for radioactivity. They constitute a very small fraction of the volume and activity of the waste, therefore BRC levels should be sought. Then they should be incinerated under permit, treated to separate the radioactive from the organic components, degraded by microorganisms, or held until there is an accepted outlet for this type of mixed waste even though it is illegal to hold these wastes longer than 90 d or 180 d depending on the location of the nearest treatment facility.

Animal tissues, which may also contain pathogens and carcinogens, should be incinerated to reduce the handling, the number of people exposed, and the time between generation and final destruction. Materials containing 1.85 kBq g^{-1} (0.05 μCi g^{-1}) or less of ^3H and/or ^{14}C should be incinerated as per NRC guidelines (10 CFR Part 20.306). *De minimis* and BRC levels for other isotopes should be obtained.

Scintillation Vials

- Preferentially, one should use mini vials since they bring a substantial savings in the volume of cocktail needed for counting as well as the volume of waste for disposal. A 55 gallon drum holds approximately 10,000 mini vials but only 3,000 maxi vials; both contain 5–10 gallons of liquid.
- The number of counts per vial should be limited. Statistically, there is little reason to exceed 10,000 cpm per vial when counted at high efficiency. Vials that exceed this amount should

B144

be segregated and held for dilution of their contents with less radioactive scintillation fluid.

• Count ^{32}P without scintillation fluid by the Cerenkov method on the ^{3}H setting of a liquid scintillation counter (~40% efficiency). These vials should be kept separate, held for decay, crushed and discarded.

• Count ^{125}I without scintillation fluid in a gamma scintillation counter, hold for decay and discard as non-radioactive waste.

• Vials containing ^{3}H, ^{14}C or other radioisotopes should be cracked and the fluids collected and sampled for activity. (An inexpensive crusher which efficiently breaks glass maxi and mini vials with hard caps is the Mark4, Balkan Ltd., England; soft plastics cannot be processed through this machine.)

• Flammable fluids containing 1.85 kBq g^{-1} (0.05 μCi g^{-1}) of ^{3}H and/or ^{14}C should be incinerated on site if possible or at the closest acceptable site and *de minimis* levels for other radioisotopes should be sought. In the mean time, flammable fluids containing 74 Bq (0.002 μCi g^{-1}) of other isotopes can be disposed through Quadrex HPS Inc., Gainesville, Florida.

• Fluids biodegradable by municipal sewage treatment should be discarded as sanitary sewerage.

• The crushed glass and plastic contains only a small fraction of the radioactivity present in scintillation vials but still has a small amount of the fluid; therefore, it should be incinerated over a bed of ashes or at least washed with 95% ethanol. Ash samples should be counted regularly to confirm that no radioactivity is present.

With present regulatory constraints, only compacted long-lived waste, mainly ^{3}H and ^{14}C, animal waste containing radioisotopes other than ^{3}H and ^{14}C, and some sealed sources, need to be sent to a disposal site. Most of these wastes could be eliminated by *de minimis* and BRC rulings, leaving only "mixed wastes" and some sealed sources.

E. Party and E. L. Gershey

The Rockefeller University
1230 York Avenue
New York, NY 10021

NRC, NCRP, ICRP and Recommendations on Prenatal Radiation Exposure

(*Received* 15 *August* 1988)

Dear Editors:

U.S. NUCLEAR Regulatory Commission (NRC) Regulatory Guide 8.13—Revision 2, December 1987, states that the NRC has proposed adoption of the 1987 Presidential guidance on prenatal radiation exposure. The Presidential guidance specifies an effective dose equivalent limit of 5 mSv (500 mrem) to the unborn child if the pregnancy has been declared by the mother. The guidance also recommends that substantial variations in the rate of exposure be avoided. A critical analysis of the recommendations reveals some problems.

I. *What is the risk to the embryo/fetus from* 5 mSv (500 mrem) *delivered uniformly over a 9-mo period?*

Based on data provided by the NRC in Table 1 of Regulatory Guide 8.13, I calculate a total risk of 14 in 10,000 as follows:

1. Risk of death from childhood cancer: 3 in 10,000.
2. Risk of small head size: 7 in 10,000 (risk of 2.7 in 10,000 from 50 mrem received during 4–7 wk; and a risk of 4.6 in 10,000 from 50 mrem received during 8–11 wk).
3. Risk of mental retardation: 4 in 10,000 from 100 mrem received during 8–15 wk.

Based on a 1986 report from the United Nations Scientific Committee on the Effects of Atomic Radiation, the National Council on Radiation Protection Report No. 91 (NCRP 1987) states that the total risk for the embryo/fetus is about 0.2 per Sv. This corresponds to a risk of 10 in 10,000 for 5 mSv (500 mrem).

Neither a risk of 10 in 10,000 (NCRP 1987) nor a risk of 14 in 10,000 (NRC 1987) is acceptable if the recommendation of NCRP Report No. 91, of a generally acceptable risk of 1 in 10,000, is to be followed. Either the risks to the embryo/fetus have to be downgraded, or the recommended dose to the embryo/fetus has to be reduced or the mother should be informed that the recommended prenatal dose exposes her unborn child to a risk about 10 times higher than is generally acceptable.

II. *Why and how should substantial variations in the rate of exposure be avoided?*

The justification for the recommendation that substantial variations in the rate of exposure be avoided is not given in the Regulatory Guide. What is meant, as stated in NCRP Report No. 91, is that the fetus/embryo should not receive substantially large fraction(s) of dose during sensitive stage(s).

But, since the sensitive stages are within 2 to 3 mo following conception, when a woman may not even be aware of her pregnancy, the recommendation does not have much practical relevance, especially if pregnancy has to be declared by the mother for the recommendation to be implemented.

To get around this problem, the International Commission on Radiological Protection Report No. 26 (ICRP 1977) recommends that women not work in areas where the annual dose may exceed 15 mSv (1.5 rem).

But, this restriction puts women at a disadvantage in the job-market. Violations of the "equal maximum permissible dose (MPD) for equal work" principle would have to be permitted and discrimination based on sex and fecundity status accepted if fertile women are to compete with others on an "equal footing" in the radiation industry.

Additionally, the ICRP recommendation may be unnecessarily restrictive in view of NCRP suggestion in Report No. 91 that a yearly MPD of 50 mSv (5000 mrem), in most cases, would not result in an embryo/fetus dose of more than 5 mSv (500 mrem). If the woman is working with low energy radiation, as would be the case for most x-ray technologists in diagnostic radiology, the mother's abdomen would provide significant attenuation.

Before concluding, I cannot help but draw the attention of the readers of *Health Physics* to the following statement on page 8.13-6 in Regulatory Guide 8.13:

"*Actually everything is radioactive and all human activities involve exposure to radiation.*"