UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD

EPA-SAB-RAC-LTR-92-018

Honorable William K. Reilly
Administrator
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D. C. 20460

Re: Drinking Water Treatment Wastes Containing NORM

Dear Mr. Reilly;

The Radiation Advisory Committee reviewed the Office of Drinking Water's "Suggested Guidelines for the Disposal of Drinking Water Treatment Wastes Containing Naturally-Occurring Radionuclides" dated July 1990. Staff from both the Office of Drinking Water and the Office of Radiation Programs briefed the Committee at its public meeting May 21-22, 1992; the American Water Works Association provided public comment.

Guidelines for the disposal of drinking water treatment wastes containing naturally occurring radionuclides are certainly needed because of the potential radiation doses to treatment plant workers and to the public. In developing these guidelines, the Office of Drinking Water has clearly recognized the potential importance of this source of exposure. The Committee applauds this move. However, the Guidelines document lacks information needed to fully assess the magnitude of risk from exposure to radioactivity in drinking water treatment wastes. (Such a risk assessment is also missing from the regulations proposed in July 1991.) The need for such an assessment was cited by the SAB in its Drinking Water Closure Commentary (EPA-SAB-RAC-COM-92-003). Another important shortcoming is the failure to specify whether the radiation exposures to drinking water treatment plant workers should be considered as occupational exposures or be viewed against the dose limits for the general public. This decision will have considerable bearing on any final guidelines. The Agency should also reevaluate the numerical criteria for the disposal of wastes containing lead-210.

In the individual sections below, the Committee has spelled out its concerns and provided recommendations in regard to each of these specific issues. Some recommendations, which address policy, are based on the members' practical experience in administration of control programs for radiation in the workplace and in the environment. We would first like to emphasize two of our conclusions and then present the responses to the charge.

The "Guidelines" are needed. The Committee commends the Office of Drinking Water staff for recognizing that public water supply system operators will need guidance both about the management and disposal of the drinking water waste residues and about protecting treatment plant workers. Compliance with the proposed drinking water regulations will result in concentration of naturally occurring radionuclides in the waste that results from treatment to meet the regulations. Few water supply personnel currently have expertise or experience with ionizing radiation exposure, nor do they have much experience with the disposal of low-level radioactive wastes. Thus unless the report is carefully written, this inexperience may lead the states and water treatment system operators to rigid compliance with the "Guidelines" suggestions in places where more experienced persons could develop alternative acceptable options for handling and disposal of radionuclide-contaminated water treatment wastes.

Sometimes it is more important to ask the right questions than to get the right answer on the first try. By July 1990, before the Science Advisory Board released Reducing Risk (September 1990), before the Radiation Advisory Committee commentaries on residual radioactivity and radionuclides in drinking water (1992), and before prominent discussions of "risk-risk" analysis such as those which took place at the July 1992 Executive Committee meeting, the Office of Drinking Water staff had developed the "Suggested Guidelines for the Disposal of Drinking Water Treatment Wastes Containing Naturally-Occurring Radionuclides". It appears that the staff recognized a very important issue early, exercised initiative in addressing it in the face of limited resources with which to do so, and approached it in a procedurally appropriate way. That the Committee found significant difficulties with the "Guidelines" document which render it inadequate for the intended purpose is not surprising since it is a first effort on a complex topic where a coherent federal regulatory structure does not exist.

The Committee is pleased that the ODW staff attempted to address this problem. These recommendations essentially encourage the Agency to obtain additional information, to explore the issues more fully, and to reach decisions on certain key policy questions that will affect the strategies adopted by water supply

operators. The Committee's critique of the document is intended to strengthen the document, not to discourage others from attempting similar analyses.

The "Guidelines" Should Be Revised. The Committee recommends that the Agency strengthen the "Guidelines" by obtaining additional data and by clarifying both the scientific rationale and the policy decisions underlying many of the recommendations. Improved "Guidelines" are very important because of potential radiation doses to workers and the public and because of the costs that states and water supply system operators will face dealing with these matters. The 1990 "Guidelines" lack critical information about waste volumes and levels of radioactivity which would allow informed decisions about water supply treatment methods, worker protection, and waste disposal. As a result, the recommendations presented in the "Guidelines" and the underlying rationales for them are not as clear as they should be for a document of this importance.

Response to the Charge. The charge for this Committee-initiated review was negotiated between the Committee and the Office of Drinking Water. The Committee's response to the individual questions in the charge appear below.

> 1. In the Guidelines document, the ODW summarized well-documented drinking water treatment technologies and disposal practices. (The summary does not include a critical evaluation of treatment technologies for Best Available Treatment (BAT) identification and costing purposes which appears in a different document.) Are the relevant available treatment technologies and available disposal practices correctly characterized?

The 1990 "Guidelines" document includes all the relevant treatment technologies but describes them only in general terms. Because the discussion of both the treatment technologies and the waste disposal practices is highly qualitative, the "Guidelines" document is not sufficient by itself for making scientific, engineering or economic choices. (Such information may exist in the separate evaluation of the treatment technologies for Best Available Treatment (BAT) which the Committee did not review.) The Committee recommends that such quantitative information be integrated into any final guidance package assembled by the Agency to be provided to interested organizations and individuals.

Neither the "Guidelines" document nor any document the Committee has seen contains an analysis of the public and occupational aspects of this issue. The revised document should examine the effect on radionuclide build-up at inlet radionuclide concentrations typically encountered. Such information could define the magnitude of the waste problem, allow estimates of personnel exposure, and provide a better basis for assessing available treatment options.

2. The ODW compiled background and technical criteria from many sources. Are the background materials and numerical criteria used in creating the 1990 Guidelines document still scientifically supportable and current, especially in terms of specific limits for solid waste disposal?

Additional consideration is needed of the numerical criteria used in creating the 1990 Guidelines document, especially with regard to the specific radioactivity limit for solid waste disposal.

A discussion of the scope and magnitude of the worker exposure and waste disposal problems would strengthen the revised "Guidelines". The discussion should include an estimate of the number of locations that may be affected and the number of workers and members of the public that may be exposed to various radiation levels. Elevated concentrations of radionuclides in water are more apt to be found in groundwater than in surface supplies and those concentrations depend upon the local geology. Therefore, the Committee suspects that water supply systems with elevated concentrations of radionuclides may be clustered and that small systems may be disproportionally affected as they are more likely to rely on wells.

The revised "Guidelines" should clarify the rationale for the specific radionuclide limits for waste disposal. In particular, additional consideration and discussion of the limits for lead-210 presented in the 1990 "Guidelines" document are needed. Guidelines for lead-210 are important because they will be a major factor in determining the feasibility of using granular activated carbon to remove radon from drinking water. The "Guidelines" state that "suggested guidelines for radium may also be applied to the radon progeny lead-210," which seems inappropriate since the guidelines for radium rely primarily on risks associated with radon gas with secondary consideration of direct external gamma exposure. Lead-210 does not emit radon and the risk from direct external gamma exposure per unit activity quoted in the "Guidelines" document is three orders of magnitude

lower for lead-210 than for radium-226. Although the lifetime ingestion risk presented in the document for lead-210 in soil is higher than the ingestion risk presented for radium-226, this ingestion risk for lead-210 is still 7 times lower than the risk from external gamma exposure from radium presented in the document. Thus, the basis for applying radium limits to lead-210 is not apparent.

The 1990 "Guidelines" document appears to assume that ingestion risks result from an individuals's total intake of vegetables, meat and milk coming from land contaminated at the level specified for the disposal residue. This assumption is conservative because it is unlikely that an individual's total food supply would come from a single location and because radionuclides would have to leach from the residues and migrate to the location of food production in order to expose persons as assumed in the analysis. The revised "Guidelines" should present data on the relationship between the radionuclide activity per gram of drinking water treatment waste and the activity per gram in the soil that could result in exposure to members of the public, either directly or through the food supply. The revised document should: (1) analyze the desorption of lead-210 contained on granular activated carbon used to remove radon from water, (2) address the migration of lead-210 away from the waste disposal area, and (3) consider the radioactive decay of lead-210 because lead-210 levels would decrease by a factor of approximately 30 over 100 years.

3. Are the rationale and guidance for selection of treatment technologies and waste disposal practices clear?

The treatment technologies were discussed under the responses to questions #1 and #2. The Committee found that the rationale and guidance for selection of treatment technologies lacks critical information for assessing the available treatment options.

The disposal of materials containing naturally-occurring radionuclides is a complex problem which has not been addressed in a systematic way by the federal government. Although the 1990 "Guidelines" identifies and considers relevant federal regulations, it is, understandably, somewhat unclear in its recommendations. The "Guidelines" should be revised to make both the scientific and policy rationales clear to the reader.

The 1990 "Guidelines" document describes liquid and solid waste streams only in terms of their likely radionuclide contamination although it is clear that,

in some cases, other hazardous contaminants as classified by RCRA may also be present. When such contaminants are present in sufficient concentration, the waste may be classified as a "mixed waste" and require special disposal. An exhaustive review of non-radioactive co-contaminants is not warranted; however, examples where this problem exists or might exist should be noted in order that water supply system operators be alerted to the potential this has for limiting available disposal options.

Some disposal options for liquid wastes are addressed under current regulations. Discharge to storm sewers and surface waters requires an National Pollutant Discharge Elimination System (NPDES) permit. Injection underground may require a Underground Injection Control (UIC) permit, depending on the radionuclide concentrations. The document's advice with respect to underground injection of liquid wastes contaminated with radionuclides (but which are defined as non-radioactive by the EPA's Underground Injection Control program) appears reasonable, but it is not clear whether the 'extensive' permitting process currently in place does indeed take the radionuclide contamination adequately into account.

In the case of discharge of liquid wastes to sanitary sewers, the "Guidelines" document recommends adherence to existing Nuclear Regulatory Commission (NRC) regulations which apply only to NRC licensees. (The NRC has revised these regulations since the publication date of the "Guidelines".) The applicability of these NRC recommendations to drinking water supply systems might be different than their applicability to other facilities (such as nuclear power plants) licensed by the NRC. Therefore, the Committee suggests that if the Agency wishes to retain this recommendation on discharge to sanitary sewers, it should provide a clear rationale for doing so.

Figure 1 in the "Guidelines" document, which summarizes the disposal alternatives, could be improved by making a clear distinction between situations where existing regulations apply and those situations where the "Guidelines" propose to add new requirements.

Although the "Guidelines" note that provisions of Resource Conservation and Recovery Act (RCRA) apply to solid wastes from water treatment, the document describes disposal concerns, etc., as if the RCRA regulations do not apply, or do not apply in all cases. Some clarification of this point should be made. Disposal of solid wastes from water treatment must meet RCRA Subtitle D criteria for sanitary landfills since they are solid wastes. Thus, even without the "Guidelines",

these wastes will be disposed in facilities that control releases to the environment for a significant period. Yet, the document lists a full range of concentration levels for wastes which would already be addressed implicitly by RCRA Subtitle D criteria. Identifying the radioactivity concentrations in treatment wastes above which Subtitle D criteria are no longer sufficient would provide a simpler guide and remove any conflict or redundancy with existing RCRA regulations.

The "Guidelines" also segregate the disposal procedures by activity concentration for radium, uranium and lead-210; however, the document does not discuss the sampling procedures or averaging periods used to determine these quantities. The revised "Guidelines" should address the sampling procedures and averaging periods because these are important for the implementation of the guidance offered.

4. Is the recommended radiation exposure guidance for workers complete, appropriate, and clear?

The basis for the guidance is not clear. No case is made whether the radiation exposures to treatment plant workers should be considered occupational exposures[1] or whether the workers should be treated as members of the general public. The basis for the eventual guide is largely determined by this distinction, and the revised document should address this point. Subsequently, it is not clear whether the suggested external gamma-radiation exposure guide is (1) based on a policy of ALARA[2] or whether it is (2) based on an apportionment of the widely accepted guidance of a maximal permissible dose of 100 mrem/yr for the general population.[3]

The "Guidelines" conclusion (p.33 paragraph 4) that an occupational exposure level of 25 mrem/year for external and committed effective dose equivalent is reasonably achievable at water treatment plants is unsupported; the

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[1] The "Radiation Protection Guidance to Federal Agencies for Occupational Exposure" limits dose to workers to an upper bound of 5,000 mrem per year and recommends that doses be as low as reasonably achievable (ALARA) and that doses not approach the limit for substantial portions of a working lifetime.

[2] ALARA is defined by the International Commission on Radiological Protection as meaning as low as reasonably achievable taking into account economic and social factors. The relevant economic and social factors are often considered to be those relating to health protection.

[3] The "Guidelines" note that individuals in the United States receive an average radiation dose of approximately 360 mrems per year from all sources including radon. This provides context for the ICRP recommendation that additional man-made exposure for members of the general public should be limited to 100 mrem per year, with no single source providing a large fraction of this limit.

Agency has not shown that an occupational exposure level of 25 mrem/yr is reasonably achievable at water treatment plants. Also, the phrase "external and committed effective dose equivalent" indicates external plus internal exposure, which is inconsistent with the separate treatment of radon in the "Guidelines" document.

The "Guidelines" (page 34, paragraph 1) suggest that, "radiation measurements be made within the plant and that areas which have external radiation levels which could lead to worker exposures equal to or greater than the limit of 25 mrem/yr be identified and posted with signs reading, 'Caution Radiation'." The Agency appears to believe that the radiation levels from treatment systems would be elevated and readily measurable and that radiation doses to workers would be the result of infrequent exposures. Thus, an appropriate approach may be to recommend posting the hourly exposure rate and to limit occupancy to stay within the exposure guideline. The Agency should evaluate the feasibility and practicality of measuring exposure rates that would produce 25 millirems per year.

The "Guidelines" recommend that persons working in areas marked "Caution Radiation" should have appropriate radiation protection training and their radiation exposure should be monitored through area or personal monitoring, as appropriate. Such a recommendation inevitably places a responsibility on water treatment plant operators to conduct a radiation control program. The revised "Guidelines" should address the feasibility of monitoring 25 mrem/yr above normal background, and consider whether the benefits of such monitoring exceed the costs.

The "Guidelines" recommend (page 36, paragraph "g") that "[r]adon levels in air be monitored and action taken, where appropriate, to reduce radon levels in air as much as possible." This guidance is inconsistent with the ICRP guidance to keep doses as low as reasonably achievable. Keeping doses as low as reasonably achievable can be accomplished by keeping radon levels in air sufficiently low or, if that is not possible, by limiting occupancy times.

5. Are there other important issues that should be addressed in the Guidelines document?

Since the individual States have the responsibility and authority for control of naturally-occurring radioactive materials, it may be useful to suggest a process

that would inform the appropriate State agencies so that they may provide informed advice and supervision to the operators of those water supplies which remove radionuclides. Such assistance with radiation matters would be particularly valuable because few water treatment personnel are currently familiar with ionizing radiation issues and protective practices.

While there are public and occupational radiation exposure issues associated with water treatment plant operation and waste handling and disposal, the Agency has not estimated the risks to either group nor compared them with the risk reductions estimated to accrue from radionuclide removal from the water. The Committee recognizes that this is not an entirely straightforward process and that there are a number of possible scenarios regarding potential exposure levels; nevertheless, an overall risk/benefit perspective would be useful. (This recommendation also appears in the Committee's previous report EPA-SAB-RAC-COM-92-003, January 29, 1992.)

In summary, the Committee finds that the "Guidelines" document is very important both for the task at hand (providing for the proper management and disposal of drinking water treatment wastes containing naturally occurring radionuclides) and because of the other science and policy issues inextricably linked with it. The four most important recommendations of the Committee are:

1. The Agency should consider performing a risk assessment that includes the occupational risks to reassure itself, and others, that the risks of exposure to radionuclides in drinking water are indeed being reduced and not just moved around as the result of their concentration and disposal.

2. The Agency should consider collecting data on waste volumes, activity levels, and costs which would allow more informed decisions regarding treatment and disposal options by water suppliers.

3. In the interests of consistency and clarity, the Agency should select and provide a rationale for an occupational protection approach from among those available, that is whether treatment plant workers are considered radiation workers or members of the public.

4. The Agency should reevaluate the numerical criteria for the disposal of wastes containing lead-210 because of the apparent internal inconsistencies and inaccuracies in the current analysis.

We appreciate the opportunity to review this document which demonstrates highly commendable Agency initiative in a complex area and we look forward to a response from the Agency on the revision of the Guidelines document which considers the points raised. We stand ready to assist you if you have questions.

Sincerely,

Raymond C. Loehr

Dr. Raymond C. Loehr, Chair
Executive Committee
Science Advisory Board

Oddvar Nygaard

Dr. Oddvar F. Nygaard, Chair
Radiation Advisory Committee
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Enclosures: Committee Roster and Table I of the "Suggested Guidelines"

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TABLE 1

Summary of Treatment Technologies and Wastes Produced During Removal of Naturally Occurring Radionuclides From Drinking Water

TREATMENT TECHNOLOGY	CONTAMINANT REMOVED	WASTE(S) PRODUCED*
Cation Exchange	Radium	Rinse and backwash water, brine regenerant solution.
Anion Exchange	Uranium	Rinse and backwash water, brine regenerant solution.
Lime Softening	Radium Uranium	Sludge from settling tanks, filter backwash, supernatants.
Coagulation/ Filtration	Uranium	Sludge from settling tanks, filter backwash, supernatant from settling or concentrating sludge and filter backwash.
Reverse Osmosis	Radium Uranium	Reject water.
Greensand Filtration	Radium	Solids and supernatant from filter backwash.
Coprecipitation with $BaSO_4$	Radium	Sludge from settling tanks, filter backwash, supernatant from settling or concentrating sludge and filter backwash.
Granular Activated Carbon	Radon Uranium	Granular activated carbon media.
Selective Sorbents	Radium	Selective sorbent media.
Aeration	Radon	Radon released into air, or radon decay products accumulated on off-gas contactors (i.e., GAC)

*NOTE: Wastes containing radioactivity may also include filter material, exchange resins, and other disposed materials.

NOTICE

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