

Radionuclide Stakeholder Meeting

MEETING SUMMARY

December 11 - 12, 1997
Hyatt Regency Crystal City
2799 Jefferson Davis Highway
Arlington, VA 22202

Thursday, December 11, 1997

9:00 Welcome, Meeting Logistics & Review of Ground Rules

Peter Bonner, ICF the meeting facilitator, welcomed participants, reviewed the agenda, and explained the ground rules for comment and discussion by the participants.

Why EPA is Revising the National Primary Drinking Water Regulations (NPDWR) for Radionuclides

Bill Diamond, EPA Office of Ground Water and Drinking Water (OGWDW), gave a 30-minute presentation on why the NPDWR for radionuclides is being revised. The current rule, which has been in effect for 20 years, covers a wide range of radioactive elements (i.e., beta (β) photon emitters, alpha (α) emitters, radium) but did not include radon or uranium. Changes to the rule were proposed in 1991 and again through the Safe Drinking Water Act (SDWA) Amendments of 1996; the rule must be finalized by November 2000. Three sequential tests are required in order to decide on the appropriate maximum contaminant level (MCL):

- Feasibility test. The MCL must be set as close to the maximum contaminant level goal (MCLG) as feasible; carcinogens have a MCLG of zero.
- Protective test. The MCL, according to existing standard 1412(b)(9), "shall maintain, or provide for greater protection of the health of persons."
- Benefit/Cost Consideration. The benefit received must outweigh the cost. The costs considered in adjusting the MCL are greater than the costs to maintain the current MCL (the no-cost option).

There are many complications to the radionuclides rule, including the abundance of natural and man-made nuclides, changing health risk estimates, legal constraints of SDWA, and cost concerns. The goal of the EPA rulemaking is to substantially maintain current radionuclide levels, correct them for recent science, and allow for public input via publication of a Notice of Data Availability prior to the final rulemaking.

Discussion:

Nancy Reilman, Maryland Department of the Environment, disagreed with the statement that if the current rule was upheld that the cost would be zero; if the current standards are maintained, there would be associated costs with regard to a new category of impacted systems.

Mr. Diamond agreed that no cost was an overstatement; there will be new contaminants that have not been regulated before. [i.e., uranium, which was proposed in 1991]. These will have to go through the entire process of cost estimates. For existing contaminants, there has been a suggestion that because some systems are not complying with current standards, the cost to these systems should be factored into the cost. However, EPA does not think this is appropriate because these systems should already be

in compliance. [Note: Changes in monitoring for ^{228}Ra independently from ^{226}Ra was proposed in 1991 and would affect an additional number of systems.]

Mitchell Childrey, Virginia Department of Health, stated that new standards will be applied to non-transient, non-community water works (NTNC), whereas previously they were only applied to community water works. This contradicts the no-cost estimate of the present standards. [Note: Inclusion of NTNCs was proposed in 1991.]

Dori Burg, Residents and Children of DeKalb, IL, brought up the issue of increased public involvement in the evaluation process. Mr. Diamond stated that with the 1991 proposal, there was an opportunity for public comment. At present, public outreach (e.g., holding stakeholder meetings, using the Federal Register) will be used for the Notice of Data Availability and the final rulemaking. The rulemaking process and the process of compliance are different; with compliance, the states inform the utilities with their obligations. The public may not be involved in the compliance effort, especially with smaller drinking water systems.

Maintaining or Providing a Greater Level of Protection Under the Safe Drinking Water Act Amendments

David Huber, OGWDW, gave a 30-minute presentation on "Revising Regulations: What Does Maintaining or Providing Greater Protection Mean?" The SDWA Amendments of 1996, Section 1412(b)(9) states that revisions to a primary drinking water regulation should "maintain or provide for greater protection of the health of persons." The Senate report on the SDWA links an increase in the MCL to an increase in the MCLG and states three situations in which a MCLG can be raised: (1) non-zero threshold is discovered; (2) smaller margin of safety; and (3) reclassification from carcinogen to non-carcinogen. The proposed goal for ionizing radiation is zero. If the MCLG were to increase from zero to something above the current MCL, e.g., with discovery of a threshold, the MCL would also increase to that same level. The lower the picoCuries of activity, the smaller the health risk (and the closer to the zero goal the number is). Conversely, any increase in the amount of radiation will result in additional relative risk.

For each nuclide, there is an associated risk of disease (morbidity) and of death (mortality). The 1976 radionuclides rule determined risk based on risk of death. Current data now allow estimates of risk of disease as well. Risk of disease is used for chemical contaminants, and the policy is to target a range of between 10^{-4} to 10^{-6} . To harmonize the risks, EPA is suggesting using the upper limit of the risk of disease for chemicals at 1×10^{-4} as well as the risk of death at the level set for the beta photon emitters in 1976, 5×10^{-5} (rounded from 5.6×10^{-5}). This risk of death level is 50% of the 1×10^{-4} risk of disease. The goal is to use the risk of death or disease, whichever is more protective. Each nuclide has an associated target organ and percent of fatal cancers. When the fatalities are 50% or less for a nuclide, the limiting factor in determining the MCL is the risk of disease level at 1×10^{-4} ; if the percent of cases of cancer for a nuclide is greater than 50%, then death becomes the limiting factor for keeping the MCL below the target of death of 5×10^{-5} .

In the future rule, EPA will continue to sum the total risks of a group of radionuclides. For example, EPA would continue to list beta and photon emitters with corresponding picoCurie (pCi) levels equating to the target risk. For multiple nuclides, the total risk cannot exceed the target; i.e., the cumulative fractional risks cannot exceed one. For example, if the risk level of a nuclide is 5 pCi and the sample has 1 pCi, that nuclide constitutes $1/5$ of the total risk. This system may be used for alpha emitters and radium as well.

Discussion:

Dan Pedersen, American Water Works Association (AWWA), wanted to clarify EPA's policy: will the EPA only lower or maintain, but never raise, the MCL. Mr. Huber said that in general, the current level will be maintained or lowered. Mr. Diamond, OGWDW, added that there are no absolutes; the statute gives the Agency the opportunity to change with science. Although the Agency has not used it, it does have flexibility in policy making.

Jennifer Cox, South Carolina Drinking Water Program, asked if the new MCLs will be an average value (e.g., measured quarterly), or if there will be a one time reading. Miguel Del Toral, EPA Region V, Safe Drinking Water Branch, stated that EPA is looking at that issue and taking comments in light of current issues that were not factors in 1991 or 1976.

Dr. Robert Rowland, Waukesha Water Utility System, disagreed with the linear, non-threshold classification of radium. He stated that recent findings have shown a threshold for radium, below which no life-shortening effects are incurred. He wanted to know if this information is being considered with regard to raising the MCLG for radium. Mr. Diamond stated that the Agency can take threshold standards into account, but they have not found data to support the position of a threshold existing for radium.

Erik Olson, Natural Resources Defense Council, questioned the cost/benefit analysis for lowering the MCL and MCLG; if the cost associated with maintaining the standard is zero, then how will the MCL and MCLG be changed? Lowering the MCL would always result in increased costs. He also questioned how long the current process of standard review would continue, and if EPA was enforcing current standards. Mr. Diamond reiterated that testing was involved in reviewing the standards. The tests are sequential; health/feasibility is first and cost/benefit is last. If there is new evidence in terms of threshold effects, then the standards can be changed. In most cases, however, cost/benefit is never discussed because health evidence does not support changing the standards. He stated that existing standards are valid and enforceable, although states may have some discretion due to uncertainty in terms of recent science and the current proposal.

Brad Addison, Georgia Department of Natural Resources, Environmental Protection Division (DNR-EPD), asked if the waste stream disposal costs and impacts of other environmental regulations are considered in a cost/benefit analysis? He also questioned whether benefit/cost will be considered for adjusted gross alpha emitters levels because modification may affect costs and/or benefits. Mr. Diamond stated that waste costs will be considered. Mr. Huber indicated that the current (1976) rule is for gross alpha (alpha emitters including ^{226}Ra) without uranium and radon; however, the 1991 proposal was for *adjusted* gross alpha emitters, which do not include ^{226}Ra . This latter proposal was less protective than the 1976 rule because it still allowed up to 15 pCi/L of the other components. Adjustments will be made to the gross alpha standard to maintain the level of protection based on risk. A simple 15 pCi/L standard represents a greater risk than originally thought in 1976 for the same nuclides because individual alpha emitter risks have increased. Benefit/cost assessment will be considered for nuclides whose risks have increased substantially.

Ms. Burg, Residents and Children of DeKalb, IL, asked if non-carcinogenic health effects (i.e., birth defects, stunted growth, crumbling teeth, spontaneous head bleeds) are considered in setting MCLs. Mr. Diamond said that health effects are considered; these data must be substantiated and well documented. The Agency believes that there is sufficient documentation of health effects and has no plans to implement further studies.

Linda Lahey stated that Illinois is using the 1991 proposed regulations of 20 pCi/L for ^{226}Ra and ^{228}Ra combined. She wanted to know if EPA was aware of this. Mr. Del Toral answered that when the 1991 proposal came out, Region V developed an enforcement discretion decision to be used until EPA decided on final action on the 1991 proposal. Although the standard is 5 pCi/L, Region V has an enforcement discretion decision in effect with the higher value.

Level of Protection: Reevaluating the Protectiveness of Current Radionuclide Regulations in Light of New Scientific Information on Health Effects

Lowell Ralston, EPA Office of Radiation and Indoor Air (ORIA), gave a 60-minute presentation on "Radionuclides in Drinking Water: Level of Protection." The MCL for radionuclides is determined using: (1) a specified target risk level (TR); (2) a radionuclide-specific risk conversion factor (RCF); and (3) total drinking water intake. He reviewed the RCFs and how they are calculated. Intake assumptions,

radionuclide activity in the body, dose amount and health effects, as well as biokinetic, dosimetry, and risk models, determine the RCF. EPA assumes that radionuclides have a linear, non-threshold dose-response. RCFs can be modified as the understanding of radionuclides increases and as the models become more accurate.

Mr. Ralston also reviewed the 1976 and 1991 regulations. The MCLs increased between 1976 and 1991 because the RCFs increased; however, the level of protection as indicated by the TR did not decrease during this time.

Discussion:

Ms. Cox, South Carolina Drinking Water Program, wanted to know the key elements in establishing an MCL. Mr. Ralston stated that the MCL is dependent on the RCF. Most of the science, which has improved in recent years, goes into calculating the RCF. When studying differences in MCLs, it is necessary to look at past RCFs in comparison to current RCFs. This difference explains the variation between the earlier and current MCLs.

The concept of subpopulations was discussed. It was asked whether there are specific subpopulations that may be up to an order of magnitude higher in terms of the risk because of their total water intake or other factors. Mr. Ralston said that EPA uses coefficients that are age-averaged, and that each age group has a single exposure level. For example, when EPA looks at five-year-olds, it uses ingestion amounts and risk factors for that age and follows the age group through the course of life. Then the figures are averaged back over time. He added that risk factors change depending on age. RCFs have not been calculated for specific ranges, i.e., zero to five years, but the Agency is looking into that issue. Jerry Puskin, ORIA, stated that the intake amount of 2 liters/day is very conservative. He said that it is possible that some people may be more susceptible to radiation, but this has not been confirmed. It is beginning to be studied in depth with atomic bomb survivors.

Scott Kirk, Nuclear Fuel Services, said that the EPA Science Advisory Board's review of the proposed criteria documents for uranium stated that the proposed standards (170 pCi/L) were conservative and protected the outliers more than the general population. With models having a margin of safety, both outliers and general population are protected. There is a discrepancy in the risk and dose values in Federal Guidance 13 and those proposed in 1991. EPA was asked to explain the peer review process for Federal Guidance 13. Mr. Puskin replied that the uranium dosimetry models in Federal Guidance 13 have changed and were peer reviewed by ICRP. Federal Guidance 13 has been peer reviewed by members of the EPA Science Advisory Board, Nuclear Regulatory Commission, Department of Energy, and outside experts.

Ms. Burg, Residents and Children of DeKalb, IL, asked that the uranium standards be tightened, because ^{238}U decays to ^{235}U and then to ^{226}U , all of which are radioactive. Mr. Ralston stated that tightening the standards is a possibility. He stated that all forms of uranium are present in drinking water and agreed that they do present a risk. However, because all forms are present, they must each be measured and extrapolated back to find out the exact amount of each component ingested.

Dr. Terry Sandman asked why, in 1976, risks were quoted as mortality, not morbidity. Mr. Ralston stated that they knew more about mortality than morbidity at that time. Morbidity includes both fatal and non-fatal effects, whereas mortality is death. Therefore, using only lifetime mortality would underestimate the risk. Dr. Sandman asked whether risk models for ^{226}Ra were adjusted for children's increased metabolic rates (e.g., in relation to bone growth). Dr. Neal Nelson, ORIA, said that age-specific models are adjusted in individual organs that show biokinetic changes with age. Dr. Sandman questioned the feasibility of an agency (i.e., EPA) studying risk in real life situations, in a manner comparable to Finkelstein in Canada. Mr. Ralston said that a large-scale study would not be feasible but a meta-analysis, pooling together many studies in a statistical analysis, would be possible. The EPA, however, has no plans to do such an analysis.

Mark Thaggard, U.S. Nuclear Regulatory Commission, wanted a clarification on the status of radionuclides: radium will not be changed from 1976 because a higher number will increase risk, gross emitters may be changed, but gross beta will not. Mr. Huber, OGWDW, said that given EPA's interpretation of SDWA, Mr. Thaggard had made a generally accurate assessment of the status of the radionuclides.

Occurrence of Radionuclides in Drinking Water

Debbie Kopsick, ORIA, began her 45-minute discussion by illustrating its four purposes: (1) to present nationwide occurrence data for regulated radionuclides; (2) to discuss co-occurrence of radionuclides; (3) to illustrate the extent of exposure and present issues related to each radionuclide; and (4) to identify additional data needs.

Ms. Kopsick discussed the four sources of occurrence information that EPA currently utilizes: U.S. Geological Survey (USGS) Largest Cities Survey from 1962, the USGS National Uranium Resource Evaluation (NURE) survey from 1980, the EPA Nationwide Radon Survey from 1985, and the EPA > National Inorganic and Radionuclides Survey (NIRS) Survey from 1986.

Ms. Kopsick then discussed the occurrence of ^{226}Ra and ^{228}Ra in water. ^{226}Ra is an alpha emitter in the ^{238}U decay series. It is soluble, moves in groundwater, and its occurrence is not related to the aquifer type. On the other hand, ^{228}Ra is a beta emitter, and is a progeny in the ^{232}Th series. It is insoluble, does not move through groundwater, and its occurrence is related to the aquifer type. She noted that the states with the highest levels of combined radium are Illinois, Wisconsin, Missouri, Minnesota, and Iowa. Under current monitoring requirements, only half of the public water systems with combined radium at levels greater than 5 pCi/L would have been identified. She indicated that ^{224}Ra is not included in the current MCL standard for radium (although it is part of the gross alpha standard), and that it is not detected with current monitoring methods due to its short half-life.

Ms. Kopsick reviewed the pertinent issues associated with beta photon emitters, alpha emitters, and uranium in water. For beta photon emitters, ^{210}Pb presents a concern because it can pose an unacceptable risk at a screening level of 50 pCi/L. For alpha emitters, ^{210}Po is possibly the most frequently occurring radionuclide. For uranium, most public water supplies with high concentrations are very small facilities, serving between 25 and 500 people.

Discussion:

Baker Hamill, New Jersey Department of Environmental Protection, Bureau of Safe Drinking Water, asked about the short-lived ^{224}Ra . He asked whether it was included in the sampling and monitoring schemes. He went on to speculate that if the sampling time was shortened so that it could be detected, then more public water systems would be out of compliance with the combined 5 pCi/L. Ms. Kopsick replied that this would probably be the case.

A question was asked about testing for ^{228}Ra on a regular basis, noting that testing for it only when ^{226}Ra is present at concentrations greater than 3 pCi/L seems inappropriate. Ms. Kopsick replied that this issue will be addressed during the monitoring discussion.

A question was asked about the occurrence data that Ms. Kopsick had discussed. It was noted that the data were from 1985 and earlier, and, therefore, were gathered before the non-transient, non-community systems were included. It was asked if the number of systems exceeding the MCL standards was based on the 1985 data only, or if the number had been updated to include non-transient, non-community systems. Ms. Kopsick replied that the MCL was based just on community systems data (i.e., pre-1985 data).

Ms. Cox, South Carolina Drinking Water Program, asked why the concentration levels in samples taken from the same system can vary so greatly from one sample time to the next. Ms. Kopsick replied that the precipitation of metals in the wells can cause a surge of radionuclide levels. Mr. Huber, OGWDW, elaborated that there is actually a quirk in some radium measurement techniques. If the radium is not measured soon enough, an ingrowth of radon can occur, causing the measurement level to increase. Zoltan Szabo, USGS, verified Mr. Huber's statement, noting that there needs to be a time standard between when the sample is collected and when it is analyzed to control for the radon ingrowth.

Mr. Ralston, ORIA, clarified that ^{210}Pb and ^{228}Ra are both naturally occurring beta-emitting radionuclides. Lead 210 is not regulated. The beta photon standard is applicable only to man-made emitters and does not include any naturally-occurring radionuclides. He noted that this oversight may need to be corrected. [The 1991 proposal included ^{228}Ra in the list of beta photon emitters. It is also part of the radium standard along with ^{226}Ra].

Dr. Rowland, Waukesha Water Utility System, asked if the databases examined by EPA reported ^{40}K (potassium) occurrence in the water. Mr. Puskin, ORIA, replied that there is no excess risk associated with having ^{40}K in the water since it is already present in the human body, therefore, these concentrations are not reported.

Pat Phibbs, Environmental Health Letter, asked if the costs of waste disposal from technologies associated with removing contaminants from groundwater were considered by EPA. Ms. Kopsick replied that they were considered and will be discussed during the treatment technologies presentation.

Ms. Burg, Residents and Children of DeKalb, IL, asked if EPA was aware of the data on Tom's River head cancer cases. Dr. Nelson, ORIA, replied that the nasal cancer cases at Tom's River are not associated with ^{224}Ra in the water. The types of cancers reported at Tom's River are associated with chemical contaminants.

Methods and Limits of Detection of Radionuclides in Drinking Water.

Steve Pia, EPA Office of Research and Development, (ORD/ESD), presented this 30-minute discussion. He began by providing a brief chronology of the methods rule. In 1976, methods and MCLs were promulgated. In 1991, a proposal with an expanded list of analytical methods was introduced. In 1995, the analytical methods were put on a separate track from the rest of the proposal to meet the needs of the regulated community, and in 1997, the new rule was released. As a result, 12 new analytical methods have been added, along with improved specific standards for gross alpha. EPA has also approved a conservative ^{234}U uranium conversion factor of 0.67 pCi/g if radiotoxicity becomes an issue.

Mr. Pia discussed the detection limits, costs, and MCLs associated with the current roster of radionuclides. He noted that as the detection level of a radionuclide decreases, the cost associated with its detection increases. With radiochemistry, it is possible to get lower detection limits by having longer counting times. This, however, decreases the throughput of the testing laboratory, so they have to increase their costs to cover the longer counting times.

Mr. Pia identified laboratories in the U.S. and Canada that perform radiochemistry, noting those ones that perform tests on drinking water.

Discussion

A representative from Maryland noted that the State of Maryland is only able to perform tests on gross alpha, gross beta, and radon. In addition, the EPA staff supports the State by performing inspections of laboratories looking for radiation certification. Mr. Pia replied that with privatization, the auditing of laboratories will be transferred to private companies.

Mr. Ralston, ORIA, asked about the conversion factor listed for uranium. He noted that the conversion factor is set for ^{234}U and ^{238}U to be present at equal concentrations, when in fact their ratios vary considerably. Mr. Pia replied that the factor is conservative, i.e., it will give more false positives than false negatives, resulting in the overidentification of uranium in the drinking water.

Mr. Huber, OGWDW, asked whether the 0.67 pCi/ μg conversion factor, being a conservative number, would underestimate the activity. Mr. Pia replied that the activity is underestimated, but in the context of determining gross alpha, a conservative value would result in a lower calculation of the contribution of uranium to the total alpha. Therefore, when the uranium is subtracted out of total alpha to determine gross alpha, the resulting number is higher.

A commenter suggested that with most of the radionuclide methods, a lower detection level can be achieved by increasing the counting times. Therefore, the issue of a detection level becomes an issue of how much time and, therefore money, is spent per sample. Mr. Pia replied that this was true.

Ms. Burg, Residents and Children of DeKalb, IL, commented that if \$1/person/year had been set aside by the State of Illinois over the last 20 years to remove radium from the drinking water, then the citizens of DeKalb would not have to pursue their current lawsuit.

Ms. Cox, South Carolina Drinking Water Program, asked if the types of bottles and preservatives used to collect samples are considered by EPA when evaluating sampling techniques, to ensure the accuracy of measurements. Mr. Pia replied that EPA does consider these factors.

Treatment Technologies

Bill Labiosa, OGWDW, discussed the best available technologies (BAT) and other technologies that have been available since 1976 for treating radionuclides in drinking water. He also addressed the small systems compliance technologies and co-treatment practices that EPA will be taking into consideration in the rule. He emphasized that treatment is always a last resort; other options include use of alternate water sources and best management practices.

The four BATs proposed in 1991 included: ion exchange, lime softening, reverse osmosis, and coagulation/filtration. Mr. Labiosa summarized the removal rate efficiencies of these technologies with regard to various radionuclides. He also discussed other technologies that may be used for radium removal (greensand filtration, co-precipitation with barium sulfate, manganese dioxide coated acrylic fibers or impregnated resins) and the use of activated alumina for uranium removal.

Mr. Labiosa discussed the issues associated with small systems. Small systems usually have less experienced operators who do not work full-time for one system. Intermittent flows in small systems can cause problems when using some technologies. In addition, a smaller customer base results in an increased cost per customer. Point of entry and point of use technologies are being used frequently in small systems and include: reverse osmosis, ion exchange with selective resins, and activated alumina. In addition, package plants with remote monitoring that allow "circuit rider operations" are more frequently being used by small systems.

At the end of Mr. Labiosa's presentation, Bernard Lucey, New Hampshire Department of Environmental Services, asked for more clarification on the manganese dioxide coated acrylic fibers. Mr. Labiosa replied that it is a fiber coated with manganese dioxide that will selectively remove radium. It is similar to a filtration process. The coating must then be disposed as a radioactive waste, due to its high concentration of radium. He added that he has literature on all of these technologies if anyone is interested.

Mr. Ralston, ORIA, asked if there are co-BATs, and if so, are there advantages to using co-BATS. He also asked about the number of systems actively treating for radionuclides in their drinking water. Mr. Labiosa replied that there are treatment technologies that will remove more than one radionuclide, and a

system would always want to use a technology that can remove more than one contaminant at a given time. He added that he did not know the number of systems that are actively treating for radionuclides.

Waste Generating and Disposal Guidelines

Amit Kapadia, OGWDW, discussed the waste generation and disposal guidelines for radionuclides. He noted the types of waste generated by the treatment technologies discussed earlier: coagulation/filtration, lime softening, ion exchange, and reverse osmosis. EPA has a program called SPARRC that measures wastes generated and the concentrations of radionuclide contaminants in waste. Disposal methods are available for solid and liquid wastes. Liquid wastes can be disposed of in surface waters, sanitary sewers, or injection wells, depending on the radionuclide concentration. At low radionuclide concentrations, solid wastes can be disposed of in a municipal landfill or a physical barrier. At high concentrations, they are disposed of on a case-by-case basis, according to state regulations, or by recovery.

Mr. Kapadia concluded by saying that in 1992 the EPA Science Advisory Board recommended that OGWDW examine the exposure of treatment plant workers to radionuclides. The typical U.S. citizen is exposed to an average of 360 mrem/yr of radiation. EPA concluded that at a treatment plant, worker exposure should be limited to 100 mrem/yr. There are times when personnel protective clothing should be worn by plant employees. He described the type of exposure a worker might have if using a specific treatment technology.

Discussion:

Mr. Hamill, New Jersey Department of Environmental Protection, Bureau of Safe Drinking Water, noted that a couple of small systems in New Jersey have had problems with waste disposal because sewage systems do not want to accept the waste. Whether it is allowed or not, they are reluctant to accept radioactive waste. Mr. Labiosa, OGWDW, replied that EPA is aware of the problem.

Mr. Ralston, ORIA, commented that well-injection is currently prohibited as a disposal technique. He added that the Nuclear Regulatory Commission is conducting a study of radiation exposure to treatment plant workers. He asked if there are costs associated with the waste disposal methods discussed. Mr. Kapadia replied that a cost study was conducted in 1991 and that another one will be done during the next regulatory impact analysis.

A question was asked if other environmental laws (i.e., at the state level) and permitting laws go into effect when radionuclides are concentrated. Mr. Labiosa replied that permitting laws are definitely considered. State laws are usually considered on a national level only if they are common to many states.

Mr. Childrey, Virginia Department of Health, supported the comments about problems with disposing of radionuclide wastes. He stated that public reaction to radioactivity makes it very difficult to dispose of this waste.

Teresa Boepple, New York State Department of Health, Bureau of Public Water Supply Protection, noted that for small systems, there is a concern with the training of operators. Given that New York is developing new training guidelines for small systems, she asked if this issue is being addressed during EPA regulation development. Mr. Labiosa replied that he would mention this concern to Peter Shanahan who is responsible for developing the new guidelines.

Ms. Burg, Residents and Children of DeKalb, IL, asked if EPA had considered the feasibility of using plugs and casings in the well systems, as it does not create any wastes. Mr. Labiosa replied that treatment is always the last resort, and that Ms. Burg's example falls under the category of best management practices.

Brad Addison, Georgia DNR-EPD, asked what constitutes a small systems. Mr. Labiosa replied that it is any system serving less than 10,000 individuals.

It was asked whether the states currently out of compliance will be granted funds to help them achieve compliance with the regulations. One state representative replied that there is a state revolving fund that has been set up that could be used for such a purpose. Mr. Childrey added that the top priority of Virginia's fund is an MCL violation. Mr. Hamill stated that, in New Jersey, local governments would be qualified to receive these funds if there was an MCL violation.

Facilitated Discussion

A question was raised regarding ^{228}Ra and the scientific evidence supporting a zero-level MCLG. Mr. Ralston, ORIA, replied that all radionuclides have the potential to damage cells because they emit ionizing radiation, thus classifying them as carcinogens. Current models do not recognize carcinogens as having thresholds, therefore, they must have zero-level MCLGs. The scientific basis for assigning any radionuclide a zero-level MCLG was questioned. EPA again pointed out that radionuclides were considered carcinogens. It is an EPA policy that carcinogens, especially known mutagens, conform to linear, non-threshold, risk models.

Sylvia Barrett, Metropolitan Water District of Southern California, questioned how liquid waste containing radionuclides can be dumped into surface water when that water might be used downstream as drinking water. EPA replied that state water quality standards and NPDS permits make sure that appropriate water quality standards are met. These permits would take into account water quality levels and downstream uses.

Ms. Cox, South Carolina Drinking Water Program, asked if de-watered waste sludges used in solid waste disposal could be land applied. Mark Parrotta, OGWDW, stated that this issue was addressed by EPA a few years ago. In EPA's Suggested Guidelines for Disposal, land application of low level radioactive waste (i.e., 1 pCi/L to 3 pCi/L) is allowed; however, this type of application had been met with protest from commenters and the EPA Science Advisory Board. Land application of radium could increase exposures in the future and there is insufficient information about how much would leach into surface waters. EPA chose to be conservative and not recommend land application; although this issue could be addressed later after further study.

Joseph Harrison, Water Quality Association, stated that 150 towns in Region V have radium levels that are out of compliance. In order to correct this, the water rates would have to be doubled. In these towns, the public is aware of the problem (i.e., water bills say that radium levels in the water exceed the limit). The funds needed to correct the problem in one town would require or exceed the total state revolving fund. The old standard of 5 pCi/L would not hold up to the cost/benefit analysis applied to the new standards, but because of Section 1412(b)(9) such analyses cannot be made. Cost/benefit analysis should be taken into account; there should also be referendums in individual towns with high radium.

Ms. Burg, Residents and Children of DeKalb, IL, suggested that tax incentive fund money (TIF) could be used to fix water systems that are not in compliance with the standards.

Ellen Partridge, Partridge and Niro, asked how many towns had radium levels exceeding current standards. Ms. Burg said that there were 500 towns nationwide, 70 of them in the State of Illinois.

Mr. Bonner, the meeting facilitator, stated that the presentations focused on information gathered through surveys and databases. He asked the audience for suggestions of other data sources that EPA would find useful in establishing the MCL. Ms. Burg suggested using data on power plants and the radioactivity they emit. Mr. Kirk, Nuclear Fuel Services, suggested using the CERCLA database and a database on groundwater contamination for cost information. Dr. Rowland, Waukesha Utility System, stated that there is a study by Petersen et al. of bone cancer incidences in areas with high radium published in two forms:

as a journal article and as a monograph. The journal article suggests that high radium areas have increased bone cancer risks in comparison to low radium areas, whereas in the unpublished monograph, the incidence of bone cancer did not differ between high and low radium areas. Ms. Burg stated that the article *Cancer Incidences in Illinois* demonstrates that bone cancer incidence among children is considerably greater in areas with high radium levels.

Peter Denk, DeKalb Daily Chronicle, questioned Dr. Rowland's theory that radium in DeKalb's drinking water is negligible and wanted to know the EPA response to this. EPA had already commented on this; saying that radium is considered linear, non-threshold and one exposure could potentially cause damage. Ambika Bathija, EPA Office of Water/Office of Science and Technology (OW/OST), stated that linear, non-threshold risk is an EPA policy based on current knowledge and may be changed based on new scientific data; i.e., future studies may show that there is a threshold for some radionuclides.

Mr. Hamill, New Jersey Department of Environmental Protection, Bureau of Safe Drinking Water, stated that animal studies and models are not as reliable as epidemiological studies, and eventually this issue should be addressed by EPA. EPA stated that epidemiological studies are difficult to perform because the exposed populations are not large enough. Meta-analysis was suggested as an alternative to epidemiological studies, but as of now, EPA does not plan to pursue this approach.

A question was raised concerning occurrence data versus natural background radiation; in areas of high radiation such as DeKalb, how does the high radiation occurrence data compare to natural background radiation across the country? Mr. Ralston indicated that it would be difficult to make the comparison without looking at the actual data, but he stated that this could be done in the future. Ms. Burg read from the ATSDR's Toxicological Profile on Radium. She said that background radiation is the same in soil, 1 pCi per gram of soil.

Mike Barker stated that, in light of the presentations, there is no legal or scientific evidence to support weakening the MCLs. Often these standards are set by PQL (Practical Quantitation Level); however, for most radionuclides, there is no justification for setting MCLs based on this approach.

Dennis Duffield, City of Joliet, Illinois, stated that for many years he had been publishing information indicating that Joliet exceeded the radium MCL. There had been no push to enforce the new standards when EPA had proposed them. But public hearings were held in every community with a radionuclide problem, the problem had not been covered up. Mr. Huber, OGWDW, admitted that there were isolated cases where people were not informed. Compliance should have taken place within three years after 1976. The issue now is not whether cost/benefit analysis should be performed for systems that needed to come into compliance with the 1976 standards; but rather, whether EPA should maintain or lower the standard. EPA has not enforced the 1976 standard since 1991 due to the confusion over the 1991 proposal.

Ms. Burg made a comment on the Illinois public hearings; they were held at the request of the public. Illinois recently published a rule that it would not require individual hearings to allow variances to "restricted status" -- which prohibits new hookups to systems not in compliance with the standards. Rather, Illinois is issuing blanket variances to communities below 20 pCi/L; any community with radionuclides under this limit cannot hold public hearings because the community does not need to receive a variance from the standard.

Friday, December 12, 1997

Costs and Regulatory Impact Analyses for Uranium

Ambika Bathija, OW/OST, began her presentation by explaining the classification of uranium as a Group A "known human carcinogen" and kidney toxicant. Since the 1991 proposal, EPA has been reevaluating

the Relative Source Contribution (RSC), the uranium conversion factor from g/L to pCi/L, and the health effects of uranium. The new data on uranium include:

- A 30%, 50%, or 80% RSC from water rather than the default RSC of 20% used in the 1991 proposal;
- A conversion factor of 0.9 pCi/L for the uranium MCL in water (for converting g/L to pCi/L) rather than 1.3 pCi/L used in the 1991 proposal; and
- A drinking water equivalent level (DWEL) of 70 g/L rather than 100 g/L as proposed in 1991 for determining health effects.

Mr. Huber, OGWDW, presented information about the relative radioactivities of the two uranium isotopes, ^{238}U and ^{234}U . ^{238}U is more prevalent and not very radioactive; its effect is on the kidneys and its mass is the most important determinant of health effects. On the other hand, because ^{234}U is more radioactive, human carcinogenicity is the health endpoint of concern. When converting measurements from mass in micrograms to activity in picoCuries, the uranium activity to mass ratio is important. The risk of cancer incidence for a uranium MCL at 30 pCi/L and 60 pCi/L and the RSCs resulting in a uranium MCL at 30 g/L and 60 g/L were also compared.

Discussion:

Mr. Lucey, New Hampshire Department of Environmental Services, asked about the speciation cost for ^{238}U and ^{234}U . In response, Mr. Ralston, ORIA, stated that an isotopic analysis would cost approximately \$300 and the cost for a fluorometric analysis would be \$100 to \$150.

A participant asked for clarification on the co-occurrence of radium and uranium. Mr. Huber responded that generally radium is found in reducing environments, whereas uranium is found in oxidizing environments. He stressed that co-occurrence may occur in fractured rock systems, or where wells were drawing water from several water bearing zones.

Mr. Ralston, ORIA, stated that the proposed MCL for uranium was an actual cap for the three natural isotopes; ^{238}U , ^{235}U , and ^{234}U . He clarified that ^{238}U and ^{234}U are in the same family and occur in equal activity concentrations at equilibrium. He stressed the importance of knowing the isotopic abundance when converting from mass to activity.

Mr. Pedersen, AWWA, asked about the activity-to-mass ratio of a system containing only ^{234}U . Mr. Huber replied that after determining that a system contained ^{234}U , the measurement would be in picoCuries to account for the activity. Mr. Puskin, ORIA, added that if a system contained only ^{238}U , the activity levels would be half that of a normal mixture.

Mr. Lucey cited uranium occurrence data for approximately 10% to 15% of the New Hampshire public water systems. He emphasized that the data fluctuated about 100% to 200% due to seasonal and temporal variability.

Mr. Szabo, USGS, explained the mobility of ^{234}U . He attributed its mobility to the alpha ionizing radiation causing damage to the crystal lattice structure of the minerals holding the uranium. The alpha recoil would allow some of the uranium to escape the crystal structure and enter the ground water where it is soluble and mobile. In addition, he cited studies from New Jersey that documented occurrence ratios of two to one for ^{234}U to ^{238}U .

Ms. Burg, Residents and Children of DeKalb, IL, insisted that the MCL should consider all the health effects for uranium including those on the fetus. In response, Ms. Bathija stated that the most sensitive endpoint for uranium was kidney toxicity. Protecting for kidney toxicity would also include protection of the reproductive and developmental organs. Ms. Burg pointed out data from the Atomic Bomb Casualty Commission data on the effects of radiation on the fetus. Mr. Huber responded that the radiation effects in

that case was probably external gamma radiation, not internal radiation resulting from drinking water. Mr. Ralston agreed and added that when developing risk numbers, the health effects associated with the daughter products and the decay chain were also considered in the metabolic model.

With regard to the MCLG and MCL, Mr. Hamill, New Jersey Department of Environmental Protection, Bureau of Safe Drinking Water, suggested reassessing the final regulation if needed. He also suggested that EPA establish a regulation which focuses only on those systems that have significant uranium concentrations.

Mr. Puskin suggested using an RSC of 80% rather than the default RSC of 20%, as was done in the proposed rule. He suggested also that there was little difference in the food contribution to total uranium intake in different parts of the country because the typical diet contains food from various parts of the country, rather than being home grown. Variations in uranium intake would be due to local water conditions.

Monitoring Framework for Radionuclides, Both Current and Proposed

Mr. Del Toral, EPA Region V, Safe Drinking Water Branch, explained the current and proposed monitoring requirements for gross alpha particle activity (^{226}Ra , ^{228}Ra , and uranium), and gross beta particle activity. Based on the proposed monitoring requirements, the limitations of the screening levels were also summarized and included:

- ^{210}Po exceeds the 1×10^{-4} risk of incidence at 1 pCi/L, which is below the gross screen of 5 pCi/L. In addition, ^{210}Po cannot be measured as low as needed for compliance purposes;
- ^{224}Ra exceeds the 1×10^{-4} risk of incidence below the MCL of 15 pCi/L;
- the gross alpha screen must be analyzed within 48 hours of collection due to the short half-life of ^{224}Ra ;
- a gross beta screen at 30 pCi/L will not measure radionuclides such as ^{228}Ra , ^{210}Po , and ^{129}I ; and
- an additional 500 systems will have to treat once the monitoring is corrected. The proposal did not require public water systems to sample for the ^{228}Ra isotope if the ^{226}Ra levels were between 2 and 3 pCi/L.

Discussion:

Mr. Ralston, ORIA, stated that the issue of decay was important because isotopes can exist individually without support from the decay chain. He stressed that although laboratories could back-calculate to determine the concentration of the isotope during collection, an accurate measurement may not be possible.

A resident from DeKalb, IL, questioned the effectiveness of extending the time interval for monitoring from four to five years. She suggested that EPA regain the public trust before promulgating the regulation.

Mr. Szabo, USGS, presented several overheads demonstrating the decrease in the gross alpha activity in a collection sample through time. He emphasized that each sample lost about half its activity within ten days and cautioned against the use of a gross alpha screen of 15 pCi/L. He recommended a gamma spectroanalysis or an alpha spectroanalysis for the measurement of ^{224}Ra . He also stated that the decrease in daughter products may necessitate individual measurements for both ^{210}Pb and ^{210}Po .

Concern was voiced over the feasibility of a 48-hour turn around when considering sample collection, shipping, and handling. In response, Mr. Huber, OGWDW, stated that only systems deemed vulnerable would have to sample regularly after the initial screening.

What's Next: Possible Strategies for Revising the Radionuclide NPDWRs

Mr. Huber, OGWDW, began his presentation by stressing that EPA's goal is to expedite the rulemaking. Several alternatives were presented for the radionuclides (e.g., ^{210}Pb , ^{210}Po) that may hinder the final rulemaking, such as the publication of a Notice of Data Availability, placement on the Contaminant Candidate List, or inclusion in the Unregulated Monitoring Regulation. Mr. Huber stated that proceeding with the final rulemaking would end the confusion and increase public health through the establishment of an immediate MCL. The revised rule would substantially maintain the current levels and include recent scientific data. In addition, further opportunities exist for public involvement prior to the final rulemaking, including comment on a Notice of Data Availability, Internet, E-mail, and possibly an additional stakeholder meeting.

November 2000 was established as the date for the final rulemaking in the radionuclides in drinking water proposal. Under this agreement, EPA will have to finalize the regulation for uranium, and with regards to radium, alpha emitters, and beta photon emitters, finalize the regulation or state reasons for not taking final action on the proposed regulations.

Discussion:

Mr. Childrey, Virginia Health Department, stated that a survey to determine occurrence would be more effective than unregulated monitoring. A similar comment was made by Ms. Reilman of the Maryland Department of the Environment. She added that the 1996 regulation enables EPA to fund unregulated monitoring for small systems.

Ms. Reilman stressed several issues including: 1) the use of screening measures to regulate only systems in noncompliance, 2) a reproposal for ^{210}Po and ^{224}Ra , 3) the upcoming contaminant rule allowing standardized monitoring which would simplify this regulation, 4) sampling at the point of entry, and 5) the ability to grandfather previous data. Mr. Huber addressed these issues by clarifying that ^{210}Po and ^{224}Ra are currently regulated by EPA, whereas ^{210}Pb is not. Screening methods will be used wherever possible to save costs, and standardizing monitoring with the chemical monitoring reform is being looked at by EPA. In response to the final issues, he stated that any previous data would have to be analyzed to ensure consistency with current data (i.e., point of entry sampling).

Diane Larsen, Department of Energy, asked how EPA would enforce compliance with public water systems. In response, Mr. Addison of the Georgia DMR-EPD indicated that the regulatory programs of each state handle most compliance issues.

Mr. Ralston, ORIA, asked if all the radionuclides would fall under a risk level of 5×10^{-5} mortality. In response, Mr. Huber stated that EPA is trying to regulate all radionuclides under a uniform risk level and is seeking input with regard to whether manmade radionuclides ought to be more stringently regulated.

Mr. Ralston stated that a chemical separation of radium will include all the isotopes. A similar comment was made by Mr. Szabo, USGS. However, Mr. Szabo added that an accurate analysis can be accomplished by determining the individual radiation emissions. A possible method to discern the presence of ^{224}Ra would be the presence of ^{228}Ra . According to the New Jersey data, all the samples that had ^{224}Ra also contained ^{228}Ra .

General Discussion of Future Stakeholder Input

Mr. Hamill, New Jersey Department of Environmental Protection, Bureau of Safe Drinking Water, encouraged EPA to collaborate with USGS in acquiring existing occurrence data. He suggested the use of a reproposal to assess the cost-benefits if the occurrence data on polonium at low levels affected more than 5% of the public water systems.

Ms. Burg, Residents and Children of DeKalb, IL, stressed sampling at various times during the pumping schedule and not averaging one point in time at the point of entry. She also suggested stringent

enforcement by the Federal government to ensure compliance by the DeKalb, IL water system. She emphasized that the high radionuclide concentration within her community has resulted in a significant increase in colon, lung, and prostate cancer.

Mr. Hamill cited the current regulation which authorizes sampling at a representative point in the distribution system. Therefore, previous State data are not based on measurements taken at the point of entry or at the well. He suggested structuring the regulation according to the Synthetic Organic Contaminant Rule and determining vulnerability by considering the number of attached aquifers. He suggested determining each aquifer's vulnerability and recommended that multiple samples not be taken for non-vulnerable aquifers. A similar comment was made by Mr. Szabo, USGS. However, Gerald Bever from the City of DeKalb, IL, stated that the radium concentration fluctuates from below 5 pCi/L to 10.4 pCi/L from nine wells within the same aquifer.

Mr. Denk of the DeKalb Daily Chronicle asked whether the states should begin enforcement of the 1976 regulation since the radium MCL would not increase with the current proposal. Mr. Huber, OGWDW, answered that blanket enforcement maybe premature because there is the possibility of a lower radium MCL which could require different treatment than meeting the current standard. In general, most systems could meet 5 pCi/L MCL with their present technology and should begin to make plans to comply.

Ms. Lahey asked if subsequent monitoring was needed after initial monitoring for ^{210}Po and ^{224}Ra to account for fluctuation. In response, Mr. Huber stated that data are not available regarding single data points or how data may vary over time. EPA will be collecting and analyzing information during the next six months. Some repeat monitoring of vulnerable systems may be required to establish a pattern to ensure that less frequent monitoring is sufficient.

Ms. Lahey was also a proxy for Gloria Rains who represents ManaSota-88. The issues summarized by Ms. Lahey included: 1) no scientific justification for decreasing the radium standard; 2) need for more stringent regulation of ^{210}Po ; and 3) maintaining the current monitoring period of four years.

Michael Weber of the U.S. Nuclear Regulatory Commission asked that during promulgation, EPA consider the application of its MCLs to other regulatory programs, such as groundwater restoration or protection. Mr. Huber replied that while other regulatory programs may use the MCLs as ARARS (Applicable or Relevant and Appropriate Requirements), OGWDW could not include such considerations in its rulemaking. As mandated by the statute, OGWDW is writing standards applicable to drinking water, not aquifer cleanup.

Dr. Rowland, Waukesha Water Utility System, provided information on the effects of radium in the human body. According to several ongoing studies, two malignancies that can be attributed to radium are bone sarcomas and head carcinomas. An increase in breast cancer also existed in the radium dial painters; however, there is insufficient evidence to determine whether the cancer can be attributed to exposure to internal or external radium (i.e., ingestion or placement of the radium paint at chest level).

Dr. Rowland also addressed the effects of natural background radiation. According to the NCRP volume 94 document, the average annual dose to the epithelial cells in bones is 170 mrem, which includes 110 mrem of internally deposited radioisotopes containing the daughter products of radium and also ^{40}K . He stated that ^{40}K is the largest single isotope in the body and was measured at a total body dose of 120,000 pCi/L. He suggested determining how the proposed regulation will affect the total body dose received from food and external radiation.

Mr. Huber thanked all the stakeholders for their participation. He indicated that written comments would also be considered and could be sent to him. The stakeholder meeting adjourned at 1:30 pm.

Stakeholder Meeting Attendees

Brad Addison
Georgia Department of Natural Resources/Environmental
Protection Division

James Bachmaier
US Department of Energy

Ambika Bathija
EPA Office of Water
Office of Science and Technology

Gerald Bever
City of DeKalb, IL

Teresa Boepple
New York State Department of Health
Bureau of Public Water Supply Protection

Dori Burg
Residents and Children of DeKalb, IL

Mitchell Childrey
Virginia Department of Health

Jeannie Cho
Vicki Cochran
Kilpatrick Stockton
Peter Coon
NAWC

Richard Cunningham
US Department of Energy

Miguel Del Toral
EPA Region V
Safe Drinking Water Branch

Bill Diamond, Director
EPA Office Ground Water and Drinking Water

Dennis Duffield
City of Joliet

Mike Focazio
US Geological Survey

Harold Fuhrman
City of Waukesha Water Utility

John Guggi

Sylvia Barrett
Metropolitan Water District of
Southern California

Jennifer Cox
South Carolina Drinking Water
Program

Thomas DeGaetano
EPA Region IV

Peter Denk
Daily Chronicle

Jacob Dumelle
American Lung Association of
Chicago

Julia Fauci
Northern Illinois University

John Hepperley
Janet Johnson
Shepard Miller, Inc.

Linda Lahey
Ellen Partridge
Partridge & Niro

Fred Pontius
AWWA

Dr. Terry Sandman
Jane Smith
Indiana State Department of Health

Gene Taylor
EPA Region X

EPA NAREL

Baker Hamill, Chief
New Jersey Department of Environmental Protection, Bureau of
Safe Drinking Water

Joseph Harrison
Water Quality Association

William Roy Harrison
US Department of Energy

Scott Hay
S. Cohen & Associates, Inc.

David Huber
EPA Office of Ground Water and Drinking Water

Ben Hull
EPA Office of Radiation and Indoor Air

Amit Kapadia
EPA Office of Ground Water and Drinking Water

John Karhnak
EPA Office of Radiation and Indoor Air

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Diane Larsen
US Department of Energy

Patricia Lawson
National Safety Council

Vicki Lloyd
EPA Office of Radiation and Indoor Air

Bernard Lucey

New Hampshire Department of Environmental Services

Frank Marcinowski
EPA

Corey McDaniel
EOP Group

Jim McFarland
Dr. Neal Nelson<
EPA Office of Radiation and Indoor Air

Erik Olson
Natural Resources Defense Council

Mike Osinski
EPA Office of Ground Water and Drinking Water

Marc Parrotta
EPA Office of Ground Water and Drinking Water

Glenn Patterson
US Geological Survey

David Pael
EPA Office of Radiation and Indoor Air

Dan Pedersen
American Water Works Association

Pat Phibbs
Environmental Health Letter

Stephen Pia
EPA Office of Research and Development/ESD

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Designers & Planners

Jerry Puskin
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Edward Regnier
US Department of Energy

Nancy Reilman
Maryland Department of the Environment

Edward Regnier

DOE Waste Management Unit

David Robbins
EPA Region 8

Dr. Robert Rowland
Waukesha Water Utility System

Tom Schaeffer
AMWA

Roger Selburg
Illinois EPA, DPWS

Shantini Senanjahe
Nancy Stanley
New Jersey Department of Environmental Protection, Radiation
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Todd Steiner
International Consultants, Inc.

Katie Sweeney
National Mining Association

Zoltan Szabo
US Geological Survey

Mark Thaggard
US Nuclear Regulatory Commission

Chao-Hsiung Tung
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Sherri Umansky
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