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Robert C. Shinn, Jr.
Commissioner

March 9, 1994

Secretary of the Commission
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001
Attention: Docketing and Service Branch

Dear Secretary of the Commission:

Thank you for the opportunity to comment on your development of radiological criteria for decommissioning. I would like to commend you and your staff on the preparation of an insightful and thorough document regarding this issue. We find we are in agreement with almost all of your proposals but do have comments regarding some aspects of the numerical criteria proposed. Our comments and suggestions are provided below for your use. As you know, we are also engaged in a rulemaking process that would result in cleanup levels for some of the same radionuclides that you are considering. Therefore, a number of our comments are directed towards the compatibility of the two processes. A description of our current approach to the development of cleanup standards is provided in the enclosure.

(2) Basis for Radiological Criteria:

We support your departure from 100 millirems (mrem) per year to 15 mrem per year as the planned for dose limit for members of the public for decommissioned sites. We believe that you have properly distinguished between an operating facility limit where human control is ongoing and a lower limit that would be necessary for sites that are decommissioned, where there is no opportunity to reduce the dose received from year to year.

We also support your basis for setting a radiation dose goal for decommissioning at a level within background variabilities. We feel that this approach will be both protective of health and safety and the most acceptable solution for members of the public. We would suggest that the text on page 18 clarify the definition of total effective dose equivalent. We are assuming that it includes the committed effective dose equivalent which in our view

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would be the appropriate measure for dealing with site contamination internal dose impacts.

(4) Statement of Radiological Criteria:

We support your proposal for a dose limit of 15 mrem per year total effective dose equivalent for residual radioactivity at a site. You may wish to note that the approach we are taking (see enclosure) allows a dose of 6 mrem per year from gamma radiation and 10 mrem per year from intakes. Therefore, our approach allows a total of 16 mrem per year (exclusive of radon contributions) which is obviously very close to your limit of 15 mrem per year. We believe this is very desirable because it should result in consistent radionuclide cleanup levels at sites where there are both NRC regulated and State regulated materials.

However, to be more compatible with a true background variability approach, we would suggest that NRC establish sublimits within the 15 mrem limit. These sublimits would reflect the common background variabilities for the terrestial gamma pathway and ingestion/inhalation pathways respectively (exclusive of radon). The national one standard deviation figure for background variations of terrestrial gamma radiation is about 6 mrem per year. Therefore, under the NRC proposal for a site with a radionuclide with gamma dose potential but no ingestion/inhalation dose potential, it may not be appropriate to permit a full 15 mrem per year since this approaches a three standard deviation level for naturally occuring terrestial gamma radiation. Such a level might not be defensible as a common or typically encountered variation in terrestrial gamma radiation. Similarly for a radionuclide with intake potential but not contributing to external exposures, allowing a dose of 15 mrem per year due solely to intake might exceed somewhat reported variations in "in the body" doses from differences in sex and age. Therefore, we suggest that you consider establishing sublimits of 6 mrem per year for the terrestrial gamma pathway and about 9 mrem per year for intakes in the proposed rule. It should also be noted that State groundwater limits may require a further sublimit within a 9 mrem "intake" limit.

(6) Finality:

In general, we support the balance that you have provided between the need to assure that remediated sites are not unnecessarily revisited in the future against the potential harm if new information is uncovered. However, we believe that the criteria for reopening a site may be too subjective, and would suggest that this language be refined. In particular, you may wish to note that recent New Jersey law, the Industrial Site Recovery Act, dealt with a similar problem by providing for a specific numerical factor of 10 under which sites would be revisited. In other words, in your situation, if the standards developed under

your proposed rules were more than an order of magnitude more stringent than those used for previous site cleanup levels, then that would be a basis for reviewing the site.

We support the steps you have proposed for involving the local public regarding decommissioning plans as outlined on page 24. We also support the effort to develop generic standards, and in fact, that is a major focus of the Industrial Site Recovery Act in New Jersey. We also recognize, as you do, that there are certain site specific aspects to implementing generic standards. We would suggest, as you imply on page 27, that these flexibilities be limited to unique characteristics of the site and waste and not extend to other more subjective assumptions such as site occupancy factors. Those types of factors, we believe, should remain fairly constant across all the sites under consideration to assure a certain degree of equity in the definition of actual cleanup levels. Also, on this subject, it is not clear why radiation background levels would constitute a site specific condition to be considered since it would seem that the 15 mrem level is an increment above background to be met at all sites.

Section 20.1402 Concepts:

While the use of the terminology "which is indistinguishable from background" was useful in the explanatory portions of the paper, we question whether this is necessary or desirable to be incorporated within the rule itself. As you state on page 18 of your paper, demonstrating that radioisotope levels at a site are indistinguishable from background would be a complex task involving sophisticated sampling, measuring, and statistical analysis techniques. In light of this, we would suggest that language be removed from the rule and replaced by a more simple term, such as, "an incremental dose of 15 mrem per year" when describing the limit. Assuring compliance with that incremental dose can be reasonably done by relying more heavily on predictive equations and models and less heavily on post mitigation measurements.

We agree with the qualitative requirements on page 71 regarding conditions on terminating a license under site use restrictions, but believe that the allowance of a 100 mrem per year limit when restrictions fail is too high a number for most radionuclides of interest. We believe that the half-life of the radionuclide needs to be factored into these considerations. For radionuclides with a short physical half life (much less than 70 years) such an approach might be acceptable because the likelihood that site restrictions will work is high, and if they do not, the time duration of dose impact is short. However, for longer physical half-life radionuclides, it is likely, rather than unlikely, that active restrictions such as deed restrictions will not be effective in the future. We believe that the resulting cumulative doses and risks from a repeated 100 mrem per year allowance are too high; beginning at about 3 fatalities per

thousand persons exposed if the dose was due to external exposure. Additionally, a 100 mrem per year intake dose from a long effective half-life radionuclide can, from repeated intakes over time which would be the case at a decommissioned site, result in a very substantial dose to a public individual, i.e., up to 5 rems per year in the fiftieth year, and lifetime risks on the order of 6 per every hundred people exposed. In addition, 100 mrem per year is outside a reasonable range of "natural variability". Therefore, we believe a reconsideration of the proposed 100 mrem per year limit is in order.

We believe the predicted allowed yearly dose, in the event of failed site restrictions, should be no greater than 30 mrem per year. This is approximately the upper level of natural variability (See e.g., Health Physics Society Position Statement of February 1994; HPS Newsletter; page 10). Further, we suggest that greater reliance be placed on the use of more permanent site features such as clean soil covers, site markers, or limitations on the vertical dimension of the contaminated zone. The latter condition would provide for some mixing with clean soils and reduction in resulting doses in the (assumed) event that structure foundation excavations occur at some point in the future.

Again, in closing, let me compliment you and your staff on a well thought out proposal. We look forward to hearing your views on the suggestions provided herein and working with you on a continuing basis as you proceed to develop this rule.

Sincerely,

Bob Stern

Robert J. Stern, Ph.D., Chief
Bureau of Environmental Radiation

Enclosure
c: Assistant Director Lipoti
Dr. Powsner, Commission On Radiation Protection
William Dornsife, Chair, CRCPD E-24
Barbara Hostage, EPA

ENCLOSURE

BASIS FOR DEVELOPMENT OF CLEAN-UP LEVELS FOR TECHNOLOGICALLY ENHANCED RADIOACTIVE MATERIALS

Legislative Background

In 1993 the Industrial Site Recovery Act (ISRA) or S-1070 was enacted into law in New Jersey. This law establishes cleanup criteria for contaminated sites in New Jersey. The criteria for cleanups are now based on an excess lifetime cancer risk of one in one million (10^{-6}) or on regional natural background levels if the risks associated with them are greater than 10^{-6}. Because background levels of radiation will result in a lifetime cancer risk of greater than 10^{-6}, the only viable option is to use the "regional natural background level" as the cleanup criteria.

Consequently, allowed background radiation values have been defined. These values are in terms of allowed increments at a site, and are chosen to be within the normal variability of radiation background levels across the State. Using these allowed increments, and generic radiation exposure factors for the pathways of interest, maximum allowed concentrations for radionuclides of interest in soils are derived that would permit future residential or nonresidential use of a site. The methodology being used to develop these radionuclide soil concentrations is presented in detail in Enclosures 1 (residential criteria) and 2 (non-residential criteria) and summarized below. The premise in developing these maximum soil concentrations is that once the site is remediated to these levels, it can be released for any residential or nonresidential use, as the case may be.

Radiation "Background"

Following the provisions of S-1070, we have analyzed the radiation from "natural background" radiation levels. Four pathways have been considered: 1) external gamma radiation, 2) indoor radon, 3) internally deposited radionuclides and 4) ground water. For external gamma background, we are currently using terrestrial background radiation data as reported in NCRP Report No. 94. Terrestrial background was the most appropriate parameter because contaminated soil is part of the "terrestrial" component. Because natural background varies from place to place, a statistical approach was needed. To accommodate such variation, natural background for terrestrial gamma is being defined as one standard deviation from the mean value of 28 mrem/yr. Based on the distribution of the NCRP data, one standard deviation is approximately 6 mrem/yr. Therefore, based on nationwide background gamma levels, contamination on site cannot contribute an incremental external gamma dose of greater than 6 mrem/yr (effective dose equivalent). New Jersey specific data still needs to be examined.

For the radon pathway, an acceptable natural background increment was determined by converting state-wide radon measurement data for residences to lognormal form and calculating the standard

deviation of the resulting distribution. The geometric mean for radon in the State is 1.35 picocuries per liter (pCi/L), with a standard deviation of 2.94 pCi/L. Therefore, incremental soil cleanup levels are based in part on meeting a 3 pCi/L incremental indoor radon level.

For internally deposited radionuclides we considered and summed crop ingestion, direct soil ingestion, inhalation from resuspended dust, and groundwater consumption component. "In the body" background was also determined using NCRP Report No. 94. According to this report, the average annual dose in the United States from ingesting and inhaling radioactive materials is 40 mrem/yr. To provide for natural variation, a 25% increment was adopted, resulting in an allowable increment of 10 mrem/yr (committed effective dose equivalent) from internally deposited radionuclides. The 25% figure was selected based on the natural variability of internal doses as a function of sex and age.

Radionuclide standards for the groundwater pathway are established in the Groundwater Quality Standards (N.J.A.C. 7:9-6) and are based on the prevailing Safe Drinking Water Act regulations in N.J.A.C. 7:10-1 et seq.. These standards are still applicable under the provision of S-1070. The standards for radionuclides are 4 mrem/yr (effective dose equivalent) for beta and gamma emitters and 5 pCi/L for alpha emitters.

Soil Concentration Standards

In order to determine the radionuclide in soil concentrations that would result in these incremental background doses, dose conversion factors (DCF) were defined using the available literature for each pathway. The DCF is the dose received from a given pathway for each picocurie per gram (pCi/g) of a radionuclide in the soil. The allowed soil concentration for a particular radionuclide is calculated by dividing the allowed incremental radiation value for each pathway by the DCF. The most restrictive pathway was then used to determine the acceptable soil concentration. This method was followed for each individual radionuclide subchain. However, in order to account for ingrowth of progeny, certain subchains had to be combined. An example of such a combination was the Ra226, Pb210 subchains. A sum of the fractions rule was used to determine the acceptable soil concentrations considering this ingrowth.

From the above analysis, certain technical requirements emerged. For example, due to high DCF's for gamma exposures from certain radionuclides, it was found that for practical soil concentration numbers, the allowed gamma level increment of 6 mrem per year could not be met without the use of cover. Thus, the need for at least one foot of clean cover to achieve acceptable gamma radiation levels became evident and is required in the rule.

In addition, since most naturally occurring radionuclides have long half-lives, we could not assume that the covered material would remain undisturbed for the length of time required for these radionuclides to decay to insignificant levels. For this reason, we also analyzed a "disruptive scenario." This scenario assumes that a basement for a house or building would be excavated on the contaminated site and that the excavated material would be mixed and brought to the surface. Allowed background radiation levels for the disruptive cases were based on two standard deviations. This was considered acceptable given the expectation that such disruptions would not occur throughout the site. As necessary, we adjusted the allowed concentration levels downward to account for the impacts of the disruptive scenario. To achieve adequate mixing upon excavation, the need to restrict the thickness of the contaminate zone - for near surface burials - arose.

Taking all of these factors into account, Table 1 displays the allowed incremental (in addition to what is present in natural soil) soil concentration levels for certain nuclides of interest.

Table 1

Preliminary
Allowed Incremental Soil Concentration Levels
To Meet Established Background[1]
(pCi/g)

	Residential Use	Nonresidential Use
Ra-226	3	6
Pb-210	3	6
Th-232	3	6
Ra-228	3	6
Th-228	3	6
U-238+U-234[2]	8	14
U-235	23	48
Pa-231	5	7
Ac-227	5	7

[1] Assumes at least one foot of cover placed on material and thickness of contaminated zone less than about 4 feet (for near surface burial).

[2] Assumes that U-238 and U-234 are in equilibrium, i.e., with equal activities.

For the nondisruptive scenario, the nonresidential use levels also meet the incremental doses outlined above: 6 mrem/yr external gamma, 3 pCi/L indoor radon, 10 mrem/yr internal and 4 mrem/yr groundwater. However, in deriving the nonresidential allowed soil concentration, we used different occupancy factors, and eliminated the child soil ingestion and crop ingestion pathways. The results indicate that the allowed radionuclide in soil concentration levels for the nonresidential scenario to be about twice that for the residential.

Comparison with Other Soil Concentration Values

The resulting allowed soil concentration numbers are close to values recommended by other federal agencies and professional organizations. For example, the Nuclear Regulatory Commission's Branch Technical Position dated October 23, 1981, titled "Disposal or On-Site Storage of Thorium or Uranium from Post Operations" specifies a incremental concentration, for unrestricted site use, of about 4 pCi/gm for Radium 226, Thorium 232, Thorium 228 and Uranium 238 which is close to the 3 pCi/gm proposed here. For Radium 226 and Radium 228, the Environmental Protection Agency's Radiation and Superfund programs have pursued a 5 pCi/gm level for recent site cleanups, and the U.S. Health Physics Society has suggested 5 pCi/gm level for Radium 226, Thorium 232, and Radium 228. In addition, the NRC has recently prepared a staff draft of its rules on radiological criteria for decommissioning. These rules contemplate a 15 mrem per year total effective dose limit from decommissioned sites, exclusive of radon gas contributions. Since the 4 mrem/year groundwater criteria is a sublimit under the 10 mrem/year intake criteria, the total allowed radiation increment under this rule (exclusive of radon) is 16 mrem per year total effective dose equivalent: 6 mrem from terrestrial gamma radiation, and 10 mrem from body intakes. The NRC and our allowed increments, i.e., 15 vs 16 mrem per year, are very close, and should lead to compatible soil cleanup levels for those sites where NRC licensed and state regulated cleanups take place. In light of the above, we believes that both the allowed radiation increments and the generic soil concentrations derived from them are consistent with current and emerging standards and practices.

Compliance Approaches

An applicant or licensee meeting these soil concentration values and associated technical requirements -cover and thickness- will automatically be deemed in compliance, and the site in question may be developed for any residential or nonresidential, as the case may be. Alternatively, we are contemplating that a person may secure an exemption from the soil concentrations, based on unique site or waste characteristics, if it is determined that the allowed incremental background radiation levels for the gamma, radon, intake, and groundwater pathways will still be met.

We are aware that remediating sites contaminated with large volumes of these radioactive material to within the levels required by S-1070 and this rule through removal to off-site licensed radioactive waste disposal facilities may result in significant costs. Therefore, the rule does not prohibit less costly alternatives to meeting the standards such as on-site mixing, use of these materials in road construction, removal to industrial landfills, deeper burial on-site or a combination of these options.