ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 192

[AH-FRL 1610-4]

Proposed Disposal Standards for Inactive Uranium Processing Sites; Invitation for Comment

AGENCY: U.S. Environmental Protection Agency.

ACTION: Proposed rule and extension of comment period.

SUMMARY: The Environmental Protection Agency (EPA) requests comments on proposed standards for disposal of residual radioactive materials (mainly tailings) from inactive uranium processing sites. EPA has developed these standards pursuant to Section 275(a) of the Atomic Energy Act, 42 U.S.C. Section 2022(a), as added by Section 206(a) of PL 95-604, the Uranium Mill Tailings Radiation Control Act of 1978. PL 95-604 requires the Department of Energy to conduct remedial actions for designated inactive uranium processing sites in accordance with standards promulgated by EPA.

The proposed standards apply to disposal of tailings which qualify for remedial actions under Title I of PL 95-604, and set limits on their radon release to the atmosphere and on water contamination. The standards also require tailings to be disposed of in a way that provides a reasonable expectation that these limits will be satisfied for at least one thousand years.

We have already proposed standards for the cleanup of open lands and buildings contaminated with residual radioactive materials from inactive uranium processing sites (45 FR 27370-27375, April 22, 1980). The cleanup standards were also made immediately effective as interim standards pending public review and promulgation of final standards (45 FR 27366-27368, April 22, 1980). We are hereby extending the comment period for the cleanup standards we proposed earlier so that it will coincide with the comment period for the disposal standards.

Additional background material for the proposed cleanup and disposal standards is given in a Draft Environmental Impact Statement (EIS) that EPA is issuing. Copies of an earlier version of the draft EIS were placed in the Docket and in Reading Rooms at EPA's Regional Offices when the cleanup standards were published. In addition to this request for written comments, the Agency will shortly announce the time and place of hearings at which interested persons may present comments on both the previously proposed cleanup standards and these disposal standards.

DATE: Comments on both the cleanup standards and the disposal standards should be received on or before May 11, 1981.

ADDRESS: Comments on the proposed cleanup and disposal standards should be submitted to Docket No. A-79-25, which is located in the Environmental Protection Agency, Central Docket Section, West Tower Lobby, 401 M Street SW., Washington, D.C. 20460. Single copies of the Draft Environmental Impact Statement (EPA Report 520/4-80-011) may be obtained by writing to the address given below.

FOR FURTHER INFORMATION CONTACT: Dr. Stanley Lichtman, Criteria & Standards Division (ANR-460), Office of Radiation Programs. U.S. Environmental Protection Agency, Washington, D.C. 20460; telephone number 703-557-8927.

SUPPLEMENTARY INFORMATION:

I. Introduction

The proposed standards were developed by EPA at the direction of Congress in order to protect public health, safety, and the environment from uranium mill tailings produced at processing sites which are now inactive. There are two major parts of the remedial actions necessary for this protection: cleanup and disposal. The cleanup process reduces the potential health consequences of tailings which have been dispersed from their original location on a tailings pile or used in construction. Disposal is the operation which places the tailings themselves in a condition which will be safe for a long time. The disposal site may be at the original location of the tailings, or a new one. Standards are proposed here for the disposal aspects of the remedial actions.[1]

In order to carry out our responsibility under PL 95-604 to set generally applicable standards for uranium mill tailings, we have examined their potential public health and environmental impacts. This examination established the radiological and nonradiological characteristics of tailings which require control.

Tailings are hazardous primarily because: 1) breathing radon and its decay products exposes the lungs to alpha particles; 2) the body may be exposed to gamma rays; 3) radioactive materials and nonradioactive toxic elements from tailings may be swallowed with food and water. The radiation hazard from tailings lasts for many thousands of years, and nonradioactive toxic elements persist indefinitely. The longevity of these hazards played a major role in determining the proposed standards.

Although the available data are consistent with many models, we believe that a linear, nonthreshold dose-effect relationship is a reasonable basis for deriving estimates of radiation risk to the general public and for establishing regulations. This model assumes that any radiation dose presents some risk to humans and that the risk of low doses is directly proportional to the risk demonstrated at higher doses. We recognize, however, that the data preclude neither a threshold for some types of radiation below which there is no damage to people, nor the possibility that low doses may do more damage to people than the linear model implies.

The alpha particles from inhaled radon decay products can cause lung cancer. Also, gamma rays can cause cancers, teratogenic effects, and genetic damage. Our health risk estimates are based on our review of epidemiological studies conducted in the United States and other countries of underground miners of uranium and other metals who have been exposed to radon decay products, and on three reports: *The Effects on Population of Exposure to Low Levels of Ionizing Radiation* (1972) *Health Effects of Alpha Emitting Particles in the Respiratory Tract* (1976) by the Advisory Committee on the Biological Effects of Ionizing Radiation of the National Academy of Sciences (the BEIR Committee), and the report of the United Nations Scientific Committee on the Effects of Atomic Radiation entitled *Sources and Effects of Ionizing Radiation* (1977). Details of our risk estimates are provided in *Indoor Radiation Exposure Due to Radium-226*

[1] The cleanup standards (Subpart B and Subpart C) were proposed earlier (45 FR 27370-27375, April 22, 1980), and simultaneously also were declared immediately effective as interim standards (45 FR 27368-27368, April 22, 1980). We issued interim cleanup standards in order to have standards in effect as soon as possible, because some buildings have been found where tailings are causing radiation levels that are very hazardous to anyone exposed to them for long times. Public Law 95-604 precludes undertaking remedial action before EPA has promulgated standards. The interim cleanup standards permit the Department of Energy to clean up open lands and buildings under PL 95-604 to alleviate these problems. In addition to having issued interim cleanup standards, however, we are following the public review process contemplated by PL 95-604 for promulgating final cleanup standards.

In this notice we propose disposal standards and invite the public to comment on them. For the convenience of the reader, we are restating here some background material from our earlier notice proposing cleanup standards.

in Florida Phosphate Lands (EPA 520/4–78–013) and in the Draft Environmental Impact Statements (EIS) (EPA 520/4–80–011).

Data from studies of underground miners lead to uncertain risk estimates for exposure to radon and its decay products. This uncertainty is increased when the data are used to estimate the risk to the general population. Nevertheless, we believe the information is sufficient to give a basis for public health standards. For gamma ray exposure standards the data base is very large and good, but again involves extrapolation for application to tailings.

Oftentimes it is not possible to remove all the risk to people exposed to radiation or many other hazardous materials. In deciding how much we should attempt to reduce the risk, we considered the longevity, efficacy, and costs of remedial actions for uranium mill tailings as well as the level of risk. We also considered things which are not easily quantified, such as equity of risk distribution, and administrative difficulties. Finally, we considered the overall implementation costs and protection offered by alternative standards to determine those which are most reasonable.

EPA's mandate is to set standards which apply to any site and method of control. Therefore, our analyses of technology, costs, risk, and other pertinent factors emphasize the general characteristics of uranium mill tailings and their control. The law gives other agencies of Government the authority to decide how these standards will be satisfied at specific locations. They will issue site-specific Environmental Impact Statements where they are required under the National Environmental Policy Act, or an Environmental Assessment will be prepared to determine whether such an EIS is required.

The information, reasoning, and judgments which lead us to issue these particular proposed disposal standards for tailings piles at inactive uranium processing sites are summarized below. Additional background information and more complete presentations of our reasoning and judgments are given in the Draft Environmental Impact Statement.

II. Disposal of Tailings

In PL 95–604, the Congress stated its findings that tailings ". . . may pose a potential and significant radiation health hazard to the public, . . . and . . . that every reasonable effort should be made to provide for stabilization, disposal, and control in a safe and environmentally sound manner of such tailings in order to prevent or minimize radon diffusion into the environment and to prevent or minimize other environmental hazards from such tailings." The Environmental Protection Agency was directed by Congress to set ". . . standards of general application for the protection of the public health, safety, and the environment . . ." for such materials. The legislative record also shows Congress intended that these standards not be site-specific.

The Committee report on the Uranium Mill Tailings Radiation Control Act expressed the intention that the technologies used for remedial actions should not be effective for only a short period of time. "The Committee does not want to visit this problem again with additional aid. The remedial action must be done right the first time," it stated (H.R. Rep. No. 1480, 95th Cong., 2nd Sess., page 40(1978)). Our proposed disposal standards are meant to ensure this long-lasting solution for those tailings piles at inactive processing sites that are covered by PL 95–604.

Pathways and Health Effects

Uranium mill tailings can effect people's health through four basic pathways. These are:

1. *Diffusion of radon-222, the noble gas decay product of radium-226, from the tailings to the air.* Breathing radon-222 and its short half-life decay products (principally polonium-218, bismuth-214, and polonium-214) exposes the lungs to alpha particles. Smaller additional doses to the lungs and other organs result from swallowing and breathing the long-lived radon-222 decay products (lead-210 and polonium-210).

2. *Small particles of tailings material in the air.* Wind erosion of unstabilized tailings piles results in airborne tailings material. Intake of thorium-230, radium-226, and lead-210 are the principal concerns from this pathway. The predominant doses are to the lungs from breathing these radionuclides and to the bones from eating foods containing them.

3. *Waterborne material.* Both wind and water flowing over or through the tailings can carry radioactive and other toxic materials to bodies of water. This could cause long-term contamination of surface and underground water, and human intake of toxic substances.

4. *External gamma radiation exposure from tailings.* A tailings pile emits gamma radiation, since many of the radioactive nuclei in it produce gamma rays along with their other decay products. The most important gamma emitters are lead-214 and bismuth-214.

The increase in cancer possibly caused by airborne substances from a pile can be estimated reasonably well by using general environmental transport models. However, the levels of waterborne contaminants and their effects are highly site-specific and we can only discuss them in general. The possible effects of direct gamma radiation from the piles are easy to estimate. They are small, except very close to the tailings piles.

EPA's analysis of the exposure pathways for uranium mill tailings piles relies on existing information provided by NRC and DOE and their contractors, and on earlier studies by EPA. [2] To significantly enhance this knowledge would require several years of intensive investigation. We believe this is unnecessary and that such a delay in promulgating standards would not be in the public interest.

Radiation Effects from Air Pathways

Based on the current U.S. population, we estimated the air-transmitted hazards of uranium mill tailings piles for people close to the pile (within several miles), in the surrounding region (within 50 miles; but not "close to the pile"), and in the remainder of the nation. Four sources of exposure were considered: inhaled short-lived radon decay products, the most important source of potential cancers; the long-lived radon decay products, principally lead-210; airborne tailings; and direct gamma radiation. Estimating the risk from exposure to the short-lived radon decay products and the gamma radiation is relatively straightforward. However, the pathways and dose calculations for long-lived radon decay products and airborne tailings depend very heavily on assumptions about the use and preparation of locally grown foodstuffs. Dose estimates for these pathways are given in the NRC Draft Generic Environmental Impact Statement on Uranium Milling (DGEIS). These estimates are likely to be high because of the assumptions made in regard to local foods. Nevertheless, the risks are small compared with those due to the short-lived radon decay products.

From our analysis we conclude:

1. Lung cancer caused by radon's short-lived decay products is the dominant radiation hazard from untreated uranium mill tailings piles on local, regional, and national scales. Effects of long-lived radon decay

[2] We analyzed 22 of the 25 tailings piles at inactive processing sites DOE has designated for remedial actions under PL 95–604. The other 3 piles were determined to be eligible for remedial actions only after our assessment was nearly completed. However, based on general descriptions of the 3 piles, we believe that including them in the assessment would not cause us to change our proposals for disposal standards that apply to all the designated sites.

products, of windblown tailings, and of direct gamma radiation from the piles are much less significant.

2. Individuals near a pile bear much higher radiation risks than those far away. For example, we estimate that individuals living continuously one mile from a large pile would have about 200 times as great a chance of a fatal lung cancer caused by radon decay products as persons living 20 miles away (7 in 10,000 versus 3 in 1,000,000). People even closer to some of the piles at inactive processing sites bear increased lifetime lung cancer risks as high as 4 chances in 100.

3. The total number of cancer deaths estimated to be caused by a uranium mill tailings pile depends strongly on the size and locations of the local populations.

4. Based on present population data, all the 22 piles at inactive sites we studied, taken together, may cause about 40 to 90 deaths from lung cancer per century among persons living 50 miles or more away from a pile. When local and regional rates are added to these, the estimated total national effect of all the 22 piles is about 200 premature deaths from lung cancer per century; i.e., about 2 deaths each year.

Part of the uncertainty in these estimates is due to necessary approximations in estimating the environmental radiation levels a tailings pile produces, and what dose people will receive. Additional uncertainty comes from our incomplete knowledge of the effects on people of these generally low exposures.

Our estimates are based upon current population sizes and geographical distributions. Overall increases in national population would raise the estimated national effects in approximate proportion. Development of new population centers near currently remote piles, and substantial growth of cities already near one, would increase these estimates proportionately to this growth.

Water Pathways

The water-transmitted hazards of uranium mill tailings are due both to radionuclides and to nonradioactive toxic substances, such as arsenic, lead, selenium, and molybdenum. Uranium, thorium, radium, and nonradioactive toxic substances can contaminate water resources and affect crops, animals, and people. A theoretical analysis of a model pile performed for NRC's DGEIS on Uranium Milling showed that ground water contamination by selenium, sulfate, manganese, and iron might exceed current drinking water standards over an area 2 kilometers wide and 8 to 30 kilometers long.

Tailing piles at inactive mill sites already have lost much of the water deposited in them during mill operation. The water evaporated, went underground, or ran out on the surface. Any future water contamination by the pile would be from erosion, rain, snow, or flooding. The quality of streams and lakes could be degraded by contaminated seepage from a pile, or by tailings which are carried to them by wind or water.

The movement of contaminants to ground water depends on a combination of complex chemical and physical properties of the underground environment, and on conditions such as precipitation and evaporation. Chemical and physical processes in the subsoil partly remove contaminants from water passing through it. However, some contaminants, such as selenium, arsenic, and molybdenum, can occur in forms which are not removed.

Future ground water contamination could be caused by either past or future releases of toxic substances from the piles. These substances are likely to move slowly through the ground. Ground water itself can move more slowly than a few feet per year, and only in coarse or cracked materials does the speed exceed one mile per year. For these reasons, pollutants from tailings may not affect the quality of nearby water supply wells for decades or longer after they are released. However, once polluted, the quality of such water supplies can not be quickly restored by eliminating the source. Even if a pile is covered so that there is no further run-off or seepage, it may take longer to restore the original water quality throughout the affected area than the time from the start of the pile to the first contamination of water supplies.

In the draft EIS for these proposed standards, we review the health problems that could arise from using water containing nonradioactive toxic substances from uranium mill tailings.

Control of Tailing Piles

The objectives of tailings disposal should be to control harmful substances so as to avoid their spread to the general environment and to people. The longevity or permanence of control methods is of prime concern. Because of the long lifetimes of the radioactive contaminants (thorium-230, for example, has a half-life [3] of about 80,000 years) and the presence of other toxic chemicals (which never decay), the potential for harming people will persist indefinitely. Many interrelated factors affect the long-term performance of tailings pile disposal methods. They include external natural phenomena, such as earthquakes, floods, windstorms, and glaciers, internal chemical and mechanical processes, and human activities. Predicitions of the stability of the piles become less certain as the time period increases. Beyond several thousand years, long-term geological processes and climatic change will determine the effectiveness of most "permanent" control methods.

Attempts to stabilize tailings piles at inactive sites by applying thin covers on them have had only limited and short-term control objectives, but the growing awareness of the hazards of tailings and passage of PL 95-604 in 1978 have led to increasing research on effective long-term control methods. Although several States and the NRC have begun regulating tailings at active mills, no disposal method has been tested sufficiently to establish its practicality or effectiveness over long periods of time. However, we believe the basic principles of effective long-term control methods are understood.

Radon release control methods range from a simple barrier between the tailings and the atmosphere to such ambitious treatments as embedding tailings in cement or processing them to remove the radon sources. Covering the tailings with permeable barriers, such as soil, slows down the radon passing through; less is released because some of the radon decays before it gets to the air. The more permeable the covering material, the thicker it must be for a given reduction in radon release. Maintaining the integrity of thin impermeable covers, such as plastic sheets, over periods as short as tens to hundreds of years, however, is highly uncertain under the likely range of chemical and physical stresses.

Methods that control radon (a gas) will also prevent releases of tailings particulates to the air or to surface water.[4] Similarly, permeable covers sufficiently thick for effective radon control will also absorb gamma radiation very well (although thin impermeable covers will not). Disruptions of the tailings by streams, floods, wind, or rain can be delayed by contouring the pile and its cover, and by

[3] A half-life is the time it takes for a given quantity of a radioactive isotope to decay to half that quantity.

[4] However, recent studies suggest that some processes occurring in tailings piles tend to carry dissolved contaminants upward, perhaps even through soil coverings. Disposal system designers must carefully consider this possibility. The Department of Energy currently is intensively investigating a variety of disposal methods.

stabilizing the surface (with stones, for example) to make it resistant to erosion. If necessary, erosion can be delayed by burying the tailings pile in a shallow pit or moving it away from a flood-prone or otherwise problematic site.

As an alternative to covering tailings on or just below the Earth's surface, nearly complete long-term control of contaminant releases to air and surface water could be achieved by burying them in deep mined cavities. In most cases, however, direct contact with ground water would be difficult to avoid. The potential hazards of tailings could also be reduced by chemically processing them to remove contaminants. Such processes have limited efficiencies, however, so the residual tailings would still require careful disposal. Furthermore, the extracted substances, radium and thorium, for example, would be concentrated and perhaps even more hazardous than before.

In the draft EIS we analyze the health and environmental protection benefits and the costs of several levels of controlling tailings, assuming a variety of potential control methods. We find that radon emission levels of an "average" pile can be reduced to approximately the levels characteristic of ordinary land by applying a soil cover at costs in a range of about 1 to 14 million (1979) dollars. The cost does not depend much on the degree of radon reduction. Rather, the range of costs mainly reflects the choices of materials for stabilizing the surface, the possible need for specific water protection features, and transportation and site preparation costs if a new site is needed. We estimate the costs for deep disposal to be about 8 to 63 million (1979) dolloars; the lowest estimate assumes the availability of a suitable open-pit mine close to the tailings pile and other favorable circumstances. Disposal using chemical processing to extract radium and perhaps other substances would cost approximately 78 million (1979) dollars per pile.

Selection of Proposed Disposal Standards

Proposed Radon Emission Standards

From several perspectives, we find it reasonable to reduce radon emission rates from tailings at inactive processing sites from their current values of several hundred pCi/m^2 sec [5] to a range more characteristic of natural emission rates from ordinary land. Typical natural emission rates are from 0.5 to 1 pCi/m^2-sec, with variations up to several times these values not unusual.

After considering the alternatives, we have concluded that the numerical limit on pile emissions, following disposal, should be chosen in a range of about 0.5 to 2.0 pCi/m^2-sec. When this emission rate is added to that of a normal earth covering, the disposal site emission rate would still be within natural variations.

Several analyses [6] of controlling radon emission by covering piles with soil suggest that the required covering thickness rises sharply [7] near an emmision rate of about 1 pCi/m^2-sec. However, there has been no opportunity to test these analyses against full-scale field experience. If soil coverings should be less efficient in controlling radon than the analyses indicate, achieving a standard at the low end of the range could be much more difficult and expensive than we estimate. Yet, the health benefit so gained would be marginal. We therefore propose an allowed tailings emission rate of 2 pCi/m^2-sec, rather than a slightly lower figure, to allow for more technical flexibility in implementing the standards.

Higher control levels, say 10–40 pCi/m^2-sec, appear unjustified, because emission rates of that size can be lowered to 2 pCi/m^2-sec for about 10% additional cost.[8] With such elevated radon emissions, the probable need for land-use restrictions adjacent to the disposal site would place a continuing administrative burden on future generations.

We also find almost total control of radon release from the tailings unjustified. Incremental costs for achieving long-term emission rates lower than 2 pCi/m^2-sec rise rapidly relative to radon emission reduction and any health benefits that might be achieved. There is no need to restrict the use of land near the disposal site because of radon releases from the tailings for emission rates near 2 pCi/m^2-sec. We have not found any administrative or aesthetic advantages in further reductions.

We believe our approach is appropriate for the new and large-scale undertaking of tailing disposal. Typically, the proposed standard would reduce radon emissions and their possible effects by 99%. Measures that will cut down radon emissions this much for at least 1000 years (see below) will also eliminate blown tailings and excess gamma radiation. Therefore, implementing the radon control standard will virtually eliminate all the potential hazards except water pollution.

Proposed Ground Water Protection Standards

The proposed ground water protection standards provide that after tailings piles are disposed of the piles will not cause ground water concentrations of selected contaminants to exceed specified levels. We chose levels we believe are adequate to protect good quality ground water for direct human consumption and for a wide variety of other purposes. If upstream ground water already exceeds the specified concentration levels for causes other than tailings, then no further degradation is allowed.

Except as noted below, the specified concentration levels are the same as the maximum contaminant levels of the National Interim Primary Drinking Water Regulations (NIPDWR). We use these levels quite differently here, however, and our standards have no legal tie to the NIPDWR. Though fluoride levels are given in the NIPDWR, we are omitting them from the proposed standards because fluorides are not important constituents of tailings. Levels for molybdenum and uranium are not given in the NIPDWR, but we believe they are needed because of the abundance of these substances in tailings, their toxicity, and their likely mobility in ground water. We selected the proposed molybdenum level on the basis of avoiding toxic effects in humans. The proposed uranium level is the one for which our estimate of bone cancer risk is about the same as the estimated bone cancer risk from radium under the NIPDWR.

The contaminants we include in the proposed ground water standard cover the most hazardous tailings substances. Conditions that control these toxic substances will also control many other substances. We do not wish to complicate the task of demonstrating compliance with the standard by including nonessential requirements, such as a much-expanded list of covered contaminants. It is in this same spirit that we are proposing to allow minimal degradation of very good quality water. There is no clear need for stricter standards than we are proposing, and substantial additional resources could be required to meet them for some piles.

[5] pCi/m^2-sec stands for picocuries per square meter per second, a measure of the release rate of radioactivity from a surface. A curie is the amount of radioactive material that produces 37 billion nuclear transformations per second. A picocurie is a trillionth of a curie. One picocurie produces a little more than two nuclear transformations per minute.

[6] These studies are cited in the draft EIS.

[7] Reducing the emission rate from 10 to 9 pCi/m^2-sec (a 10% reduction) requires about 1 cm of added soil; the same size reduction from 2 to 1 pCi/m^2-sec (50%) takes about 50 cm of added soil.

[8] This assumes that covering the tailings with soils and clay is a feasible method for radon control to an emission rate of about 2 pCi/m^2-sec.

There is evidence of limited ground water contamination at some of the inactive sites, but the prospects for long-term contamination have not been fully assessed. The proposed ground water protection standards, however, apply only to releases from tailings that may occur after disposal of the piles. It may sometimes be possible to improve the quality of an already-contaminated aquifer, but we believe a generally applicable requirement to meet pre-set standards is not feasible.

The Department of Energy will prepare Environmental Impact Statements or Environmental Assessment reports for each site to support the decisions it will reach, with NRC's concurrence, on necessary remedial action to satisfy the standards. We believe that disposal methods that satisfy the standards will avoid ground water problems caused by future releases from the piles for at least 1000 years (see below). We expect DOE to consider the need for and practicality of controlling contaminants that have already seeped under the tailings pile, and to apply technical remedies that are found justified. Institutional controls should also be applied, however. If tailings are found to be contaminating ground water that is being used, we would expect DOE to provide alternate water sources or other appropriate remedies. We note that PL 95-604 will terminate DOE's authority to do so as a remedial action seven years after we promulgate standards, unless Congress extends the period. However, PL 95-604 provides for Federal custody of the disposal sites under NRC licenses after the remedial action program is completed. The custodial agency is authorized to carry out such monitoring, maintenance, and emergency measures as the NRC may deem necessary to protect public health. We expect NRC's monitoring requirements will be sufficient to ensure detection of any contamination by the tailings of usable ground water near the disposal sites, and to cause the custodial agency to take necessary measures to avoid any significant public health problem.

The actions necessary to avoid future ground water contamination may increase disposal costs in some cases up to double the cost of radon control alone. Available information suggests that such measures often will not be needed because many tailings piles do not threaten ground water. Moreover, where the standards might be exceeded only in the immediate neighborhood of a pile, we do not believe the substantial costs and disruptions necessary to avoid the violation would be warranted. Therefore, when existing tailings sites are used for disposal, we propose that the ground water protection standards be applied 1.0 kilometer from the pile. If tailings are moved to a new disposal site for any reason, then site selection and preparation are possible. We propose that the standard for a new site be applied 0.1 kilometer from the pile.

EPA is developing a ground water protection strategy which, to the extent that various legislative authorities allow and it is practicable, will guide the development of consistent regulations for a number of its programs. These include programs for disposal of solid wastes under the Resource Conservation and Recovery Act, underground injection control under the Safe Drinking Water Act, wastewater sludge disposal under the Clean Water Act, and disposal of uranium mill tailings under the Uranium Mill Tailings Radiation Control Act. Persons wishing to comment on this issue (consistency) should refer to EPA's notice (45 FR 66816-23, October 8, 1980) discussing various approaches for protecting ground water from hazardous wastes at land disposal sites covered under Subtitle C of the Resource Conservation and Recovery Act.

We would be pleased to receive suggestions for alternative formulations of ground water standards for disposal of uranium mill tailings covered by Title I of PL 95-604. Should the standard contain limits on allowed degradation, or should it specify nondegradation (no increases in concentrations), or no releases? If degradation limits are used, as we propose, in what other ways might they be determined? Should the standards apply at different distances from the tailings for new disposal sites than for existing sites? What should these distances be? Are more substances needed in the list of covered contaminants, or are any of them superfluous? Comments on these issues will be most useful when supported by reasons and data.

Proposed Surface Water Protection Standards

Wind, rain, or floods can carry tailings into rivers, lakes, and reservoirs. Pollutants may also seep out of the piles and contaminate surface waters. However, implementing the radon emission limits and the ground water protection requirements will greatly reduce this. A pile with severely restricted radon releases will not be able to release particulates to wind or water. Similarly, the ground water protection requirements imply limited water flow through the pile, which limits flow to the surface as well as under the ground. Thus, we expect that the radon emission and ground water standards will protect surface water. However, to assure adequate protection, we propose to require that surface water not be degraded by tailings after disposal of the piles. This means that after disposal, any contaminant releases from the disposal site should not increase the concentration of any harmful substances in surface water.

Longevity of Disposal Standards

Congress recognized that uranium mill tailings are hazardous for a long time, and directed EPA to set reasonable standards for their long-term disposal. We propose requiring a reasonable expectation that the radon emission and water protection standards for disposal of tailings piles will be satisfied for at least 1,000 years.

Institutional control methods such as recordkeeping, maintenance, monitoring, and land-use restrictions are useful adjuncts to an adequate disposal system, to provide greater protection than the standards require, and to regulate deliberate disruptions of the tailings by people.[9] However, we do not believe they should be relied upon for periods longer than a century, and are inappropriate for long-term control. They should not replace use of adequate long-term physical disposal methods.

The choice of a 1,000-year period of application results from practical considerations. Based on existing knowledge of control methods and natural processes, we believe it unreasonable to *generally* require longer protection under this remedial action program, because adequate methods for demonstrating compliance are not clearly available and may be very costly. We consider it likely, however, that the implementers of the standards will require longer protection at some piles, based on site-specific evaluations of disposal methods and their costs.

We believe 1,000 years meets the Congressional criterion that "the remedial action must be done right the first time." This does not mean our concern for the future is limited to 1,000 years, but does reflect our judgment that the remedial actions must be practical. We would be pleased to receive comments on whether 1,000 years is the best choice.

[9] For example, Sec. 104(h) of PL 95-604 anticipates that subsurface minerals at a tailings disposal site may be used. However, it provides that any tailings disturbed by such use "will be restored to a safe and environmentally sound condition." Therefore, we propose to apply the disposal standards to the use of any subsurface mineral rights acquired under the provisions of Sec. 104(h).

III. Implementation

PL 95–604 requires the Secretary of Energy to select and perform remedial actions for uranium mill tailings from inactive processing sites in accordance with EPA's standards, with the full participation of any State that shares the cost. Remedial actions will be selected and performed with the concurrence of the Nuclear Regulatory Commission and in consultation, as appropriate, with affected Indian tribes and the Secretary of the Interior. The costs of the remedial actions will be borne by the Federal Government and the States as prescribed by law.

The disposal standards will be implemented by showing that the disposal method provides a reasonable expectation of satisfying the radon emission limits and water protection provisions of the standards for at least 1,000 years. We intend for this expectation to be founded upon analyses of the physical properties of the disposal system and the potential effects of natural processes over time. Computational models, theories, and expert judgment will be major tools in deciding that a proposed disposal system will satisfy the standard. Post-disposal monitoring can serve only a minor role in confirming that the standards are satisfied. Where measurements are necessary to determining compliance, they may be performed within the accuracy of available field and laboratory instruments used in conjunction with reasonable survey and sampling procedures.

Disposal of tailings piles from inactive processing facilities is a large scale undertaking for which there is very little experience. Although preliminary engineering assessments for the sites affected by these standards have been performed, specific engineering requirements and costs to meet the standards at each site have yet to be determined. We believe disposal costs averaging about 11 million (1979) dollars per tailings pile are most likely. This estimate includes some costs that will probably not always be incurred, because some piles will not need to be moved to a new site or buried in an excavated pit. For some sites, the disposal cost will be partly offset by recovered land values or by uranium or other minerals recovered through reprocessing the tailings prior to disposal.

Exceptions

We believe that our proposed standards are the strictest that are justified for general application at all the inactive uranium processing sites covered by PL 95–604. However, providing greater protection may be reasonable at specific sites. Therefore, we urge the implementers to lower the residual risk as far below the required level as is reasonably achievable.

On the other hand, the standards could be unreasonably strict for certain circumstances. Because the scale of material-moving activity is so great, the possibility of serious harm to both workers and the general public from accidents associated with transporting an entire tailings pile to a new disposal site deserves particular consideration. Relocating a pile should be considered whenever it may not be practical to satisfy all the disposal standards at the original location. However, circumstances might be such that one would not expect the standards to be greatly exceeded within a thousand years, and that substantial human exposure to any resulting pollution would not necessarily occur. If all practical transport methods would probably cause serious harm to people from accidents, and if this and other risks associated with the transportation system are large enough, the near-term endangerment may outweight the additional long-term benefits of full rather than partial compliance with the standards. By carefully considering all these factors for each tailings pile where the issue arises, exceptions to the disposal standard could be justified because of the degree of unavoidable endangerment in attempting full compliance.

We do not consider the current remoteness of a pile from population centers sufficient by itself to justify relaxing the standards. Even small numbers of people nearby require protection, and the population of an area could increase considerably over the one thousand year period to which the standards apply. Furthermore, radon released from tailings piles travels over long distances.

In order to allow for reasonable implementation of PL 95–604, we are proposing criteria that may be used to determine whether particular circumstances justify exceptions to the disposal standards. In such exceptional cases, DOE, with the concurrence of NRC, may select and perform remedial actions that come as close to meeting the disposal standards as is reasonable. When doing so, DOE shall also inform EPA.

Note.—The costs and benefits of these standards are discussed in the Draft Environmental Impact Statement. However, our program to set remedial action standards for PL 95–604 does not require preparation of an economic analysis under Executive Order 12044. We expect the costs of the remedial action program in any calendar year to be less than the 100 million dollar criterion EPA has established (44 FR 30988–30998, May 29, 1979) for requiring an economic analysis.

Dated: December 31, 1980.

Douglas M. Costle,

Administrator.

Note.—Subparts B and C of the following were proposed earlier (45 FR 27370–27375, April 22, 1980) and are repeated here for the convenience of the reader.

The Administrator of the Environmental Protection Agency hereby proposes to add a Part 192, Subpart A, to Title 40 of the Code of Federal Regulations as follows:

PART 192—ENVIRONMENTAL PROTECTION STANDARDS FOR URANIUM MILL TAILINGS

Subpart A—Environmental Standards for the Disposal of Residual Radioactive Materials From Inactive Uranium Processing Sites

Subpart B—Environmental Standards for Cleanup of Open Lands and Buildings Contaminated With Residual Radioactive Materials From Inactive Uranium Processing Sites

Subpart C—Exceptions

Authority: Section 275 of the Atomic Energy Act of 1954, 42 U.S.C. 2022, as amended by the Uranium Mill Tailings Radiation Control Act of 1978, PL 95–604.

Subpart A—Environmental Standards for Disposal of Residual Radioactive Materials From Inactive Uranium Processing Sites

§ 192.01 Applicability.

This subpart applies to the disposal of residual radioactive material at any designated processing site or depository site as part of any remedial action conducted under Title I of the Uranium Mill Tailings Radiation Control Act of 1978 (PL 95–604), or following any use of subsurface minerals at such a site.

§ 192.02 Definitions.

(a) Unless otherwise indicated in this subpart, all terms shall have the same meaning as in Title I of the Uranium Mill

Tailings Radiation Control Act of 1978 and the Atomic Energy Act.

(b) *Remedial action* means any action performed under section 108 of the Uranium Mill Tailings Radiation Control Act of 1978.

(c) *Disposal* means any remedial action intended to assure the long-term, safe, and environmentally sound stabilization of residual radioactive materials.

(d) *Disposal site* means the region within the smallest practical boundaries around residual radioactive material following completion of disposal.

(e) *Depository site* means a disposal site selected under Section 104(b) or 105(b) of the Uranium Mill Tailings Radiation Control Act of 1978.

(f) *Aquifer* means a geologic formation, group of formations, or portion of a formation capable of yielding usable quantities of ground water to wells or springs.

(g) *Ground water* means water below the land surface in the zone of saturation.

(h) *Underground source of drinking water* means:

(1) An aquifer supplying drinking water for human consumption, or

(2) An aquifer in which the ground water contains less than 10,000 milligrams/liter total dissolved solids.

(i) *Curie* (Ci) means the amount of radioactive material which produces 37 billion nuclear transformations per second. One picocurie (pCi)=10–12 Ci.

(j) *Surface waters* means "waters of the United States, including the territorial seas" ("navigable waters") as defined in the Federal Register Volume 44, page 32901, June 7, 1979. [*Comment:* This definition is taken from the Regulations for the National Pollutant Discharge Elimination System, 40 CFR 122.3(t). In essence, it includes all U.S. surface waters which the public may traverse, enter, or draw food from.]

§ 192.03 Standards.

Disposal of residual radioactive materials shall be conducted in a way that provides a reasonable expectation that for at least one thousand years following disposal—

(a) The average annual release of radon-222 from a disposal site to the atmosphere by residual radioactive materials will not exceed 2 pCi/m^2-sec.*

(b) Substances released from residual radioactive materials after disposal will not cause

(1) The concentration of that substance in any underground source of drinking water to exceed the level specified in Table A, or

(2) An increase in the concentration of that substance in any underground source of drinking water, where the concentration of that substance prior to remedial action exceeds the level specified in Table A for causes other than residual radioactive materials. This subsection shall apply to the dissolved portion of any substance listed in Table A at any distance greater than 1.0 kilometer from a disposal site that is part of an inactive processing site, or greater than 0.1 kilometer if the disposal site is a depository site.

(c) Substances released from the disposal isite after disposal will not cause the concentration of any harmful dissolved substance in any surface waters to increase above the level that would otherwise prevail.

§ 192.04 Effective date.

The standards of this Subpart shall be effective 60 days after final promulgation of this rule.

Subpart B—Environmental Standards for Cleanup of Open Lands and Buildings Contaminated With Residual Radioactive Materials From Inactive Uranium Processing Sites

§ 192.10 Applicability.

This subpart applies to open lands and buildings which are part of any processing site designated by the Secretary of Energy under Public Law 95–604, Section 102. Section 101 of Public Law 95–604, states that "processing site" means—

(a) Any site, including the mill, containing residual radioactive materials at which all or substantially all of the uranium was produced for sale to any Federal agency prior to January 1, 1971 under a contract with any Federal agency, except in the case of a site at or near Slick Rock, Colorado, unless—

(i) Such site was owned or controlled as of January 1, 1978, or is thereafter owned or controlled, by any Federal agency, or

(ii) A license (issued by the [Nuclear Regulatory] Commission or its predecessor agency under the Atomic Energy Act of 1954 or by a State as permitted under section 274 of such Act) for the production at such site of any uranium or thorium product derived from ores is in effect on January 1, 1978, or is issued or renewed after such date; and

(b) Any other real property or improvement thereon which—

(i) Is in the vicinity of such site, and

(ii) Is determined by the Secretary, in consultation with the Commission, to be contaminated with residual radioactive materials derived from such site.

Any ownership or control of an area by a Federal agency which is acquired pursuant to a cooperative agreement under this title shall not be treated as ownership or control by such agency for purposes of subparagraph (A)(i). A license for the production of any uranium product from residual radioactive materials shall not be treated as a license for production from ores within the meaning of subparagraph (A)(ii) if such production is in accordance with section 108(b).

§ 192.11 Definitions.

(a) Unless otherwise indicated in this subpart, all terms shall have the same meaning as defined in Title I of the Uranium Mill Tailings Radiation Control Act of 1978.

(b) *Remedial action* means any action performed under Section 108 of the Uranium Mill Tailings Radiation Control Act of 1978.

(c) *Open land* means any surface or subsurface land which is not a disposal site and is not covered by a building.

(d) *Working Level (WL)* means any combination of short-lived radon decay products in one liter of air that will result in the ultimate emission of alpha particles with a total energy of 130 billion electron volts.

(e) *Dose equivalent* means absorbed dose multiplied by appropriate factors to account for differences in biological effectiveness due to the type and energy of the radiation and other factors. The unit of dose equivalent is the "rem."

(f) *Curie (Ci)* means the amount of radioactive material which produces 37 billion nuclear transformations per second. One picocurie (pCi) = 10^{-12}Ci.

§ 192.12 Standards.

Remedial actions shall be conducted so as to provide reasonable assurance that—

(a) The average concentration of radium-226 attributable to residual radioactive material from any designated processing site in any 5 cm thickness of soils or other materials on open land within 1 foot of the surface, or in any 15 cm thickness below 1 foot, shall not exceed 5 pCi/gm.

(b) The levels of radioactivity in any occupied or occupiable building shall not exceed either of the values specified in Table B because of residual radioactive materials from any designated processing site.

*Note.—The radon emitted from a tailings site after disposal will come from the tailings and from materials covering them. Radon emissions from the covering materials should be estimated as part of developing a disposal plan for each site. These plans will be reviewed and concurred with by the Nuclear Regulatory Commission prior to disposal. After disposal, the radon emission standard is satisfied if the emission rate is less than or equal to 2 pCi/m^2-sec plus the emission rate expected from the disposal materials.

(c) The cumulative lifetime radiation dose equivalent to any organ of the body of a maximally exposed individual resulting from the presence of residual radioactive materials or byproduct materials shall not exceed the maximum dose equivalent which could occur from radium-226 and its decay products under paragraphs (a) and (b) of this section.

§ 192.13 Effective date.

The standards of this Subpart shall be effective 60 days after promulgation of this rule.

Subpart C—Exceptions

§ 192.20 Criteria for exceptions.

Exceptions to the standards may be justificable under any of the following circumstances:

(a) Public health or safety would be unavoidably endangered in attempting to meet one of more of the requirements of Subpart A or Subpart B.

(b) The goal of environmental protection would be better served by not satisfying cleanup requirements for open land, § 192.12(a) or the corresponding part of § 192.12(c). to justify an exception to these requirements there should be a clearly unfavorable imbalance between the environmental harm and the environmental and health benefits which would result from implementing the standard. The likelihood and extent of current and future human presence at the site may by considered in evaluating these benefits.

(c) The estimated costs of remedial actions to comply with the cleanup requirements for buildings, § 192.12(b) or the corresponding part of § 192.12(c), are unreasonably high relative to the benefits. Factors which may be considered in this judgment include the period of occupany, the radiation levels in the most frequently occupied areas, and the residual useful lifetime of the building. This criterion can only be used when the values in Table B are only slightly exceeded.

(d) There is no known remedial action to meet one or more of the requirements of Subpart A or Subpart B. Destruction and condemnation of buildings are not considered remedial actions for this purpose.

§ 192.21 Remedial actions for exceptional circumstances.

Section 108 of PL 95–604 requires the Secretary of Energy to select and perform remedial actions with the concurrence of the Nuclear Regulatory Commission and the full participation of any State which pays part of the cost, and in consultation, as appropriate, with affected Indian tribes and the Secretary of the Interior. Under exceptional circumstances satisfying one or more of the conditions § 192.20(a), (b), (c), and (d), the Department of Energy may select and perform remedial actions, according to the procedures of Section 108, which come as close to meeting the standard to which the exception applies as is reasonable under the exceptional circumstances. In doing so, the Department of Energy shall inform any private owners and occupants of affected properties and request their comments on the selected remedial actions. The Department of Energy shall provide any such comments to the parties involved in implementing Sec. 108 of Public Law 95–604. The Department of Energy shall also inform the Environmental Protection Agency of remedial actions for exceptional circumstances under Subpart C of this rule.

Table A

Milligrams/liter:	
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Lead	0.05
Mercury	0.002
Molybdenum	0.05
Nitrogen (in nitrate)	10.0
Selenium	0.01
Silver	0.05
pCi/liter:	
Combined radium-226 and radium-228	5.0
Gross alpha particle activity (including radium-226 but excluding radon and uranium)	15.0
Uranium	10.0

Table B

Average Annual Indoor Radon Decay Product Concentration (including background) (WL)	0.015
Indoor Gamma Radiation (above background) (milliroentgens/hour)	0.02

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