ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 192

[AH-FRL 3219-6]

Environmental Standards for Uranium and Thorium Mill Tailings at Licensed Commercial Processing Sites; Invitation for Comment

AGENCY: U.S. Environmental Protection Agency.

ACTION: Proposed rule.

SUMMARY: In this notice we propose health and environmental standards to govern stabilization and control of byproduct materials (primarily mill tailings) at licensed commercial uranium and thorium processing sites. These standards were developed pursuant to Section 275 of the Atomic Energy Act (42 U.S.C. 2022), as added by Section 206 of the Uranium Mill Tailings Radiation Control Act of 1978 (Pub. L. 95-604).

The standards would apply to tailings at locations that are licensed by the Nuclear Regulatory Commission (NRC) or the States under Title II of the Act. The standards for disposal of tailings would require stabilization so that the health hazards associated with tailings will be controlled and limited, in most cases, for at least one thousand years. They would limit releases of radon to 20 pCi/m²s, averaged over the surface of the piles, and require measures to avoid releases of other hazardous substances from tailings to water. The standards for tailings at operating mills, prior to disposal, would add limits on the radiation levels in effluents to ground water to the limits now specified under the Solid Waste Disposal Act, as amended. Existing EPA regulations and Federal Radiation Protection Guidance currently applicable to tailings would remain unchanged.

This notice summarizes the technical information and other considerations upon which these proposed standards are based. More detailed background material is contained in a Draft Environmental Impact Statement (DEIS) and in a Regulatory Impact Analysis (RIA). We invite written comments on all of this material and, in addition, will hold public hearings on these proposed standards.

DATES:

Written Comments. Comments should be received on or before May 31, 1983.

Public Hearings. Requests to participate in the public hearings should be received on or before May 20, 1983. Public hearings on this proposed rule will begin on May 31, 1983. All hearings will commence at 9:30 a.m.

ADDRESSES:

Written Comments. Comments should be submitted to Docket No., A-82-26 at the address specified for the docket below. We would appreciate an additional copy sent to Mr. Jack Russell at the address listed below (see the heading "FOR FURTHER INFORMATION.")

Public Hearings. Requests to participate in the public hearings should be submitted in writing to the Director, Criteria and Standards Division (ANR-460), Office of Radiation Programs, Environmental Protection Agency, Washington, D.C. 20460. All requests for participation must include at least an outline of the topics to be addressed, the amount of time requested, and the names of the participants. Statements should not repeat information already presented in written comments, but should address additional matters. Public hearings on this proposed rule will be held at the DuPont Plaza Hotel, Embassy Hall, 1500 New Hampshire Avenue, NW., Washington, D.C. 20036. All hearings will commence at 9:30 A.M.

Background Documents. Background information is contained in the reports entitled *Draft Environmental Impact Statement for Standards for the Control of Byproduct Materials from Uranium Ore Processing (40 CFR Part 192),* EPA Report 520/1-82-022; and *Regulatory Impact Analysis of Environmental Standards for Uranium Mill Tailings at Active Sites,* EPA Report 520/1-82-023. Single copies of these reports, as available, may be obtained from the Program Management Office (ANR-458), Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, D.C. 20460; telephone number (703) 557-9351.

Docket. Docket Number A-82-26 contains the rulemaking record. The docket is available for public inspection between 8:00 a.m. and 4:00 p.m., Monday through Friday, at EPA Headquarters. The address is: Central Docket Section (LE-130), West Tower Lobby, 401 M Street, SW., Washington, D.C. 20460. A reasonable fee may be charged for copying.

FOR FURTHER INFORMATION:
Contact Mr. Jack Russell, Guides and Criteria Branch (ANR-460), Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, D.C. 20460; telephone number (703) 557-8610.

SUPPLEMENTARY INFORMATION:

I. Introduction

On November 8, 1978, Congress enacted Pub. L. 95-604, the Uranium Mill Tailings Radiation Control Act of 1978 (henceforth designated "UMTRCA"). In the Act, Congress stated its finding that uranium mill 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 Administrator of the Environmental Protection Agency (EPA) was directed to set "* * * standards of general application for the protection of the public health, safety, and the environment * * *" to govern this process of stabilization, disposal, and control.

UMTRCA established two programs to protect public health, safety and the environment from uranium mill tailings, one for certain designated sites which are now inactive (i.e., at which all milling has stopped and which are not under license) and another for active sites (those sites licensed by the Nuclear Regulatory Commission or the State in which the site is located, when this State is an Agreement State of the NRC under Section 274 of the Atomic Energy Act).

Tailings at the inactive uranium milling sites are defined in UMTRCA as residual radioactive materials. The program for inactive sites covers the disposal of tailings and the cleanup of onsite and offsite locations contaminated with tailings. EPA has established health and environmental standards to govern each of these activities. The U.S. Department of Energy (DOE) is reponsible for carrying out these activities in conformance with these standards, with the concurrence of the NRC, and in cooperation with the States.

EPA proposed standards for cleanup of residual radioactive materials from open lands and buildings and made them effective on an interim basis on April 22, 1980 (45 FR 25682 and 45 FR 27370), and proposed standards for disposal of these materials at inactive uranium processing sites on January 9, 1981 (46 FR 2556). Final cleanup and disposal standards for the inactive sites were published on January 5, 1983 (48 FR 590).

Tailings at active uranium milling sites are defined in UMTRCA as uranium byproduct materials. The program for active sites covers the final disposal of tailings and the control of effluents and emissions during and after milling operations, but does not address cleanup of contaminated offsite locations. UMTRCA requires EPA to establish standards for this program, and that standards for nonradioactive hazards protect human health and the environment in a manner consistent with standards established under Subtitle C of the Solid Waste Disposal Act, as amended. The NRC or the licensing Agreement State is responsible for assuring compliance with the standards at active mill sites.

UMTRCA was amended by the NRC Authorization Act during December 1982. These amendments changed the date by which these standards must be promulgated (Cong. Record, 515310; Dec. 16, 1982). The amendments also provide that "If the Administrator fails to promulgate standards in final form * * * by October 1, 1983, the authority of the Administrator to promulgate such standards shall terminate, and the Commission may take action under this Act without regard to any provision of this Act requiring such actions to comply with, or to be taken in accordance with, standards promulgated by the Administrator." WE are therefore proceeding to establish these standards expeditiously.

A. The Uranium Industry

The major deposits of high-grade uranium ores in the United States are located in the Colorado Plateau, the Wyoming Basins, and the Gulf Coast Plan of Texas. Most ore is mined by either underground or open-pit methods. At the mill the ore is first crushed, blended, and ground to the proper size for the leaching process which extracts uranium. Several leaching processes are used, including acid, alkaline and a combination of the two. After uranium is leached from the ore it is concentrated from the leach liquor through ion exchange or solvent extraction. The concentrated uranium is then stripped or extracted from the concentrating medium, precipitated, dried, and packaged. The depleted ore, in the form of tailings, is pumped to a tailings pile as a slurry mixed with water.

Since the uranium content of ore averages only about 0.15 percent, essentially all the bulk of ore mined and processed is contained in the tailings. These wastes contain significant quantities of radioactive uranium decay products, including thorium-230, radium-226, and decay products of radon-222. Tailings can also contain significant quantities of other hazardous substances, depending upon the source of the ore and the reagents used in the milling process. Most of the tailings are a sand-like material and are attractive for use in construction and soil conditioning.

In 1980 there were 21 operating uranium mills, located in Colorado, New Mexico, Texas, Utah, Washington, and Wyoming. All of these mills have tailings stored at their sites, as have two additional licensed mills in Edgemont, South Dakota, and Ray Point, Texas, which were no longer operating in 1980. The total quantity of tailings was about 146 million metric tons (MT) at these 23 sites as of January 1980.

As of September 1982 there were 27 licensed uranium mills, of which only 16 were operating. Eight mills closed during the period from January 1981 to September 1982, and the two mills with tailings piles which were not operating in 1980 remained closed. Another mill has been constructed and licensed, but has not started operation. By early 1982, the amount of stored tailings had reached about 170 million MT. The size of individual tailings piles ranges from about 2 million MT to about 30 million MT.

The future demand for uranium is projected to be almost exclusively for electrical power generation. Thus, the demand should be stable and reasonably predictable, depending mainly on the number of operating nuclear power reactors. Based on recent DOE projections, it is estimated that at least an additional 350 million MT of tailings will be generated by the year 2000 in the United States. This projection is for the conventional milling of uranium described above. A small quantity of uranium is also recovered as a secondary product in the extraction of other minerals, such as phosphate and copper, and also by solution (*in situ*) mining methods. Foreign sources of uranium may also influence demand projections for the domestic uranium industry, especially since some foreign deposits are richer in uranium, which permits lower pricing.

The United States Government purchased large quantities or uranium, primarily for use in defense programs, from 1943 to 1970. Many of the producers of this uranium continued operating after 1970 to supply the commercial demand for uranium. In most cases the tailings from Government and commercial purchases were mixed and stored in the same pile. These mixed tailings are now referred to as "commingled" tailings. There are about 56 million MT of defense-related tailings commingled with approximately 82 million MT of other tailings at 13 sites which are now licensed for milling uranium ore.

B. Hazards Associated With Uranium Byproduct Materials

The most important of the hazardous constituents of uranium mill tailings is radium, which is radioactive. We estimate that currently existing tailings at the licensed sites contain a total of about 85,000 curies [1] of radium. Radium, in addition to being hazardous itself, produces radon, a radioactive gas whose decay products can cause lung cancer. Figure 1 shows the radon production of tailings as a function of time.

[1] A curie is the amount of radioactive material that produces 37 billion nuclear transformations (e.g. disintegrations of radium into radon) per second.

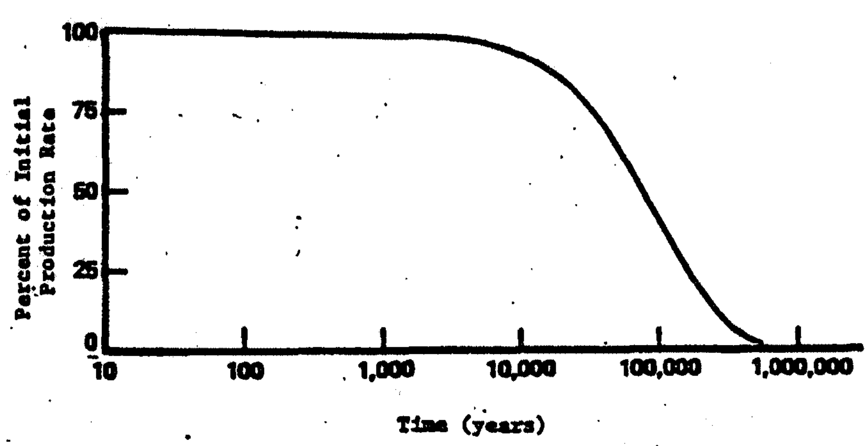

Figure 1. Radon production in a tailings pile.

The amount of radium in tailings, and, therefore, the rate at which radon is produced, will decay to about 10 percent of the current amount in several hundred thousand years. Other potentially hazardous constituents of tailings include arsenic, molybdenum, selenium, uranium and, usually in lesser amounts, a variety of other toxic substances. The concentrations of all of these materials vary from pile to pile.

The radioactivity and toxic materials in tailings may cause cancer and other diseases, as well as genetic damage and teratogenic effects. More specifically, tailings are hazardous to man primarily because: (1) Radioactive decay products of radon may be inhaled and increase the risk of lung cancer; (2) individuals may be exposed to gamma radiation from the radioactivity in tailings; and (3) radioactive and toxic materials from tailings may be ingested with food or water. The first of these hazards is by far the most important.

As noted above, the radiation hazard from tailings lasts for many hundreds of thousands of years, and some nonradioactive toxic chemicals persist indefinitely. The hazard from uranium tailings therefore must be viewed in two ways. Tailings pose a present hazard to human health. Beyond this immediate but generally limited health threat, the tailings are vulnerable to human misuse and to dispersal by natural forces for an essentially indefinite period. In the long run the future risks to health of indefinitely extended contamination from misused and dispersed tailings overshadows the short-term danger to public health. The Congressional report accompanying UMTRCA recognized the existence of long-term risks, and expressed the view that the methods used for disposal should not be effective for only a short period of time. It stated: "The committee believes that uranium mill tailings should be treated * * * in accordance with the substantial hazard they will present until long after existing institutions can be expected to last in their present forms * * *" and, in commenting on the Federally-funded program to clean up and dispose of tailings at the inactive sites, it stated "The committee does not want to visit this problem again with additional aid. The remedial action must be done right the first time." (H.R. Rep. No. 1480, 95th Cong., 2nd Sess., Pt. I, p. 17, and Pt. II, p. 40 (1978).)

For the purpose of establishing standards for the protection of the general public from radiation, we assume a linear, nonthreshold dose-effect relationship as a reasonable basis for estimating risks to health. This means we assume that any radiation dose poses some risk and that the risk of low doses is directly proportional to the risk that has been demonstrated at higher doses. We recognize that the data available preclude neither a threshold for some types of damage below which there are no harmful effects, nor the possibility that low doses of gamma radiation may be less harmful to people than the linear model implies. However, the major radiation hazard from tailings arises from alpha radiation, and, as the National Academy of Sciences' Advisory Committee on the Biological Effects of Ionizing Radiation (the BEIR Committee) stated in its 1980 report, for "* * * radiation, such as from internally deposited alpha-emitting radionuclides, the application of the linear hypothesis is less likely to lead to overestimates of risk, and may, in fact, lead to underestimates."

Our quantitative estimates of radiation risk are based on our review of epidemiological studies, conducted in the United States and in 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 Populations of Exposure to Low Levels of Ionizing Radiation* (1972) and *Health Effects of Alpha Emitting Particles in the Respiratory Tract* (1976) by 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 a previous EPA report, *Indoor Radiation Exposure Due to Radium-226 in Florida Phosphate Lands* (EPA 520/4-78-013), and in the DEIS.

Although the studies of underground miners show that there is a significant risk of lung cancer from exposure to radon decay products, there is some uncertainty about its magnitude. Exposures of miners were estimated from the time spent in each location in a mine and the measured radon decay product levels at those locations. However, radon decay product measurements were infrequent and often nonexistent for exposures of miners prior to the 1960's. The uncertainty increases when data for miners are used to estimate risk to members of the general public, because there are differences in age, physiology, exposure conditions, and other factors between the two populations.

In addition, we must make numerous assumptions when estimating the radiation dose to individuals and population groups which introduce other uncertainties. For example, we make our estimates for individuals who are assumed to spend their lifetimes in the same location, and we assume that people will continue to have the same life expectancy as the U.S. population did in 1970. Nevertheless, we believe the information available supports an estimate of risk which is sufficiently reliable to provide an adequate basis for these proposed standards. EPA's risk estimates are to be viewed as "best estimates," considering the above factors.

It is not possible to reduce the risk to zero for people exposed to radiation or, for that matter, to many other hazardous materials. To decide on an appropriate level of (small) residual risk, we evaluated the costs and benefits of different levels of control. We also considered technical difficulties associated with implementing different levels of control.

C. Environmental Standards and Guidance Now Applicable to Uranium Tailings

EPA recognizes that it is establishing standards in an area that is already the subject of governmental regulation and has taken into account the existing schemes and levels of protection in developing this proposal.

EPA promulgated 40 CFR Part 190, "Environmental Radiation Protection Standards for Uranium Fuel Cycle Operations," on January 13, 1977 (42 FR 2858). These standards specify the upper limits of radiation doses to members of the general public to which normal operations of the uranium fuel cycle must conform. They cover radiation doses due to all environmental releases of uranium byproduct materials during the period a milling site is licensed, with the exception of emissions of radon and its decay products.

The Nuclear Regulatory Commission promulgated rules in 10 CFR Part 40 on October 3, 1980, which specify licensing requirements for uranium and thorium milling activities, including tailings and wastes generated from these activities (45 FR 65521). These rules specify technical, surety, ownership, and long-term care criteria for the management and final disposition of uranium byproduct materials. Some of these rules would be affected by these proposed standards, and the NRC has noted that any changes necessary will be made when these EPA standards are promulgated.

The NRC has also enumerated in 10 CFR Part 150 the authorities reserved to it in its relations with Agreement States under the provisions of UMTRCA, and has specified conditions under which Agreement States may issue licenses under UMTRCA (45 FR 65521). Under the Agreement State program, States can issue licenses for uranium processing activities, including control and disposal of uranium byproduct materials. These NRC conditions include the specification that State licenses must ensure that the standards proposed here are adhered to when they have been promulgated.

EPA promulgated 40 CFR Part 260 et seq., "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," under Subtitle C of the Solid Waste Disposal Act, as amended (SWDA) on July 26, 1982 (47 FR 32274). Although radioactive materials controlled under the Atomic Energy Act of 1954, as amended, are not covered by the SWDA, UMTRCA requires that the standards proposed herein provide for protection of human health and the environment from nonradioactive hazards in a manner consistent with applicable standards promulgated under Subtitle C of the SWDA. The Act also requires the NRC to ensure conformance to "* * * general requirements established by the Commission, with the concurrence of the Administrator, which are, to the maximum extent practicable, at least comparable to requirements applicable to the possession, transfer, and disposal of similar hazardous material under [Subtitle C of the SWDA]."

EPA promulgated 40 CFR Part 440, "Ore Mining and Dressing Point Source Category; Effluent Limitations Guidelines and New Source Performance Standards, Subpart C—Uranium, Radium and Vanadium Ores Subcategory," on December 3, 1982 (47 FR 54598). The purpose of 40 CFR Part 440 is to establish effluent limitations, guidelines, and standards under the Clean Water Act for existing and new sources in a number of ore mining and dressing subcategories. Out of 27 mills in the uranium, radium and vanadium ores subcategory existing at that time, only one was discharging directly to surface water. In view of this, the regulations did not establish best available technology (BAT) limitations for existing sources in this subcategory. The one direct discharging uranium mill is currently regulated by a discharge permit in accordance with previously existing best practicable control technology (BPT) effluent limitations contained in 40 CFR Part 440. The new source performance standards were based upon the demonstration of no discharge to surface waters at the 26 other mills. These standards were derived for locations where the annual evaporation rate exceeds the annual precipitation rate (as is the case in most uranium milling areas), and require that "There shall be no discharge of process waste water from mills using the acid leach, alkaline leach, or combined acid and alkaline leach process for the extraction of uranium or from mines and mills using in-situ leach materials." That is, it prohibits any contamination of surface waters by these activities.

Finally, radiation protection guidance to Federal agencies for the conduct of their radiation protection activities was issued by the President on May 13, 1960 and published on May 18, 1960 (25 FR 4402). Federal Radiation Protection Guidance governs the regulation of radioactive materials by the NRC and Agreement States, and includes the following guidance: "* * * every effort should be made to encourage the maintenance of radiation doses as far below [the Federal Radiation Protection Guides] as practicable * * *" and "There can be no single permissible or acceptable level of exposure without regard to the reason for permitting the exposure. It should be general practice to reduce exposure to radiation, and positive effort should be carried out to fulfill the sense of [this Guidance]. It is basic that exposure to radiation should result from a real determination of its necessity." This guidance is currently known as the "as low as reasonably achievable" (ALARA) principle. It is particularly suited to minimizing radiation exposure in situations which vary greatly from site to site, or from time to time, and is an integral part of NRC and Agreement State licensing determinations.

The standards proposed here would supplement the above standards, guidance, and regulations in order to satisfy the purposes of UMTRCA to "* * * stabilize and control * * * tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards to the public." UMTRCA does not provide specific criteria to be used in determining that these purposes have been satisfied. EPA's objective, when not preempted by other statutory requirements, has been to propose standards that (1) take account of the tradeoffs between health, safety, and environmental and economic costs and benefits in a way that assures adequate protection of the public health, safety, and the environment; (2) can be implemented using presently available techniques and measuring instruments; and (3) are reasonable in terms of overall costs and benefits.

The legislative record shows that Congress intends that EPA set general standards and not specify any particular method of control. Therefore, our analyses of control methods, costs, risks, and other pertinent factors emphasize the general characteristics of uranium mill tailings and the affected sites. UMTRCA gives the NRC and the Agreement States the responsibility to decide what methods will assure these standards are satisfied at specific sites. (However, EPA must concur with NRC regulations established to implement Section 82a(3) of UMTRACA.)

II. Summary of Background Information

The information upon which we have based these proposed health and environmental standards for tailings as licensed commercial uranium processing sites is summarized below. Additional background information and more complete presentations are given in our DEIS and RIA.

A. The Risks From Tailings

Uranium mill tailings can affect man through four principal environmental pathways:

• *Diffusion of radon-222, the decay product of radium-226, from tailings into indoor air.* Breathing radon-222, an inert gas, and its short half-life decay products, which attach to tiny dust particles, exposes the lungs to alpha radiation (principally from polonium-218 and polonium-214). The exposures involved may be large for persons who have tailings in or around their houses, or who live very close ot tailings piles. Additional, but smaller, exposures to alpha radiation may result from long-lived radon-222 decay products (principally lead-210 and polonium-210). Exposure due to radon from tailings in or around buildings is best estimated from direct measurements of its decay products in indoor air.

• *Disposal of radon and of small particles of tailings material in air.* Radon emitted from tailings is widely dispersed in air, and exposes both nearby residents and those at greater distances. These doses are predominately to the lungs. Wind erosion of unstabilized tailings pilies creates local airborne tailings material. The predominant dose from airborne tailings is to the bones from eating foods contaminated by thorium-230, radium-226, and lead-210, and is small. Exposure due to airborne transport of radon and particulates from a pile usually can be directly measured only near the pile, but may be reliably estimated for larger distances using meteorological transport models.

• *Direct exposure to gamma radiation.* Many of the radioactive decay products in tailings produce gamma radiation. The most important are lead-214, bismuth-214, and thallium-210. Hazards from gamma radiation are limited to persons in the immediate vicinity of piles or removed tailings. Exposure due to gamma radiation from tailings is readily estimated from direct measurements.

• *Waterborne transport of radioactive and toxic material.* Dispersal of unstabilized tailings by wind or water, or leaching, can carry radioactive and other toxic materials to surface or ground water. Current levels of contamination appear to be low. However, contamination of surface and ground water and consequent intake by man and animals is possible. Potential exposure due to this possibility of ground and surface water contamination is highly site-specific and can generally only be determined by a careful survey program.

Our assessments of risks from tailings deal primarily with risks to man. This is because risks to other elements of the environment are judged to be much less significant, and would therefore be controlled to acceptable levels by measures adequate to protect man. In addition, the following discussion focuses largely on *current* levels of risk to man from tailings through air and water pathways. However, these current risks could be expanded by future misuse of tailings by man and by uncontrolled future effects of natural forces. Our proposed disposal standards reflect consideration of both current and potential future risks from tailings.

• *1. Air Pathways.* We estimated the hazards posed by emissions to air from tailings piles and from tailings used in and around houses. For the first case we used standard meteorological transport models and considered representative examples of exposure of people in the immediate neighborhood of a pile, the population in the local region, and the remainder of the national population. For the second, we drew largely upon experience from houses contaminated by tailings in Grand Junction, Colorado. Four sources of exposure were considered: inhaled short-lived radon decay products, gamma radiation, long-lived radon decay products, and airborne tailings particulates.

From this analysis we conclude:

(a) Lung cancer caused by the short-lived decay products of radon is the dominant radiation hazard from tailings. Estimated effects of gamma radiation, of long-lived radon decay products, and of airborn tailings particulates from the piles are generally much less significant, although high gamma radiation doses may sometimes occur.

(b) Individuals who have tailings in or around their houses often have large exposures to indoor radon and hence high risks of lung cancer. For example, in 50 percent of a sample of 190 houses with tailings in Grand Junction, Colorado, we estimate that the excess lifetime risk to occupants due to exposure to short-lived radon decay products prior to remediation may have been greater than 4 chances in 100.

(c) Individuals living near an uncontrolled tailings pile are also subject to high risks from short-lived radon decay products of radon emitted directly from tailings piles. For example, we estimate that people living continuously next to some tailings piles may have lifetime excess lung cancer risks as high as 4 chances in 100.

(d) Based on models for the cumulative risk to all exposed populations, we estimate that, *without* remedial action, the radon released directly from all tailings at presently (1982) licensed sites together would cause about 500 lung cancer deaths per century. This figure does not account for any likely additional deaths from misuse or windblown tailings because their number is difficult to predict, even though risk to individuals from such tailings may be somewhat greater than from direct radon emissions. By the year 2000, we estimate that, *without* remedial action, then-existing tailings would cause approximately 1200 to 1400 lung cancer deaths per century, depending on the amount of tailings generated by future demand for uranium. Of these, roughly 50 percent are projected to occur less than 50 miles from the piles.

There is substantial uncertainty in these estimates because of uncertainties in the rate of release of radon from tailings piles, the exposure people will receive from its decay products, and from incomplete knowledge of the effects on people of these exposures. The values presented here represent best estimates based on current knowledge. In addition, these estimates are based upon current sizes and geographical distributions of populations. If populations continue to increase in the future, the estimated impact would be larger.

We conclude that the primary objective of standards for control of hazards from tailings through air pathways is isolation and stabilization to prevent their misuse by man and dispersal by natural forces, such as wind, rain, and flood waters. The second objective is to minimize radon emissions from tailings piles. A third objective is the elimination of significant exposure to gamma radiation from tailings.

2. Water Pathways. Water contamination does not now appear to be a significant source of radiation exposure at most piles. However, in addition to radionuclides, nonradioactive toxic substances, such as arsenic, molybdenum, and selenium, can be leached from tailings and contaminate water. Such contamination could affect crops, animals, and people. Process water is used to carry tailings to the piles as a slurry. Rainwater also may collect on the piles. The greatest threat of contamination appears to be from process water discharged to the piles from the mill, although, in principle, it could be from the gradual effects of rainwater over the indefinite future. Most of this water eventually evaporates or seeps away. Elevated concentrations of toxic or radioactive substances in ground water have been observed at many active sites (seven are identified in the DEIS), and in some standing surface water ponds (but only rarely in surface running water). Any future contamination of water after disposal would arise from the effects of rain or through flooding of a pile, from pentration of a pile from below by ground water, or from leaching of tailings transported off a pile.

A theoretical analysis performed for the NRC of a large model pile with no seepage control showed that contamination of ground water by selenium, sulfate, managese, and iron might exceed current drinking water standards over an area 2 kilometers wide and 8 to 30 kilometers long. More than 95 percent of this projected contamination was attributed to initial seepage of process water discharged to the pile during mill operations.

We recognize that the NRC generic model is only one of several that could be applied to contaminant transport in groundwater. Other models could predict greater or less risks of ground water contamination. An example of greater risk is a plume of contamination that, under certain circumstances, could still move cohesively towards a water supply after the flow of liquid through the tailings has stopped following closure of a pile.

In general, the movement of contaminants through a pile and subsoil to ground water depends on a combination of complex chemical and physical properties, as well as on local precipitation and evaporation rates. Chemical and physical processes can effectively remove or retard the flow of many toxic substances passing through subsoil. However, some contaminants, such as arsenic, molybdenum, and selenium, can occur in forms that are not removed. Typically, ground water can move as slowly as a few feet per year, and only in coarse or cracked materials does the speed exceed one mile per year. For these reasons, contaminants from tailings may not affect the quality of nearby water supply wells for decades or longer after they are released. However, once contaminated, the quality of water supplies cannot usually be easily restored simply by eliminating the source (although, in some cases, removing or isolating the tailings may contribute to improving water quality).

Based on results from the NRC generic model for mill tailings piles, it is likely that the observed cases of ground water contamination result from seepage of the liquid waste discharges from the mill, and can be controlled by preventing this seepage until the piles dry out by natural evaporation. Additional future contamination of ground water after these liquid wastes are dried up should be much smaller, and in most cases would be expected to be eliminated by measures required to control misuse of disposed tailings by man and dispersal by wind, rain, and flood waters. These measures should also effectively eliminate the threat of contamination of surface water by runoff or from leaching of tailings transported off piles, and provide a degree of protection of surface and ground water from contamination by flooding. However, at some sites, especially in areas of high rainfall or where ground water tables intersect the piles, special consideration of potential future contamination of ground water may be needed in designing disposal systems.

We conclude that the primary objective of standards for control of hazards from tailings through water pathways is to prevent loss of process water through seepage, prior to closure. A secondary objective is to avoid surface runoff and infiltration both before and after disposal.

B. Methods for Control of Hazards From Tailings

As noted above, the objectives of tailings disposal (and of tailings management prior to disposal) are to prevent misuse by man, to reduce radon emissions and gamma radiation exposure, and to avoid the contamination of land and water by prevenitng erosion of piles by natural processes and seepage of process water. The longevity of control is particularly important. This can be affected by the degree to which control measures discourage disruption by man; and by the resistance of control measures to such natural phenomena as earthquakes, floods, windstorms, and glaciers, and to chemical and mechanical processes in the piles. Prediction of the long-term integrity of control methods becomes less certain as the period of concern increases. Beyond several thousand years, long-term geological processes and climatic change become the dominant factors.

Methods to prevent misuse by man and disruption by natural phenomena may be divided into those whose integrity depends upon man and his institutions ("active" controls) and those that do not ("passive" controls). Examples of active controls are fences, warning signs, restrictions on land use, inspection and repair of semi-permanent tailings covers, temporary dikes, and drainage courses. Examples of passive controls are thick earthen covers, rock covers, massive earth and rock dikes, burial below grade, and moving piles out of locations highly subject to erosion, such as unstable river banks.

Erosion of tailings by wind, rain, and flooding can be inhibited by contouring the pile and its cover, by stabilizing the surface (with rock, for example) to make it resistant to erosion, and by constructing dikes to divert rapidly moving flood waters. If necessary, erosion can be inhibited by burying tailings in a shallow pit or by locating them away from particularly flood-prone or otherwise geologically unstable sites.

Methods to inhibit the release of radon range from applying a simple barrier (such as an earthen cover) to such ambitious treatments as embedding tailings in cement or processing them to remove radium, the precursor of radon. Covering tailings with a permeable (porous) barrier, such as earth, delays radon diffusion so that most of it decays in and is therefore effectively retained by the cover. In addition to simple earthen covers, other less permeable materials such as asphalt, clay, or soil cement (preferably in combination with earthen covers) may be used. The more permeable the covering material, the thicker it must be to achieve a given reduction in radon release. However, maintaining the integrity of control of radon by thin, very impermeable covers, such as plastic sheets, is unlikely, even over a period as short as several decades, given the chemical and physical stresses present at piles.

The most likely constituents of cover for disposal of tailings are locally available earthen materials. The effectiveness of an earthen cover as a barrier to radon depends most strongly on its moisture content. Typical clay soils in the uranium milling regions of the West exhibit ambient moisture contents of 9 percent to 12 percent. For nonclay soils ambient moisture contents range from 6 percent to 10 percent. The following table provides, as an example, the cover thicknesses that would be required to reduce the radon emission to 20 pCi/m^{2}s for the above ranges of soil moisture. Four examples of tailings are shown that cover the probable extreme values of radon emission from bare tailings (100 to 1000 pCi/m^{2}s); the most common value for new tailings is approximately 300 pCi/m²s. These values are for homogeneous covers. In practice, multi-layer covers using clay next to the tailings can significantly reduce the total thickness required. The DOE and NRC have conducted extensive studies which provide a basis for optimum design of tailings covers based on the locally available materials.

ESTIMATED COVER THICKNESS[1] (IN METERS) TO ACHIEVE 20 PCI/M²S

Radon Emission from Tailings (pCi/m²s)	Percent moisture content of cover			
	6	8	10	12
100	1.7	1.3	1.0	0.7
300	2.8	2.2	1.5	1.1
500	3.4	2.6	2.0	1.5
1000	4.1	3.2	2.4	1.8

[1] These values were calculated from equation (9) in Appendix P of the Final Generic Environmental Impact Statement on Uranium Milling, U.S. Nuclear Regulatory Commission, NUREG-0706, September 1980.

[2] A picocurie (pCi) is a trillionth of a curie. One picocurie of material produces just over two transformations per minute. A pCi/m²s is a unit for the release rate of radioactivity from a surface (m=meter, s=second).

Methods that control radon emissions will also prevent transport of particulates from the tailings pile to air or to surface water. Similarly, permeable covers sufficiently thick for effective radon control will also absorb gamma radiation effectively (although thin impermeable covers will not).

Two methods may be considered for protecting ground water at new tailings piles. The first is the placement of a physical barrier, called a liner, between the tailings and the aquifer zone, to prevent water containing hazardous constituents from entering the aquifer. Either clay or plastic liners can be used at about the same cost. Plastic liners are expected to perform satisfactorily throughout the lifetime of a model mill, i.e., about 15 years. Clay liners may require use of additional measures, such as partial neutralization of the tailings, especially at acid leach mills, to satisfactorily protect ground water, but are expected to retain their effectiveness for longer periods of time. The second method could be treatment of process water to modify its acidity or alkalinity, if such treatment were shown to prevent contamination. At a neutral level many hazardous constituents of tailings liquids become insoluble and thus not available to contaminate ground water. However, not all hazardous constituents are so affected, and the action of rainwater, selected weathering processes, and mineralization of the soil or rock matrix can upset this neutralization over time, thereby releasing contaminants. There is little difference in costs for these two methods. Liners are currently required by NRC as a matter of good engineering practice for most new tailings impoundments.

EPA does not believe it is necessary to require all new wastes at existing sites to be placed on new piles. Satisfying ground water standards at existing tailings sites without liners, however, will require widely varying actions from site to site. Ground water contamination is known to have occurred at seven sites, and may be occurring at many others. It may not be possible to clean up the ground water at some sites. In the worst cases a new, lined tailings pile may be required to prevent future contamination. In other cases existing tailings piles may release essentially no contaminants to ground water because the type of soil they rest on acts as an effective liner. In practice, most tailings ponds will fall somewhere between these two extremes. Less expensive corrective action than a new liner may be sufficient to satisfy ground water standards for hazardous constituents at many sites. For example, an active water management program may be employed to reduce the quantity of water in the tailings and thus reduce the driving force for ground water contamination, or back pumping of water around the piles may prevent losses to the surrounding ground environment. Corrective actions are already being taken at certain sites (Cotter Mill, Canon City, Co., and Homestake Mill, Grants, N.M., for example).

Control of possible long-term low-level contamination of ground water may sometimes be difficult. In cases where intrusion of contamination into ground or surface water is a potentially significant problem, liners and/or caps may provide a good degree of protection for at least many decades. However, more permanent protection may, in such cases, require choice of (for new tailings) or removal to (for existing tailings) a site with more favorable hydrological, geochemical, or meteorological characteristics.

Very effective long-term inhibition of misuse by man, as well as of releases to air and surface water, could be achieved by burying tailings in deep mined cavities. In this case, 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 some control. Furthermore, the extracted substances (e.g., radium and thorium) would be concentrated, and would themselves require careful control.

We analyzed the costs of a number of possible control methods. These are described in the DEIS and the RIA. The total cost is affected most strongly by the type of material used to stabilize the surface of the tailings against erosion and to inhibit misuse by man, by the water protection features required, and by the number of piles that must be moved to new sites. In general, costs of covers using man-made materials (e.g., asphalt) are somewhat higher than costs for earthen covers. Active control measures are usually less costly in the short term than are passive measures. The costs for deep burial of tailings piles or for using chemical processing to extract radium are much higher than those for surface or shallow burial disposal using covers.

III. Scope of the Proposed Standards

UMTRCA defines the term "byproduct material" as " * * * the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content." The processing wastes included in this proposed rule are the tailings from uranium or thorium ore milling processes and from ores which have been heap leached primarily to recover source material, and solid wastes from *in situ* mining. It is clear from the definition of byproduct material, however, that Congress intended UMTRCA to apply to the conventional uranium (or thorium) industry and not to industries where source material is recovered as a secondary product. Thus, tailings from the phosphate and copper extraction industries are not covered by these proposed standards.

Solution extraction, or *"in situ"* mining, is a processing method in which uranium is recovered from ore without moving or disturbing the ore body. In this method holes are drilled at selected points around an ore body and a solvent is pumped into some holes and the resulting solution out other holes. The solvent passes through the ore, dissolves the uranium, and carries it back to the surface. The uranium is then stripped from the solution and concentrated. The solvent, which is stored in holding ponds, can be treated and reused or discarded. Although this method produces no sandy tailings, it does produce sludges that contain many of the same radioactive and nonradioactive substances found in tailings piles. Consequently, the above-ground wastes from *in situ* mining are covered in these proposed standards. We note that because *in situ* mining and conventional milling currently are done in the same regions of the country, disposal of sludges on tailings piles may often be arranged.

Protection of ground water from the underground operations of *in situ* mining is provided by the Underground Injection Control program promulgated under Sections 1421 and 1422 of the Safe Drinking Water Act. The associated regulations, 40 CFR Parts 122, 123, and 146, impose administrative and technical requirements on such operations, through either approved State programs or EPA-implemented programs. The underground ore bodies depleted by *in situ* urnaium mining operations are excluded from these proposed standards under UMTRCA.

We are proposing standards for thorium byproduct material that are derived from and comparable to the proposed standards for uranium byproduct material. To our knowledge there is currently no processing of ore primarily to recover its thorium content. Projections of thorium demand indicate there will be little need for thorium during the next decade. Nuclear power programs using thorium consist of only one power plant, Fort St. Vrain in Colorado. There is a facility processing monazite sands for recovery of rare earths, operated by the W.R. Grace Co., near Chattanooga, Tennessee. This facility can also recover thorium from this ore, which is the primary source of thorium. However, thorium is a secondary product at this facility. We will keep informed of the situation involving thorium and, if additional information on thorium-related tailing develops, will consider the need for revising the general environmental standards proposed here for the wastes from thorium processing activities.

IV. The Proposed Standards for Operations

These proposed standards are divided into two parts. The first part, described immediately below, would apply to management of tailings during the active life of the pile and during the subsequent "closure period," i.e., after cessation of operations but prior to completion of final disposal, including the period when the tailings are drying out. These are standards that govern milling operations. Most are already in effect, but these proposed standards would make some small additions for the protection of ground water.

The second part specifies the conditions to be achieved by final disposal. Those standards would guide the activities carried out during the closure period to assure adequate final disposal. They are standards that govern the design of disposal systems.

There are four parts to the standards for operations prior to completion of closure. These limit particulate emissions, radon emissions, and contamination of surface and ground water.

A. Particulate Emissions

Radionuclides in particulate emissions from uranimum mill tailings piles during the period a mill is licensed are currently limited by standards under 40 CFR Part 190. These standards limit the annual radiation dose to members of the public to 25 millirem to the whole body or any organ (except the thyroid, which is limited to 75 millirem) as a result of discharges to the general environment from uranium fuel cycle facility operations.

B. Radon Emissions

Limits on radon emissions from active uranium mill tailings sites during operation are not currently included in EPA standards. Radon and its decay products were excluded form 40 CFR Part 190 because at the time those regulations were established considerable uncertainty existed about the feasibility of control of radon emissions from tailings piles. We concluded then that the considerations associated with controlling radon emissions were sufficiently different from those for other radionuclide emissions from uranium fuel cycle facilities to warrant separate consideration at a future time.

Radon concentrations in air in unrestricted areas are currently limited only by the NRC's general regualtions for protection against radiation (10 CFR Part 20). These standards, which are based on the Federal Radiation Protection Guides (25 FR 4402), provide an upper limit on the radon concentration of 3 pCi/1 in air in areas to which individual members of the public have unlimited access. Unrestricted areas in which permanent access by more than a few identified people is possible are further limited to an upper limit of one third of this value, or 1 pCi/1, through the operation of Federal Radiation Protection Guidance for situations in which individual doses are not monitored. The incremental increase in the working level concentration inside houses caused by 1 pCi/1 of radon in indoor air is about 0.005 WL. Such an increase maintained over a 15-year period (the operational period of an average mill) would cause an incremental lifetime risk of lung cancer of 1 in 1000.

In addition to these upper limits, Federal Radiation Protection Guidance calls for the further reduction of radiation exposure to levels that are "as low as practicable," based on consideration of the particular circumstances associated with control of exposures from any specific source (the so-called ALARA principle). Neither of the above limits were derived for application to the specific case of uranium mill tailings.

Practical methods which significantly reduce radon emissions during the operational phase of existing mills are management schemes limited in their effectiveness and can achieve, at most, factors of 2 or 3 reduction. The degree of reduction possible through such management schemes depends heavily on the characteristics of a given site. Such control involves keeping the tailings wet (usually with process liquids) or covering with earth those portions of the pile that are not in active use. (Another control method is to acquire additional land adjacent to a site so as to exclude public access, and thus limit the potentially high level of risk which could occur if people live very close to an operating tailings pile.) EPA believes that milling operations are too diverse to permit establishment of a general numerical standard without the need for so many exceptions that the standard itself would be meaningless.

Based on all of the above we have tentatively concluded that a more restrictive general radon standard than now exists for the operating phase of a mill is not practical or necessary and that application of the ALARA principle by the regulatory agency will assure adequate control of radon releases during the operating phase of a mill. However, we are soliciting comments on this and alternative means to limit radon; see Section VI below. Our tentative conclusion is based in large part on EPA's assumption that existing and future management schemes will reflect ALARA principles and will involve the specific measures described above. The regulatory agency should assure that exposure to radon emissions is minimized at each site, as far below existing limits as is reasonably achievable, through the choice of optimized tailings management procedures and site boundaries.

C. Discharges to Surface Waters

Only one site currently discharges wastes to surface waters. Such discharges are unnecessary where annual natural evaporation is greater than precipitation because liquid wastes can be stored in a pond which has been lined to prevent seepage into ground water and allowed to evaporate.

Discharges to surface waters are currently governed by the provisions of the Clean Water Act. EPA regulations are in effect which define best practicable technology (BPT), and new source performance standards (NSPS) for control of discharges from mills using the acid leach, alkaline leach, or combined acid and alkaline leach process for the extraction of uranium (40 CFR Part 440).

In view of the comprehensiveness and adequacy of the regulatory program in place for surface water discharges from the uranium milling industry, we believe no additional standards for surface water are needed under UMTRCA.

D. Protection of Ground Water

Section 275b(2) of the Atomic Energy Act, as added by the UMTRCA, requires that these standards protect human health and the environment from nonradiological hazards in a manner consistent with the standards required under subtitle C of the Solid Waste Disposal Act (SWDA). Section 84a(3) directs the NRC to "* * * insure that the management of any byproduct material * * * conforms to general requirements established by the Commission, with the concurrence of the administrator, which are, to the maximum extent practicable, at least comparable to requirements applicable to the possession, transfer, and disposal of similar hazardous material regulated by the Administrator under the Solid Waste Disposal Act, as amended."

In considering standards for groundwater protection for active uranium mill tailings piles in relation to SWDA regulations, EPA was guided by two considerations, each of which is discussed in some detail below. The first consideration is that, unlike the statutory scheme of SWDA, the statutory scheme of UMTRCA shares responsibility between EPA and NRC. Under UMTRCA, NRC is responsible for promulgating regulations to implement the EPA standards, subject to EPA concurrence that the NRC regulations are consistent with SWDA.

The second consideration is EPA's view that Congress intended that EPA adhere to the protection principles and standards reflected and embodied in the SWDA regulations where appropriate and, where adherence seems inappropriate, to explain why deviation from the SWDA regulations in particular instances is reasonable.

The proposed regulations are standards which EPA considers appropriate to the divided EPA and NRC responsibilities and as consistent as is reasonable with the standards promulgated under SWDA. This means that the proposed UMTRCA standards differ from the SWDA standards in some respects. This also means that the UMTRCA standards do not address some areas addressed by the SWDA regulations. EPA expects that a comparable degree of comprehensiveness would be afforded under UMTRCA when the companion NRC regulations are in place.

Congress in 1978 excluded the active uranium mill tailing waste it was addressing in UMTRCA from the ambit of SWDA to avoid duplication of NRC licensing and EPA permitting functions. In requiring "consistency," Congress could not have meant that the UMTRCA standards be those applicable to active uranium mill tailings under SWDA since by its own definition there would be none. What Congress intended, EPA believes, is that EPA bring to bear on the non-radioactive hazards associated with wastes regulated under UMTRCA (primarily but not exclusively groundwater contamination) the same protection principles it applies to similar hazards associated with the waste regulated under SWDA.

Since Congress in UMTRCA was addressing the hazards associated with radioactivity in waste, as well as any non-radioactive hazards, it follows that EPA should take cognizance of both kinds of hazard in these regulations. Likewise, EPA may take cognizance of any differences between the nonradioactive hazards presented by these wastes and those addressed by SWDA. Both these considerations lead EPA to believe that Congress did not intend that the UMTRCA standards achieve a purely mechanical consistency with SWDA regulations which ignores differences in the hazards presented. EPA believes instead that Congress intended the UMTRCA standards to be consistent with SWDA standards where possible and that EPA explain differences where it believes a different standard to be appropriate. That is the course which EPA has pursued in these regulations.

EPA's requirements to protect health and the environment form radiological hazards in groundwater are discussed in the context of its treatment of nonradiological hazards through the SWDA requirements. The SWDA requirements (47 FR 32274, July 26, 1982) are a comprehensive regulatory program to protect human health and the environment from hazardous waste disoposal in or on the land.[2] This program includes identification and listing of hazardous materials; a manifest system to track hazardous materials from cradle to grave; controls for the transportation of hazardous materials; standards for owners and operators of hazardous waste treatment, storage and disposal facilities; and a permitting system for the treatment, storage and disposal of hazardous waste.

Unlike EPA's role in SWDA, EPA's role for controlling hazardous materials from uranium tailings under UMTRCA is limited to setting standards and does not include an implementing responsibility. That responsibility is vestd in the NRC and the States as the licensing agencies under Title II of UMTRCA (Section 84a(3)) and would be carried out through regulations set by the NRC, with the concurrence of the Administrator, upon promulgation of these standards by EPA.

The primary purpose of the SWDA ground water regulations is to protect ground water quality so as to provide reasonable assurance that human health and the environment will be protected. To accomplish this, the goal of the regulations is to minimize the migration of hazardous components of wastes. The SWDA strategy for achieving this goal has two basic elements. The first is a liquids management strategy that is intended to minimize leachate generation and to remove leachate before it enters the subsurface environment. This is the "first line of defense," in the sense that it seeks to prevent ground water contamination by controlling the source of the contamination. The second element is a ground water monitoring and response program that is designed to remove leachate from ground water if contamination is detected in excess of specified standards. This monitoring and response program serves as a backup to liquids management.

The SWDA strategy for groundwater protection is carried out differently depending on the nature of the facility involved. Subpart K of Part 264 applies this strategy to surface impoundments. Subpart L applies it to waste piles. Supart N applies it to landfills. EPA was faced with the question which of these applications provided the best model to follow in regulating hazards associated with waste disposed of at uranium mill tailings piles.

Waste piles under SWDA are considered a storage rather than disposal facility and thus do not provide an appropriate model.

Surface impoundments under SWDA function primarily to store or dispose of

[2] In the following, any references to SWDA regulations shall apply to those regulations, as amended, as of January 1, 1983.

solid and liquid waste. Regulations addressing surface impoundments used only for storage require a liner which is removed (along with the waste) after closure. Since the liner will be removed,the regulations permit liner design involving permeable materials that will allow liquid into but not through the liner. Regulations addressing suface impoundments used for disposal require use of a liner during active use of the facility which will prevent permeation of liquid into the liner and removal of free liquid and installation of a cover at closure. The cover is required to be equally or more impermeable than the liner.

Landfills under RCRA function primarily to dispose of solid waste. The regulations require that such units have a liner and a leachate collection and removal system and, after closure, a cover. Both liner and cover are required to have permeability characteristics similar to those for impoundments.

In both cases, the liner must be designed to prevent migration of liquid into the liner. For surface impoundments, postclosure migration of liquid waste is prevented by removal of the liquid. For landfills, which are not used for storage of liquid wastes, it is expected that any leachate will be removed before closure by the leachate collection and removal system. In both cases, leaching after closure is minimized by minimizing infiltration through use of a cover.

The standards proposed here are modeled on Subpart K. Active mill tailings piles typically contain large amounts of waste liquids. Leachate collection and removal systems such as those required in Subpart N are not appropriate for such situations.

The standard proposed here would put into effect the first element of the ground water protection strategy as to new piles or lateral extensions of existing piles by incorporating the standard of 40 CFR Section 264.221 of the SWDA regulations, relating to surface impoundments. This section requires a liner that is designed, constructed, and installed to prevent migration of wastes out of the impoundment to the adjacent subsurface soil, or ground water, or surface water during the active life (including the closure period) of the impoundment. In establishing the SWDA regulations, EPA considered as an alternative a requirement that the liner for waste facilities be designed, constructed, and installed to minimize migration of wastes out of the impoundment. Operators would have been able to comply with this alternative by using either a clay or a synthetic liner. The Agency ultimately rejected this alternative in favor of a no migration policy based on a synthetic liner requirement because (1) it prevents escape of all hazardous constituents, and (2) causes constituents reaching the liner to be retained so that they can be more readily removed before closure. However, under § 264.221, an exemption to the liner requirement may be granted if the owner or operator demonstrates that alternate design and operating practices, together with location characteristics, will prevent the migration of any hazardous constituents into ground or surface water. Uranium mill tailings are produced at primarily arid western sites. For specific waste/site combinations of this type it may be that clay liners, natural soils, or combinations thereof may afford an equivalent level of protection and provide substantial advantages in terms of cost.

Section 264.221 also exempts the pre-existing portion of an impoundment and new wastes placed upon it from the liner requirement. The existing portion under these regulations is defined as the land surface area on which wastes (in this case, tailings) have been placed prior to the date of publication of these standards in final form.

Two points are important here. First, by providing an exemption procedure under SWDA to the liner requirement, EPA recognized that adequate ground water protection can be achieved at some locations through alternative facility designs (which might in this application include use of clay liners, or, in some cases the elimination of a liner requirement through use of natural soils). Although the presence or absence of these factors should not be deemed conclusive, an example of a situation for which this exemption may be appropriate is when the unsaturated zone below the impoundment is composed of materials that are capable of fixing any hazardous constituents in the process liquid before it reaches ground or surface water (e.g., holding up hazardous constituents through ion exchange).

Second, the requirement for a liner does not *a priori* apply to the land surface areas where tailings are currently placed, i.e., liners would not usually have to be installed under existing tailings. Depositing tailings on existing piles could continue as long as the pile surface area is not expanded and the secondary standards for concentrations of hazardous constituents in groundwater (see below) are not exceeded. However, any expanded portion of an existing impoundment would be subject to the same liner requirements (or their equivalent) as a new impoundment. If hazardous constituent concentrations exceed the ground water standards, continued deposition of tailings on an existing pile would not be permissible unless corrective actions are expected to achieve compliance or alternate standards have been established for the site. The EPA Regional Administrator could concur in such alternate standards only if doing so would result in no substantial present or potential hazard to human health or the environment.

While modeled on Subpart K, the proposed standards modify the Subpart K requirements to take cognizance of two characteristics of active mill tailing sites: their arid location and their association with radon emissions. EPA recognizes that disposal facilities regulated under SWDA may also be located in arid areas.

As part of that consideration, EPA is considering whether the arid location of the wastes allows post-closure removal of the liquid by evaportation. It is also considering whether net evaporation makes it less important that the liner be of impermeable rather than relatively impermeable materials so long as the liner is designed so that liquid not enter the groundwater prior to closure. After closure, the pile will be drying out and reducing the pressure head which creates the hazard of groundwater contamination. Treating the pile as if it were a surface impoundment used for storage would allow designers to capitalize on possible advantages clay may have over synthetic liners: e.g., the viscosity of the mateiral, which allows it to flow into gaps; and the chemical interaction with liquids, which fixes, filters out, and chelates hazardous constituents in the liquid. EPA solicits comment on these considerations.

The radiological hazard affects the permeability characteristics desirable for the cap. Subpart K requires the cap to be at least as impermeable as the liner to prevent build-up of liquid in the facility and increase of hydrostatic pressure. In theory, therefore, an impermeable liner necessitates an impermeable cap. However, long-term radiological protection requires a thick cover that retains some moisture (6–12%) in order to function as an effective barrier to radon. Such a cover requires a relatively stable foundation. For this reason EPA considers it appropriate to specify a cover permeability requirement for these wastes which differs from that of Subpart K.

Thus, the proposed standard would not apply the surface closure requirements of § 264.228 to uranium byproduct material impoundments. This modification is proposed since the proposed standards for disposal of tailings (§ 192.32(b)) are adequate to protect ground water. The considerations involved are discussed in more detail below.

In summary, we propose here, as a primary ground water protection requirement for tailings placed on new piles, a liner to prevent seepage of leachate from tailings into ground water. However, consistent with the primary ground water protection standard specified in the SWDA regulations, we also permit exceptions to be granted to this requirement. (We propose as a ground water protection standard for existing tailings, and new tailings added to existing piles, the secondary numerical ground water standards discussed below.) In Section VI below we request comment on what exceptions are appropriate to this liner requirement, and on how the exception procedure should be applied. We also request comment on whether these proposed primary liner requirements are appropriate for application to these tailings sites.

The standard proposed here to carry out the second element of the SWDA ground water protection strategy is that contained in existing SWDA regulations, at 40 CFR 264.92 (and related sections). This proposed standard has several parts. The first part is contained in § 264.93 and identifies hazardous constituents as those listed in Appendix VIII of Part 261. We propose to add two hazardous chemical elements, molybdenum and uranium, commonly present in tailings. A second part is contained in § 264.94 and requires that "* * * no increase over background levels" be allowed for most listed constituents. This approach is consistent with a ground water protection philosophy that seeks to maintain ground water quality. The second part also contains Table 1—"Maximum Concentration of Constituents for Ground water Protection." These standards are maximum concentration limits for a particular set of toxic metals and pesticides, and were first established in the National Interim Primary Drinking Water Regulations (NIPDWR) as health-based concentration limits. We propose to add to the Table 1 standards the NIPDWR limit for alpha radioactivity, to cover the radioactive materials found in tailings.

These proposed standards would be established through the measurement of background concentrations of hazardous constituents in ground water at each tailings site for those hazardous constituents that are reasonably expected to be in or derived from the tailings. Standards would be established for most constituents at the background ground water concentrations, except in the case of materials listed in Table 1 of § 264.94. Those standards would be established as the higher of the background levels or the Table I concentration.

The SWDA regulations provide that the EPA Regional Administrator may exclude a hazardous constituent from the list of hazardous constituents applicable to a site if he finds that the constituent is not capable of posing a substantial present or potential hazard to human health or the environment (§ 264.93(b) and (c)). He is also allowed to establish an alternate concentration limit for a hazardous constituent if he finds that the constituent will not pose a substantial present or potential hazard to human health or the environment as long as the alternate concentration is not exceeded (§ 264.94(b) and (c)). EPA believes that determinations as to what constituent levels pose a health hazard are a primary responsibility of EPA and cannot be delegated to other agencies. Therefore, we propose to retain effective control over granting of exemptions and establishment of alternate standards for ground water by requiring EPA concurrence in regulatory decisions regarding such exemptions and alternate standards.

Section 264.100 of the SWDA regulations requires that a corrective action program be initiated when hazardous constituent concentration limits are exceeded in ground water. The regulatory agency will review the plans for such corrective actions, and approve them only if they provide a reasonable degree of confidence that the proposed corrective actions will succeed. The SWDA regulations do not specify a numerical time limit within which such corrective actions are to be in operation. We propose to require corrective actions to be in operation as soon as is practicable, but in no case later than within one year of a finding by the licensor that a concentration limit has been exceeded. This requirement is reasonable for tailings sites because the fewer than 30 licensed sites all contain similar materials. The SWDA regulations require only that corrective action begin within a "reasonable" time period. However, the SWDA regulations are applicable to thousands of sites, with a wide variety of hazardous constituents.

The SWDA regulations similarly do not specify a time by which corrective actions should be completed. We believe flexibility in this respect is the only practical course. Once corrective actions have begun, the regulatory agency should evaluate their effectiveness and determine whether to continue, alter, or discontinue the actions. Because corrective actions are very site-specific such determinations should not be made under a uniform, pre-established schedule. It is the regulatory agency's responsibility, however, to assure that necessary decisions are rendered in a timely fashion. Acceptable plans for corrective actions should offer a high likelihood of achieving compliance with the standards. Furthermore, corrective actions which, once begun show inadequate promise of achieving compliance, should result in the regulatory agency's promptly disallowing the addition of new tailings to a noncomplying tailings pile.

Under our proposed standard, all new waste storage areas (whether new waste facilities or expansions of existing piles) are subject to the primary standard—the liner requirement. If new wastes are added to an existing pile, however, the pile must comply with the secondary standard—the hazardous constituent concentration standards for health and environmental protection. Whether for a new or existing pile, if the secondary standards are found not to be satisfied and subsequent corrective actions fail to achieve compliance in a reasonable time, the operator must cease depositing waste on that pile.

We considered treating all new wastes the same, without regard to whether they would be placed on new or existing piles. We did not select this alternative because we concluded it would result in less overall environmental protection than the proposed standard. That is, exempting new waste added to existing piles from the primary standard is environmentally preferable because the alternative, creating new piles, would increase radon emissions by increasing surface to volume ratios. If the primary standard were applied to all new waste, we believe mill operators would generally choose to create new lined impoundments and discontinue the use of existing piles. (Our economic analysis indicates that refitting existing tailings with liners is not cost effective.) Therefore, until disposal of the discontinued piles occured, which usually would take several years, two tailings pile surfaces would be exposed instead of one. Under available controls, radon and particulate releases to the air from two piles would exceed releases from one by approximately a factor of two. Furthermore, post-disposal radon emissions from two piles will continue indefinitely to be about twice those from only one. Congress stated in UMTRCA that "* * * every reasonable effort (should) be made to provide for the stabilization, disposal, and control * * * of such tailings in order to prevent or minimize radon diffusion into the environment * * *" (Section 2.(a)). Creating additional tailings piles would not satisfy this primary objective of Congress.

A second objective of Congress under UMTRCA is that these standards be consistent with standards under UMTRCA so as to "* * * prevent or minimize other environmental hazards from such tailings * * *" If the primary standard were applied to all new tailings, most operators would be likely to choose to construct new, lined impoundments and discontinue use of existing piles. We believe this would not increase protection of the underground environment, but would create potential for additional contamination. Subsurface soils beneath existing, unlined impoundments are usually already contaminated. The ground water beneath these contaminated soils may or may not also be contaminated. However, if it is corrective actions must be taken to achieve compliance with the ground water protection standards. This situation (contaminated subsurface soil and, possibly ground water) exists regardless of whether or not new tailings are added to existing impoundments.

Placing new tailings in new, lined impoundments would cover additional land surface with tailings, beneath which soils are not initially contaminated. The liner is expected to prevent seepage of hazardous constituents into the subsurface. However, if the liner fails, the underlying soils, and perhaps ground water, would become contaminated.

Since the secondary standard basically requires that ground water not be degraded, the major additional effect of a fully successful liner would be to prevent hazardous constituents from entering the ground beneath a pile. Therefore, applying the primary standard to existing piles would force their replacement with new lined piles, which, if they are fully effective, would leave the underground environment at the facility as it is, and if not fully effective, could approximately double the contaminated area.

The secondary standard assures that any leakage from either lined or unlined piles will not significantly degrade the environment or pose a hazard to human health. In our judgment, creating additional piles produces a health detriment from airborne radioactivity that exceeds any benefits from improved water protection and creates the possibility of additional contamination of subsurface soil. We find, therefore, that requiring liners (the "primary" standard) for all future operations of existing piles rather than conformance to ground water standards (the secondary standard) would be likely to: (1) Increase radon and particulate releases; (2) not materially improve protection of the ground water; and (3) commit additional land surface permanently to waste disposal. Therefore, on balance, it appears that exempting new waste added to existing uranium mill tailings piles from the primary requirement if preferable for both health and environmental protection.

There are several SWDA regulations that specify monitoring after closure of an impoundment. Monitoring is a compliance activity conducted to assure that health and environmental standards are being met. The regulatory agency is responsible for establishing such requirements, including post-closure monitoring consistent with the SWDA regulations. The period over which post-closure monitoring is normally required under SWDA is 30 years. The regulatory agency should recognize, however, that monitoring of ground water for shorter or longer periods may be needed for the specific sites where tailings are located and, when appropriate, change this requirement.

The SWDA regulations are complex as well as comprehensive. In order to facilitate comment on these proposals we summarize below the sections of those regulatons which relate to the separate EPA and NRC responsibilities. EPA's responsibilities to establish standards under Section 206 of UMTRCA would be carried out through adoption of all or part of the following sections of the SWDA regulations:

i. Subpart F:
40 CFR 264.92 Ground water protection standard
40 CFR 264.93 Hazardous constituents
40 CFR 264.94 Concentration limits (these three sections are modified and adopted as 192.32(a)(2))
40 CFR 264.100 Corrective action program (this section is modified and adopted as 192.33)
ii. Subpart G:
40 CFR 264.111 Closure performance standard (this section is adopted as part of § 192.32(b)(1))
iii. Subpart K:
40 CFR 264.221 Design and operating requirements for surface impoundments (this section is modified and adopted as § 192.32(a)(1))

NRC's responsibilities under UMTRCA are to implement EPA's standards and to "insure that the management of any byproduct material * * * is carried out in such a manner as * * * conforms to general requirements established by the Commission, with the concurrence of the Administrator, which are, to the maximum extent practicable, at least comparable to requirements applicable to the possession, transfer, and disposal of similar hazardous material regulated by the Administrator under the SWDA, as amended." EPA will insure that NRC's regulations satisfy these admonitions through its concurrence role. Relevant SWDA regulations are those embedded in Subparts A (except § 264.3), B, C, D, E, F, G, H, and K. Examples of areas which NRC must address in discharging these responsibilities involve functions under the six sections immediately above which are incorporated into these proposed EPA standards, and the following sections of the SWDA regulations:

i. Subpart F:
40 CFR 264.91 Required programs
40 CFR 264.95 Point of compliance
40 CFR 264.96 Compliance period
40 CFR 264.97 General ground water monitoring requirements
40 CFR 264.98 Detection monitoring program
40 CFR 264.99 Compliance monitoring program
ii. Subpart G:
40 CFR 264.117 Post-closure care and use of property
iii. Subpart K:
40 CFR 264.226 Monitoring and inspection (of impoundment liners), as applicable

EPA and NRC are coordinating their efforts to insure health and environmental protection from uranium byproduct materials. In particular, we are working closely with the NRC to assure that NRC's general requirements for ground water protection will be comparable, to the maximum extent practicable, to EPA's requirements under the SWDA for similar hazardous materials.

V. The Proposed Standards for Disposal

The objectives of tailings disposal and measures available to achieve these objectives have been described in Section II. We evaluated a range of alternatives for disposal standards based on these objectives and control measures. These alternatives are presented below. The ranges of the controls vary widely, from no control (Alternative A) to high levels of control (Alternative F). They do not include different levels of ground water protection, since those requirements must be consistent with standards that have already been established under the SWDA. However, the length of time ground water is expected to be protected is indicated.

Uranium mill tailings will remain hazardous for hundreds of thousands years, due to the 75,000-year half-life of thorium-230. Protection of public health by disposal of these tailings for such periods is difficult to conceptualize, much less assure. On a practical basis, we have assumed that the different types of controls can be reasonably relied on for the following typical periods:

- Active controls—about 100 years.
- Practical engineered controls—from a few hundred years to greater than 1,000 years.
- Controls featuring great isolation—many thousands of years, limited only by major geological activity.

Brief descriptions of each alternative follow:

Atlernative A. This is the "no standards" case and represents conditions if nothing is done. The piles would remain hazardous for a long time, taking about 265,000 years for the radioactivity to decay to 10 percent of current levels. The radon emission rate is estimated to be 500 pCi/m²s from a typical existing pile and 300 pCi/m²s from a typical new pile. The background rate for typical soils is about 1 pCi/m²s. The concentration of some toxic chemicals in the tailings is hundreds of times background levels in ordinary soils, so that the potential for contaminating water and land is present and continues indefinitely.

Alternative B. Control measures include a minimal, thin earthen cover that is subject to active inspection and maintenance for 100 years. Active controls would also be required to prevent significant contamination of ground water, or ground water would be treated before use. No radon emission rate is specified.

Alternative C. A radon emission limit of 100 pCi/m²s is specified. This would usually require an earthen cover of about 1 meter thickness. The number of years for which the control measures shall be designed to be effective is not specified, but control systems would be actively maintained for 100 years, and should have some effectiveness for several centuries. Engineered control measures used to meet this limit should prevent contamination of ground water for at least a few hundred years.

Alternative D. In this alternative control measures are required to be designed to be effective for 1,000 years to the extent reasonably achievable and, in any case, for at least 200 years. (Therefore it is assumed control may not rely primarily on institutional maintenance.) The radon emission limit is 20 pCi/m²s. This would usually require an earthen cover of 2 to 3 meters thickness. Ground water would be protected for at least 1,000 years.

Alternative E. Passive control measures are required to be effective for at least 1,000 years at new tailings piles. This longevity is achieved by making any new impoundments below grade. Existing tailings would be subject to controls similar to those required under Alternative D. The radon emission limit is 20 pCi/m²s. This would usually require an earthen cover (up to the original ground level) of 2 to 3 meters thickness. Ground water would be protected for thousands of years.

Alternative F. Passive control measures are required to be effective for at least 1,000 years. This longevity is achieved through application of a very thick earthen cover usually 4 to 5 meters thick. The radon emission limit is 2 pCi/m²s. Ground water would be protected for many thousands of years.

These alternative cleanup and control standards can be generally categorized as:

(1) *Least cost* alternatives which provide minimum acceptable health and environmental protection, and depend upon the use of active methods of control (B and C);

(2) *Cost-effective* alternatives which provide greater and longer term health and environmental protection without reliance on active controls, but at somewhat higher costs (D and E); and

(3) *Nondegradation* alternatives which attempt to achieve close to the same health and environmental protection as might exist if the ore had not been mined; these entail much higher costs (F).

The analysis was based on assuming that remedial actions to satisfy a "least cost" tailings pile control standard would entail applying a thin earthen cover over the tailings and stabilizing it. Integrity of the cover would be assured through active maintenance for 100 years. Only minimal flood protection measures would be applied. Covers would be progressively thicker and much less dependent upon care under the more stringent alternatives, with commensurate upgrading of flood protection. Under the "nondegradation" alternatives, very thick covers or asphalt and/or cement fixation would be required.

We concluded that a "nondegradation" alternative would be difficult to justify, since the small incremental health and environmental benefits, when compared to the benefits for less stringent alternatives, do not appear to justify the relatively large additional costs.

We selected a "cost-effective" rather than a "least cost" alternative for the proposed standards, in part because it provides much greater protection of health and the environment for only a small cost increase above the least cost alternatives, and in part because it does not place primary reliance on institutional methods of control. The proposed standards provide for control and stabilization which would ensure, to the extent reasonably achievable, fully effective control for 1000 years, and in any case, for at least 200 years. Some effectiveness of control would be expected to continue for much longer periods. This control and stabilization would be designed to provide a barrier that will effectively minimize the potential for misuse and spread of the tailings, limit the average radon emission from the surface of tailings piles to no more than 20 pCi/m²s, protect against flooding, and protect from wind and water erosion.[3]

It was not possible to carry out a formal quanitative cost-benefit analysis to reach these conclusions. Many of the hazards reduced (or avoided) through application of alternative standards can neither be evaluated quantitatively nor restated in terms of a common index of value. The major hazard, the extent of possible future misuse of tailings by

[3] These proposed radon emission and longevity standards for disposal of tailings from active mills are essentially identical to the corresponding standards (40 CFR Part 192, Subpart A) we have already promulgated for tailings piles at inactive sites (48 FR 590–604, January 5, 1983). Subpart A, however, contains an approximately equivalent alternative standard, expressed in terms of the radon concentration in air at the edge of the tailings pile. We developed this alternative at the request of the Department of Energy, which will perform the actions needed to comply with that standard. The concentration alternative in Subpart A requires basically the same level of control as the 20 pCi/m²s emission standard, because the radon concentration we allowed at the edge of a pile was derived from the average radon emission rate from its surface. By contrast, an ambient concentration standard applied at the site boundary could be satisfied by establishing the boundary far enough from the pile, without necessarily reducing its radon emissions. Since the special form of concentration standard in Subpart A may be readily confused with ambient concentration standards that have a very different basis and purpose, we decided not to propose such an alternative to the emission standard for active mills.

man, is almost impossible to quantify. A further complication is that the benefits of successful control accrue over a very long period of time, whereas the costs occur now. We can only roughly estimate how long control will last and how many cases of lung cancer might be avoided over the full term of effective control.

Instead of a quantitative cost-benefit analysis, we have cited examples of the impact of misuse and dispersal by wind and water in the DEIS, and have estimated the impact of radon emissions from unstabilized piles. We have then estimated the extent to which these impacts might be avoided over the long term under realistic alternative standards, and made judgments about which alternatives offer the most cost-effective reduction of these impacts. The proposed standards are based on the results of such an analysis of alternatives including a detailed consideration of their costs.

One notable conclusion from our analysis is that applying thin covers that will require active maintenance and last a shorter time results in a small saving over providing tailings piles with thick, durable covers. This conclusion follows from the initial expenditures required to undertake any significant level of disposal at mill sites. For example, the saving in cost is only 20% for Alternaive C over Alternative D. (Other things being equal, we estimate the cost of adding 1 meter of earthen cover to all existing tailings to be 36 million dollars (1981 dollars, present worth)). Alternative D, however, provides significantly greater protection than Alternative C, a five fold lower risk to individuals and an order of magnitude (about a factor of ten) greater number of cancer deaths avoided over the lifetime of the cover. This accrues from the difference in degree and longevity of radon control alone. Thick covers, which do not require continuing inspection and maintenance activities, also offer greatly increased benefits by inhibiting misuse, and increasing the longevity of the cover's effectiveness against erosional spreading.

Cost and benefit estimates for the alternative standards we considered are reported in detail in the RIA and DEIS. These are summarized in the following two tables. The estimates are based on a low-growth scenario for uranium production prepared by DOE. The low-growth scenario currently appears to be the most likely case due to the recent cancellation of reactor orders and the long lead time (14 years) for licensing and constructing new reactors.

We estimated benefits under the assumption, when appropriate, that tailings pile control systems will be partially effective longer than a standard requires. For example, if control systems are required to be effective for as long as reasonably achievable up to 1000 years, but for not less than 200 years, as under Alternative D, most of the tailings piles will be stable against erosion and casual intrusion for misuse for much longer than 1000 years. Those few piles that are susceptible to flood damage would be protected for at least 200 years, and are unlikely to suffer real damage for much longer. During the period of full control, the maximum risk for individuals living very near a tailings pile from exposure to its radon emissions would be reduced by about 95 percent from about 4 chances in 100 to about 2 chances in 1000. An estimated 1200 potential premature deaths per century would be avoided during the period of full control (assumed here to be 1,000 years), for a total of many thousands over the life of the covers.

COSTS OF ALTERNATIVE STANDARDS FOR TAILINGS CONTROL TO THE YEAR 2000

[Millions of 1981 dollars]

Alternative	Present worth costs (10 percent discount rate) [1]		Total cost
	Existing tailings	Future tailings	
A	0	6	6
B	98	228	326
C	128	259	387
D	174	311	485
E	174	325	499
F	296	444	740

[1] Cost estimates are based on a low growth industry demand scenario to the year 2000. It is assumed that 75 percent of new tailings generated at existing mills will be stored in existing piles and the other 25 percent will be placed in new, lined impoundments. We assume that the average radium content of existing and future tailings will be 500 pCi/m³s and 300 pCi/m³s, respectively. These costs are derived from the costs presented in the DEIS and the RIA based on the specific cover thickness required to meet the radon emission limits of each alternative standard.

BENEFITS OF CONTROLLING URANIUM MILL TAILINGS AT ACTIVE MILL SITES THROUGH THE YEAR 2000 [a]

Alternative standards	Stabilization			Radon control			Water protection (longevity)
	Chance of misuse	Misuse inhibited	Erosion avoided	Maximum risk [b] of lung cancer (percent reduction)	Deaths avoided		
		(y)	(y)		100 years	Total	(y)
A	Very likely	0	0	4 in 10^2 (0)	0	0	0
B	Likely	100	Hundred	2 in 10^2 (50)	600	2,800	100
C	Less likely	Few 100	Hundreds	1 in 10^2 (80)	1,000	Several thousands	100's
D	Unlikely	1,000	Thousands	2 in 10^3 (95)	1,200	Tens of thousands	1,000
E	Unlikely	>1,000	Many thousands	2 in 10^3 (95)	1,200	Tens of thousands	>1,000
F	Very unlikely	> 1,000	Many thousands	1 in 10^4 (10>99)	1,200	Tens of thousands	>1,000

[a] These estimates incude the benefits resulting from control of 23 existing piles and 40 projected new piles based on the low growth uranium supply estimate.
[b] Lifetime risk of fatal cancer to an individual assumed to be living 600 meters from center of a tailings pile.

Our estimates of the number of potential lung cancer deaths due to *uncontrolled* radon emissions from two model sites provides some perspective on the health benefits from control of radon releases at differently populated sites. For a moderately populated site (identified as a rural site in the DEIS), 39 lung cancer deaths per century were projected, and for a sparsely populated site (identified as a remote site in the DEIS), 13 lung cancer deaths per century were projected. (Total lung cancer deaths from all the piles were estimated by assuming that 25% of the piles are located in "rural" areas.) Most piles are located in areas where the population falls somewhere between these two cases.

The longevity of tailings control is governed primarily by natural forces. Reasonable assurance of avoiding casual intrusion by man can be provided through the use of relatively thick and/or difficult-to-penetrate covers (such as soil, rock, or soil-cement). No standard can guarantee absolute protection against the purposeful works of man, and these proposed standards would not require such protection. Protection against natural forces requires consideration of wind and surface water erosion, and of the possibility of flood damage. Wind and surface water erosion are relatively well-understood and predictable, and are easily inhibited through the use of rock or, in some cases, vegetative surface stabilization. Similarly, a body of scientific and engineering knowledge exists to predict the frequency and magnitude of floods for periods of many hundreds of years, and to provide the engineering controls to protect against such floods (including the possibility of moving a pile if this is more economical). We considered longevity requirements ranging from 100 to 10,000 years and have concluded that existing knowledge permits the design of economically feasible control systems for these tailings for up to periods of 1,000 years. We recognize that it may not always be practical, however, to project such performance with a high degree of certainty, because of limited engineering experience with such long time periods.

We are aware of no historical examples of societies successfully maintaining active care of decentralized materials through public institutions for periods extending to many hundreds or thousands of years. We have concluded that primary reliance on passive measures is preferable, since their long-term performance can be projected with more assurance than that of measures which rely on institutions and on continued expenditures for active maintenance.

Section 202 of the UMTRCA requires the Federal Government or the States to acquire and retain control of these tailings disposal sites under licenses. The licensor is authorized to require performance of any maintenance, monitoring, and emergency measures that are needed to protect public health and safety. We believe that these institutional provisions are essential to support any project whose objective is as long-term as are these disposal operations, and for which we have as little experience. This does not mean we believe that primary reliance should be placed on institutional controls; rather, that institutional oversight is an essential backup to passive control. For example, as long as the Federal Government or the States exercise their ownership rights and other authorities regarding these sites, they should not be inappropriately used by people. In this regard, even with the disposal actions required by these standards it would not be safe to build habitable structures on the disposal sites. Federal or State ownership of the sites is assumed to preclude such inappropriate uses.

In the proposed standard we have designed the requirement for longevity of control so as to assure that it is practical for agencies to certify that the standards are implemented in all cases. We recognize that our ability to predict the longevity of engineered designs is not always adequate to the task at hand. The proposed standard would require that control measures be carried out in a manner that provides reasonable assurance that they will last, to the extent reasonably achievable, up to 1,000 years and, in any case, for a minimum of 200 years. The widely varying characteristics of the active sites, the uncertainties involved in projecting performance of control measures over long periods of time, and the large costs involved in moving some tailings piles to provide a very high degree of assurance of longevity make this choice appropriate. The choice does not signify that there are circumstances under which the maximum term of protection contemplated by the proposed standards is not appropriate. The choice merely acknowledges that implementing agencies may in some cases have difficulty certifying that control measures that are appropriate can reasonably be expected to endure without degradation for 1,000 years. Man's ability to predict the future is notoriously limited. That fact, which on the one hand warrants our making responsible societal efforts to limit risk to future generations, also warrants our refraining from actions undertaken merely in the name of necessarily artificial levels of statistical certainty.

We selected this period of performance because we believe there is a reasonable expectation that readily achievable controls will remain effective for at least this period. Every reasonable effort should be made to design controls to achieve this expectation. However, we recognize that uncertainties increase significantly beyond a thousand years, and we conclude it would be unreasonable to require assurance that the controls will be effective for longer periods, such as up to 10,000 years.

We believe that limiting radon emissions from tailings piles serves several important functions: reducing the risk to nearby individuals; reducing the impact of radon on large populations; and furthering the goals of reliable long-term deterrence of misuse of tailings by man and control of erosion of piles by natural processes. The degree of reduction of radon emissions achieved by a disposal system is more or less directly related to the degree of abatement of each of these hazards.

Our analysis predicts significant risk to people living next to tailings piles, and field measurements confirm elevated levels of radon in air close to the piles. If radon emissions are not reduced, we estimate that individuals residing permanently near some of the piles could incur as much as three to four chances in a hundred of a fatal lung cancer in addition to normal expectations. The fact that increases in radon levels due to the piles cannot be distinguished relative to background levels further away from a pile does not mean that radon is not present or that there is no increased risk from this radon—it merely means that measurements are not capable of unambiguously detecting such levels. For individuals at greater distances the risks are smaller, but the total number of people exposed is so large and exposure continues for so long that the collective risk is clearly significant (many thousands of fatal lung cancers over the duration of emission control for all of the piles).

On January 5, 1983, EPA published disposal standards for inactive tailings piles (48 FR 590). On the basis of the record before us in that proceeding we concluded that radon emission was:

> * * * The preferred quantity to be specified by the standard because, unlike ambient air concentration at the site boundary, it is directly related to the degree of radon control achieved and therefore directly fulfills the statutory intent to reduce emissions. A site boundary standard would serve merely as an encouragement to rely on dispersion because it would not necessarily result in control of radon emissions since the boundary might be moved far from the pile. It would rely for compliance on indefinitely excluding access to the site.

We also concluded that:

> * * * A limit on a radon emission is the most direct and appropriate means for furthering the Congressional objective of adequate and reliable long-term control of tailings. Such a limit assures a sufficent earthen cover (or its equivalent) to provide an acceptable degree of stabilization and isolation of the tailings over a long period of time. Congress did not intend that EPA set standards for one generation only, or that it set standards without consideration of the long-term reliability of whatever means are available for implementing them. (Similarly, Congress anticipated that short-term institutional controls would not provide the primary basis for protection.) Although the implementing agencies will decide which specific controls to employ, this does not preclude our considering, in accordance with Congress' directive, the effect of a particular numerical limit on the maintenance of future control. Therefore, in selecting the value for radon emissions, an important consideration was that the standard promote the objectives of adequate isolation and stabilization to control both intrusion by man and erosion by natural forces.

We have reached, on a tentative basis, the same conclusions for these proposed standards for active sites.

However, during the review of the standards for inactive sites by certain Federal agencies required by Section

206(a) of the Act and Executive Order 12291, questions were raised regarding the appropriateness of the control standards for general application to all 24 inactive sites. These questions were focused on the degree to which these standards should depend upon institutional control, and on the assumption that all piles should be treated equally, regardless of the size of the nearby population. In view of these concerns, EPA requested public comments on this issue in an advanced notice of proposed rulemaking (48 FR 605; January 5, 1983). We believe that these questions are relevant as well in establishing disposal standards for mill tailings at the active sites. In Section VI below we request comment on these issues and on whether the standards should reflect different judgments.

Primary ground water protection after disposal of tailings is best provided by a well-designed cover. The requirements for closure (disposal) of surface impoundments under EPA's regulations for hazardous waste include a cover designed and constructed to: (a) Provide long-term minimization of the migration of liquids through the closed impoundent; (b) function with minimum maintenance; (c) promote drainage and minimize erosion or abrasion of the final cover; (d) accommodate settling and subsidence so that the cover's integrity is maintained; and (e) have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present (40 CFR 264.228).

EPA's policy on long-term protection of ground water is stated in the preamble of the notice establishing the above regulations (47 FR 32274):

> EPA's view of the function of a liner contrasts somewhat with that of some members of the public and the regulated community. Some have argued that liners are devices that provide a perpetual seal against any migration from a waste management unit. EPA has concluded that the more reasonable assumption, based on what is known about the pressures placed on liners over time, is that any liner will begin to leak eventually.
>
> Others have argued that liners should be viewed as a means of retarding the movement of liquids from a unit for some period of time. While this view accords with how liners do in fact operate, EPA does not believe that this is a sound regulatory strategy for ground-water protection because it is principally designed to delay the appearance of ground-water contamination rather than to achieve a more permanent solution. Accordingly, EPA views liners as a barrier technology that can be best used to facilitate the removal of liquids from a waste management unit during its active life (including the closure period) and thereby provide a greater assurance of long-term protection at the facility.
>
> While liners may remain effective at preventing migration from [a tailings pile] until well after closure, their principal role occurs during the active life [of the pile.] After closure, EPA believes that a protective cap becomes the prime element of the liquids management strategy. A well-designed and carefully maintained cap can be quite effective at reducing the volume of liquids entering a unit and therefore can substantially reduce the potential for leachate generation at the unit for long periods.

We believe that complying with the post-closure standards we are proposing for uranium mill tailings piles will satisfy the overall objectives of EPA's SWDA regulations for hazardous waste. The SWDA regulations, however, were developed primarily for ground water protection for regions in which precipitation seeping through wastes might pose a continuing long-term hazard. In contrast, most tailings piles are in arid regions, and providing physical barriers against removal of tailings and reducing the piles' gaseous (radon) emissions to air are important concomitant objectives of our standards under UMTRCA.

Certain closure and post-closure care requirements in § 264.228 of the SWDA regulations, such as the requirements to eliminate free liquids from the waste and for the cover to be less permeable than any bottom liner or natural subsoils, may be unnecessary for tailings piles or interfere with control objectives other than ground water protection. (For example, allowing moisture into a cover increases its effectiveness as a barrier to radon release.) Other requirements in § 264.228 are not standards so much as broad objectives that are already implicit in § 264.111, which we have incorporated in the proposed standards, or tailings management rules that fall under NRC's regulatory authority. Therefore, we have not incorporated § 264.228 in the proposed standards.

The proposed rules are based on experience and an analysis of tailings management in arid regions. We know of no plans for construction of new mills in regions that are not arid, although some firms have conducted exploration in such regions. However, if uranium mining and milling is conducted in such regions, the adequacy and appropriateness of these standards may have to be reviewed, particularly the water protection requirements.

The final consideration regarding the disposal of tailings is specification of when disposal must take place. Several factors must be evaluated in this regard, including: (1) The likelihood that a mill will resume operations; (2) the specific condition of the tailings impoundment, such as the fraction of design life remaining, and environmental contamination problems, such as windblown tailings and the likelihood that significant quantities of tailings might be spread by flooding; and (3) the cost of maintaining releases from the inactive pile in conformance with the regulations which apply to operating mills prior to disposal (including maintaining radon emissions at ALARA levels). Evaluating these factors may be difficult and complex. However, although an adequate drying-out period makes possible long-term isolation of the tailings and stabilization of the piles, radon emissions will be greater during this period than before or after disposal. For this reason the regulatory agency should require, once a pile is allowed to begin to dry out, that disposal proceeds in an expeditious fashion, and that new liquids are not introduced to the pile so that a new drying-out period will be incurred.

The period required for the tailings to dry out is highly dependent on local meteorology. This precludes establishing a single fixed time for disposal of the tailings. We have concluded that the regulatory agency should exercise the responsibility of determining when disposal should occur, by site-specifically judging the advantages and detriments associated with all pertinent factors. This responsibility is governed by the need to conform to regulations established to satisfy the SWDA, by 40 CFR 190, and by the ALARA requirement on radon emissions.

NRC's closure regulations must be comparable, to the maximum extent practicable, to requirements under the SWDA, wherein short closure periods (90 and 180 days) are specified. Drying out of piles will take much longer. However, disposal should occur promptly when piles are allowed to dry out. In addition, some of the older mill sites already contain essentially completed (filled) tailings piles. The regulatory agency should promptly identify and require disposal of such tailings.

The proposed post-closure standards are intended for control of tailings piles; i.e., bulk tailings with elevated radium concentrations relative to those of common soils and rocks. Such post-closure control criteria need not apply to portions of a mill site that may contain low enough residual levels of byproduct material (tailings) to not warrant taking action for environmental or public health protection. Tailings that have been distributed over the mill site by wind or water can readily be cleaned up. Therefore, we propose to apply the post-closure standards only where the radium concentrations exceed the criteria stated in § 192.32(b)(2). These criteria are equivalent to the final cleanup standards (40 CFR Part 192, Subpart B) for land that is affected by tailings from inactive sites. Unless special c.rcumstances prevail that would indicate otherwise, land that satisfies the criteria should be usable without restriction.

Section 83 of the Atomic Energy Act, as amended by UMTRCA, provides that the ownership of land used for disposal of tailings shall be transferred to the United States or to the State in which it is located, unless the Nuclear Regulatory Commission determines that such transfer is not necessary.

VI. Solicitation of Comments

These proposed standards are supported by two documents, a Draft Environmental Impact Statement for the Control of Byproduct Materials from Uranium Ore Processing (40 CFR Part 192), EPA 520/1–82–022 and a Regulatory Impact Analysis of Environmental Standards for Uranium Mill Tailings at Active Sites, EPA 520/1–82–023. We invite the submission of written comments on these proposed standards and on these supporting documents. Whenever appropriate, it will be most useful if these are supported by factual material. We are also holding a public hearing. Times and addresses for both written comments and the public hearings are specified under the headings "dates" and "addresses" at the beginning of this notice.

In addition to comments on the above, we are interested in receiving comments and data on three specific matters: (1) Should the radon control standards require a specific level of control of radon from tailings prior to disposal, and, if so, how; (2) should the health and environmental goals for standards for remote sites be different from those in more populated areas, and, if so, how; and (3) should the provisions of these proposed standards for a liner under tailings (new or existing) be modified for this specific category of wastes, and, if so, how.

The proposed standards do not specify an emission rate limit nor an airborne concentration limit for radon from tailings piles during the period when tailings are being pumped into the pond, nor while it is drying out. The estimated numbers of cancer deaths attributable to uncontrolled radon emissions during the assumed 15-year operating and 5-year dry-out periods of our model sites are significant: 1.8 lung cancer deaths for our model remote site and 5.5 for our model rural site. We estimate the total cancer deaths due to emissions from all sites to the year 2000 could range from 60 to 160 if there is no control of radon prior to disposal.

We estimate that applying the most effective control methods, such as staged disposal of new tailings, would reduce these effects to about 30. Seventy percent of these residual effects would be from existing tailings, for which little improvement in current practices is possible. The DEIS contains a discussion of the effectiveness of various pre-disposal radon control methods and their costs.

In Section IV we discussed the reasons we are proposing that these pre-disposal radon releases continue to be regulated under the ALARA ("as low as reasonably achievable") principle, rather than by proposing a generally applicable numerical requirement. Alternatively, under authority of the Clean Air Act, as amended, we could consider "work practice" standards, which, for present purposes, are narrative specifications of tailings management techniques to control radon emissions during mill operations and during the dry out period preceding disposal.

During the review of the standards for the inactive sites by certain Federal agencies, questions were raised regarding the appropriateness of the control standards for general application to all 24 inactive sites. Some reviewers suggested that less restrictive standards might be appropriate for sites that are in currently sparsely populated areas. Other reviewers suggested that we consider a radon standard that applies at and beyond the fenced boundary of such a site, i.e., a standard that relies in part on institutional maintenance of control of access. In view of these concerns EPA requested public comments on these issues for the inactive sites (48 FR 605 January 5, 1983). These issues are most simply stated as: (1) Should the degree of radon control after disposal depend in part or on the size of the current local population, and (2) Should implementation of the disposal standards be permitted to depend primarily or in part on maintenance of institutional control of access (e.g., by fences)? We believe it is also necessary to examine these issues for the active sites, both in relation to the public health and environmental objectives enunciated in this Notice and with repect to the objectives of the UMTRCA. Also, are there any other forms of the standard or control methods that EPA should consider? We request comments on all of these issues with respect to these proposed standards, to aid us in determining final standards for active mills.

The primary reason to consider revising the standards as the Federal reviewers suggested is to reduce disposal costs. Savings of up to 30 percent could be realized by applying the most relaxed standards at all sites. The actual savings would be less than this since such relaxed standards would apply at only a subset of all sites. This Notice and the supporting documents—the DEIS and the RIA—provide detailed information on the costs and benefits of a wide range of alternative standards, including examples of standards that permit reliance on institutional control methods. We invite comments on whether the cost savings from applying relaxed standards at remote sites or relying primarily on institutional controls is sufficient to justify any reduced level of health and environmental protection. We solicit comments on what *criteria* the Agency could use to define population levels below which a less restrictive standard might apply, and on whether there should be different risk levels permitted to the most exposed individuals in such cases. These is no reliable way to predict what future populations will be at currently remote sites. Should the standard be predicated on the assumption that current distributions of populations adequately predict future populations, or is it sufficient to protect only current populations?

It is also important to consider the other goals (other than control of radon emissions) of these proposed standards when assessing the cost savings that could be achieved by applying less restrictive standards at remote locations. The greatest risks from radon occur when tailings are misused in and around buildings, and an objective of the proposed radon emission standard is to require a thick enough cover to discourage such misuse. Is the likelihood of misuse of tailings from remote sites greater or smaller? Prevention of spreading of tailings and protection of water, depends on either the integrity and thickness of the cover or the reliability of institutional control. Are there differences in the likelihood of success of institutional controls at remote vs. populated sites? Commenters are asked to consider each of the goals of these proposed standards when commenting on the suitability of applying less restrictive standards to tailings located in currently remote areas.

Institutional controls have been suggested that would apply a radon concentration limit at the boundary ("fenceline") of the government-owned property around a tailings pile located in a sparsely populated area. Such a standard could be satisfied largely by acquiring and maintaining control over access to land; e.g., through use of fences or other restrictions. These proposed standards can be satisfied only by generally more costly physical methods (such as applying thick earthen covers) that control tailings and their emissions with minimal reliance on institutional methods. EPA is particularly interested in receiving comments regarding the adequacy of a standard which places primary reliance on the maintenance of institutional as opposed to passive control to meet the long-term disposal objectives of UMTRCA.

The primary standard for ground water protection under the SWDA is a requirement for a liner. Because the SWDA covers many kinds of wastes, those regulations provide a mechanism for exceptions from this requirement. However, uranium mill tailings are a well-characterized waste that is produced in relatively well-characterized regions of the country (primarily arid western sites). Should the proposed requirements for liners be modified for these mill tailings sites, and if so, how? How should the exemption procedure be applied to this category of wastes? Should all uranium mill tailings be placed on liners? If so, what specifications are appropriate for such liners? If not, what types of exceptions are appropriate? Finally, should existing tailing piles be exempted from a liner requirement if new tailings are placed on them? We invite comments on each of these subissues.

Finally, in establishing standards for remedial actions at inactive uranium processing sites, we provided a procedure for applying "supplemental standards" where circumstances may require some adjustment in our final standards. Because of the varied conditions at the designated sites and the limited experience with remedial actions, we felt our standards for inactive sites might be too strict in some circumstances. We have not proposed "supplemental standards" as a part of this rulemaking. However, we are soliciting comments on the need for such standards. Is there a need for supplemental standards because of differences in conditions at these active sites? If so, what form should such supplemental standards take?

Regulatory Impact Analysis

Under Executive Order 12291, we must judge whether a regulation is "Major" and therefore subject to the requirement of a Regulatory Impact Analysis. We have classified this proposed rule as minor, since it will not cause significant incremental costs above those which must be incurred for compliance with existing regulations. We have prepared a Regulatory Impact Analysis (RIA), however, since there are wide variations in views regarding the need for environmental controls in the uranium industry. The RIA provides an additional basis for our conclusions. To meet the general reguirements of the order, an RIA must show that:

- There is adequate information concerning the need for and consequences of the proposed action;
- The potential benefits to society outweigh the potential costs; and
- Of all the altnerative approaches to the given regulatory objective, the proposed action will maximize net benefits to society.

There is a need for the proposed standard beyond the fact that Congress directed the Agency to develop them. Since uranium milltailings are essentially a waste product with no value, there is no market to assure that mill operators on their own accord will isolate the tailings and provide health protection to the public. Consequently, the Government must intervene to protect the public from the hazards associated with the tailings. Federal Government intevention is necessary because some mills are licensed by state authorities while others are licensed by the NRC directly. Four of the seven states with currently licensed mills are NRC Agreement States and have devloped their own licensing regulations for uranium mills. Therefore, relying on State regulations would address only about one-half of the tailings problem. Furthermore, the Act requires that regulations for mill tailings developed by the Agreement States be "equivalent, to the extent practicable, or more stringent than standards" promulgated by NRC and EPA. Therefore, the State regulations are also dependent on the EPA standards.

The RIA examines the benefits and costs of selected tailings disposal methods for both existing and new tailings piles, on a model pile basis. As discussed earlier, most of the benefits of tailings disposal cannot be quantified. The benefit we are best able to estimate is the number of lung cancer deaths avoided by controlling the radon emanation from tailings piles. Since the other benefits of disposal—prevention of misuse, ground water protection and prevention of the surface spread of tailings—cannot be quantified (let alone monetized), we could not make a numerical determination, within the traditional benefit-cost analysis framework, that the societal benefits outweigh the societal costs. Instead, we have made a qualitative judgment that this is the case, based on our assessment of the long-term continuing train of benefits to society from isolating these hazardous materials from man and the environment.

We performed a cost-effectiveness analysis of the alternative disposal methods to determine the optimal level of control for disposal of mill tailings. To perform this analysis, we developed an index which quantifies the relative effectiveness of the disposal methods in providing designated classes of control which correspond to the benefit categories. We evaluated the changes in incremental cost of alternative levels of control and determined which level would be optimal. Once this level was determined, we chose values for these proposed environmental standards which would require this level of control.

In the RIA, we developed 22 cases for analyzing the industry-wide costs and economic impacts associated with tailings disposal. Each case represented a different combination of disposal methods applied to both existing and new tailings. The estimated economic impacts include potential mill closures (on a model mill basis) and uranium price increases. We estimated the impacts for each case according to different industry demand projections, several financial scenarios, and different assumptions on the ability of companies to pass-through tailings disposal costs to their customers. The results from this analysis are used to represent the costs and impacts of the proposed standards.

We estimate that compliance with the proposed standards, if other regulatory requirements did not exist, would cost the uranium milling industry about 175 million dollars for all tailings which exist today at licensed sites. If we include all those tailings which we estimate will be generated by the year 2000, under low-growth projection conditions the total cost to the uranium milling industry would be from 400 to 700 million dollars. These costs are present worth estimates (discounted at a 10 percent rate) expressed on a 1981 constant dollar basis. The range in cost is due to different assumptions on what actions are needed to meet requirements for ground water protection for new tailings at existing mills. The range of industry costs becomes 500 million to 750 million dollars under baseline projection conditions. Due to recent cancellations of nuclear power plants, lack of orders for new plants, and the long lead time (14 years) for licensing and construction, we believe the low-growth scenario is the most likely.

We estimate that increases in the price of uranium could range from 2 to 8 percent. In light of the currently poor economic condition of the industry and the threat of foreign competition, it is unlikely that mills will be able to pass-through substantial portions of the disposal costs. Using our models, we estimate that if mills are forced to absorb the entire cost of disposal, one small model mill may cease operation, depending on the implementation of ground water protection requirements. We further estimate that under the conditions of a more favorable cash-flow or a limited price pass-through, this single mill closure would be avoided. On the other hand, with no pass-through and a lower cash-flow, two small model mills and a large model mill may close.

These costs and economic impacts are not incremental costs of the proposed standards, since much of this cost would probably occur in the absence of the standards due to other regulatory requirements. These other requirements are NRC licensing regulations and State regulations. We did not estimate the costs imposed by these other regulations because that would require a site-specific investigation. Since our standards are required by Congress to be of general application, we deciced to develop a generic analysis based on model facilities. Therefore, we could not estimate the net impact of the proposed standards.

However, these proposed standards are less restrictive than existing NRC regulations. Therefore, costs of implementation of these proposed standards are likely to be less than implementation on the current NRC regulations. For example, the thickness of earthen cover to achieve the 20 pCi/m²s proposed herein is estimated to range from 2 to 3 meters. The thickness to achieve the NRC regulation of 2 pCi/m²s is estimated to range from 4 to 5 meters, and the NRC regulations specify a minimum thickness to 3 meters. These proposed standards specify a design lifetime of 1,000 years, but in any case at least 200 years. The cost of providing long-term protection under these proposals will be less than under the NRC regulations, which specify a minimum design lifetime of 1,000 years. While actual disposal costs will be highly site specific, it is reasonable to assume that these proposed standards lead to lower costs than current regulations.

This regulation was submitted to the Office of Management and Budget for review as required by Executive Order 12291. We believe the analysis discussed above complies with the intent of the Order. Any comments from OMB to EPA and any EPA response to those comments are available for public inspection at the docket cited above under "addresses."

Regulatory Flexibility Analysis

This regulation would not have a significant impact on a substantial number of small entities, as specified under Section 605 of the Regulatory Flexibility Act (RFA). Therefore, we have not performed a Regulatory Flexibility Analysis. The basis for this finding is that of the 27 licensed uranium mills, only one qualifies as a small entity and this mill will not be impacted by the standards. Almost all the mills are owned by large corporations. Three of the mills are partly-owned by companies that could qualify as small businesses, according to the Small Business Administration generic small entity definition of 500 employees. However, under the RFA, a small business is one that is independently owned and operated. Since these three mills are not independently owned by small businesses, they are not small entities.

List of Subjects in 40 CFR Part 192

Environmental protection, Radiation protection, Uranium.

Dated: April 20, 1983.

New Subparts D and E are proposed to be added to 40 CFR Chapter I, Subchapter F, Part 192, Health and Environmental Protection Standards for Uranium Mill Tailings, to read as follows:

Subpart D—Standards for Management of Uranium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended

Subpart E—Standards for Management of Thorium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended

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

Subpart D—Standards for Management of Uranium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended

§ 192.30 Applicability.

This subpart applies to the management of uranium byproduct materials under Section 84 of the Atomic Energy Act of 1954 (henceforth designated "the Act"), as amended, during and following processing of uranium ores, and to restoration of disposal sites following any use of such sites under Section 83(b)(1)(B) of the Act.

§ 192.31 Definitions and cross-references.

References in this subpart to other parts of the Code of Federal Regulations are to those parts as codified on January 1, 1983.

(a) Unless otherwise indicated in this subpart, all terms shall have the same meaning as in Title II of the Uranium Mill Tailings Radiation Control Act of 1978, Subparts A and B of this part, or Parts 260, 261, and 264 of this chapter. For the purposes of this subpart, the terms "waste," "hazardous waste," etc., as used in Parts 260, 261, and 264 of this chapter shall apply to byproduct material.

(b) *Uranium byproduct material* means the tailings or wastes produced by the extraction or concentration of uranium from any ore processed primarily for its source material content. Ore bodies depleted by uranium solution extraction operations which remain underground do not constitute "byproduct material" within this definition.

(c) *Control* means any action intended to stabilize, inhibit future misuse of, or reduce emissions or effluents from uranium byproduct materials.

(d) *Licensed site* means the area contained within the boundary of a location under the control of persons generating or storing uranium byproduct materials under a license issued pursuant to Section 84 of the Act. For purposes of this subpart, "licensed site" is equivalent to "regulated unit" in Subpart F of Part 264 of this chapter.

(e) *Disposal site* means a site selected pursuant to Section 83 of the Act.

(f) *Disposal area* means the region within the perimeter of uranium byproduct materials to which the post-closure requirements of § 192.32(b)(1) of this subpart apply.

(g) *Regulatory agency* means the U.S. Nuclear Regulatory Commission.

(h) *Closure period* means the period of time beginning with the cessation, with respect to a waste impoundment, of uranium ore processing operations and ending with completion of a closure plan that satisfies the requirements of § 192.32(b) of this subpart.

(i) *Existing portion* means that land surface area of an existing surface impoundment on which significant quantities of uranium byproduct materials have been placed prior to promulgation of this standard.

§ 192.32 Standards.

(a) *Standards for application during processing operations and prior to the end of the closure period.* (1) Surface impoundments (except for an existing portion) subject to this subpart must be designed in such manner as to conform to the requirements of § 264.221 of this chapter, except that the requirements of § 264.228 referenced in § 264.221 do not apply.

(2) Uranium byproduct materials shall be managed so as to conform to the ground water protection standard in § 264.92 of this chapter, except that:

(i) To the list of hazardous constituents referenced in § 264.93 of this chapter are added the chemical elements molybdenum and uranium,

(ii) To the concentation limits provided in Table 1 of § 264.94 of this chapter are added the radioactivity limits in Table A of this subpart,

(iii) Monitoring programs required to establish the standards required under § 264.92 shall be completed within one (1) year of promulgation,

(iv) The functions and responsibilities designated in Part 264 of this chapter as those of the "Regional Administrator" with respect to "facility permits" shall be carried out by the regulatory agency, except that no exemptions of hazardous constituents under § 264.93(b) and (c) of this chapter and no alternate concentration limits established under § 264.94(b) and (c) of this chapter shall be final unless EPA has concurred therein.

(3) Nothing in this section shall be deemed to alter or affect the applicability of the provisions of Part 190 of this chapter, "Environmental Radiation Protection Standards for Nuclear Power Operations," Part 440 of this chapter, "Ore Mining and Dressing Point Source Category: Effluent Limitations Guidelines and New Source Performance Standards, Subpart C, Uranium, Radium, and Vanadium Ores Subcategory," and any other applicable environmental and public health protection standards, regulations, or guidelines. In addition, the regulatory agency shall make every effort to maintain radiation doses from radon emissions from surface impoundments of uranium byproduct materials as far below the Federal Radiation Protection Guides as is practicable at each licensed site.

(b) *Standards for application after the closure period.* (1) Uranium byproduct material subject to this subpart shall be managed so as to comply with the closure performance standards in § 264.111 of this chapter with respect to nonradiological hazards and disposal of such materials shall provide for control of radiological hazards designed [6] to

(i) Be effective for one thousand years, to the extent reasonably achievable, and, in any case, for at least 200 years, and,

(ii) Provide reasonable assurance that releases of radon-222 from uranium byproduct materials to the atmosphere will not exceed an average [7] release rate of 20 picocuries per square meter per second.

(2) Section 192.32(b)(1) shall not apply to any portion of a licensed and/or disposal site in which the concentration of radium-226 in land averaged over an area of 100 square meters exceeds the background level by less than—

(i) 5pCi/g, averaged over the first 15 cm of soil below the surface, and

(ii) 15pCi/g, averaged over 15 cm thick layers of soil more than 15 cm below the surface.

§ 192.33 Corrective action program.

If the ground water standards of § 192.32(a)(2) are exceeded at any licensed site, a corrective action program as specified in § 264.100 of this chapter shall be put into operation as soon as is practicable, and in no event later than one (1) year after the date of a noncompliance determination by the regulatory agency.

§ 192.34 Effective date.

Subpart D shall be effective 60 days after promulgation.

TABLE A

	PCi/liter
Combined radium-226 and radium-228	5
Gross alpha-particle activity (excluding radon and uranium)	15

Subpart E—Standards for Management of Thorium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended

§ 192.40 Applicability.

This subpart applies to the management of thorium byproduct materials under Section 84 of the Atomic Energy Act of 1954, as amended, during and following processing of thorium ores, and to restoration of disposal sites following any use of such sites under Section 83(b)(1)(B) of the Act.

§ 192.41 Provisions.

The provisions of Subpart D of this part, including §§ 192.31, 192.32, and 192.33, shall apply to thorium byproduct material except that:

(a) Provisions applicable to the element uranium shall apply instead to the element thorium;

(b) Provisions applicable to radon-222 shall apply instead to radon-220; and

(c) Provisions applicable to radium-226 shall apply to radium-228.

§ 192.42 Substitute provisions.

The regulatory agency may, with the concurrence of EPA, substitute for any provisions of § 192.41 of this subpart any provisions it deems more practical that will provide at least an equivalent level of proteciton for human health and the environment.

§ 192.43 Effective Date.

Subpart E shall be effective 60 days after promulgation.

[6] The standard applies to design. Monitoring for radon-222 after installation of an appropriately designed cover is not required.

[7] This average shall apply over the entire surface of the disposal area and over at least a one-year period. Radon will come from both uranium byproduct materials and from materials covering them. Radon emissions from the covering materials should be estimated as part of developing a closure plan for each site. The standard, however, applies only to emissions from uranium byroduct materials to the atmosphere.

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