REPORT TO THE CONGRESS

Controlling The Radiation Hazard From Uranium Mill Tailings

Energy Research and Development Administration

Nuclear Regulatory Commission

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

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To the President of the Senate and the
Speaker of the House of Representatives

This is our report on efforts by the Energy Research and Development Administration and the Nuclear Regulatory Commission to control the radiation hazard from uranium mill tailings. A major part of the report deals with the federally supported Remedial Action Program in Grand Junction, Colorado, authorized in June 1972 by title II of Public Law 92-314.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget; the Administrator, Energy Research and Development Administration; and the Chairman, Nuclear Regulatory Commission.

Comptroller General
of the United States

Contents

ABBREVIATIONS

AEC	Atomic Energy Commission
CDH	Colorado Department of Health
EPA	Environmental Protection Agency
ERDA	Energy Research and Development Administration
GAO	General Accounting Office
NEPA	National Environmental Policy Act
NRC	Nuclear Regulatory Commission

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

CONTROLLING THE RADIATION HAZARD FROM URANIUM MILL TAILINGS

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D I G E S T

WHY THE REVIEW WAS MADE

Because of possible adverse health effects of long-term exposure to low-level radiation from uranium tailings (a sand-like radioactive waste material resulting from the extraction of uranium from uranium ore), GAO reviewed Federal-State efforts to

--limit exposure of individuals to radiation from tailings and

--control and stabilize uranium mill tailings piles in the Western United States.

About 85 percent of the radioactivity in uranium ore remains in the tailings. Radium is the major radioactive waste product in the tailings; it takes thousands of years for radium to lose its radioactivity. (See p. 2.)

Unless tailings piles are effectively controlled and stabilized, radioactivity can be spread to the environment by wind and water erosion, ground water and soil contamination, and deliberate removal and unauthorized use of tailings material.

FINDINGS AND CONCLUSIONS

A federally supported remedial action program was authorized in June 1972 to provide financial assistance to the State of Colorado to limit exposure of individuals to radiation from uranium mill tailings used in construction projects in Grand Junction.

Remedial action includes

--removing tailings by excavation or pneumatic conveyance,

--using sealants,

--improving ventilation, or

--combinations of these methods.

The program is administered by the Energy Research and Development Administration and the Colorado Department of Health.

The law authorizes $5 million in Federal funds to cover not more than 75 percent of the program's costs. Colorado has authorized up to $1.7 million to cover its share of costs. Property owners notified by the Department that they are potentially eligible for

remedial action based on initial radiation surveys have until June 1976 to apply to the program. (See pp. 1 and 5.)

The Administration expects the program to cost considerably more than the $6.7 million currently authorized. (See p. 10.)

In 1970 the Department, the Atomic Energy Commission, and the U.S. Public Health Service started surveys of radiation levels throughout the Grand Junction area. Results showed there were tailings on more than 5,400 of about 15,000 property locations surveyed, and as of November 30, 1974, corrective action had been taken or was scheduled on 206, or about 40 percent, of the 522 property locations on which remedial action was recommended. (See pp. 4 and 9.)

About 3,650 locations have not been surveyed to determine the existence of tailings and the radiation levels principally because property owners or occupants could not be contacted. Based on the percentage of those properties already surveyed and determined potentially eligible, GAO estimated that 124 of the unsurveyed locations could be potentially eligible for remedial action. (See p. 13.)

Although considerable efforts have been made to inform property owners about the program, no further efforts were made to contact them directly after the program was established. (See p. 12.)

One objective of the program is to assess the need for remedial action. Additional survey efforts are needed to

--help achieve this objective,

--insure equitable treatment to all property owners, and

--assist in program planning. (See p. 14.)

At the time of GAO's review, the Department had notified 1,060 property owners where tailings were located near or under structures that there was "no undue concern" about any radiation hazard and that immediate corrective action was not needed. However, radiation levels at 436 of these properties indicated possible eligibility for remedial action under the Administration's regulations. (See p. 14.)

At GAO's request, the Department reviewed the basis for the "no undue concern" determinations on 33 properties which were possibly eligible for remedial action. The reviews indicated that further radiation measurements were needed to properly assess the radiation hazard at about half of these properties. (See p. 15.)

The Department agreed to

--perform further analyses of other "no undue concern" locations and

--take further radiation measurements where needed.

"No undue concern" determinations should not have been made without having obtained the necessary radiation measurements. Supervisory management officials in the Department and the Administration systematically should review such "no undue concern" determinations. (See p. 15.)

As of December 1974, owners of 136 properties on which recommendations for remedial action were made had not submitted applications to the program. Because of the program's voluntary nature, it is not possible to determine how many of the property owners will apply by June 16, 1976--the last day that applications can be accepted. (See p. 16.)

If these property owners do not apply and radiation assessments are not made at the remaining unsurveyed locations, the program will fall short of meeting its objectives. (See p. 16.)

The Department and the local governments have taken actions outside of the Grand Junction Remedial Action Program to complete radiation assessments. Such actions will help prevent further construction over tailings and protect future property owners; however, these efforts are not mandatory and may not be fully effective. (See p. 16.)

Accordingly, it is important that results of the program be evaluated by the Administration and Department to determine whether further actions are needed to protect future property owners. (See p. 17.)

Efforts to control and stabilize uranium tailings

Although the extensive use of uranium tailings for construction purposes was unique to the Grand Junction area, there has been growing concern over control and stabilization of the estimated 110 million tons of uranium mill tailings located in Western States. (See pp. 1 and 18.)

There are currently 14 mills processing uranium in the United States with a combined processing rate of about 21,500 tons of ore a day. By the late 1970s, a rapid expansion of the uranium milling industry is expected; by 1990, about 68 additional mills with a combined capacity of 170,000 tons of ore a day will be needed. (See p. 18.)

Nearly the entire mass of ore processed by the mills ends up in the tailings piles.

Tailings control and stabilization measures include

--restricting access,

--isolating tailings piles from sources of water, and

--containing them by using suitable ground cover. (See p. 19.)

The Atomic Energy Commission, the Environmental Protection Agency, and various States have surveyed the condition of tailings and the need for corrective action at 21 inactive

uranium mills in the United States. The results, reported to the Joint Committee on Atomic Energy in October 1974, showed that conditions and degree of stabilization of the tailings varied greatly and that improvements in control and stabilization were needed at all sites. (See pp. 23 and 24.)

A further study of the tailings at the inactive mills will take 2 years to complete and will cost an estimated $1.4 million. (See p. 23.)

Regulatory authority over licensed uranium mills appears to be adequate. Once a mill license has been terminated, however, the regulatory agencies--Nuclear Regulatory Commission or State agencies operating under agreement with the Commission--no longer have enforcement authority over a former mill licensee unless additional regulatory authority is provided by the State. (See p. 18.)

In 6 of the 10 States with uranium mills, additional regulatory authority requiring tailings stabilization at mills which are no longer licensed has been provided. (See p. 19.)

The ineffectiveness of existing stabilization methods highlights the importance of continuing regulatory authority and establishing arrangements for periodic inspection and long-term control to insure continuing integrity of tailings control and stabilization programs. (See p. 25.)

RECOMMENDATIONS

The Administrator of the Energy Research and Development Administration should:

--Request the Colorado Department of Health to make additional efforts under the remedial action program to contact property owners of unsurveyed locations directly to obtain the necessary radiation measurements. (See p. 14.)

--Request the Colorado Department of Health to have its determinations of "no undue concern," which were based on subjective judgment, reviewed by supervisory management officials and require the Administration to review all such determinations. (See p. 15.)

The Chairman, Nuclear Regulatory Commission, should:

--Assess the capability and willingness of public health authorities or other State agencies to assume responsibility for and carry out adequately programs for long-term monitoring of tailings piles and for correcting any problems in tailings' stabilization and control programs.

--Determine what additional Federal authority, if any, is needed to improve such programs. (See p. 26.)

AGENCY ACTIONS AND UNRESOLVED ISSUES

The Adminstration and the

Commission generally agreed with GAO's findings and recommendations. Specific comments by the Administration are discussed in chapters 3 and 4, and the comments by the Commission are discussed in chapter 4.

Comments received from the Department were also considered in the preparation of this report.

MATTERS FOR CONSIDERATION BY THE CONGRESS

Since it is likely that certain objectives of the Remedial Action Program will not be met because of its voluntary nature, the Congress should have the Administration submit a report on its progress and the extent to which program objectives will not be accomplished. (See p. 17.)

Such a report should be useful to the Congress in determining the need to extend or otherwise amend the Remedial Action Program.

CHAPTER 1

INTRODUCTION

Title II of Public Law 92-314, dated June 16, 1972, established a cooperative Federal-State Remedial Action Program--currently being conducted by the Energy Research and Development Administration (ERDA) and the State of Colorado--to limit the exposure of individuals to radiation hazards resulting from the use of uranium mill tailings 1/ for construction purposes in the area of Grand Junction, Colorado. Before January 19, 1975, the program was administered by the Atomic Energy Commission (AEC).2/

The law authorized $5 million in Federal funds to cover not more than 75 percent of the costs to assess the need for and take remedial action to limit the exposure of individuals to radiation from uranium mill tailings. Colorado has authorized up to $1.7 million for its share of the program's costs, giving the program a total authorized funding level of $6.7 million.

Within ERDA, the program is administered at the Headquarters level by the Division of Operational Safety under the Assistant Administrator for Environment and Safety and in the field by ERDA's Grand Junction Office. In Colorado the program is administered by the Colorado Department of Health (CDH).

Although the extensive use of uranium mill tailings for construction purposes was unique to the Grand Junction area, there has been growing concern over the health effects of long-term exposure to low-level radiation and the possible exposure of individuals to such radiation from uranium tailings at other locations. This concern prompted proposed Federal legislation last year (S. 2566 and H.R. 11378 introduced by Senator Frank E. Moss and Representative Wayne Owens of Utah, respectively) to control uranium tailings from a mill near Salt Lake City, Utah, and an evaluation of

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1/ Uranium mill tailings are sand-like radioactive waste materials resulting from the extraction of uranium from uranium ore.

2/ The Energy Reorganization Act of 1974 (42 U.S.C. 5801), which was made effective on January 19, 1975, abolished AEC and established ERDA and the Nuclear Regulatory Commission.

uranium tailings control and stabilization activities at inactive uranium mills. This proposed legislation, however, was not enacted into law. (See ch. 4.)

URANIUM MILL TAILINGS AND RADIATION

Because uranium ore generally contains less than 1 percent uranium, the amount of tailings produced in the milling process is only slightly less than the amount of uranium ore processed. Through 1973, an estimated 110 million tons of uranium mill tailings had been produced by uranium mills in Western States.

About 15 percent of the radioactivity in uranium ore is removed with the uranium during the milling process; the remaining 85 percent remains in the tailings. Radium is the major radioactive waste product in the tailings.

Radium has a long radioactive life; it takes thousands of years for it to lose its radioactivity. The loss of radioactivity by radium (radioactive decay) produces two distinct types of potentially hazardous radiation conditions--gamma radiation and emission of gaseous radon.

Gamma radiation is highly penetrating. Exposure to sufficient gamma radiation can cause cancers such as leukemia. Radon gas can readily diffuse through most porous materials, including concrete. Through further radioactive decay, the radon gas produces radioactive products which attach to particles in the air and are deposited in the lungs when inhaled. Exposure of the lungs to large concentrations of these radon products can increase the risk of lung cancer. Because radon gas dissipates rapidly in the atmosphere, radon products can only accumulate in a closed environment, such as a building.

Exposure to gamma radiation and radon gas also occurs naturally from radium and other radioactive elements in the soil and in some building materials. Naturally occurring radiation is called background radiation. Uranium mill tailings under or near structures increase the exposure to such radiation above background levels.

IDENTIFICATION OF POTENTIAL RADIATION HAZARD

Because uranium mill tailings compact easily, they serve well as fill material in construction projects. The operator of the uranium mill in Grand Junction gave the tailings to construction contractors and anyone else who wanted them at no cost. Contractors used the mill

tailings extensively for construction projects in the area between 1952 and 1966.

Some of the more common uses of tailings were for backfill around building foundations and for grading material under sidewalks, driveways, garages, and concrete floors of homes.

In 1971 the mill operator estimated that about 300,000 tons of tailings had been used for construction purposes. About 250,000 tons were for nonstructural uses, such as roads, sidewalks, and driveways, and about 50,000 tons were used in constructing buildings.

In 1966 representatives of CDH and the U.S. Public Health Service determined that tailings from the mill in Grand Junction, which were being used as fill material around new buildings in the surrounding community (Mesa County), had created a potential public health hazard. 1/ Radon gas testing was performed in two buildings where tailings had been used. The results of these tests showed radon products levels above background radiation in both buildings. Because of the potential health hazard associated with radon products, the State ordered the mill to stop releasing uranium mill tailings. In December 1966, State regulations were adopted which prohibited removing tailings from all uranium mills in Colorado without CDH's approval.

RADIATION MEASUREMENTS

Gamma radiation is relatively easy to detect and measure with the type radiation instruments used for uranium exploration. Radon products' levels are more difficult to measure; they require air sampling over extended periods of time.

In 1968 CDH and the U.S. Public Health Service initiated studies to determine the extent of uses of

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1/ The studies made in connection with the Grand Junction Remedial Action Program have revealed that radon can diffuse more rapidly through materials with slight porosity, such as concrete, than was previously considered possible. This diffusion characteristic of radon was not realized when the tailings were being used in construction in Grand Junction.

tailings and the magnitude of radon exposure. In one of these studies, an evaluation of 100 locations where tailings existed showed that more than 40 percent of them had radon products' levels significantly above background.

In 1970, CDH, AEC, and the U.S. Public Health Service started surveying the radiation levels throughout Mesa County to identify general areas of possible tailings use. The surveying included gamma radiation screening--the simplest method of getting a general indication of where mill tailings were located. The screening was followed by measurements of gamma and radon products levels, where necessary, at individual locations within such areas. These surveys continued until the summer of 1972 and the results showed tailings on more than 5,400 locations out of about 15,000 surveyed; about 3,650 locations were not surveyed.

CDH notified property owners by letter whose properties were surveyed as to whether tailings were found on their property and, if so, whether remedial action was necessary. Many of these notifications were sent before the program began. CDH urged property owners to apply for remedial action if such action was indicated. The results of CDH's evaluations as of November 1974 are summarized below.

		Number of locations
No tailings on property-- no action recommended		a/9,700
Tailings on property:		
Located away from structure, no action recommended	3,823	
Located near or under structure:		
no action recommended	1,079	
action recommended	b/ 524	5,426
Total		15,126

a/ Approximate.

b/ Two property locations have been determined ineligible.

CDH's evaluations were principally based on radiation exposure guidelines the U.S. Surgeon General issued in July 1970. These guidelines recommended actions based on the intensity and type of radiation. For example, for residences and schools they provided that:

1. Corrective action is indicated when either the net radon products or the net gamma radiation levels are high relative to the average natural background level.

2. No corrective action is indicated when both the net radon products and the net gamma radiation levels are low relative to the average natural background level.

3. Corrective action may be indicated when either the net radon products or the net gamma radiation levels are in the intermediate range relative to the average natural background level.

THE REMEDIAL ACTION PROGRAM

In establishing the cooperative Federal-State Remedial Action Program in 1972, the Congress stated that it recognized the compassionate responsibility of the U.S. Government to provide the State of Colorado financial assistance to assess the need for and take remedial action for limiting the exposure of individuals to radiation from uranium mill tailings which had been used as construction material in the area of Grand Junction.

Under the legislation, AEC was authorized to enter into a cooperative arrangement with the State of Colorado which was to include the following provisions:

--The U.S. Surgeon General guidelines for radiation exposure limits will be the basis for undertaking remedial action.

--AEC, with the consultation and recommendations of the State, will determine the need for and the types of remedial action to be undertaken.

--The need for and the type of remedial action to be undertaken will be determined only after eligible property owners apply. June 16, 1976, is the application deadline.

--The State of Colorado, or its authorized contractors, will perform all remedial action. The State of Colorado will pay for such actions.

--The U.S. Government will be released from any liability or claim related to mill tailings use when remedial action is completed or when remedial action

by the property owners on their own behalf and on behalf of their heirs, successors, and assigns is waived. The U.S. Government will also not be held responsible under any claim arising from the performance of remedial action.

--The State of Colorado will retain custody and control of and responsibility for any uranium mill tailings removed from any site where remedial action is taken.

--The law of the State of Colorado will be applied to determine all questions of title, rights of heirs, trespass, and so forth.

--AEC will be provided with such reports, accounting, and rights of inspection as it deems appropriate.

CHAPTER 2

PROGRESS OF THE REMEDIAL ACTION PROGRAM

The Remedial Action Program has entered a phase of substantial activity. Efforts are being made to improve techniques for measuring radiation and for taking remedial action. If the techniques are successfully developed and implemented, they should help limit the exposure of individuals to radiation hazards at those locations where the use of uranium mill tailings for construction purposes had been identified.

IMPLEMENTATION OF THE PROGRAM

In October 1972, AEC and the State of Colorado entered into a cooperative arrangement which required CDH, with AEC approval, to

--notify property owners of the possible need for corrective action;

--evaluate the nature and extent of tailings involvement to determine the remedial action needed and prepare an engineering assessment of the extent and cost of such action;

--enter into arrangements with property owners to carry out the remedial action;

--perform the remedial action according to AEC criteria, procedures, and other requirements, including an order of priorities;

--determine the effectiveness of the remedial action taken; and

--retain custody and control of tailings removed.

In December 1972, AEC issued implementing regulations which, based on the U.S. Surgeon General's guidelines, established criteria for taking remedial action. For remedial action to be taken, property owners must apply to CDH. CDH reviews these applications and forwards its recommendations to ERDA. CDH and ERDA must agree on the need for and the type of remedial action.

As applications were received, CDH grouped and scheduled (phased) the property locations for engineering assessments to determine the type of remedial action needed. In establishing the order of priority for taking remedial action, the

regulations (10 CFR, Part 12) require that consideration be given, but not necessarily limited, to the following factors:

1. Classification of structures and availability of data--residences and schools would be given consideration first.

2. Order of application--where possible, remedial actions would be taken in the order in which applications were received.

3. Magnitude of radiation level--generally those structures with the highest radiation levels would be given primary consideration.

4. Geographical location of structures--priority consideration may be given to a group of structures located in the same vicinity, particularly where similar remedial actions are involved.

5. Availability of structures and climatic conditions--remedial action would be scheduled during periods when minimum interference would occur, where possible, and with consideration for the weather.

The types of remedial actions that can be or have been taken are (1) removing tailings by excavation or pneumatic conveyance, (2) using sealants, (3) improving ventilation, or (4) combinations of these methods.

The cost and complexity of tailings removal depends on the amount of tailings and their location relative to the structure. For example, tailings used as backfill around the outside of a foundation can be removed easily at a relatively low cost. On the other hand, removing tailings from under a foundation involves breaking up concrete to reach the tailings; it is both complex and costly. The majority of the corrective actions taken have involved removing tailings from under structures.

Pneumatic conveyance is a technique which uses vacuum to remove tailings from under structures with crawl spaces. On a demonstration basis, the technique has shown that it cannot be effectively used on tailings mixed with larger pieces of other material. The technique has been used successfully, however, in removing tailings from easily accessible areas in schools. CDH officials said that the technique can only be used effectively at a limited number of locations.

The use of sealants to prevent radon gas from escaping into living areas was demonstrated in 15 residences during the summer of 1974. This work was performed under the supervision of Colorado State University. In September 1974, CDH issued a report on the results of the work which showed that epoxy type sealant, when carefully applied, is highly effective as a radon barrier and that it is suitable for use where the gamma radiation intensity levels are relatively low. ERDA officials told us that the use of sealants will be an acceptable alternative in many structures and can result in substantial savings. They also told us that another potentially useful sealant, which can be injected directly into the tailings, is being investigated.

EFFORT TO IMPROVE RADON PRODUCTS MEASUREMENT

Because the measurement of radon products levels requires air sampling over extended periods of time, the Environmental Protection Agency (EPA) has been conducting research to evaluate a simple, inexpensive method for measuring such levels using film plates (Track-etch) sensitive to radioactivity. To expedite the measurements of radon products levels in the Remedial Action Program, CDH and EPA began to test the film plates at tailings locations during the summer of 1973. As of January 1975, the project had not been completed.

STATUS OF REMEDIAL ACTION EFFORTS

In February 1973, CDH contracted with an architect-engineer to perform engineering assessments and other activities relative to taking remedial action. CDH scheduled the program work into 26 phases. The first 12 structures selected for remedial action (Phase I) were at locations where the gamma radiation levels were high enough to require removal. At one of these locations where complete tailings removal was not possible, a sealant was used. The contract for tailings removal for these 12 locations was awarded in August 1973. As of November 30, 1974, 206 locations (191 residences and 15 schools), nad been scheduled for remedial action. Work on 71 structures had been completed as of November 30, 1974.

The contracting for remedial action partly depends on the number of qualified contractors participating in the program. Contracts have been awarded to nine contractors for most of the locations requiring remedial action; however, according to CDH, there are four other qualified contractors that could participate in the program. A CDH official told us that the season and the availability of other construction work in the Mesa County area influences the contractors'

interest in remedial action work. Because the contracts are competitively awarded and because some of the contractors are awarded several contracts, the completion of remedial action is affected by the contractors' ability to perform a number of jobs concurrently.

COST OF THE PROGRAM

In May 1974 CDH estimated the total cost of the program at slightly more than its $6.7 million total authorized funding level. The estimated cost by work phase is shown in appendix I.

The estimated cost was based on actual cost experience as of May 1974 and included work at all locations where remedial action was recommended. The estimate assumed that sealants would be extensively used, and included other program activities, such as (1) removed tailings disposal, (2) projects to demonstrate and study the effectiveness of pneumatic conveyance and sealant techniques, (3) public information, (4) radiation measuring equipment purchases, and (5) temporary living allowances for residents of structures when remedial action is being taken. The estimated cost did not include the cost to ERDA or EPA for their technical assistance or other involvement with the program. ERDA officials told us that the CDH estimate was reasonable at the time it was prepared. In January 1975, ERDA estimated the total cost of the program at $10.5 million based on actual cost experience and a possible additional 125 structures needing remedial action at those property locations which had not yet been surveyed.

The original AEC-CDH agreement provided that costs incurred by AEC and the State for administering the program, including the costs for administering subcontracts entered into by the State, would not be paid with program funds. According to a CDH official, the lack of funds to cover administrative expenses and the extensive manpower effort required by the program have made CDH's management of the program difficult. A June 5, 1973, modification to the agreement provided that the salary and travel expenses of the CDH field representative in Grand Junction would be paid with program funds.

CONCLUSION

The program has entered a phase of substantial activity. Efforts are being made to improve (1) radiation measurement techniques for radon products levels and (2) construction techniques for effective remedial action using sealants. Successful development of these techniques should help limit the exposure of individuals to radiation hazards at those

locations where the use of uranium mill tailings for construction purposes have been identified.

At the time of our review, the program's scope had not been determined because of problems in its implementation. These problems are discussed in the next chapter.

CHAPTER 3

PROBLEMS IN IMPLEMENTING THE REMEDIAL ACTION PROGRAM

The scope and cost of the Remedial Action Program cannot be reasonably determined primarily because

--information is not available on the remedial action needs of a large number of locations and

--remedial action requirements for some structures need to be reassessed.

In addition, the program's scope and cost will be affected if property owners who took remedial action on their own are reimbursed.

The program's voluntary nature may prevent it from fully meeting its objective because all property locations where the exposure to radiation from uranium mill tailings should be limited may not be identified and because remedial action may not be taken at all of the locations where the need for such action was identified.

NEED FOR FURTHER EFFORTS TO DETERMINE RADIATION HAZARDS AT UNSURVEYED LOCATIONS

During the radiation surveys in Mesa County, which were conducted before the Remedial Action Program was established, the potential radiation hazard from mill tailings at a large number of locations was not determined.

From November 1971 to June 1972, CDH, with considerable help from EPA and AEC contractor personnel, attempted to contact property owners of unsurveyed locations to arrange for radiation surveys. CDH officials told us that survey teams were unable to enter various locations and had left business cards with return-call messages and had followed up about 2 months later with another visit and card if required. The officials also told us that, if a telephone number was available, they made at least two attempts during day and evening hours to contact owners or occupants at unsurveyed locations. In addition, announcements were made on radio, television, and in the local newspaper to try to encourage property owners to contact CDH to arrange for radiation surveys.

CDH officials told us that since the Remedial Action Program was established no further efforts have been made to directly contact property owners of unsurveyed locations or to analyze the locations to identify those needing surveys.

They told us that such efforts have not been made primarily because of higher priority work, the extensive amount of time and expense involved, and their belief that the public was adequately informed of the need for radiation surveys. ERDA officials told us that they believed considerable efforts had been made under the program through the use of the media and discussions at meetings of the Federal-State Advisory Panel and the Local Advisory Committee, which also received press coverage.

The potential hazard from mill tailings has not been determined at about 3,650 property locations because

--there was no one to contact at 2,380 locations,

--the owners or occupants refused to permit the survey at 711 locations,

--radiation surveys were incomplete at 380 locations, and

--of various other reasons at 181 locations.

Outside gamma radiation measurements indicated that tailings were present at about 80 of the 380 locations where incomplete radiation surveys were performed. CDH, in commenting on our report, told us that the owners of these 80 properties were notified by mail regarding a need for completed surveys. They also said that some of the owners contacted CDH for surveys and subsequently applied to the program.

Based on the percentage of those properties already surveyed and determined potentially eligible, we estimated that 124 of the 3,650 unsurveyed locations could be eligible for remedial action. CDH cost projections for the program did not include the estimated cost for remedial action at these potentially eligible locations from among all unsurveyed locations. ERDA's January 1975 cost estimate for the program includes $1.5 million for an estimated 125 additional structures in need of remedial action from among all unsurveyed locations.

Conclusion

We recognize that this is a voluntary program and that CDH has tried to contact property owners of unsurveyed locations. However, no followup efforts to directly contact owners of unsurveyed locations were made since the program was established.

Since one of the program's basic objectives is to assess the need for remedial action, additional efforts are needed under the program to make radiation surveys to (1) help achieve this objective, (2) insure equitable treatment to all property owners by making sure that property owners have been made aware of the program, and (3) assist in program planning.

Recommendation to the Administrator, ERDA

We recommend that ERDA request CDH to make additional efforts under the program to directly contact property owners of unsurveyed locations to obtain the necessary radiation measurements.

In commenting on this report, ERDA concurred and said that efforts would be made to contact all property owners and occupants and obtain either a consent or refusal for performance of surveys.

NEED TO REASSESS REMEDIAL ACTION REQUIREMENTS FOR SOME STRUCTURES

At the time of our review CDH had sent letters to 1,060 property owners where tailings were located near or under structures stating that there was "no undue concern" about any radiation hazard and that corrective action was not needed at this time. Although the recipients of these letters were not prevented from applying to the program for eligibility determination, they were not invited to do so and many may have concluded by the statements made in the letters that there was no reason to do so.

The gamma radiation levels at 436 of these properties indicated possible eligibility for remedial action under ERDA regulations. We examined CDH files on 90 locations having the highest gamma radiation levels of the 436 to determine the basis for the decision that there was no undue concern about any radiation hazard.

CDH personnel who determined there was no undue concern told us that their decisions were based on available radiation measurements together with such factors as the (1) material composition of the structure, (2) location and amount of tailings, and (3) ventilation of the structure. Such determinations enabled CDH to estimate the total number of locations potentially eligible for remedial action and to eliminate duplicative evaluations of property locations with similar structures and radiation measurements. Supervisory management officials did not systematically review these determinations.

We asked CDH officials to review the basis for the determinations on 33 of the 90 locations. CDH officials told us that further radiation measurements would be needed to properly assess the radiation hazard at 16 of the 33 locations. On the basis of their review of the "no undue concern" determinations, CDH officials agreed to further analyze other "no undue concern" locations and to take further radiation measurements where needed.

Conclusions

We believe that (1) "no undue concern" determinations should not have been made without having obtained the necessary radiation measurements to help make such determinations and (2) determinations of "no undue concern" based on subjective judgments should have been systematically reviewed by supervisory management officials in CDH and ERDA, particularly since such determinations make it less likely that property owners would apply for remedial action.

Recommendations to the Administrator, ERDA

We recommend that ERDA request CDH to have its determinations of "no undue concern," which were based on judgment, reviewed by supervisory management officials in CDH. We also recommend that ERDA review all such CDH determinations.

ERDA concurred and stated that it would institute a review with CDH of the technical information supporting such determinations to insure that no eligible persons have been discouraged from applying under the program.

REIMBURSEMENT FOR SELF-INITIATED REMEDIAL ACTIONS COULD AFFECT PROGRAM SCOPE AND COST

As of March 18, 1974, there were 38 locations where some degree of tailings removal had been accomplished by property owners outside of the program. Fifteen of the property owners who took remedial action on their own had applied for reimbursement from the program at the time of our review.

The ERDA and CDH staffs have agreed on procedures to use for reimbursing property owners who removed tailings at their own expense. However, according to ERDA, Public Law 92-314 will have to be amended to allow for such reimbursement. In commenting on this report, ERDA officials told us that other problems need to be considered, such as the adequacy of authorized funds in view of inflation before submitting to the Congress recommendations for any legislative

changes to the program, including any change related to reimbursement for self-initiated remedial actions.

NEED TO DETERMINE WHETHER FURTHER ACTION SHOULD BE TAKEN TO PROTECT FUTURE PROPERTY OWNERS

As of May 1974, 290 property owners had applied under the program for remedial action. In June and August 1974, CDH sent reminder letters to those who had not yet applied urging them to apply for consideration under the program and explaining that early application would assist in effective planning for, and appropriate funding of, the program. CDH notified AEC in December 1974 that through November 1974 there had been a substantial increase in applications received from property owners who had been notified of possible eligibility for remedial action. In December 1974, CDH information showed that the owners of 136 properties on which recommendations of remedial action were made had not submitted applications to the program. Because of the voluntary nature of the program, it is not possible to determine how many of the property owners will apply by June 16, 1976, the last day that applications can be accepted under the program.

If these property owners do not apply and radiation assessments are not made at the remaining unsurveyed locations, the program will not fully meet its objective because all property locations where the exposure to radiation from uranium mill tailings should be limited may not be identified and remedial action may not be taken at all of the locations where the need for such action was identified.

CDH and ERDA cannot compel the property owners to cooperate in the accomplishment of the program objectives. However, attempts are being made through other programs to complete radiation assessments. For example, CDH officials told us that organizations involved with real estate transfers have been informed about the availability of the results of radiation assessments and have been asked to use this information in connection with property title searches.

In addition, local governments have attempted to get radiation assessments completed through their building permit programs. CDH officials told us that this is a collaborative effort among various government offices and that radiation surveys are being made before building permits are issued. However, in the past CDH found instances where radiation assessments were not being made under the building permit program because participation in it was voluntary. CDH has urged the local governments to make this program mandatory

and CDH officials told us that an ordinance is under consideration to require such surveys.

Conclusions

Because of the voluntary nature of the program, CDH and ERDA are having difficulty in completing radiation surveys at all property locations and in having owners of properties where the need for remedial action has been identified apply for such action. We believe that the actions taken by the local governments will help prevent further construction over tailings and preclude innocent buyers from purchasing property without knowing about the tailings. However, since these efforts are not currently mandatory, it is questionable whether they will be fully effective, particularly in view of the long-term nature of the tailings hazard.

We believe that, before the Remedial Action Program terminates, CDH and ERDA should evaluate the results of the program to determine the need for further actions to protect future property owners in the Grand Junction area. Such actions could include (1) further encouragement to the local government to formally structure and make mandatory the building permit and real estate transfer programs and (2) posting the official property records with the results of radiation assessments or a statement that radiation assessments have not been made.

Matter for consideration by the Congress

Because it is likely that certain objectives of the Remedial Action Program will not be fully met due to its voluntary nature, the Congress should have ERDA submit a report on the progress made and the extent to which program objectives will not be accomplished.

In commenting on this report, ERDA told us that, if the Congress so desires, it would provide a report on the progress made under the program and the extent to which it was not possible to meet program objectives.

CHAPTER 4

STATUS OF EFFORTS TO CONTROL AND STABILIZE URANIUM TAILINGS

Long-term monitoring and permanent control and stabilization of tailings piles is needed. Under the Nuclear Regulatory Commission's (NRC's) program for regulating users of radioactive material (before January 19, 1975, the regulatory program was administered by AEC's Director of Regulation), sufficient authority is available to regulate licensed uranium mills. However, when such licenses terminate, the regulatory agencies--NRC or State agencies operating under agreement with NRC to regulate users of radioactive material--no longer have regulatory authority unless additional authority is provided by the State. Some States have provided additional authority to require the continuing control and maintenance of tailings at mills which are no longer licensed.

A recent study of tailings control and stabilization programs at inactive uranium mills showed that the stabilization programs have not been effective and that long-term stabilization methods are needed. The ineffectiveness of existing stabilization methods highlights the importance of continuing regulatory authority and establishing arrangements for periodic inspection and long-term control to insure continuing integrity of tailings control and stabilization at uranium mills.

NEED FOR LONG-TERM MONITORING AND PERMANENT CONTROL AND STABILIZATION OF TAILINGS PILES

There are currently 14 mills processing uranium in the United States with a combined processing rate of about 21,500 tons of ore a day.

By the late 1970s, a rapid expansion of the uranium milling industry is expected and by 1990 NRC estimates that about 68 additional mills with a combined 170,000 tons a day ore capacity will be needed.

Nearly the entire mass of ore processed by the mills end up in the tailings piles. Unless tailings piles are effectively controlled and stabilized, radioactivity can be spread to the environment by wind and water erosion, ground water and soil contamination, and deliberate removal and unauthorized use of tailings material. When radioactivity from tailings is released into the environment, man can be internally and externally affected.

Tailings control and stabilization measures are intended to prevent such exposures. These measures generally include (1) restricting access, (2) isolating the tailings piles from sources of water, and (3) containing them by using suitable ground cover.

Regulation of uranium mills

Uranium mills are licensed by NRC or the States. Mills are licensed by NRC except where NRC and the States have entered into agreements under which the States assume regulatory responsibility for radioactive materials (agreement States).

Uranium tailings piles are located at 41 uranium mills in 10 States, as shown in the following table.

State	Active mills	Inactive mills
NRC licenses:		
South Dakota	1	-
Utah	2	4
Wyoming	7	2
Agreement States licenses:		
Arizona	-	2
Colorado	2	9
Idaho	-	1
New Mexico	3	3
Oregon	-	1
Texas	1	2
Washington	1	-
Total	17	24

Licenses have been terminated for 9 of the 24 inactive mills as follows: 1 in Colorado, 4 in Utah, 3 in New Mexico, and 1 in Wyoming.

Active mills, inactive licensed mills, and future mills operate or will operate under an NRC or agreement State license. NRC and the States exercise control over the operation of uranium mills through provisions in each license. The licensees' radiation control programs, which are described in their applications, are incorporated in their licenses. NRC and the States periodically inspect the mills to determine whether mill operators are complying with the terms of their licenses and applicable NRC and State regulations. Following license terminations, the regulatory agencies do not have authority to inspect and monitor the tailings piles to insure

that tailings control and stabilization measures taken do not deteriorate and cause a potential health hazard. However, six States, including four agreement States, have provided additional regulatory authority requiring tailings stabilization at mills which are no longer licensed.

Uranium mills licensed by NRC

NRC officials told us that under the National Environmental Policy act of 1969 (NEPA) (42 U.S.C. 4321) and the Code of Federal Regulations (10 CFR 51), NRC is required to prepare and issue an environmental impact statement when it issues a license to a new mill. For license renewals and terminations, NRC is required to review and evaluate the proposed action. If this environmental review shows that there will be little or no adverse environmental impact, an environmental impact statement does not have to be issued.

A NRC official told us that one of the principal goals of NRC's environmental reviews is to commit the licensee to stabilize the tailings and to establish satisfactory arrangements for their long-term monitoring and control. Before passage of NEPA, uranium mill licensees were not required to commit themselves to establishing long-term stabilization and control of tailings.

NRC's current procedures specify that the licensee must establish a tailings control program. For example, an inactive mill licensee requested termination of its license on June 18, 1974. NRC is requiring the licensee to establish procedures for tailings control and stabilization and for cleaning up and decontaminating the plant and equipment. NRC officials told us that they will inspect the site before terminating the license and will provide the State, for its review and comment, a copy of the draft environmental impact statement which will include information on the licensee's proposed control and stabilization program.

Recent licenses contain requirements for control and stabilization of tailings for 50 years. These licenses also prohibit the removal of tailings without approval. The 50-year period was selected because NRC believes that a more permanent solution to the tailings problem will be available by then.

NRC currently licenses uranium mills in Utah, Wyoming, and South Dakota--10 mills are currently operating in these States. Wyoming and South Dakota have their own regulations for stabilizing tailings piles; Utah has not promulgated such regulations. In commenting on this report, NRC officials

told us that the stabilization procedures for mills in Utah will be initiated as soon as the pile is in a condition to accept the stabilization and must be accomplished before the license is terminated by NRC. The long-term maintenance and monitoring aspects of tailings piles in Utah will go into effect upon notice from the State of Utah that the State will accept the responsibility for holding a surety bond and for overseeing the maintenance and monitoring of the tailings piles after NRC terminates the license.

Of the 10 operating mills, NRC has issued an environmental impact statement on a new mill in Wyoming and is currently conducting environmental reviews on 3 others--2 in Utah and 1 in Wyoming. The newly licensed mill on which an environmental impact statement has been issued must implement an environmental monitoring and tailings stabilization program. In addition, the licensee and successive owners are bound for a 50-year period by the Environmental Impact Statement to prevent the release of the tailings material to the surrounding area and to restrict the use of the tailings area for other purposes, such as not permitting structures to be built on the tailings piles. Furthermore, NRC officials told us that the licensee is posting a surety bond, as required by the Wyoming Open Cut Land Reclamation Law, to guarantee that funds will be available for reclamation.

For the three mills under environmental review:

--NRC decided that environmental impact statements were needed for two of the mills and draft environmental impact statements requiring the licensees to provide environmental monitoring and tailings stabilization have been issued. For one of these two mills, NRC officials told us that they have obtained a commitment from the licensee for a surety bond for long-term maintenance and monitoring and have asked the State of Utah to hold the bond and oversee the maintenance program after NRC terminates the license.

--An environmental impact statement for the other mill may not be required; however, the licensees' environmental report contains commitments for environmental monitoring and tailings stabilization.

The licenses for four of the remaining six mills will expire between November 1975 and March 1976. The licenses for the other two mills expired in 1973. However, since these two licensees filed applications for license renewal at least 30 days before expiration, they may continue to

operate the mills until NRC reviews their applications. NRC will begin to review these license renewals in May and July 1975.

Uranium mills licensed by agreement States

The seven agreement States contain 7 active mills and 18 inactive mills. Three of the States--Texas, New Mexico, and Washington--have general radioactive materials regulations, but no specific regulations for controlling and stabilizing tailings piles. The other four States--Colorado, Arizona, Idaho, and Oregon--have specific regulations for stabilizing tailings piles. The earliest tailings regulations were established by Colorado in 1966. An NRC official told us that the other States probably modeled their regulations after Colorado's regulations.

The specific regulations adopted by these States impose requirements on mill operators for maintaining and stabilizing tailings piles and prohibit transferring tailings without the approval of the State.

All seven agreement States with licensed mills have inspection programs to determine the mill operators' compliance with regulations and conditions of the licenses. Tailings control and stabilization procedures are generally a part of the applications for licenses and are made part of the licenses. Representatives of the agreement States told us that they require licensees to stabilize inactive tailings piles by covering with earth or other material, seeding for vegetation, and restricting access with fences and signs.

NRC is responsible for insuring that an agreement State's overall radioactive materials control program for materials covered by the agreement is adequate to protect public health and safety. However, NRC does not necessarily review detailed portions of State programs, such as uranium tailings control, because a State is not required to submit to NRC a detailed monitoring program to become an agreement State.

NRC annually reviews agreement States' programs. During the last 2 years, as a part of such reviews, uranium mill control programs in Colorado, Texas, and Washington were evaluated. An evaluation report, based on one such review of the Colorado program, noted that the mill license contained a description of the monitoring program to be used by the licensee.

Efforts to identify the extent of the tailings problem at inactive uranium mills

As a result of March 1974 hearings by the Joint Committee on Atomic Energy on proposed legislation (S. 2566 and H.R. 11378) to control and stabilize a uranium tailings pile location in Salt Lake City, AEC, EPA, and the various States involved undertook a two-phase study of 21 of the 24 inactive uranium mill sites in the United States. This study was to determine whether the tailings at these sites are properly controlled and stabilized and to identify the appropriate remedial actions for correcting potential public health problems.

The first phase of the study involved a review of records and a visit to each mill site to determine (1) the condition of the site, (2) the need for remedial action, (3) ownership of the property, (4) proximity to populated areas, and (5) prospects for increased population in the vicinity of the tailings. In October 1974, AEC summarized and issued to the Joint Committee on Atomic Energy a preliminary report on each site to be used in determining the need for detailed engineering assessments.

The second phase of the study will include (1) a detailed evaluation of the problem, (2) an examination of alternative solutions, (3) the preparation of cost estimates and plans for appropriate remedial action for each site, and (4) extensive radiation measurements to determine exposure or potential exposure to man. ERDA officials told us that a contractor would be selected in April 1975 to begin the second phase study with work on the Salt Lake City tailings pile which will take about 6 months to complete. The second phase will take about 2 years to complete and ERDA has estimated it will cost $1.4 million.

The first phase of the study showed that the conditions and degree of stabilization of the tailings piles varied greatly and that the tailings piles in Colorado were generally better stabilized than those in other States. However, the report said that improvements in control and stabilization were needed at all sites. Stabilization efforts previously believed to be adequate were found to have deteriorated so that tailings were no longer being effectively stabilized.

At one mill site chemical stabilizers used in 1968 did not have adequate long-term endurance and in May 1974 the tailings were found exposed to wind erosion. At another mill site tailings were stabilized in 1969 and 1970 with a minimum

6-inch covering of top soil, which was fertilized, seeded, and watered for 1 year to establish the root system. However, heavy rainfall in June 1973 eroded some of the cover material and caused other damage to the integrity of the stabilization program.

The report to the Joint Committee noted that the stabilization efforts to date are not a satisfactory answer to long-term control of tailings and recommended that research and development be undertaken to improve stabilization methods. The report also recognized that arrangements will have to be made for periodic inspection and long-term control to insure continuing integrity of tailings control and stabilization programs. Furthermore, the report noted that until such time as long-term control stabilization methods are developed there is a need to regulate and control land use in the vicinity of the tailings piles.

Status of stabilization efforts at selected uranium mills

We visited three uranium mills which held NRC licenses to observe their stabilization efforts. One of these mills was a newly licensed mill with a tailings control and stabilization program specifically provided for in its license. Another mill was active, although it was not currently processing uranium ore. The third mill was inactive and was not covered by the joint Federal-State study of inactive mills.

At the new mill the small quantity of tailings that had been created by mill operations were being adequately maintained to prevent erosion. We saw an area where the mill operator had dumped the material which had been removed to gain access to the uranium ore deposit. This area had been covered and vegetation was well established. The mill operator told us the tailings piles would be stabilized using similar covering and vegetation and that when one of the mines was exhausted the mine pit could be used for deposit of tailings.

At the active mill, which was not currently processing uranium ore, there were two tailings piles which had been or were being covered with soil or other materials and seeded. The vegetation was sparse. According to the mill operator, the sparse vegetation was due to a lack of rainfall. The need for possible reseeding has not yet been determined by the operator.

At the inactive mill we saw that coarse gravel and sand had been used to cover the tailings pile. Sparse vegetation

was visible. The mill operator told us this was due partly to a lack of rainfall and partly because these stabilization efforts had only begun in the fall of 1973.

Based on EPA information on this tailings pile, progress has been made in stabilization efforts. EPA officials who visited this mill shortly after our visit told us that the condition of the tailings pile was improved. However, EPA officials noted that the tailings pile is not yet in a long-term controlled condition. They noted that tailings need to be completely contained, ground water needs to be drained off, and vegetation needs to be well established.

CONCLUSIONS

Regulatory authority for NRC and agreement States for licensed uranium mills appears to be adequate. Within the next 2 years, NRC will have scheduled an environmental review of the tailings control and stabilization programs of all the mills it has licensed.

Efforts to establish effective control and stabilization of uranium tailings were underway at the three mills we visited. At two of the mills, which had large quantities of tailings (the inactive mill and the active mill not currently processing uranium ore), the mill operators were having greater difficulties in establishing their programs, but progress was being made.

The first phase report on inactive mills identified deficiencies in stabilization programs previously thought to be adequate and pointed out the need to improve the effectiveness of stabilization methods. The ineffectiveness of existing stabilization methods highlights the importance of continuing regulatory authority and establishing arrangements for periodic inspection and long-term control to insure continuing integrity of tailings control and stabilization programs.

Establishing arrangements to insure the continued integrity of stabilized tailings and to prevent their unauthorized use is the most important element in effective long-term control and stabilization of mill tailings. However, there is a lack of regulatory authority in some States to provide this assurance. NRC should determine the capability and willingness of public health authorities or other State agencies to assume responsibility for and adequately carry out programs for the long-term monitoring of tailings piles and for correcting any problems in tailings stabilization and control programs.

RECOMMENDATION TO THE CHAIRMAN, NRC

We recommend that NRC (1) assess the capability and willingness of public health authorities or other State agencies to assume responsibility for and to adequately carry out programs for the long-term monitoring of tailings piles and for correcting any problems in the tailings' stabilization and control programs and (2) determine whether additional Federal authority is needed to improve such programs.

In commenting on this report, ERDA and NRC agree that there is a need to establish responsibility for long-term monitoring and for correcting any problems in tailings stabilization and control programs. ERDA told us that it will investigate the means to accomplish this task in its second phase of the study of inactive uranium mills. NRC told us that it is in the process of attempting to identify agencies capable and willing to assume this responsibility in Wyoming and Utah. NRC also told us that methods of stabilization and long-term control of tailings piles should be based on the information and recommendations from the second phase of the study of inactive uranium mills and that until this study is completed NRC will continue to seek commitments from licensees for long-term maintenance and monitoring of tailings piles before license termination.

CHAPTER 5

SCOPE OF REVIEW

We examined the progress being made by CDH and ERDA in the Remedial Action Program. We gathered information on the historic development of the program; examined reports and documents; and discussed the program's funding history, results of radiation surveys, and methods of taking remedial action with program officials. We also discussed the program with EPA personnel and observed remedial actions in progress.

We also gathered information on the status of efforts for long-term control and stabilization of uranium tailings. We examined reports and documents; discussed such efforts with ERDA, NRC, EPA, and State officials; and observed tailings control programs at selected mills.

We performed our work at AEC Headquarters, Germantown, Maryland; AEC operations and CDH Offices in Grand Junction, Colorado; CDH Offices in Denver, Colorado; NRC Headquarters, Bethesda, Maryland; and selected uranium mills in South Dakota and Wyoming. We also discussed our findings with ERDA and NRC officials after these agencies were created on January 19, 1975.

SCHEDULE OF REMEDIAL ACTION ACTIVITIES (note a)

Work phase	Number of locations or purpose	Estimated cost
I	12 residences	$b/237,543
II	32 residences	477,773
III	1 school	44,775
IV	15 residences (sealant demonstration)	185,516
V	pneumatic conveyance demonstration	79,325
VI	tailings respository	13,400
VII	miscellaneous public information	13,100
VIII	instrument acquisition	12,250
IX	2 schools	822,429
X	35 residences	433,910
XI	dislocation cost	150,725
XII	32 residences	402,275
XIII	7 schools	207,161
XIV	25 residences	293,769
XV	30 residences	c/270,162
XVI	30 residences	350,532
XVII	30 residences	c/270,162
XVIII	30 residences	350,532
XIX	30 residences	c/270,162
XX	30 residences	350,532
XXI	30 residences	c/199,302
XXII	15 residences and 15 commercials	350,532
XXIII	30 residences	c/199,302
XXIV	15 residences and 15 commercials	207,552
XXV	20 residences and 10 commercials	207,552
XXVI	34 residences	235,225
Total		$6,715,498

a/ Based on program's projected commitments and actual costs as of May 15, 1974. CDH's decisions on the possible need for remedial action changes based on its evaluations. As of November 30, 1974, the owners of 522 structures had been notified by CDH that remedial action was recommended.

b/ Actual costs.

c/ Assumes use of sealants.

PRINCIPAL OFFICIALS OF ERDA AND NRC RESPONSIBLE FOR ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
ERDA		
ADMINISTRATOR, ENERGY RESEARCH AND DEVELOPMENT:		
Robert C. Seamans, Jr.	Jan. 1975	Present
ASSISTANT ADMINISTRATOR FOR ENVIRONMENT AND SAFETY:		
James L. Liverman (Deputy)	Jan. 1975	Present
DIVISION OF OPERATIONAL SAFETY:		
Martin B. Biles, Director	Jan. 1975	Present
NRC		
CHAIRMAN, NUCLEAR REGULATORY COMMISSION:		
William A. Anders	Jan. 1975	Present
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS:		
Kenneth R. Chapman, Director	Mar. 1975	Present
Howard J. Larson (acting Director)	Jan. 1975	Mar. 1975

PRINCIPAL OFFICIALS OF THE FORMER AEC RESPONSIBLE FOR ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
CHAIRMAN:		
Dixy Lee Ray	Feb. 1973	Jan. 1975
James R. Schlesinger	Aug. 1971	Feb. 1973
GENERAL MANAGER:		
John A. Erlewine	Jan. 1974	Jan. 1975
Robert E. Hollingsworth	Aug. 1964	Jan. 1974
ASSISTANT GENERAL MANAGER FOR BIOMEDICAL AND ENVIRONMENTAL RESEARCH AND SAFETY PROGRAMS:		
James L. Liverman	May 1973	Jan. 1975
DIRECTOR, DIVISION OF OPERATIONAL SAFETY:		
Martin B. Biles	Nov. 1966	Jan. 1975
DIRECTOR REGULATION:		
L. Manning Muntzing	Oct. 1971	Jan. 1975

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