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PROGRAMMATIC ENVIRONMENTAL REPORT
FOR
REMEDIAL ACTIONS AT UMTRA PROJECT VICINITY PROPERTIES

MARCH, 1985

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1.0 SUMMARY

This Environmental Report (ER) examines the environmental consequences of implementing a remedial action that would remove radioactive uranium mill tailings and associated contaminated materials from 394 vicinity properties near 14 inactive uranium processing sites included in the Uranium Mill Tailings Remedial Action (UMTRA) Project pursuant to Public Law 95-604, the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978.

Vicinity properties are those properties in the vicinity of the UMTRA Project inactive mill sites, either public or private, that are believed to be contaminated by residual radioactive material originating from one of the 14 inactive uranium processing sites, and which have been designated under Section 102(a)(1) of UMTRCA.

The principal hazard associated with the contaminated properties results from the production of radon, a radioactive decay product of the radium contained in the tailings. Radon, a radioactive gas, can diffuse through the contaminated material and be released into the atmosphere where it and its radioactive decay products may be inhaled by humans. A second radiation exposure pathway results from the emission of gamma radiation from uranium decay products contained in the tailings. Gamma radiation emitted from contaminated material delivers an external exposure to the whole body. If the concentration of radon and its decay products is high enough and the exposure time long enough, or if the exposure to direct gamma radiation is long enough, cancers (i.e., excess health effects) may develop in persons living and working at the vicinity properties.

The proposed action

The proposed remedial action, which is discussed in this ER, is the following:

- o Conduct a radiological and engineering assessment to define the extent of radioactive contamination at the 394 vicinity properties and to identify technical information necessary for the preparation of detailed designs for each remedial action.
- o Remove an estimated 39,400 cubic yards of contaminated material from the vicinity properties, and transport the contaminated material to the inactive uranium processing sites for temporary storage.
- o Restore the vicinity properties.

Comprehensive radiological surveys have not been completed for vicinity properties at all 14 of the UMTRA Project sites addressed in this ER. Estimated inclusion rates were developed for properties designated for further radiological evaluation based on radiological characteristics and inclusion/exclusion recommendations for the 262 properties previously surveyed by Oak Ridge National Laboratory (ORNL), the UMTRA Project Inclusion Survey Contractor (ISC).

The estimated inclusion rates were then applied based on the results of preliminary aerial and ground radiological surveys. Properties for which radiological data were not available were included on the basis of aggregate inclusion rates. These aggregate inclusion rates also were estimated based on the survey data noted above. The result is an estimated total of 394 properties that will be included and cleaned up (DOE, 1984a).

The proposed action consists of identification of the extent of contamination, followed by removal of contaminated material from each property. The remedial action program, depending on the type of contamination, would consist of excavating, wiping, chipping, cutting, brushing, and sandblasting material. Some demolition of structures, foundations, or parking lots may be required. The properties would be restored or other compensation provided following the remedial action. When warranted, Environmental Protection Agency (EPA) supplemental standards would be applied.

Environmental consequences of the proposed action

The primary impact of the proposed action would result from the radiological exposure to remedial action workers and the general public during remedial action. During the proposed action, workers would come in contact with contaminated materials. In one working year (2080 hours), each worker would experience a total excess dose equivalent of 0.26 rem and 0.56 working level months. During the worker's lifetime, this could increase the likelihood of developing cancer due to cleanup work by 8.7 chances in 100,000. Assuming a worker was exposed to these radiation levels for 50 years of his life, the chance of cancer due to radiation exposure during remedial action would be increased by approximately 2.9 percent.

Radiological impacts have been evaluated for the general public during and after the proposed action. These evaluations show that the radioactive material increases the chance that a resident at a typical vicinity property will develop cancer by about 36.8 chances in 100,000 for each year the resident lives there. During remedial action, the resident's exposure would remain approximately the same; if activity at the property lasts for one month, the exposure during the action would increase the resident's chances of developing cancer by about three chances in 100,000. After remedial action has been completed, the resident's chances of developing cancer from all causative sources would be about 15,000 chances in 100,000 for the resident's lifetime.

Radiological impacts resulting from an accident could increase the chances of public exposure to contaminated material. An accidental spill of contaminated material into the street during transport is the worst-case credible accident envisaged. Such an accident would take a few hours at most to clean up. No appreciable exposure to either the cleanup crew or the public would occur.

Approximately 19 non-fatal loss-of-work illnesses and injuries would occur during cleanup of the 394 vicinity properties, or an average of 1.3 injuries and illnesses at each of the 14 project areas. The probability of a transportation-related accident during the remedial action is one in 1000, and the probability of a transportation-related fatality is one in 10,000 for each of the 14 project areas. Transportation impacts would be similar to those caused by any construction activity in a residential or industrial neighborhood. Disturbance of local traffic patterns would be both minor and temporary.

Cleanup activities would cause a temporary increase in noise levels near the vicinity properties. The noises produced by the remedial action work would be typical of urban background noise. Public annoyance would be minimized by scheduling work during daytime hours.

During the excavation, loading, and hauling phases of the proposed action, vehicle emissions and fugitive dust emissions would occur. Mitigation measures (e.g., dust suppressants) would be employed as required. No appreciable increases in total suspended particulates for the area would occur, nor would there be any permanent air-quality impacts.

No adverse impacts to soils would be expected as the affected environment is primarily in developed areas where natural soil profiles have already been disturbed. Good quality topsoil would be used for reclamation where appropriate.

No adverse impacts on water quality would be expected to result from the proposed remedial action. The very small potential that now exists for migration of radionuclides from the vicinity properties to local water supplies would be eliminated by the removal of the tailings.

Impacts on plants and animals would be minimal. Losses of vegetation would be confined mainly to horticultural species. The disturbance would be of short duration, lasting until fill is replaced and revegetation is completed. Some birds and small mammals may be displaced during the actual work, but no long-term impacts are expected.

No historic or cultural resources are expected to be affected by the clean-up activities.

No long-term socioeconomic impacts are expected from the cleanup activities. Owners of some commercial establishments may have to be compensated for economic loss incurred during remedial action.

Upon completion of the remedial action, radiation exposure to individuals and the public as a whole would be permanently reduced to levels at or below those prescribed in the Environmental Protection Agency Health and Environmental Protection Standards for Uranium Mill Tailings (40 CFR Part 192). Other benefits would include reductions in unemployment for local construction industries in the areas affected by the remedial action program, and increased land values, in some cases, because of improvements to the properties cleaned up during the remedial action. Ensuring compliance with the National Environmental Policy Act (NEPA) for remedial action at vicinity properties at 14 UMTRA Project areas through the programmatic analyses presented in this report would allow the U.S. Department of Energy (DOE) flexibility in the scheduling of vicinity property remedial actions independent of actions at the uranium mill tailings sites, thereby resulting in an overall cost savings to the UMTRA Project.

2.0 INTRODUCTION

2.1 BACKGROUND

From the early 1940s through 1970, uranium ore from multiple sources in the United States was processed by private companies to sell uranium to the Manhattan Engineer District and the U.S. Atomic Energy Commission (AEC). As these uranium ore bodies were depleted and the demand for uranium oxide decreased, many of the mills were deactivated. Large quantities of processed ore residue, or tailings, from the milling operations were left behind. These uranium tailings still contain much of the radium available in the raw ore and are a source of low-level radiation.

Since uranium milling processes followed conventional metallurgical industry practices, these tailings were deposited either in ponds or stockpiles (depending upon the uranium extraction technique employed) adjacent to the mills, and were allowed to dry. Some of these dried piles were unprotected so that windblown losses of the solid residue occurred. Also, some piles were accessible to the public for withdrawal and, in some locations, the tailings were used as a sand substitute or backfill material in construction projects.

Later research on the health effects of all forms of low-level radiation exposure indicated that there is a potential health hazard associated with uranium mill tailings which was determined to be principally from the inhalation of Rn-222 and radon daughter products.

As radiological criteria for allowable dosages became more stringent, the Federal, state, and tribal governments became more concerned about the radiological hazards associated with the inactive uranium mill tailings sites; in particular, the possible exposures caused by the earlier direct transfer of tailings materials to properties with habitable structures in the vicinity of these abandoned processing sites. These properties included residences, schools, hotels, hospitals, and commercial buildings, and are referred to as "vicinity properties."

On November 8, 1978, Public Law 95-604, the Uranium Mill Tailings Radiation Control Act of 1978, was passed. This act authorized the DOE to perform remedial actions at 22 inactive uranium mill tailings sites and at each site's associated vicinity properties.

Since 1970, aerial and ground radiological surveys have been conducted by DOE to identify those areas around tailings piles which could possibly be contaminated. These surveys indicated that 626 properties with anomalous radioactive characteristics exist in the vicinity of the 14 abandoned mill tailings sites examined in this ER (DOE, 1984b). These properties have been designated for further radiological evaluation.

Vicinity property "inclusion" is the process by which residual radioactive contamination suspected to originate from the inactive processing site in excess of levels provided in the EPA standards is identified and the property is declared eligible for remedial action.

Properties which do not exceed the standard are excluded from remedial action. The Inclusion Survey Contractor will perform inclusion surveys at the 626 vicinity properties designated for further radiological evaluation and develop reports which document survey results. These surveys will consist of radiological survey measurements and analyses performed for designated properties to provide data for the inclusion process.

A summary of the inclusion procedure and an estimate of the number of vicinity properties to be included for remedial action, by property category and site, are presented in Appendix A.

2.2 PURPOSE OF THIS REPORT

This ER examines the environmental consequences of implementing a remedial action that would remove radioactive uranium mill tailings from vicinity properties associated with 14 of the 22 inactive uranium processing sites included in the UMTRA Project pursuant to UMTRCA. The environmental impacts resulting from planned remedial actions at vicinity properties associated with five of the 22 (Canonsburg, Pennsylvania; Salt Lake City, Utah; Shiprock, New Mexico; and Grand Junction and Durango, Colorado) sites have been or are being examined in other reports in compliance with NEPA. Three of the 22 sites do not have any contaminated properties designated for remedial action at this time. Inclusion of specific properties at these sites is not expected; however, should any properties be identified for inclusion during future radiological surveys, the impacts associated with cleanup of these properties would be similar to the impacts addressed in this document for vicinity properties at the 14 other UMTRA Project sites.

This document has been prepared to evaluate planned remedial actions at vicinity properties near the following UMTRA Project sites:

Belfield, North Dakota
Bowman, North Dakota
Falls City, Texas
Green River, Utah
Gunnison, Colorado
Lakeview, Oregon
Lowman, Idaho

Mexican Hat, Utah
Naturita, Colorado
Rifle, Colorado
Riverton, Wyoming
Slick Rock, Colorado
Spook, Wyoming
Tuba City, Arizona

A total of 394 individual properties have been estimated for inclusion in the UMTRA Project vicinity properties program at the 14 sites listed above. Comprehensive radiological surveys have not been completed for vicinity properties at all 14 sites. Consequently, the exact volume of materials and levels of contamination are not known.

A programmatic approach to the evaluation of the environmental consequences of conducting remedial actions at the vicinity properties is considered in this document. The remedial actions considered would be removal and decontamination, application of supplemental standards, and in-place controls at the vicinity properties rather than remedial actions for site-specific vicinity properties. Each remedial action would involve

consolidation of contaminated material from vicinity properties to the nearby inactive mill tailings pile. Environmental impacts associated with remedial actions at the inactive processing sites and windblown acreage will be addressed in site-specific NEPA documents.

Methods for deriving estimates of impacts used in this report were selected to present a conservative approach to impact analysis. Assumptions required for calculation of impacts were developed to be representative of remedial action at a site requiring a greater than average commitment of resources. As a result, the impacts presented in this ER represent a reasonable upper limit for the impacts that are likely to occur.

Specific objectives of this ER are as follows:

- o To provide a technical basis for determining if further evaluation is required for compliance with NEPA.
- o To discuss pre- and post-project conditions.
- o To present alternatives for disposing of off-site tailings in an environmentally acceptable manner.
- o To describe how EPA standards would be met.

3.0 THE PROPOSED ACTION

3.1 NEED FOR THE ACTION

Tailings piles deposited during milling operations at uranium processing sites located in the western United States have been left largely unprotected since deactivation of the mills. Small amounts of tailings from the piles were used as fill and construction material at locations near the processing sites at a time when the potential health hazards of uranium mill tailings were unrecognized.

The tailings at the vicinity properties emit radon gas at low concentrations and at low levels of alpha and gamma radiation. Radon gas is of particular concern because its concentration can build up in enclosed structures and may cause cancer if the exposure time is of sufficient duration and concentrations are high enough.

UMTRCA authorizes the DOE to determine which properties require cleanup and to perform the cleanup activities in accordance with the EPA standards (40 CFR Part 192). The EPA standards are presented in Table 3.1.

3.2 THE PROPOSED ACTION: REMOVAL AND DECONTAMINATION

Prior to commencement of remedial action activities, DOE would execute a Remedial Action Agreement (RAA) with the owner of the affected property. An RAA is a legal agreement that is entered into by the DOE, the state or tribe, and the owner of an included property. The agreement outlines the intent of UMTRCA and contains provisions for execution of remedial actions. The DOE would perform the work at each residence only in full cooperation with the owners/tenants.

The proposed remedial action for cleanup of vicinity properties would be accomplished as follows:

Radiological and Engineering Assessment (REA)

Properties which have been included for remedial action would be assessed from a radiological and engineering viewpoint so that the extent of contamination and cost of remedial action would be adequately addressed prior to initiation of remedial action.

A team of health physicists would conduct an on-site radiological assessment to define the areal extent and depth of any tailings material which exceeds the EPA cleanup standards (40 CFR Part 192.12). The radiological assessment may involve any of the following survey activities:

- o Gamma-ray scanning of the property both outdoors and within buildings.
- o Gamma-ray logging of areas selected on the basis of the gamma-ray scanning or in otherwise suspected areas of fill, particularly

Table 3.1 EPA Standards

Part 192 - Health and Environmental Protection Standards for Uranium Mill Tailings

SUBPART B - Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites

192.12 Standards

Remedial actions shall be conducted so as to provide reasonable assurance that, as a result of residual radioactive materials from any designated processing site:

- (a) The concentration of radium-226 in land averaged over any area of 100 square meters shall not exceed the background level by more than -
 - (1) 5 pCi/g, averaged over the first 15 cm of soil below the surface, and
 - (2) 15 pCi/g, averaged over 15 cm thick layers of soil more than 15 cm below the surface.
- (b) In any occupied or habitable building -
 - (1) The objective of remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL. In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL, and
 - (2) The level of gamma radiation shall not exceed the background level by more than 20 microroentgens per hour.

SUBPART C - Implementation (condensed)

192.20 Guidance for Implementation

Remedial action will be performed with the "concurrence of the Nuclear Regulatory Commission (NRC) and the full participation of any state that pays part of the cost" and in consultation as appropriate with other government agencies (including tribal nations).

192.21 Criteria for Applying Supplemental Standards

The implementing agencies may (and in the case of Subsection (f) shall) apply standards under Subsection 192.22 in lieu of the standards of Subparts A and B if they determine that any of the following circumstances exists:

- (a) Remedial actions required to satisfy Subparts A or B would pose a clear and present risk of injury to workers or to members of the public, notwithstanding reasonable measures to avoid or reduce risk.

Table 3.1 EPA Standards (Continued)

Part 192 - Health and Environmental Protection Standards for Uranium Mill Tailings

192.21 (Continued)

- (b) Remedial actions to satisfy the cleanup standards for land, Subsection 192.12(a), or the acquisition of minimum materials required for control to satisfy Subsection 1292.02(b), would, notwithstanding reasonable measures to limit damage, directly produce environmental harm that is clearly excessive compared to the health benefits to persons living on or near the site, now or in the future. A clear excess of environmental harm is harm that is long-term, manifest, and grossly disproportionate to health benefits that may reasonably be anticipated.
- (c) The estimated cost of remedial action to satisfy Subsection 192.12(a) at a "vicinity" site (described under Section 101(6)(B) of the Act) is unreasonably high relative to the long-term benefits, and the residual radioactive materials do not pose a clear present or future hazard. The likelihood that buildings will be erected or that people will spend long periods of time at such a vicinity site should be considered in evaluating this hazard. Remedial action will generally not be necessary where residual radioactive materials have been placed semi-permanently in a location where site-specific factors limit their hazard and from which they are costly or difficult to remove, or where only minor quantities of residual radioactive materials are involved. Examples are residual radioactive materials under hard surface public roads and sidewalks, around public sewer lines, or in fence post foundations. Supplemental standards should not be applied at such sites, however, if individuals are likely to be exposed for long periods of time to radiation from such materials at levels above those that would prevail under Subsection 192.12(a).
- (d) The cost of a remedial action for cleanup of a building under Subsection 192.12(b) is clearly unreasonably high relative to the benefits. Factors that should be included in this judgement are the anticipated period of occupancy, the incremental radiation level that would be affected by the remedial action, the residual useful lifetime of the building, the potential for future construction at the site, and the applicability of less costly remedial methods than removal of residual radioactive materials.
- (e) There is no known remedial action.
- (f) Radionuclides other than radium-226 and its decay products are present in sufficient quantity and concentration to constitute a significant radiation hazard from residual radioactive materials.

Table 3.1 EPA Standards (Concluded)

Part 192 - Health and Environmental Protection Standards for Uranium Mill Tailings

192.22 Supplemental Standards

Federal agencies implementing Subparts A and B may in lieu thereof proceed pursuant to this section with respect to generic or individual situations meeting the eligibility requirements of Subsection 192.21.

- (a) When one or more of the criteria of Subsection 192.21(a) through (e) applies, the implementing agencies shall select and perform remedial actions that come as close to meeting the otherwise applicable standard as is reasonable under the circumstances.
- (b) When Subsection 192.21(f) applies, remedial actions shall, in addition to satisfying the standards of Subparts A and B, reduce other radioactivity to levels that are as low as reasonably achievable.
- (c) The implementing agencies may make general determinations concerning remedial actions under this Section that will apply to all locations with specified characteristics, or they may make a determination for a specific location. When remedial actions are proposed under this Section for a specific location, the Department of Energy shall inform any private owners and occupants of the affected location and solicit their comments. The Department of Energy shall provide any such comments to the other implementing agencies. The Department of Energy shall also periodically inform the Environmental Protection Agency of both general and individual determinations under the provisions of this section.

192.23 Effective Date
Subparts A, B and C shall be effective March 7, 1983.

Ref. EPA, 1983.

along building foundations and in open land areas where above-background gamma levels are detected.

- o Soil sample analysis for Ra-226.
- o Radon-daughter concentration measurements within occupied or habitable buildings.

The Remedial Action Contractor (RAC) would then perform an engineering assessment to identify technical and engineering considerations at specific vicinity property sites for use as a basis for detailed design of remedial action. A detailed description of existing conditions at each site would be developed to ensure accuracy of restoration activities.

Tailings removal

An estimated 39,400 cubic yards of tailings and other contaminated material from 394 vicinity properties would be removed and transported to the appropriate existing tailings pile for temporary storage.

Removal techniques that may be implemented include excavating, chipping, cutting, brushing, and sandblasting, depending on the type of contamination. Demolition may involve only part of a foundation or parking area. Commercial as well as residential structures would be affected. Backhoes and shovels may be used to excavate contaminated soils and related materials.

During remedial action at each property, the contaminated material would be placed in covered dump trucks and transported to the processing site at least once a day. No trucks containing contaminated material would be left on the streets overnight.

Vicinity properties restoration

After the contaminated material has been removed from a property, the area would be monitored to ascertain whether the EPA standards have been met. Then, replacement materials such as wood, concrete, and soils would be brought to the property, as required. Uncontaminated material would be used to restore each property to the condition it had immediately before cleanup.

Restoration would be accomplished using the following techniques:

- o Reclaiming excavated areas by backfilling with uncontaminated fill or good quality topsoil, as required.
- o Recontouring and revegetating backfilled areas.
- o Reconstructing affected structures using building materials compatible with existing materials.

Final radiation measurements taken following restoration would be evaluated, and the property would be certified as meeting the EPA standards.

Details of these actions are discussed in the following paragraphs.

All of the individual remedial actions would require hauling of contaminated material and uncontaminated fill on public roads. Assuming that each property has 100 cubic yards of contaminated materials, an estimated 39,400 cubic yards of contaminated soils, tailings, rubble, and structural materials would be removed from properties. All of this material would be relocated to the appropriate existing tailings pile at the processing site and an equal amount of uncontaminated fill would be brought in from nearby existing sources to replace the material excavated. The average distance between the contaminated sites and the tailings piles is assumed to be three miles; uncontaminated fill is assumed to be available within three miles of the vicinity properties. Assuming trucks with a 10-cubic-yard capacity would be used, the remedial actions would require a total of about 3,940 loads to move the contaminated tailings and another 3,940 loads to bring in the uncontaminated fill.

Where properties are located in groups, construction workers would attempt to decontaminate all properties in a particular neighborhood before proceeding to the next group. Construction and engineering activities would be sequenced so that remedial action could be accomplished in a manner which allows efficient use of equipment and personnel.

For purposes of this document, it was assumed that each of the 394 properties would require four weeks for cleanup, and that an average of four workers would be employed full-time during this period. Thus, about 120 man years of labor would be required. Costs of cleanup of the vicinity properties are estimated to be \$9,112,000, exclusive of allowances for engineering and management costs, and contingencies. Based on a total of 394 individual properties, the average cost per site is \$23,100 (DOE, 1984b).

4.0 ALTERNATIVES TO THE PROPOSED ACTION

4.1 ALTERNATIVE 1: NO ACTION

If the vicinity properties are not decontaminated, the result would be a continuation of the existing radiation conditions and health hazard. These conditions slightly increase the chance that a person living at a vicinity property will die of cancer. Expressed numerically, the increase is about 36.8 chances in 100,000 per year of exposure (see Section 6.1.1); during a person's lifetime, the normal chance of dying of cancer is more than 15,000 chances in 100,000.

The selection of the no-action alternative would not be consistent with the intent of Congress in UMTRCA and would not result in DOE's compliance with the EPA standards. Thus, "no action" would become an option only if the law is amended by Congress, if the owners/tenants of the properties do not give the consent necessary to permit the cleanup, or if Congress fails to appropriate monies for cleanup. The no-action alternative is discussed here only as a basis for comparison with the other alternatives.

4.2 ALTERNATIVE 2: IN-PLACE RADIATION CONTROL

Under this alternative, the contaminated material would remain in place at each vicinity property, and protective barriers would be installed to decrease gamma radiation and to prevent or minimize the emanation of Rn-222 to living spaces. The ventilation in the buildings could be increased or the walls and floors could be sealed to prevent Rn-222 from concentrating indoors.

This alternative is not preferred because:

- o It is more expensive over the long-term than the proposed action.
- o It requires continual inspection and maintenance to ensure that the controls remain effective.
- o It does not guarantee that exposure would be permanently reduced below the EPA standards.
- o It may contribute to continuing concerns by property owners and the general public in regard to radiological hazards.

4.3 ALTERNATIVE 3: APPLICATION OF SUPPLEMENTAL STANDARDS

The application of supplemental standards is permitted by 40 CFR Part 192.22 for situations where application of the control or cleanup standards would: 1) pose a clear and present risk of injury to workers or the public notwithstanding reasonable measures to limit damage; 2) directly

produce environmental harm that is clearly excessive compared to the health benefits to persons living on or near the site, now or in the future; 3) result in an estimated cost of remedial action which is unreasonably high relative to the long-term benefits, and the remedial radioactive materials do not pose a clear, present, or future hazard; or 4) result in an unreasonably high cost of cleaning up a building relative to the benefits. In addition, supplemental standards may be applied where there is no known remedial action.

Supplemental standards may be applied where certain uses or placements of tailings have not resulted in an adverse impact on the occupants of the properties nor is it anticipated that these tailings will create health or environmental problems in the future. Situations that may warrant the consideration of a supplemental standard include locations where:

- o Tailings have been placed around water, gas, or sewer lines under public thoroughfares or easements.
- o Tailings have been used as a constituent in concrete or asphalt.
- o Tailings have been used as a foundation base for public statues or monuments.
- o Tailings have been used as a base for hard-surface public roads or railroad berms.
- o Tailings have been placed in acceptable waste repositories.
- o Tailings exist in cemeteries.

Use of supplemental standards would be anticipated only in exceptional circumstances. This alternative is not preferred because residual radioactivity levels would be reduced only to levels that are as low as reasonably achievable and may not be permanently reduced below the EPA standards. This could contribute to continuing concerns by property owners and the general public regarding radiological hazards.

5.0 AFFECTED ENVIRONMENT

Those aspects of the environment that would be affected by the vicinity property remedial action are described in the following subsections.

5.1 LAND USE

The types of properties that would be affected by the proposed action include homes, businesses, and open lands in the vicinity of an inactive mill site. Building lots (residential and commercial) may range from small lots of approximately 5,000 square feet to several acres in size. However, a typical lot measures approximately 100x100 feet (0.25 acre). A private residence or commercial building exists on most identified properties. Preliminary radiological surveys indicate there are contaminated structures on 47 properties. Of the 394 vicinity properties, 276 are classified as residential, 69 are commercial properties, and 49 are open lands.

The existence of the tailings piles and potential contamination of properties has had relatively little impact on land use or values. However, following decontamination, property values may increase principally because of improvements during restoration. Most of the potentially contaminated businesses show little impact from the presence of the tailings. DOE property value assessments do not devalue properties due to tailings contamination.

5.2 SOCIOECONOMICS

Generally, the communities evaluated in this ER that would be affected by the proposed action are relatively small, and are not near major metropolitan areas. Populations range from 3,192 in 1980 at San Miguel County, Colorado (U.S. Bureau of Census, 1980), to 41,071 in 1983 at Fremont County, Wyoming (DOE, 1984c). Total work force ranges from very low at Slick Rock, Colorado in 1976 (FBDU, 1979), to 13,300 in Fremont County in 1982 (DOE, 1984c). Unemployment varies up to 11 percent in Fremont County, Wyoming during 1982 (DOE, 1984c), with some areas reporting seasonal fluctuations in unemployment reflecting dependence on tourism, agriculture, mining, logging, construction, and other seasonal occupations. In some areas, community services were developed in the 1970's in response to growth projections in the energy industry. Many areas are now experiencing a decline in population and employment as a result of the current recession in the energy industry.

5.3 ECOSYSTEMS

Most of the affected properties occupy developed areas. The affected environment for these sites includes lawns, driveways, small private gardens, parking lots, and other open areas. Thus, the natural environment has been altered during the settlement of the area. An urban or suburban ecosystem has developed, signified by the lack of native species of plants

and animals and the presence of horticultural species. Vicinity properties classified as open land may provide habitat for small mammals and songbirds.

A small number of vicinity properties exist near inactive mills in remote areas. The affected environment at these locations is open rangeland that may support plants and animals native to the region.

5.4 CULTURAL AND HISTORIC RESOURCES

At this time, there are no known vicinity properties which are eligible for inclusion on the National Register of Historic Places (NRHP). Although historic surveys of the vicinity properties have not yet been performed, most of the properties are less than 50 years old and therefore are not eligible for inclusion in the NRHP. Should properties greater than 50 years old be identified, the DOE will consult with the affected state as required by National Historic Preservation legislation.

5.5 RADIOLOGICAL ENVIRONMENT

Based on aerial and ground radiological surveys conducted for the DOE, elevated radioactivity levels are known to be present at the 394 vicinity properties. The results of the radiological surveys suggest that the radioactive contamination in and around structures consists of uranium mill tailings and uranium ore.

The EPA standards require that the concentration of tailings in contaminated soils be no greater than 5 picocuries of Ra-226 per gram of soil in the 15-centimeter surface layer, and 15 picocuries of Ra-226 per gram of soil in any 15-centimeter layer below the surface layer. Typical background concentrations of Ra-226 in soil may be as low as 1.5 picocuries per gram of soil, whereas uranium mill tailings may contain Ra-226 concentrations as high as 1000 picocuries per gram (EPA, 1982).

Soils with radium concentrations of 5 picocuries per gram deposited over a very large area have been determined to result in a gamma radiation level of 80 millirem per year which is in the range of natural background. Areas adjacent to tailings piles and areas contaminated with tailings may exhibit gamma radiation levels as high as 500 millirem or more, and levels from 100 to 200 millirem per year are common (EPA, 1982). This may be compared with field measurements taken on top of tailings piles ranging from 4000 to 8000 millirem per year.

At the vicinity properties with contaminated structures, the primary concern is the indoor Rn-222 concentration. Since radiological assessments have not been completed at these properties, indoor Rn-222 concentrations monitored at vicinity properties at Edgemont, South Dakota, are used to represent the levels that are expected at these properties. Indoor Rn-222 concentrations at the Edgemont vicinity properties ranged from 0.001 to 0.901 working level (WL). As stated in the EPA standards, the objective of the remedial action is to achieve an annual average radon decay product concentration (including background) not to exceed 0.02 WL.

5.6 NOISE

Most cleanup activities would occur in developed areas that have moderately high daytime noise levels from traffic, construction, and other activities. Background noise levels have not been measured for each property. Typical daytime noise levels for light industrial areas, commercial areas with traffic, and residential areas are 40 to 56 decibels, 60 to 65 decibels, and 43 to 47 decibels, respectively (DOE, 1982a).

5.7 AIR QUALITY

Ambient air quality in the areas that would be affected by the proposed action is generally good. None of the project areas are near heavily industrialized major metropolitan areas.

5.8 TRANSPORTATION

Most vicinity properties exist in developed areas, and are accessible by paved public highways and city streets. Transportation networks between the vicinity properties and the inactive processing sites are well developed in most project areas, allowing designation of a primary transportation route and an alternate route. Where vicinity properties exist in remote areas, designation of an alternate route would not be required as disruption of traffic patterns would not be expected.

6.0 ENVIRONMENTAL CONSEQUENCES DURING REMEDIAL ACTION

6.1 RADIOLOGICAL IMPACTS

There are five principal radiological pathways by which individuals could be exposed during the remedial action. These are: 1) inhalation of radon and radon daughters; 2) direct exposure to gamma radiation emitted; 3) inhalation and ingestion of airborne radioactive particulates; 4) ingestion of ground and surface water contaminated with radioactive materials; and 5) ingestion of contaminated foods produced in areas contaminated by tailings. For the calculation of health effects, only those pathways which would result in the largest radiological doses were considered: inhalation of radon and radon daughters and direct exposure to gamma radiation. Exposures via the other three pathways would be much smaller (several orders of magnitude) than the doses from radon daughter inhalation and exposure to direct gamma radiation, and, thus, are not addressed in this document.

Radon is an inert (i.e., does not react chemically with other elements) gas produced from the radioactive decay of Ra-226 in the U-238 decay series. As a gas, radon can diffuse through the soil and into the atmosphere where it is dispersed by atmospheric winds. In the atmosphere, radon decays into its solid daughter products which attach to airborne dust particles and may be inhaled by humans. These dust particles, with the radon daughter products attached, may adhere to the lining of the lungs and decay, with the release of alpha radiation directly to the lungs.

Gamma radiation is also emitted by many members of the U-238 decay series. Gamma radiation behaves independently of atmospheric conditions and travels in a straight line until it impacts with matter. Gamma radiation emitted from the tailings may deliver an external exposure to the whole body.

In terms of direct gamma radiation, members of the general population, as well as survey and construction workers, may be exposed to elevated levels. During removal and replacement of the contaminated materials, slightly elevated levels of Rn-222 and its decay products may be generated in the work area, resulting in a potential increase in worker exposures due to inhalation.

6.1.1 Radiation doses and health effects during remedial action

Radiological assessments have not yet been performed at most of the vicinity properties identified by aerial and ground radiological surveys. Therefore, radiological measurements reported for Grand Junction, Colorado; Salt Lake City, Utah; Edgemont, South Dakota; and Durango, Colorado, are used to estimate the radiation doses that give an upper limit to the impacts of the complete remedial action.

The work called for in the proposed action would be similar to ordinary construction work and would consist of soil removal, decontamination of surfaces, and possibly the demolition of sidewalks and other structures. These activities may cause a small, temporary increase in radioactivity levels as contaminated material is brought to the surface.

The storage of material from the vicinity properties at the mill sites would not appreciably increase the impacts of the radiation already being emitted from those sites. The radioactivity per unit volume of the vicinity property material would, in most cases, be lower than that of the material at the storage site.

For calculations of health effects, a risk estimator of 100×10^{-6} deaths per working level month (WLM) per person is used for the radon daughter concentration (RDC) exposure, and 120×10^{-6} deaths per person rem is used for external gamma radiation exposure (Evans et al., 1981). This is a conservative assumption for public exposure since individual properties will take less than a year to clean up (generally three to four weeks). A high outside gamma radiation level was estimated by calculating the mean high outside gamma exposure rate for 659 vicinity properties at four western sites. An average mean indoor RDC value was estimated by calculating the RDC for 366 vicinity properties at four western sites.

After subtracting the background external gamma of 12 micro-roentgens per hour (uR/hr), estimates of the exposures that the general public and cleanup workers could experience during the cleanup period were 124 uR/hr of external gamma radiation outdoors and 0.046 working levels (WL) of radon daughters.

The outdoor gamma radiation level was used to calculate an upper limit of cancer risk increase. In one year, each member of the local population living on the vicinity properties undergoing cleanup would have experienced a total excess dose equivalent of 1.09 rem and 2.37 WLMs. These dose estimates are very conservative because they assume that members of the local public will stay on the property 24 hours every day.

This could result in an excess of approximately 13.1 chances in 100,000 of a person developing cancer due to external gamma radiation exposure and 23.7 chances in 100,000 of a person developing cancer due to inhalation of radon-daughter products.

The cleanup workers would be exposed to the same estimated radiation levels as the local public for a working year of 2080 hours. Thus, in one working year, each worker would have experienced a total excess dose equivalent of 0.26 rem and 0.56 working level months. During the worker's lifetime, this could result in approximately 3.1 chances in 100,000 of developing cancer due to external gamma radiation exposure, and 5.6 chances in 100,000 of developing cancer due to inhalation of radon daughter products. Thus, for each year worked on the project, a worker would increase

the likelihood of developing cancer due to cleanup work by 8.7 chances in 100,000. A summary of the estimates of excess radiation doses and health effects per person per year of exposure is presented in Table 6.1. The probability of dying from cancer from any cause during a person's lifetime has been estimated by the National Cancer Institute as more than 15,000 chances in 100,000 (DOE, 1982b). Thus, the chance of contracting cancer due to radiation exposure to a worker during remedial action would be increased by approximately 2.9 percent assuming the worker was exposed to these radiation levels for 50 years of his life.

The driver of a truck hauling material would acquire a much smaller dose equivalent than 0.01 rem. Because the dose rate at one meter from a truckload of contaminated material is about 0.00002 rem per hour, the driver would receive less than 0.000003 rem during each three-mile trip (DOE, 1982b).

The proposed cleanup activities would reduce the average radiation exposure at each vicinity property to meet EPA standards. The EPA standards do not allow indoor gamma-radiation levels to exceed the background level by more than 20 microroentgens per hour. Indoor radon-decay products shall not exceed 0.03 WL, and to the extent practical, the concentration of radon daughters in a building should not exceed 0.02 WL. EPA's action level for gamma radiation (20 microroentgen per hour above background) would allow gamma radiation doses from the tailings of about 130 mrad per year. This is about twice the average annual outdoor background dose from gamma rays in the western United States (EPA, 1980). The EPA (1983) estimates that each increase of 0.02 WL inside a house increases the risk of lung cancer to each of its inhabitants by approximately 0.5 to 1.0 in 100, for an assumed lifetime residency.

6.1.2 Radiation doses and health effects from hypothetical accidents

The worst-case credible accident, which has a probability of one in 2000 of happening during the vicinity properties cleanup activities, would occur if a truck carrying contaminated materials overturned and spilled its load into the street (DOT, 1977). This type of accident could expose nearby people to low levels of gamma radiation, radon gas, and radon daughter products associated with those materials for a short time. This exposure rate, however, would not exceed that delivered to local residents during the cleanup activities themselves, because simple steps, taken immediately, would effectively reduce the exposure. Ribbons, flags, and radiation signs would be used at the accident scene to warn people. The cleanup crew would stop their activities, go to the accident scene, and reload the spilled material. The final cleanup would consist of sweeping, and possibly vacuuming any residue, with guidance from a safety team that would locate contaminated materials with their instruments. If the accident occurred during rainy weather, the cleanup work would probably be more difficult

Table 6.1 Estimated excess radiation doses and estimated excess health effects per person per year of exposure for the residents and the cleanup workers

	During cleanup	
	Local residents	Workers
Radon-daughter-product concentration (working levels)	0.046	0.046
Exposure to radon daughters (hours per year)	8,760	2,080
Exposure to radon daughters (working-level months)	2.37	0.56
Chance of an excess case of lung cancer per person per year of exposure to radon daughters	23.7/100,000	5.6/100,000
External-gamma-dose rate above background (microroentgens per hour)	124	124
Exposure to gamma radiation (hours per person per year)	8,760	2,080
Exposure to gamma radiation (rem per person per year)	1.09	0.26
Chance of an excess case of cancer per person per year of exposure to gamma radiation	13.1/100,000	3.1/100,000
Total chance of an excess health effect per person per year of exposure	36.8/100,000	8.7/100,000

because the contaminated material might be washed away by runoff. The cleanup procedure would be the same, however, and the risk of public exposure would be minor.

This type of accident would take a few hours, at most, to clean up. There would be no appreciable exposure to the cleanup crew or to the public. A person standing one meter from the spill for 15 minutes would receive a dose of 0.000005 rem. Workers who clean up the spill would be irradiated at roughly 0.00002 rem per hour; in a 2.5-hour cleanup, a worker's total dose would be 0.00005 rem (DOE, 1982b).

6.2 NONRADIOLOGICAL IMPACTS

6.2.1 Air quality

Air emissions have been estimated for activities associated with the cleanup and restoration of a "typical" vicinity property. Emphasis has been placed on vehicular emissions from heavy-duty diesel trucks used to haul materials, automobiles used by the workers, and scrapers used to load and unload the material. Fugitive dust emissions have not been addressed since the acreage disturbed would be relatively small (estimated to average 0.25 acres per property) and most of the material would have a fairly high moisture content.

Emissions factors have been developed using the assumptions for vehicle use presented in Appendix A, Vicinity Properties Overview.

Table 6.2 presents the emission factors used in the calculations and Table 6.3 presents the total emissions associated with the cleanup and restoration of a typical vicinity property. In general, the largest combined emission sources would be the automobiles used by the workers. However, automobile emissions would occur over a relatively wide geographic area (e.g., along an assumed 10-mile commute route). These automobile emissions also would occur over a fairly long time span (four weeks). Total pollutant emission from the other two emission sources, heavy-duty diesel trucks and scrapers, would be geographically distributed; pollutants from scrapers would be emitted at the vicinity property location and the borrow site, and truck emissions would be distributed over the assumed three-mile haul route corridor.

As shown in Table 6.3, a total of 195.3 pounds of vehicular emissions would result from activities associated with remedial action at a typical vicinity property. For remedial actions at 394 vicinity properties, a total of 5082.6 pounds of hydrocarbons (HC), 19298.0 pounds of nitrogen oxides (NO_x), 275.8 of sulfur oxides (SO_x), 62,094.4 pounds of carbon monoxide (CO), and 197.0 pounds of total suspended particulates (TSP) would be emitted from vehicles. These emissions would be distributed geographically and temporally, and would not cause any permanent air quality impacts.

Table 6.2 Emission factors associated with vicinity property remedial action

Vehicle type	Units	Emission factor				
		HC	NO _x	SO _x	CO	TSP
Light-duty auto ^a	grams/mile	3.06	2.65	neg	42.12	neg
Heavy-duty diesel truck ^a	grams/mile	4.50	19.90	neg	27.00	neg
Scraper	pounds/1000 gal	42.20	374.00	31.10	78.00	22.20

^aRef. EPA, 1978.

^bRef. EPA, 1975.

neg = Indicates a negligible level of emissions.

Table 6.3 Emissions associated with remedial action at a typical vicinity property

Source	Emissions ^a (pounds)				
	HC	No _x	SO _x	CO	TSP
Light-duty autos ^b	10.7	9.3	neg	148.6	neg
Heavy-duty diesel trucks ^c	1.2	5.3	neg	7.1	neg
Scrapers ^d	<u>1.0</u>	<u>9.0</u>	<u>0.7</u>	<u>1.9</u>	<u>0.5</u>
Total	12.9	23.6	0.7	157.6	0.5

^aBased on the emission factors presented in Table 6.1.

^bAssumes the use of four workers five days per week for four weeks with an average round trip commuting distance of 20 miles for a total of 1,600 vehicle-miles traveled (VMT).

^cAssumes the removal of 100 cubic yards of contaminated material per vicinity property and the replacement of 100 cubic yards of uncontaminated fill material at each site. Hauling of materials was assumed to be done with 10-cubic-yard trucks traveling a six-mile round trip per load.

^dBased on a total fuel consumption rate of 24 gallons.

neg = indicates a negligible level of emissions.

6.2.2 Soils

Soils at some of the 394 individual properties have been mixed with tailings. These soils are mostly on sites in developed areas where buildings, driveways, roads, utility lines, and other disturbances have already altered the natural soil profile. Excavation to varying depths not expected to exceed 10 feet would be required to meet EPA standards.

About 39,400 cubic yards of uncontaminated fill would be brought in to replace the contaminated material. Some of the uncontaminated fill would be topsoil of good quality. Wherever possible, uncontaminated fill would be taken from existing local borrow pits to replace the excavated contaminated soil. A sufficient amount of uncontaminated fill is available near most vicinity properties and its use would not deplete existing sources of fill. Permits would be obtained from local authorities for excavation of borrow sites. Reclamation of the borrow areas would be accomplished by recontouring and revegetating affected acreage, as required.

6.2.3 Water quality

No adverse impacts on water quality would be expected to result from the proposed remedial action. The very small potential that now exists for migration of radionuclides from the vicinity properties to local water supplies would be eliminated by the removal of the tailings.

6.2.4 Ecosystems

Because most vicinity properties are located in developed areas, the biological communities consist of horticultural plant species, common "weedy" plant species, songbirds, and small mammals. Vicinity properties classified as open lands may contain habitat for a greater variety of wildlife. Here the excavation of contaminated material could temporarily remove available habitat. After the cleanup activities are completed, measures such as reseeding and replanting would help re-establish similar habitat. It is unlikely that any threatened or endangered species would be encountered in the areas where the vicinity properties are located.

6.2.5 Noise

Cleanup activities would cause a temporary increase in noise levels near the vicinity properties. The projected noise levels would be noticeable, but they would be typical of small-scale construction or street repair work that often occurs in residential neighborhoods. The increased noise levels would not be harmful, and public annoyance would be minimal.

Equipment used during the cleanup work would be typical earthmoving machines such as dump trucks, front-end loaders, backhoes, and air compressors. Sound levels for the types of heavy equipment that would be used are presented in Table 6.4. These sound levels are greater than the EPA recommended level for outdoor activity interference and annoyance of 55dB (EPA, 1974), but do not exceed the levels permitted by the Occupational Safety and Health Administration for times as short as the duration of the project (DOL, 1983).

Table 6.4 Sound levels for equipment used for remedial action at vicinity properties

Equipment	Maximum sound level at 50 feet (dB)
Backhoe	82
Compactor	82
Compressor	82
Front-end loader	86
Dump truck	85

Ref. Kessler et al., 1978.

6.2.6 Historic and cultural resources

No historic resources would be affected by the proposed remedial action. Uranium milling operations were initiated less than 50 years ago; consequently, structures contaminated with tailings are generally less than 50 years old. Historic surveys would be conducted for all structures over 50 years old that may be impacted by remedial action.

6.2.7 Socioeconomic effects

Because few of the properties have had complete radiological surveys, it is not possible to estimate the amount of disruption that some of the businesses might suffer. Inaccessibility or damage to structures could result in economic loss to owners of commercial properties during remedial action. Disruption of routine operations would be minimized by executing remedial action as quickly as possible, or sequencing construction activities to avoid conflicts with business activities. Reclamation and/or reconstruction of affected properties would be conducted immediately following remedial action. In exceptional circumstances, property owners would be compensated for economic loss. Activities on open lands would not result in socioeconomic impacts. Disruption to occupants of residences would be limited as most contaminants are located outside buildings and require external cleanup only.

Short-term benefits to the local economy would accrue from employment of local contractors to conduct the remedial action and increased revenues locally resulting from increased spending by construction employees for goods and services. Most of the 14 project areas would have adequate housing, health care, schools, and social services to support the small level of immigration that would result from the remedial action. Immigration of construction workers would be minimized by use of local contractors for cleanup activities where appropriate. Any immigration of workers would be temporary, and would not strain local resources.

Land use impacts would be negligible. Land use would develop as projected, as most areas show current development unrestricted by the presence of contamination. Land values would increase at some locations following remedial action primarily from improvements during restoration.

Where utility service would be affected by remedial action, the application of supplemental standards would be considered. Any disruption of service would be temporary.

6.2.8 Transportation

Transporting materials from vicinity properties to the processing site and bringing uncontaminated fill to the vicinity properties would cause only temporary and minor disturbance of local traffic patterns.

The transportation impacts would be similar to those caused by any construction activity conducted in a residential or industrial neighborhood. The present surface conditions and narrow streets near some of the vicinity properties could slow the trucks. The trucks would have estimated capacities of 10 cubic yards and would create some noise. There may be some damage to the local roads from the fully loaded trucks, especially those traveling repeatedly to and from the larger properties. The existing road conditions and the location of the utilities underneath them would be analyzed before the cleanup to ensure that any potential damage to them is minimized. The contractor would load the trucks in conformity with local load limits. The truck drivers would be fully trained in handling the large trucks and would obey all local traffic laws.

Access to borrow areas in some cases may require road construction or improvement to accommodate the large vehicles used to haul borrow materials for restoration of vicinity properties. Use of borrow areas would be coordinated with remedial action planned for the inactive processing site.

Table 6.5 shows calculations of the miles traveled and fuel used to clean up and restore vicinity properties at the 14 project areas. The assumptions used for these calculations are presented in Appendix A, Vicinity Properties Overview.

Table 6.5 Calculation of miles traveled and fuel used to clean up and restore 394 vicinity properties at 14 UMTRA Project sites

<u>Distance</u>	
Vicinity properties to existing site (average round trip)	6 miles
Vicinity properties to uncontaminated fill borrow area (average round trip)	6 miles
<u>Trips</u>	
To tailings pile and return: 39,400 yd ³ at 10 yd ³ /trip	3,940 trips
To borrow area and return: 39,400 yd ³ at 10 yd ³ /trip	3,940 trips
<u>Miles traveled</u>	
To tailings pile and return: 6 miles/trip x 3,940 trips	23,640 miles
To borrow area and return: 6 miles/trip x 3,940 trips	<u>23,640 miles</u>
TOTAL	47,280 miles
<u>Gallons of fuel used</u>	
47,280 miles - 5 miles/gallon	9,456 gallons
Earthmoving and other on-site equipment	<u>9,456 gallons</u>
TOTAL	18,912 Gallons
<u>Ton-miles traveled</u>	
To tailings pile: 39,400 yd ³ x 1.32 ton/yd ³ x 3 miles	156,024 miles
From borrow area: 39,400 yd ³ x 1.32 ton/yd ³ x 3 miles	<u>156,024 miles</u>
TOTAL	312,048 ton miles

Assuming one cubic yard weighs 1.32 tons, the cleanup of 394 properties would require about 312,000 ton-miles of travel (Table 6.4). Approximately 5.03×10^{-8} accidents and 4.94×10^{-9} fatalities occur per ton-mile during routine truck operations (DOT, 1978). Thus, one could expect to see 0.016 accidents and 0.0015 fatalities over the duration of the project. This means that for each of the 14 project areas, an average of 0.001 accidents and 0.0001 fatalities could be expected. These values indicate that the odds of an accident average 1 in 1,000 and that the odds of a fatality average 1 in 10,000 for a single project area.

Approximately 0.16 occupational injuries and illnesses per man-year occur among construction workers (U.S. Bureau of Census, 1982). Four workers would be employed for four weeks at each of the 394 properties; thus, the effort would result in approximately 19 injuries and illnesses during cleanup activities at the 394 properties, or an average of 1.3 injuries and illnesses at each of the 14 sites (Table 6.6).

Impacts to transportation networks resulting from a hypothetical accident would be minor. An accidental spill of contaminated material into the street during transport is the worst-case credible accident envisaged. Temporary disruption of traffic would occur during the cleanup of spilled material. Public exposure would be minimized by immediately securing the area through the use of flags, ribbons, and warning signs. Such an accident would take a few hours at most to clean up. Once a health physics team had completed monitoring the accident scene to ensure that all contaminated materials had been removed, the area would be released for unrestricted use, and normal traffic patterns would resume.

Table 6.6 Calculation of transportation accidents and fatalities and nontransportation injuries and illnesses associated with the cleanup and restoration of 394 vicinity properties at 14 UMTRA Project sites

Calculation of transportation accidents and fatalities

5.03×10^{-8} accidents per ton-mile x 312,048 ton-miles =	0.016 expected accidents
4.94×10^{-9} fatalities per ton-mile x 312,048 ton-miles	0.0015 expected fatalities

Calculation of occupational injuries and illnesses among construction workers

0.16 injuries and illnesses/man-year x 120 man-years =	19.2 expected injuries and illnesses
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6.3 RESOURCES COMMITTED

Total fuel consumption for the cleanup activities at all 394 sites is estimated to be about 18,912 gallons for the earth moving equipment and trucks (Table 6.5). This estimate is based on the assumption that the trucks average five miles per gallon, and earthmoving equipment and other on-site equipment (e.g., gasoline powered compressors or generators) consume fuel at a comparable rate. Not included in the estimate is fuel consumed by the worker's personal vehicles and for miscellaneous inspection trips and meetings.

Other uses of resources would include water for dust control, electricity, and consumable materials required for cleanup activities. Uncontaminated fill and other materials for reclamation would be required. The total consumption of these resources would be minor.

Financial resources would be expended for contracting of construction contractors, for compensation of property owners demonstrating severe economic loss directly resulting from remedial action, and for contingencies. The cost for cleanup of the vicinity properties, exclusive of engineering and management costs, is estimated to be \$9,112,000 (DOE, 1984b).

6.4 MITIGATION MEASURES

The proposed remedial action would be designed to minimize long-term risks of exposure to radioactivity. However, the cleanup activities could cause a temporary increase in exposure to radioactivity. This short-term risk would result from raising dust and bringing contaminated materials to the surface. To minimize this increase, a variety of techniques may be used, such as wetting the soil for dust control, hauling material in covered trucks, and using erosion-control materials consisting of straw bales, filter cloths, tarps, and covers. Within the structures, dust curtains would be used to reduce the spread of dust. Monitoring would determine the effectiveness of the control methods. To ensure that proper health procedures are followed, a qualified radiological health contractor, acting for the DOE, would supervise the decontamination work carried out by a private contractor to ensure that it is performed in compliance with the UMTRA Project Health and Safety Plan. Dust masks and ear-protection devices would be made available on the site. During times of high wind, work would stop.

During the remedial action, there could be damage to some residential and business properties. Damaged structures would be repaired or replaced or the owners compensated. In order to mitigate socioeconomic impacts, the schedule for remedial action could be staggered or accelerated based on the preference of the property owner. In certain exceptional situations where property owners demonstrate extreme economic loss directly resulting from remedial action, application of supplemental standards would be considered.

Local noise ordinances may exist for localities where remedial action is proposed. Where noise would temporarily exceed permissible levels, a permit would be obtained from local authorities as required. Equipment noise levels would be controlled by the use of mufflers and by scheduling activities for daytime hours only. Travel times could be scheduled during workday hours to minimize noise impacts.

During cleanup activities, worker safety regulations prohibiting excessive exposure to noise would be adhered to. An effective hearing conservation program is required for worker noise exposures equal to or in excess of an eight-hour time-weighted average of 85 decibels measured on the A scale (slow response) (DOL, 1983). For extended exposure to noise levels greater than 85 decibels, either ear protection or exposure time limits would be implemented.

Vehicle emissions and the tendency of vehicles to raise dust would be subject to inspection by local and state authorities. Based on these inspections, recommendations may be made to reduce air-quality impacts. Recommendations could include such things as water-sprinkling and changes in vehicle maintenance. Emissions from the trucks and scrapers would be minimized by ensuring that the equipment is well maintained and that all emission control equipment is in proper working order. Fugitive emissions would be mitigated, as needed, through measures such as application of water to suppress dust and the use of covered trucks. Air pollution control measures would be applied as required, and compliance with local restrictions on emissions would be achieved.

The transport of contaminated material to the processing sites would be made in carefully inspected trucks covered with canvas shrouds and tightly fitting tailgates. Procedures would be developed to assure that material is not spilled along the transportation routes. Before haul trucks are released for use in other projects, they would be washed, scrubbed with brushes, steam cleaned and/or sandblasted as necessary to remove contaminated materials.

Uncontaminated fill or good quality topsoil would be used for reclamation of excavated areas, as appropriate. The contaminated material removed from each site would be stabilized at the processing site against high winds. This may be done by compaction, water sprinkling, or placement of debris on top of the tailings.

Measures that could be taken to mitigate and monitor the potential adverse impacts of vicinity property remedial actions are summarized here:

- o Controls over the possible spread of contamination, including worker and environmental monitoring, and decontamination of vehicles.
- o Erosion and dust controls, including prompt reclamation and revegetation of disturbed areas; use of mulch and dikes to control sheet and rill erosion during rainstorms, as necessary; use of surfactants and dust suppressants; temporary cover over storage piles, as necessary; watering of disturbed areas and unpaved truck routes; covering truckloads of contaminated material with tarps.

- o Air monitoring; vehicle emission controls.
- o Noise mitigation, including periodic checks of mufflers and compressors; work scheduled during daytime to minimize nuisance to nearby residents.
- o Scheduling of truck movements and provision for traffic controllers, as necessary, to minimize traffic congestion.
- o Consultation, cooperation, and coordination with local authorities and concerned citizens throughout the action, including regular meetings and designation of someone to provide on-site public information.
- o Implementation of worker radiological health protection measures, including use of respirators, boots, coveralls, and posting of access control bulletins.
- o Controlling access to the site to prevent non-workers from encountering contaminated material during remedial action.
- o Developing emergency procedures prior to initiation of remedial action.

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GLOSSARY

aerial radiological surveys	Surveys conducted by means of a specially equipped helicopter or plane to detect elevated gamma levels at land surface.
background radiation	Levels of radiation, or concentrations of radionuclides which are typical of an undisturbed area, or area not effected by residual radioactive material.
bid package	The compilation of vicinity property design drawings and specifications, developed by the RAC for remedial action bids.
certification	The final judgement of DOE, indicating that a vicinity property has been cleaned up in accordance with EPA standards.
curie	The unit of radioactivity of any nuclide, defined as precisely equal to 3.7×10^{10} disintegrations per second.
daughter product(s)	A nuclide resulting from radioactive disintegration of a radionuclide, formed either directly or as a result of successive transformations in a radioactive series; it may be either radioactive or stable
decontamination	The reduction of radioactive contamination from an area to a predetermined level set by a standards-setting body, such as the EPA, by removing the contaminated material.
designation	The formal procedure for listing a property as a candidate for inclusion in the UMTRA Project.
dose	A general term denoting the quantity of radiation or energy absorbed, usually by a person; for special purposes, it must be qualified; if unqualified, it refers to absorbed dose.
engineering assessments	The engineering work required to develop the vicinity property Radiological and Engineering Assessment.
EPA standards	Health and Environmental Protection Standards for Uranium Mill Tailings; Subparts A, B & C; 40 CFR Part 192.
exclusion	The elimination of a property from cleanup consideration under the UMTRA Project.
external radiation	Radiation from a source outside the body.
gamma radiation	High energy electromagnetic radiation emitted from some radioactive nuclides. The energy levels are specified for different radionuclides.
gamma-ray logging	The process for determining the radioactivity profile of an augered hole.

gamma-ray scan	To measure the gamma radiation level of surfaces using a portable gamma scintillation survey meter.
health physics	A term in common use for that branch of radiological science dealing with the protection of man from harmful effects of ionizing radiation.
implementing agencies	The agencies responsible for implementing the EPA standards. These agencies include the U.S. DOE, U.S. NRC, affected states and Indian tribes, and/or the Secretary of the Interior.
inclusion	The determination that a property warrants cleanup as part of the UMTRA Project.
inclusion survey contractor	The contractor selected by the DOE to provide data and recommendations regarding vicinity property inclusion or exclusion.
internal radiation	Radiation from a source within the body (as a result of deposition of radionuclides in body tissue).
low-level radiation	Radiation that is of such intensity or concentration that it poses a minimal health hazard.
micro	A prefix meaning one millionth ($\times 1/1,000,000$ or 10^{-6}).
milli	A prefix meaning one thousandth ($\times 1/1000$ or 10^{-3}).
mobile surveys	Surveys conducted by means of a specially equipped van to detect elevated gamma levels.
picocurie	A unit of radioactivity defined as 0.037 disintegrations per second.
post-remedial action survey	A survey performed to verify that radiological contamination has been reduced to the level specified by the EPA standards.
rad	The standard unit of absorbed dose, equal to energy absorption of 100 ergs per gram (0.01 joule per kilogram); supersedes the roentgen as the unit of dosage.
radiation	The emission and propagation of energy through matter or space by means of electromagnetic disturbances which display both wave-like and particle-like behavior; in this context, the "particles" are known as photons. Also, refers to the energy so propagated. The term has been extended to include streams of fast-moving particles (alpha and beta particles, free neutrons, cosmic radiation, etc.). Nuclear radiation is that which is emitted from atomic nuclei in various nuclear reactions, including alpha, beta, and gamma radiation and neutrons.
radiation monitoring	Continuous or periodic determination of the amount of radiation present in a given area.

radiological assessment	An evaluation of the radiological survey work required to develop the vicinity property Radiological and Engineering Assessment.
radiological survey	The process of measuring the various radiation levels associated with a specified site and the proper documentation and evaluation of the data.
radionuclide	A radioactive species of atom that exists for a measurable length of time. Individual radionuclides are distinguished by their atomic weight and atomic number.
radium-226	A radioactive daughter product of uranium-238. Radium is present in all uranium bearing ores; it has a half-life of 1620 years.
radon-222	The gaseous radioactive daughter product of radium-226; it has a half-life of 3.8 days.
radon-daughter	One of several radioactive daughter products of radon-222. All are solids.
rem	Unit of dose equivalent. That quantity of any type of ionizing radiation which, when absorbed by man, produces an effect equivalent in biological damage of a specified type to 1 rad of 25 keV X-rays.
remedial action	The construction activities required to clean up residual radioactive contamination on vicinity properties.
residual radioactive material	Radioactive waste in the form of tailings resulting from the processing of ores for the extraction of uranium and other valuable constituents of the ores; and other waste at a processing site which relate to such processing, including any residual stock of unprocessed ores or low-grade materials.
roentgen	The unit of exposure, equal to 2.58×10^{-4} coulomb per kilogram of air.
standard	The result of a particular standardization effort approved by a recognized authority.
supplemental standards	Subpart C of the EPA Standards; allowing flexibility in the application of Subparts A & B.
tailings	As defined in Public Law 95-604, Section 101(8), the term "tailings" means the remaining portion of a metal-bearing ore after some or all of such metal, such as uranium, has been extracted.
uranium	A radioactive element with the atomic number 92 and, as found in natural ores, an average atomic weight of approximately 238. The two principal natural isotopes are uranium-235 (0.7 percent by weight of natural uranium) and uranium-238 (99.3

percent by weight of natural uranium). Natural uranium also includes a minute amount of uranium-234. Uranium is a basic raw material of nuclear energy.

uranium-238

A naturally-occurring radioisotope with a half life of 4.5 billion years; it is the parent of uranium-234, thorium-230, radium-226, radon-222, and others.

uranium mill
tailings site

A site utilized in the handling, processing and/or storage of uranium ores and their residues.

UMTRA Project

Uranium Mill Tailings Remedial Action Project.

vicinity
properties

Those properties, either public or private, in the vicinity of the UMTRA Project inactive mill sites, that are believed to be contaminated by residual radioactive material, and have been designated under Section 102(a)(1) of the Uranium Mill Tailings Radiation Control Act of 1978 (PL95-604).

working level
(WL)

Any combination of short-lived Rn-222 progeny in one liter of air such that the ultimate emission of alpha particle energy is 1.3×10^5 MeV. It is a measure of radon daughter concentration (RDC).

LIST OF ACRONYMS

AEC	U.S. Atomic Energy Commission
CFR	Code of Federal Regulations
dB	Decibels
DOE	U.S. Department of Energy
DOL	U.S. Department of Labor
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ISC	Inclusion Survey Contractor
mrem/year	Millirem per year
uR/hr	Microrentgens per hour
NEPA	National Environmental Policy Act
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
ORNL	Oak Ridge National Laboratory
RAA	Remedial Action Agreement executed between the DOE and the individual vicinity property owner.
RAC	The Remedial Action Contractor to DOE on the UMTRA Project vicinity properties (Morrison-Knudsen, Inc.; NLO, Inc.; Bendix Field Engineering Company; Ford, Bacon & Davis, Inc.).
Ra-226	Radium-226
Rn-222	Radon-222
RDC	Radon Daughter Concentration
REA	Radiological and Engineering Assessment developed by the RAC on UMTRA Project vicinity properties.
UMTRCA	The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604.
UMTRA	Uranium Mill Tailings Remedial Action

WL

Working Level is a measure of radon-daughter-product concentration. Any combination of short-lived radon decay products in one liter of air that will result in the ultimate emission of alpha particles with a total energy of 130,000 MeV.

WLM

Working level month

APPENDIX A
VICINITY PROPERTIES OVERVIEW

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A.1 INTRODUCTION

This appendix sets forth the data and methods used to estimate the total number of vicinity properties that would be included for remedial action at the 14 UMTRA Project sites considered in this Environmental Report. Existing conditions estimated for the vicinity properties are summarized, and the remedial action schedule and resource requirements are presented.

A.2 ESTIMATED NUMBER OF VICINITY PROPERTIES TO BE CLEANED UP

In December, 1983, the DOE designated 626 vicinity properties at the 14 project areas considered in this ER as candidate sites for cleanup under the UMTRA Project. This designation list does not include 1,131 windblown acres previously identified as off-site contaminated properties. Table A.2.1 sets forth the currently designated properties by location (DOE, 1984a). The number of these designated properties, and other properties not yet identified, to eventually be included and cleaned up under the UMTRA Project is uncertain. This uncertainty, however, has significant impacts on the budgets and schedules for all UMTRA Project participants. Consequently, an analysis of what that number will be, was warranted as a first step in the development of vicinity property cleanup baseline resource requirements.

Estimated inclusion rates have been developed for designated properties. This was done by applying inclusion rates based on radiological characteristics and inclusion/exclusion recommendations for the 262 properties previously surveyed by Oak Ridge National Laboratory (ORNL), the UMTRA Project Inclusion Survey Contractor (ISC). The estimated inclusion rates were then applied based on each property's radiological characteristics. Properties for which radiological data are not currently available were included on the basis of aggregate inclusion rates. These aggregate inclusion rates also were estimated based on the survey data noted above. The result is an estimate of the total number of properties that will be included and cleaned up.

In addition, officials of state health departments in all states that contain vicinity properties, as well as the Navajo Nation, were contacted. These officials were asked to estimate how many (if any) additional vicinity properties, that had not yet been identified and designated, existed in their states. Officials in Colorado, Utah, and Wyoming estimated that there are still approximately 117 vicinity properties undiscovered in their states; the Navajo Nation, as well as officials in Idaho, New Mexico, North Dakota, Oregon, and Texas, feel it is likely that all candidate vicinity properties in their jurisdictions have been identified. Estimates also were developed on the number of candidate properties that were not identified by the mobile gamma-ray scan that has been used to designate properties at various locations in Colorado. This estimate is 82 vicinity properties. A breakdown of the estimated number of additional vicinity properties to be designated is shown in Table A.2.2.

The estimated total number of vicinity properties that will be included in the UMTRA Project is presented in Table A.2.3. As shown in this table, it is expected that 394 properties ultimately will be included at the 14 project areas considered in this report. This reflects an inclusion rate of 62.9 percent for all currently designated vicinity properties and an inclusion rate of 52.3 percent for the 199 "includable" properties that either have not been discovered or were missed by the mobile gamma-ray scan (DOE, 1984b).

Existing conditions estimated for 394 vicinity properties at 14 UMTRA Project sites are presented in Table A.2.4. The estimates are based on the results of radiological surveys performed under contract to DOE, and on the assumptions listed in Section A.4.

Table A.2.1 UMTRA Project-designated vicinity properties

Location	Total
Gunnison, CO	14
Rifle, CO	384
Riverton, WY	50
Tuba City, AZ	8
Mexican Hat, UT	21
Lakeview, OR	4
Naturita, CO	60
Falls City, TX	20
Green River, UT	29
Slick Rock, CO	4
Belfield, ND	11
Bowman, ND	3
Lowman, ID	17
Spook, WY	<u>1</u>
TOTAL	626

Ref. DOE, 1984a.

Table A.2.2 Vicinity properties - estimated additional designations

Location	State estimate	Estimated "van misses"	Total
Rifle, CO	55	58	113
Naturita, CO	9	9	18
Gunnison, CO	2	2	4
Slick Rock, CO	3	1	4
Green River, UT	36	4	40
Riverton, WY	<u>12</u>	<u>8</u>	<u>20</u>
TOTAL	117	82	199

Ref. DOE, 1984b.

Table A.2.3 Estimated number of vicinity properties
to be included for remedial action

Site	Commercial	Residential	Open lands	Total
Gunnison, CO	5	3	1	9
Rifle, CO	33	208	1	242
Riverton, WY	6	10	4	20
Tuba City, AZ	0	1	0	1
Mexican Hat, UT	3	3	4	10
Lakeview, OR	1	4	1	6
Naturita, CO	8	14	17	39
Falls City, TX	1	6	3	10
Green River, UT	4	20	15	39
Slick Rock, CO	2	1	0	3
Belfield, ND	2	2	1	5
Bowman, ND	0	1	0	1
Lowman, ID	3	3	2	8
Spook, WY	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>
TOTAL	69	276	49	394

Ref. DOE, 1984b.

Table A.2.4 Summary of existing conditions estimated for vicinity properties at 14 UMTRA Project sites

Site	Volume of contaminated material to be removed ^a (yd ³)	Weight of contaminated material to be removed ^a (tons)	Approximate acreage disturbed (acres)	Contaminated structures ^b
Gunnison, CO	900	1,188	2.25	None
Rifle, CO	24,200	31,944	60.5	29
Riverton, WY	2,000	2,640	5.0	3
Tuba City, AZ	100	132	0.25	None
Mexican Hat, UT	1,000	1,320	2.5	None
Lakeview, OR	600	792	1.5	None
Naturita, CO	3,900	5,148	9.75	4
Falls City, TX	1,000	1,320	2.5	1
Green River, UT	3,900	5,148	9.75	7
Slick Rock, CO	300	396	0.75	None
Belfield, ND	500	660	1.25	None
Bowman, ND	100	132	0.25	1
Lowman, ID	800	1,056	2.0	2
Spook, WY	100	132	0.25	None
TOTAL	39,400	52,008	98.5	47

^aAn equal amount of uncontaminated fill would be required for restoration of vicinity properties.

^bContamination indicated by presence of indoor radon daughter concentration in excess of 0.015 WL. Reported numbers are based on preliminary surveys and are subject to change.

A.3 PROJECT REQUIREMENTS

A baseline scenario for vicinity property remedial action resource needs has been developed to guide the management of the manpower, time, and dollars required to accomplish vicinity properties remedial action by the statutory deadline of March, 1990. This baseline scenario is based on: 1) per unit (i.e. per property) estimates provided by the UMTRA Project prime contractors and participants of the manpower, schedule, and budgets required to complete each of their vicinity property tasks; 2) the procedural requirements set forth in the Vicinity Properties Management and Implementation Manual (DOE, 1984c); and 3) the estimated number of properties to be cleaned up.

Table A.3.1 summarizes the baseline schedule, manpower, fuel consumption, and cost requirements for all contractors and participants. As shown in Table A.3.1, total baseline project costs for remedial action are estimated as \$9,112,000. Not included in this estimate are engineering and management costs or adjustments for inflation. Total baseline project manpower requirements for subcontractors are estimated at 121.2 man-years. Fuel consumption for operation of work vehicles is estimated at 18,912 gallons. Not included in the estimate of fuel consumption is fuel required for commuting by construction field workers and inspection trips or other field trips by supervisory or management personnel.

Table A.3.1 Project schedule/resource requirement summary

Site	Start date ^a	End date ^a	Duration ^a (months)	Labor requirement (man-years)	Fuel consumption for cleanup and restoration (gallons)	Cost ^b estimate ^b (\$000)
Gunnison, CO	04-01-86	06-30-87	15	2.8	432	370
Rifle, CO	04-01-87	06-30-89	27	74.5	11,616	5,742
Riverton, WY	07-01-85	06-30-86	12	6.2	960	670
Tuba City, AZ	07-01-86	09-30-87	15	0.3	48	15
Mexican Hat, UT	10-01-86	09-30-87	12	3.1	480	195
Lakeview, OR	07-01-86	06-30-87	12	1.8	288	110
Naturita, CO	04-01-87	06-30-88	15	12.0	1,872	720
Falls City, TX	07-01-88	03-31-89	9	3.1	480	160
Green River, UT	07-01-88	03-31-89	9	12.0	1,872	656
Slick Rock, CO	04-01-88	06-30-89	15	0.9	144	90
Belfield, ND	04-01-89	06-30-89	3	1.5	240	106
Bowman, ND	04-01-89	08-15-89	4.5	0.3	48	30
Lowman, ID	04-01-89	06-30-89	3	2.5	384	206
Spook, WY	04-01-89	06-30-89	3	0.3	48	42
TOTAL				121.2	18,912	9,112

^aRef. DOE, 1984b.^bRef. DOE, 1984a. Cost estimate is for remedial action only. Not included are engineering and management costs, contingencies, or adjustments for inflation.

A.4 ASSUMPTIONS USED IN THE CALCULATION OF IMPACTS RESULTING FROM REMEDIAL ACTION

Methods for deriving estimates of impacts were selected to present a conservative approach to impact analysis. Assumptions made to provide a basis for calculation of impacts were developed to be representative of remedial action at a site requiring greater than average commitment of resources. As a result, impacts presented in this document represent a reasonable upper limit of the impacts that would be likely to occur.

Presented below are the assumptions used in the calculation of impacts resulting from remedial action:

- o One cubic yard of earth weighs 1.32 tons.
- o Each property requires four workers working four weeks to complete.
- o 100 cubic yards of contaminated material per property.
- o 10-cubic-yard capacity trucks used.
- o Six-mile average round trip distance between vicinity property and processing site.
- o Six-mile average round trip distance between vicinity property and source of uncontaminated fill.
- o 20-mile average round trip commute to job site per construction worker.
- o 0.25 acre of land disturbed per site (average).
- o Truck efficiency of five miles/gallon.
- o On-site earthmoving equipment consumes fuel at the same rate as trucks.

REFERENCES

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